INDIAN MUSEUM NOTES.

ISSUED BY THE TRUSTEES.

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VOLUME IV.

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CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1900.

Dog. 10
18 pitts noted.

PREFACE TO VOLUME IV.

THIS volume of *Indian Museum Notes* on Economic Entomology has been compiled by the late Mr. Edward Barlow, under the immediate supervision of the Superintendent of the Museum.

Among other original matter, it contains several systematic papers, and a large series of miscellaneous notes in which numerous insect-pests of this country are described, and their habits and the nature of their ravages indicated; several reports on the results of some of the remedial experiments that have been tried on insects hurtful to Indian agriculture; and eighteen photo-etched plates in which a large number of insects of economic interest are figured.

The illustrated systematic papers include four by Mr. G. B. Buckton, F.R.S., on *Homoptera*, chiefly on *Aphidæ*; an important one on *Coccidæ* by Mr. E. E. Green, who is now Government Entomologist for Ceylon; two on certain destructive *Homoptera*, by the late Mr. W. M. Maskell; one on some noxious Tineid Moths, by Lord Walsingham, F.R.S.; two, by Messrs. Kerremans and Desbroches des Loges, on some destructive Beetles; one, by Herr E. Brenske, in which a number of new Indian species of the plant-damaging Cockchafer family are described; and, finally, a paper by Mr. D. W. Coquillet, on a parasitic species of Tachinid fly which is likely to prove useful to planters by destroying certain caterpillars that ravage tea-bushes. Almost all these papers are based on material furnished by the Museum, and to the gentlemen—all of whom are high authorities in their special subjects—who have contributed them, the best thanks of all who are concerned for the welfare of Indian Entomology in its economic aspects are due.

The Miscellaneous Notes on Inspect Pests are in this volume for the first time systematically arranged under headings relating to the several industries affected. They include, in regular order, accounts of insects affecting Tea, the various Crops and Cereals, Fruit-trees, Timber-trees, and Domestic Animals. A paper on insects which are beneficial to agriculture by devouring insect-pests is also included in this series, more in the hope of drawing attention to the important subject of Natural Remedies than with the intention of handling the matter critically.

It is with great regret that the editor has here to place on record the death of Mr. Edward Barlow, which occurred shortly after the 5th *fasciculus* of this volume had been sent to press.

CALCUTTA;
The 6th June, 1900.

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

CONTENTS OF VOL. IV.

EXPLANATION OF PLATES IN VOL. IV.

PLATE I—

FIG. 1. ASSAMIA DENTATA, n. sp. (1) imago : (2) elytrum with hooks : (3) lower wing with hooks : (4) head showing (*a*) antennæ ; (*b*) clypeus with keels ; and rostrum at (*r*) : (5) Lower end of tibia and tarsus of hind leg.

PLATE II—

FIG. 1. MARUCA TESTUALIS, Geyer. (*a*) moth ; (*b*) chrysalis ; (*c*) caterpillar.

„ 2. PERINA NUDA, Fabr., (*a*) and (*b*) moths ♂ and ♀ ; (*c*) chrysalis ; (*d*) caterpillar.

„ 3. THIACIDAS POSTICA, Walk., (*a*) and (*b*) moths ♂ and ♀ ; (*c*) chrysalis ; (*d*) caterpillar.

„ 4. HYPSA ALCIPHRON, Cram., (*a*) moth ; (*b*) chrysalis ; (*c*) caterpillar.

„ 5. HYMENIA RECURVALIS, Fabr., (*a*) moth ; (*b*) chrysalis.

PLATE III—

FIG. 1. MAHASENA GRAMINIVORA, n. sp., (*a*) moth ♂ ; (*b*) moth ♀ ; (*c*) larva.

„ 2. EUMETA CRAMERI, West, (*a*) moth ♂ ; (*b*) larval case of ♂.

„ 3. RHOPALOSIPHUM DIANTHI, Schr., (*a*) apterous viviparous ♀ ; (*b*) pupa ; (*c*) winged viviparous ♀.

„ 4. MILLEPEDE.

PLATE IV—

FIG. 1 PEMPHIGUS NAPÆUS, n. sp., (*a*) apterous ♀ or foundress ; (*b*) pupa ; (*c*) imago or winged ♀ ; (*d*) antenna of the apterous ♀ ; (*e*) rostrum of the apterous ♀ ; (*f*) antenna of the imago ; (*g*) tarsi of the imago ; (*h*) Gall.

„ 2. PEMPHIGUS IMMUNIS, n. sp., (*a*) pupa ; (*b*) imago or winged viviparous ♀ ; (*c*) antenna of the imago ; (*d*) Galls.

PLATE V—

FIG. 1. THOSEA RECTA, Hamps., (*a*) larva and cocoon on tea twig ; (*b*) and (*c*) moths ♂ and ♀.

(*d*). Ichneumonid parasite of *Thosea recta* (twice enlarged).

„ 2. XYLOBORUS FORNICATUS, Eichoff. (*a*) larva ; (*b*) pupa ; (*c*) and (*d*) imagos ♂ and ♀ ; (*e*) affected tea stem.

„ 3. CARTERIA DECORELLA, Mask., (*a*) adult females in tests on twig ; (*b*) tests of 2nd stage, females and males, on twig ; (*c*) tests of adult females, enlarged ; (*d*) test of male, enlarged ; (*e*) adult male ; (*f*) antenna of male (after Maskell).

„ 4. SYNCLERA MULTILINEALIS, Guen. moth, natural size.

PLATE V—*contd.*

FIG. 5. DACTYLOPIUS LONGIFILIS, Comstock. Female, enlarged (after Comstock).

PLATE VI—

FIG. 1. PODONTIA 14-PUNCTATA, Linn., (*a*) larva ; (*b*) pupa ; (*c*) imago, (*d*) earthen pupa cell.

„ 2. ASPIDIOTUS FICUS, (Riley) Comstock., (*a*) scales, on leaves of orange, natural size ; (*b*) scale of female, enlarged ; (*c*) scale of male, enlarged ; (*d*) young larva, enlarged ; (*e*) adult male, enlarged (after Comstock).

„ 3. ARGAS REFLEXUS, Fabr. Upper, under, and side views, enlarged.

PLATE VII—

FIG. 1. CRYPTOPHLEBIA CARPOPHAGA, Wlsm., n. sp., (*a*) larva ; (*b*) and (*c*) moths ♂ and ♀ ; (*d*) pod of *Cassia fistula* with chrysalis skins protruding from it.

„ 2. EREUNETIS ? SEMINIVORA, Wlsm., n. sp., (*a*) larva ; (*b*) chrysalis ; (*c*) moth ♀ ; (*d*) pod of *Cassia occidentalis* with a chrysalis skin protruding from it.

PLATE VIII—

FIG. 1. MYLLOCERUS MACULOSUS, Desbr. de Loges., n. sp., (*a*) and (*b*) weevil, dorsal and side views (enlarged) ; (*c*) weevil, natural size ; (*d*) antenna (enlarged).

„ 2. MYLLOCERUS SETULIFER, Desbr. de Loges, n. sp., (*a*) and (*b*) weevil, dorsal and side views (enlarged) ; (*c*) weevil natural size ; (*d*) antenna, enlarged.

„ 3. LEUCOMIGUS ANTENNALIS, Faust, (*a*) and (*b*) weevil, dorsal and side views ; (*c*) antenna (all enlarged).

PLATE IX—

FIG. 1 Strawson's "Coronette."
„ 2. Vermorel's "Torpille."
„ 3. „ "Eclair."
„ 4. Strawson's "Notus."
„ 5. „ "Antipest."
„ 6. Chiswick Co.'s Sprayer.

PLATE X—

Coolie using Vermorel's "Eclair."

PLATE XI—

FIG. 1. ACANTHOPSYCHE (BRACHYCYTTARUS) SUBTERALBATA, Hamps., (*a*) larva-case ; (*b*) moth ♂.

„ 2. LEPTISPA PYGMÆA, Baly, (*a*) and (*b*), beetle, dorsal and side views (enlarged).

„ 3. ARÆOCERUS FASCICULATUS, Degeer, (*a*) larva ; (*b*) pupa ; (*c*) and (*d*), beetle, dorsal and side views.

„ 4. ADORETUS CARDONI, Brenske, (*a*) and (*b*), beetle, dorsal and side views ; (*c*) antenna (enlarged).

PLATE XII—

FIG. 1. ALEURODES BARODENSIS, Mask., (*a*) larvæ, pupæ, and eggs on leaf (enlarged); (*b*) larva, dorsal view; (*c*) diagram of larva, showing arrangement of pores; (*d*) margin of larva and pupa; (*e*) vasiform orifice, operculum and lingula.

„ 2. ALEURODES EUGENIÆ, var. AURANTII Mask., (*a*) pupæ on leaf; (*b*) pupa-case, showing enclosed insect; (c) diagram of pupa-case, showing radiating patches; (*d*) one of the radiating patches, enlarged; (*e*) margin of pupa-case; (*f*) vasiform orifice, operculum and lingula (diagram).

„ 3. ALEURODES COTESII, Mask., (*a*) larvæ and pupæ on leaf; (*b*) larva, dorsal view (enlarged); (*c*) marginal and dorsal pores of larva; (*d*) pupa-case, dorsal view (enlarged); (*e*) margin of pupa-case; (*f*) pupa-case, side view; (*g*) vasiform orifice, operculum, and lingula (diagram).

PLATE XIII—

FIG. 1. HOLOTRICHIA IMITATRIX, Brensk., n. sp., (*a*) and (*b*), beetle, dorsal and side views (natural size); (*c*) antenna (enlarged).

„ 2. HOLOTRICHIA ANDAMANA, Brensk., n. sp., (*a*) and (*b*), beetle, dorsal and side views (natural size); (*c*) antenna (enlarged).

„ 3. SERICA CALCUTTÆ, Brensk., n. sp., (*a*) and (*b*) beetle, dorsal and side views (natural size); (*c*) antenna (enlarged).

„ 4. SERICA ASSAMENSIS, Brensk., n. sp., (*a*) and (*b*) beetle, dorsal and side views; (*c*) antenna; (*d*) hind leg (all enlarged).

PLATE XIV—

FIG. 1. EUPROCTIS LATIFASCIA, Walk., (*a*) larva; (*b*) and (*c*) moths ♂ and ♀.

„ 2. THOSEA CERVINA, Moore, (*a*) and (*b*) larva, dorsal and side views; (*c*) cocoon; (*d*) and (*e*) moths ♂ and ♀.

„ 3. THOSEA DIVERGENS, Moore, (*a*) cocoon; (*b*) and (*c*) moths ♂ and ♀.

„ 4. BELIPPA LOHOR, Moore, (*a*) cocoon; (*b*) and (*c*) moths ♂ and ♀.

PLATE XV—

FIG. 1. CREMASTOGASTER ROGENHOFERI, Mayr., (*a*) ant; (*b*) nest (quarter natural size).

„ 2. PLUTELLA MACULATA, Curt., (*a*) and (*b*) larva, dorsal and side views; (*c*) chrysalis; (*d*) moth; (*e*) piece of cauliflower attacked by larvæ.

„ 3. ERIOCOCCUS PARADOXUS, var. INDICA, Mask., piece of twig covered with larva scales.

PLATE XVI—

FIG. 1. LACHNUS PYRI, Buck., n. sp., (*a*) half grown larva; (*b*) winged female, March brood; (*c*) antenna (*d*) winged female, June brood; (*e*) Apterous adult, June brood (all enlarged).

PLATE XVII—

FIG. 1. CHAITOPHORUS MACULATUS, Buck., n. sp., (*a*) apterous female; (*b*) head; (*c*) wings; (*d*) nectary (*e*) hind femur (all enlarged).

„ 2. RHIZOBIUS JUJUBÆ, Buck., n. sp., (*a*) Apterous adult; (*b*) young insect; (*c*) part of the head and antenna; (*d*) tarsus with single claw.

PLATE XVIII—

FIG. 1. EXORISTA HETERUSIÆ, Coquillett., n. sp., (*a*) fly; (*b*) and (*c*) front and side views of the face; (*d*) puparium.

„ 2. HETERUSIA CINGALA, Moore, (*a*) and (*b*), moths ♂ and ♀; (*c*) larva (*d*) cocoon.

INDEX TO VOLUME IV.

T

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;
1st March 1895.

ILLUSTRATIONS.

PLATE I—

FIG. 1. Assamia dentata, n. sp.

PLATE II—

FIG. 1. Maruca testulalis, Geyer.
„ 2. Perina nuda, Fabr.
„ 3. Thiacidas postica, Walk.
„ 4. Hypsa alciphron, Cram.
„ 5. Hymenia recurvalis, Fabr.

PLATE III—

FIG. 1. Mahasena graminivora, n. sp.
„ 2. Eumeta crameri, Westw.
„ 3. Rhopalosiphum dianthi, Schr.
„ 4. A millepede.

CONTENTS.

INDIAN MUSEUM NOTES.

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1896.

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Vol. IV.] [No. 1.

NOTICE OF A NEW INDIAN HOMOPTERON.[1]

By G. B. BUCKTON.

TRIBE TETTIGIDÆ.

FAMILY FULGORIDÆ, BURM.

Assamia dentata, n. sp.

PLATE I.

Generic character.—Face with three keels, the central keel passing over the vertex. Antenna second joint globular, ending with a fine seta and placed below the eyes. Thorax large and corrugated. Abdomen short and stout, deeply ringed, and ending with a complete pygofer. Legs long, the hind tibiæ crowned at the lower ends with leaf-like spurs. Tarsi three-jointed, last joint furnished with two claws and bristles. Wings voluminous and prettily clouded with brown. Costal edges of both elytra and wings, with a row of fine teeth. Venation of wings peculiar and represented in figures 2 and 3.

Rostrum long and cylindrical, containing three bristles.

A. dentata.—Body shining black, wings brocaded with brown; legs, part of the abdominal rings and antennæ yellow. Pygofer of ♂ complex.

Expanse of imago, 14 millemetres.

Attacks the leaves of Palm tree.

Dibrugarh, Assam.

EXPLANATION OF DRAWINGS.

FIG. 1.—The imago which shows the long clypius and also the form of the pygofer in profile.

FIGS. 2 and 3.—The elytron and lower wing with hooks.

FIG. 4.—Head showing antennæ (*a*), clypius with keels (*b*), and rostrum at (*r*).

FIG. 5.—Lower end of tibia and tarsus of hind leg.

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[1] [The specimens from which this species is described were forwarded to the Museum by Rev. C. Dowding, Chaplain of Dibrugarh, Assam, who found them in considerable numbers on the under-side of the leaves of a kind of palm tree.—*Ed.*]

CATALOGUE OF COCCIDÆ COLLECTED IN CEYLON.

BY MR. E. E. GREEN.

[The following list of Coccidæ, which contains many undescribed species, is to be regarded as preliminary to a more exhaustive paper with figures of all the new species, now in course of preparation by the same author.—*Ed.*]

1. *Chionaspis braziliensis*, Sign.—On cultivated ferns, *Strobilanthus* sp., and *Acacia melanoxylon*, occurring, when present, in enormous numbers, the males usually predominating. A remarkable exception being in the case of specimens found on the *Acacia* which were all females.

Locality Punduloya.

2. *C. biclavis*, Comst.—Very common on stems of Cinchona and Tea, sometimes in such numbers as to considerably injure the plants. Found also occasionally on stems of Grevillea and Coffee; never on leaves, though the American type is described from examples found on leaves of fig. Male unknown. The female shield very inconspicuous, from the fact that it is always covered with the superficial fibres and loose material of the bark upon which it rests.

Locality Punduloya.

3. *C. aspidistræ*, Sign., var. *mussændæ*, n. var.—Found on stems and twigs of *Mussænda frondosa*. Differs from type chiefly in the character of the female shield, which is opaque, greyish white, and covered with the hairs and fibres of the bark instead of being of a "clear transparent yellow" as in Signoret's type. The male puparia are crowded together in large groups, each individual attached by the anterior extremity only, the rest of the body elevated.

Locality Punduloya.

4. *C. eugeniæ*, Mask., var. *varicosa*, n. var.—Found on under surface of leaves of *Gelonuim lanceolatum*. Differs from type chiefly in character of female shield, which is proportionately broader and marked with ramifying raised creases resembling veins.

Locality Punduloya.

5. *C. eugeniæ*, Mask., var. *litseæ*, n. var.—Found on under surface of leaves of *Litsea zeylanica*. Differs from type in the female shield being very thin and semi-transparent. Male with 3 knobbed digitules on feet.

Locality Punduloya.

6. *C. vitis*, n. sp.—Found on under surface of leaves of *Vitis*, producing discoloration of the leaf, the punctured parts turning pale yellow. Very occasionally found on upper surface of leaves of *Elæagnus*. Female shield thin, colourless and semi-transparent. Pygidial lobes small but prominent. Female insect pale yellow before gestation; afterwards reddish. Male with 4 knobbed digitules on feet.

Locality Punduloya.

7. *C. graminis*, n. sp.—On lemon-grass (*Andropogon*). Punctured area of leaf turning dark purple. Female shield snowy white; insect reddish orange. Pellicles of male puparium dark brown. Adult male with 3 knobbed digitules on feet.

Locality Punduloya.

8. *C. minuta*, n. sp.—On *Tetranthera*. A very small species, appearing to the naked eye like minute yellowish specks on under surface of the leaf. Female shield colourless and transparent. Male puparium also very thin and transparent. Adult female insect very pale yellow. Male with 3 knobbed digitules on feet.

Locality Punduloya.

9. *C. acuminata*, n. sp.—Found on both surfaces of leaves of Ardisia and several unidentified plants. Female shield very long and narrow with a median ridge, yellowish brown. Insect very pale yellow, tinged with bright orange in older individuals. Pygidia lobes very small. Male puparium strongly carinate, the furrows coloured reddish, giving a general pink tinge to the mass. Feet with 3 knobbed digitules. Terminal point of antenna with 3 knobbed hairs.

Locality Punduloya.

10. *C. elæagni*, n. sp.—On *Elæagnus latifolia* under surface of leaves. Female shield thin, whitish, but closely covered with the stellate hairs of the leaf. Insect bright yellow. Pygidium reddish. Pygidial lobes large and prominent. Male with 3 knobbed digitules on feet.

Locality Punduloya.

11. *C. exercitata*, n. sp.—On both surfaces of leaves of Tea, *Psycaotria* and other plants, in colonies consisting usually of one, or a very few females and a large number of males; the white carinated male puparia being disposed very regularly in parallel lines. Female shield long and narrow, reddish brown. Insect dull purplish red: pygidium with single median lobe. Male with 2 knobbed digitules on feet.

Locality Punduloya.

12. *Aspidiotus nerii*, Bouché.—Common on Tea, *Loranthus*, *Dalbergia*, Palms, etc.

Localities Punduloya, Kandy, Colombo.

13. *A. aurantii*, mask.—On Agave (American aloe) and *Citrus pomela*.

Locality Punduloya.

14. *A. osbeckiæ*, n. sp.—On stems of *Osbeckia*, not common. Allied to *nerii*, but differs in the opaque brownish shield, and the marginal hairs of the insect. Male with black apodema. Feet with 4 knobbed digitules. Terminal joint of antenna with 3 knobbed hairs.

Locality Punduloya.

15. *A. occultus*, n. sp.—In minute galls on leaves of *Grewia orientalis*. Female pale yellow: no grouped spinnerets. Male with 4 digitules on feet, and 3 knobbed hairs on terminal joint of antenna.

Locality Punduloya.

16. *A. trilobitiformis*, n. sp.—On leaves of unidentified tree. Female shield broad and flat, opaque, reddish brown. Insect very regularly and symmetrically formed; segments strongly marked: a deep transverse groove behind the cephalic segments. Pygidium with well-marked reticulated patch on upper surface.

Locality Punduloya.

17. *Diaspis lanata*, Morg. and Ckll.—Very common on stems of geranium, *Callicarpa lanata*, and *Tylophora asthmatica*. Very destructive to cultivated geranium, the stems often being completely covered with the white male puparia.

Locality Punduloya.

18. *D. circulata*, n. sp.—Common on young tea plants, and on the twigs of older bushes: also on Cinchona and *Osbeckia*. Female shield yellowish: pellicles usually dark, with a small whitish central boss surrounded by several concentric raised circles. Insect yellow. Male unknown.

Locality Punduloya.

19. *Mytilaspis citricola*, Packard.—On orange, and leaves of *Cocculus indicus*.

Localities Punduloya, Kandy.

20. *M. elongata*, n. sp.—On leaves of *Arundinaria*. Female shield very long and narrow, snowy white. Insect also very long; almost linear; pale yellow to orange. Male with 4 knobbed digitules on feet, and 6 knobbed hairs on terminal joint of antenna.

Locality Punduloya.

21. *M. pallida*, n. sp.—On leaves of unidentified shrubs. Allied to *M. citricola*. Female shield proportionately longer, smoother and more regular, very pale yellowish or brownish. Insect creamy white : pygidium pale reddish. Male pale lilac : foot with 3 knobbed digitules : terminal joint of antenna with 3 knobbed hairs.

Locality Punduloya.

22. *Aonidia corniger*, n. sp.—On upper surface of leaves of *Psychotria* and *Litsea*. A very remarkable form, the first pellicle bearing a series of 16 long, glassy, colourless horn-shaped processes. Adult female pale lilac : completely enclosed within second pellicle : pygidiums without spinnerets : margin produced into tooth-like processes.

Locality Punduloya.

23. *Fiorinia saprosmæ*, n. sp.—On under surface of leaves of *Saprosma*. Female shield almost completely occupied by the second pellicle, which is pale orange coloured. Male puparia concealed beneath a mass of loose white filaments. Female insect pale yellow : minute jointed tubercles on margins of abdominal segments.

Locality Punduloya.

24. *F. secreta*, n. sp.—In small galls on leaves of *Grewia orientalis*. Female insect yellow : pygidium long and pointed, with a prominent double median lobe : no grouped spinnerets.

Locality Punduloya.

25. *F. scrobicularum*, n. sp.—In glandular pits at base of veins on leaves of *Gærtnera kœnigii*. Female shield very narrow in front, widened behind : pale yellowish with reddish median area. Insect pale yellow : pygidium with deep median cleft.

Locality Punduloya.

26. *F. palmæ*, n. sp.—On fronds of Cocoanut palm. Differs from *F. saprosmæ* in smaller size, and in possession of a long stout spine-like process on rudimentary antennæ.

Locality Punduloya.

27. *Planchonia bambusæ*, Boisd.—On stems of Giant Bamboo. Male unknown.

Locality Punduloya.

28. *P. miliaria*, Boisd., var. *longa*, n. var.—On *Arundinaria*. Differs from type in proportionately greater size and length. Male yellow. Terminal joint of antenna with 3 knobbed hairs.

Locality Punduloya.

29. *P. delicata*, n. sp.—On leaves of *Arundinaria*. Much less convex than *P. bambusæ* : sometimes almost flat. Male reddish ;

antennæ with 6 very long whip-like hairs, and 3 knobbed hairs on terminal joint.

Locality Punduloya.

30. *P. solenophoroides*, n. sp.—On leavesof *Arundinaara*, a minute species. Hinder part of female test narrowed and elevated. Insect bright yellow. Male pale yellow ; foot with 3 digitules : antenna with 3 knobbed hairs at apex.

Locality Punduloya.

31. *Walkeriana floriger*, Walk.—On stems of *Litzea zeylanica*.

Locality Punduloya.

32. *W. compacta*, n. sp.—On stem of unidentified tree. Without the silky filaments and tufts of *W. floriger*. Short, stout, compact, conical white processes on dorsum.

Locality Kelani valley.

33. *W. euphorbiæ*, n. sp.—On branches of *Euphorbia antiquorum*. Very convex behind ; narrowed and depressed in front. Short curved conical processes in concentric series.

Locality Hambantota.

34. *W. poleii*, n. sp.—On stems and twigs of *Dodonæa viscosa*. Pinkish grey : short, conical, truncate yellowish processes : very convex dorsally : laterally compressed : inner side of femur with stout spines.

Locality Chilaw.

35. *W. senex*, n. sp.—On stems and twigs of *Dodonæa viscosa*. Broader, flatter than *W. Poleii :* processes very long and curling, white or brownish.

Locality Chilaw.

36. *Orthezia insignis*, Dougl.—On numerous ornamental shrubs, affecting especially *Acanthaceæ*. A very destructive species. Male slaty-grey with a brush of long silky filaments from extremity of abdomen. This species has been redescribed from Ceylon specimens by Mr. Buckton under the name of *O. nacrea ;* but I can find no distinguishing points between this and the species from Kew. In fact our specimens are doubtless the direct descendants from the Kew insect, as they first appeared in the plant-houses of the Government Botanical Gardens at Peradeniya.

Locality Kandy.

37. *Monophlebus zeylanicus*, n. sp.—On trunks of *Antidesma bunius*. Female bright orange-red : rather long and narrow. Insects of second stage occupying small cells in the living tissue of the bark.

Locality Punduloya.

38. *Icerya ægyptiaca*, Dougl.—On leaves of variegated Croton. Locality Chilaw.

39. *I. tangalla*, n. sp.—On leaves of unidentified plant. Differs from *ægyptiaca* in absence of dorsal waxy cushions, and the marginal processes being very short, stout and truncate.

Locality Tangalla.

40. *I. crocea*, n. sp.—On leaves of Citrus, Croton and Cocculus. Body reddish orange : dorsal area covered with bright yellow mealy secretion, with double marginal series of yellow waxy tufts and numerous delicate silky filaments.

Locality Punduloya.

41. *I. pilosa*, n. sp.—On a species of wiry grass growing on sea-shore. Body dull crimson : dorsal area completely covered with white granular powder and short white filaments : skin with blackish hairs.

Locality Chilaw.

42. *Eriococcus arancariæ*, Mask.—On *Arancaria*, occurring locally in enormous numbers, making infested trees quite unsightly from the sooty fungus that accompanies the insect.

Localities Newera, Eliya.

43. *Coccus cacti*, Anct.., var. *ceylonicus*, n. var.—On *Opuntia*. Differs from type in proportions of antennæ in different stages. Male, with a pair of longish knobbed hairs on each of last seven joints of antenna.

Locality Hambantota.

44. *Pseudococcus mangiferæ*, n. sp.—On *Mangifera indica*. Female pale yellow, dorsal area covered with white mealy powder, except on a subtriangular median patch : a marginal series of stout white fragile processes. Male very pale yellow.

Locality Punduloya.

45. *Dactylopius adonidum*, Lin.—On nearly every cultivated plant and in every part of Ceylon.

Localities Punduloya, Kandy, Colombo, Chilaw, Hambantota.

46. *D. longifilis*, Comst.—On *Jasminum* and *Adiantum*.

Localities Punduloya, Kandy.

47. *D. talini*, n. sp.—On *Talinum*, *Lilium*, Croton. Female purplish brown, sparsely dusted with white powder : a single pair of longish stout filaments at abdominal extremity : numerous long, very delicate, colourless, glassy filaments.

Localities Colombo, Kandy, Chilaw.

48. *D. scrobicularum*, n. sp.—In glandular pits at base of veins of leaves of *Elæocarpus*. Dark slaty-grey, sparsely covered with whitish powder, abdominal segments only with stout white processes, which protrude from the opening of the cell in which the insect lives.

Locality Punduloya.

49. *Vinsonia stellifer*, Westw.—On leaves of Mango, *Ficus antimesma*, Cocoanut palm and other shrubs.

Localities Punduloya, Kandy, Colombo.

50. *Ceroplastes floridensis*, Comst.—On Tea, Mango and *Citrus*.
Locality Punduloya.

51. *C. ceriferus*, Anders.—On stems of *Antigouon* and *Poutzolzia*. Specimens from the hills less than half size of those from low country.
Localities Punduloya, Chilaw.

52. *C. actiniformis*, n. sp.—On leaves of Cocoanut palm. Very convex. Median area of test with radiating purple lines.
Localities Punduloya, Kandy.

53. *Pulvinaria psidii*, Mask.—On Guava, Tea, Cinchona and numerous shrubs and plants. Occurring in enormous numbers and doing considerable injury to infested plants.
Locality Punduloya.

54. *P. tessellata*, n. sp.—On leaves of *Ophiorrhiya pectinata*. Female scale with tessellated markings; bright green ovisac, fluted.
Locality Punduloya.

55. *P. tomentosa*, n. sp.—On unidentified tree. Female scale olive-brown; median area rather thickly covered with small balls of tightly curled woolly filaments, ovisac with deep median longitudinal furrow.
Locality Punduloya.

56. *Lecanium coffeæ*, Walk.—Common on leaves and stems of Tea, Coffee, various ferns, and numerous other plants.
Localities Punduloya, Kandy, Colombo, etc.

57. *L. longulum*, Dougl.—On branches and twigs of *Albizzia* and *Grevillea*.
Locality Punduloya.

58. *L. viride*, Green.—On Coffee, Cinchona and numerous shrubs and trees. A very injurious species. But though it has killed out the coffee in whole districts, it has fortunately not seriously attacked Tea.
Localities Punduloya, Kandy, Colombo, etc.

59. *L. mangiferæ*, Green.—On leaves of cultivated mango trees. Locality Punduloya.

60. *L. nigrum*, Nietner.—Rather common on various shrubs and plants, Croton, Asparagus, *Begonia*, *Cobœa*, etc. Though originally described from coffee, it is now very seldom seen upon this plant.

Localities Punduloya, Kandy, Colombo, etc.

61. *L. tessellatum*, Sign.—Rather common on leaves of *Caryota urens*. Found also on Cinnamon and some other shrubs.

Localities Punduloya, Colombo.

62. *L. planum*, n. sp.—On upper surface of leaves of unidentified tree. Bright castaneous to dark chocolate brown. Flat, broad. Subtriangular: pointed in front. Antennæ 6-jointed. Margin with continuous fringe of very delicate overlapping fan-shaped scales. Dermal cells small and circular on median area, oblong and irregular towards margin. Male puparium divided into 18 plates. Adult male without caudal filaments.

Locality Punduloya.

63. *L. planum*, var. *maritimum*, n. var.—Found on both surfaces of leaves of a thorny shrub growing on the sea-shore (within reach of surf). Differs from type in smaller size and absence of dermal cells. Scale protected by a secretion that becomes tough and gelatinous under treatment with potash.

Locality Bentota.

64. *L. geometricum*, n. sp.—On leaves of unidentified shrub. Pale castaneous, or fulvous. Flattish, sub-circular, median dorsal area with concentric series of polygonal depressed spaces. Antennæ 6-jointed. Marginal fringe of overlapping fan-shaped scales. Dermal cells oblong, irregular.

Locality Punduloya.

65. *L. marginatum*, n. sp.—On upper surface of leaves of *Psychotria thwaitesii*. Pale fulvous to castaneous, a sub-marginal zone almost colourless. Oval, pointed in front. Antennæ 6-jointed. Marginal fringe of overlapping semi-circular scales. No dermal cells. Male with long caudal filaments; costal nervure of wing bright carmine.

Locality Punduloya.

66. *L. expansum*, n. sp.—On leaves of *Litzea* and *Dalbergia*. A very large flattish species. Longest diameter nearly $\frac{1}{3}$ inch. Margin with continuous fringe of fan-shaped scales. Antennæ obscurely 6(?)-jointed. Legs wanting.

Locality Punduloya.

67. *L. antidesmæ*, n. sp.—A single specimen found on leaf of *Antidesma bunius*. Very flat, but opaque: reddish brown with a thin greyish powdery film. Antennæ 8-jointed. Margin with simple stoutish hairs. A distant series of short, fine, white cottony filaments springing from glandular spots near margin.

Locality Punduloya.

68. *L. caudatum*, n. sp.—Very abundant on leaves of *Passiflora*, occasionally on Coffee. Convex oblong, oval; broadest behind. Colour varying with age from bright orange to deep chestnut brown; the paler specimens with a dark brown longitudinal and several transverse bands. Three or four very long white thread-like filaments springing from anal aperture, frequently extending two or three times length of insects. The hairs from ano-genital ring very conspicuous, stout and dark coloured; marginal hairs dilated and toothed. Antennæ 7-jointed.

Locality Punduloya.

69. *L. acutissimum*, n. sp.—On under surface of leaves of Cocoanut and other palms. Very narrow; pointed in front and behind of the shape and size of a carroway seed. Reddish brown to black. Antennæ 6-jointed. Single stigmatic spine.

Localities Punduloya, Kandy, Colombo.

70. *L. piperis*, n. sp.—On leaves of wild pepper, upper surface. Female broadly oval, flattish, with prominent median longitudinal, and two transverse ridges. Pale fulvous to pale reddish brown. Antennæ 8-jointed. Stigmatic spines in deep cleft, four to six. Male puparium divided into 18 waxy plates.

Locality Punduloya.

71. *L. ophiorrhizæ*, n. sp.—On leaves and stems of *Ophiorrhiza pectinata*. Oblong, pointed in front. Pale fulvous with dark reddish, reticulated pattern. Stigmatic spines three, the central one very long and prominent. Antennæ 8-jointed. Male puparium composed of 9 glassy plates, a median longitudinal series of prominent points.

Locality Punduloya.

72. *L. formicarii*, n. sp.—On stems of Tea and other shrubs, always sheltered by nests of a small brown ant (*Cremastogaster*, sp.). Highly convex, almost globular; dull brown.

Locality Punduloya.

REMEDIES FOR PLANT DISEASES.

[The following are some reliable formulæ for the treatment of fungi and insect pests. They have been taken from the Report of the Agricultural Experiment Station of the University of California, and are reprinted here for the benefit of the many inquirers in this country to whom the original reports are not, perhaps, accessible. It should be very constantly borne in mind that "Paris Green" and "London Purple" contain the powerful poison arsenic, and should therefore be used with the greatest caution, especially in the case of plants any part of which is used in the preparation of food or drink. The same caution applies, though with less emphasis, to "Bordeaux mixture," which contains an irritant copper salt.]

FOR POWDERY MILDEWS use SULPHUR, dusting it on the plants.

FOR FUNGI in general use BORDEAUX MIXTURE, made as follows: For every 10 gallons take 1 pound of lime and 1 pound of bluestone. Dissolve these separately in hot water and mix when cool, adding the rest of the water. Spray on the plants. Or spray with AMMONIACAL COPPER CARBONATE SOLUTION, made as follows: Dissolve 1 ounce of copper carbonate in 6 ounces of ammonia and add 10 gallons of water.

FOR FUNGI and SCALE INSECTS use LIME, SALT AND SULPHUR MIXTURE, a *winter* wash composed of lime 8 pounds, salt 3 pounds, and sulphur 4 pounds, for each 12 gallons of water. Mix one-fourth of the water, one-fourth of the lime, and all the sulphur, and boil for one and a half hours; put the salt with the rest of the lime and slake with hot water; add to the above and boil half an hour longer; add the remainder of the water and apply as a spray.

FOR SCALE INSECTS use RESIN SOAP as follows: For 100 gallons for *summer* use take resin 18 pounds, caustic soda (98%) $3\frac{1}{2}$ pounds, and fish oil $2\frac{1}{2}$ pints; for *winter* use, resin 30 pounds, caustic soda $6\frac{1}{4}$ pounds, and fish oil $4\frac{1}{2}$ pints. The material is put in a kettle and covered with four or five inches of water. The lid is put on and the mixture boiled two hours or more, and then the rest of the water is added, a little at a time. Spray on the plants. Or use the GAS TREATMENT: Cover the plant with an oiled tent, and for each 100 cubic feet of contents place in a bowl beneath the tent $\frac{2}{3}$ ounce of water, $\frac{1}{3}$ ounce of sulphuric acid (oil of vitriol), and $\frac{1}{3}$ ounce of potassium cyanide (58%). Be careful not to inhale the poisonous gas, not to allow it to escape from the tent for half

an hour. The leaves may be injured if used during the middle of the day.

FOR INSECTS in general use KEROSINE EMULSION, as follows: Make a soap solution of half a pound of soap to a gallon of water. Heat it to boiling and add two gallons of kerosine. Pump it through the spray pump, with good pressure, for five or ten minutes. For use add ten times as much water as you have of emulsion. Apply as a spray. Sour milk may be used instead of the soap solution. The emulsion is made more effective by the addition of a very small amount of arsenic to the soap solution, or of buhach to the kerosine.

FOR fruit or leaf-eating INSECTS use PARIS GREEN or LONDON PURPLE as a powder at the rate of 1 to 5 pounds to the acre, distributed by walking or riding over the field, carrying a pole, at both ends of which are hung muslin bags containing the poison. As a spray use 1 pound to 200 gallons of water. In spraying these arsenites the nozzle should be held at some distance from the plant and *no more should be applied after the leaves begin to drip*. Do not use these on crops where the poison would be injurious to health.

MISCELLANEOUS NOTES

FROM THE ENTOMOLOGICAL SECTION, BY MR. EDWARD BARLOW.

MARUCA TESTULALIS, Geyer.

Plate II, Fig. 1, a *moth,* b *chrysalid,* c *caterpillar.*

On the 4th December 1894 specimens of Asiatic bean (*Dolichos lablab*) from the Calcutta bazar, bored by caterpillars, were received in the Indian Museum. Some of the affected pods that were split open for examination contained young caterpillars, each pod harbouring but one insect. The colour of the caterpillars in this stage was of a light pinkish-brown with semi-transparent hairless bodies.

On the 8th idem all the larvæ appeared to be full fed, and changing their colour into a light pea-green hue, left their respective pods and began to pupate on the side of the breeding cage, making for themselves flimsy cocoons of glistening white silk.

The moths, which emerged after eight days' incubation, proved to be identical with the species *Maruca testulalis*, Geyer.

The following is Mr. F. Moore's description of the above :—

Crochiphora testulalis, (Hübner) Geyer, Zütrage Samml. Exot. Schmett., iv. 12, 315, fig. 629-30 (1832).

Stenia testulalis, Guénee, Delt. et Pyral. p. 247 ; Walker, Catal. Lep. Het. B. M. xvii, p. 420.

Siriocauta testulalis, Lederer, Pyral. Wien. Ent. Monat. vii, p. 424; Meyrick, Trans. Ent. Soc. Lond. 1884, p. 299 ; Snellen, Tijd, voor Ent. 1884, p. 39.

Hydrocampa aquatilis, Boisduval, in Guerin-Meneville's Icon. Règ. Anim. Ins. pl. 90, fig. 9 (1844).

Maruca aquatilis, Walker, Catal. Lep. Het. B. M. xviii, p. 540 (1859).

Fore wing ochreous-brown, clouded with darker brown; a transverse discal black-bordered hyaline-white band extending from costal vein to lower median, a similar white oblique pyriform spot within the cell, and a punctiform spot below its middle : hind wing hyaline-white, with an irregular black-bordered ochreous-brown marginal band. Cilia brown anteriorly, white posteriorly, with a slender black inner line. Body ochreous-brown above ; palpi ochreous-brown above, white beneath ; legs whitish with brown bands.

Expanse $\frac{9}{10}$ to 1 inch.

The Indian Museum possesses specimens from Calcutta, Khandala, Kulu, Sibsagar, Dansiri, Ceylon.

PERINA NUDA, Fabr.

Plate II, Fig. 2, a b *moths* ♂, *and* ♀ c *chrysalid,* d *caterpillar.*

On the 9th August 1894 specimens of a caterpillar found destructive to jack tree (*Artocarpus integrifolia,* Linn.) in a miniature garden adjoining the Indian Museum compound, were brought under notice through one of the Museum insect collectors.

A number of the caterpillars received began to pupate on the second day of their confinement, perfect insects emerging on the 17th idem.

The moth which belongs to the group Bombyces (Fam. Lymantriidæ) appears to be identical with *Perina nuda,* Fabr.

The following is Mr. G. F. Hampson's description of the above:—

Perina nuda, Fabr. Mant. Ins. II, p. 117; Moore, Lep. Ceyl. II, pl. 114, figs. 1, 1*a*, *b* (larva); C. and S. No. 867.

Stilpnotia subtincta, Wlk. Cat. IV, p. 843.

Perina basalis, Wlk. Cat. IV, p. 966.

Euproctis combinata, Wlk. Cat. XXXII, p. 347.

Male.—Head and legs orange; antennæ black; thorax grey and brown; abdomen brown, the segments fringed with white; anal tuft orange. Forewing hyaline, with a patch of brown scales on inner basal area. Hind wing dark brown, with the apical area hyaline.

Female.—Pale ochreous; the anal tuft orange; fore wing irrorated with brown scales below the cell.

Larva.—Greyish green, with short dorsal tufts of black hair and long anterior and posterior tufts; lateral tufts of grey and black hair; a dark sap-green dorsal band broken by a white line on thoracic somites and with red spots on its edge; 5th to 11th somites with subdorsal blue tubercles.

Pupa.—Greenish; all the somites, except the two medial, red-brown below with paired black spots.

Hab.—China and throughout India and Ceylon. *Exp.* male 38, female 50 millim.

THIACIDAS POSTICA, Walk.

Plate II, Fig. 3, a b *moths* ♂ *and* ♀, c *chrysalid,* d *caterpillar.*

On the 28th June 1894 numerous specimens of a hairy caterpillar were brought in by one of the Museum collectors, with the information that he had picked them off the leaves of a plum tree (*Zizyphus jujuba*) in the suburbs of Calcutta while engaged in collecting insects.

The caterpillars that were received were put in a breeding cage and duly supplied with plum leaves up to the 8th of July, when they began to pupate, forming cocoons constructed partly of hair and partly of a kind of silk-like brown thread.

On the 18th instant moths commenced to emerge, which, however, appeared to be unrepresented in the Indian Museum collection, so specimens were submitted to Mr. F. Moore, who has kindly examined them and identifies them as belonging to the species *Thiacidas postica*, Walk. (group Bombyces, Fam. Lymantriidæ).

The following is Mr. G. F. Hampson's description of the moth:—

Thiacidas postica, Wlk. Cat. V, p. 1028; Swinh. P. Z. S. 1885: pl. 21, figs. 1, 1a, 2; C. and S. No. 1060.

Drymonia denotata, Wlk. Cat. XXXII, p. 414; C. & S. No. 1165.

Heterocampa nigroscripta, Wlk. Cat. XXXII, p. 423.

Cnethocampa curvata, Wlk. Cat. XXXII, p. 429, C. & S. No. 1046.

Cnethocampa basifurca, Wlk. Cat. XXXII, p. 430; C. & S. No. 1044.

Head, thorax, and abdomen greyish brown. Fore wing greyish brown, with obliquely curved subbasal and antemedial black double lines angled below median nervure; a double postmedial line excurved round end of cell and bent inwards below the cell with some streaks from it to outer margin. Hind wing with an indistinct curved postmedial line; a brown patch at anal angle with a dark streak on it; some strigæ on margin.

Hab.—Throughout India and Burma. *Exp.*, male 38, female 44 millim.

HYPSA ALCIPHRON, Cram.

Plate II, Fig. 4, a *moth*, b *chrysalid*, c *caterpillar*.

On the 28th June 1894 specimens of a Bombycid caterpillar found defoliating "Dumar" tree (*Ficus hispida*, Linn.) were collected by one of the Museum collectors and reared in the Indian Museum.

The caterpillars, when full fed, rolled themselves into leaves so as to form a kind of protective covering in which they pupated on the 7th July. Moths began to emerge on the 16th idem, which, on comparison with the Museum collection of moths, proved to be identical with ***Hypsa alciphron***, Cram.

The following is Mr. Moore's description of the above :—

Phal. Att. Alciphron, Cram. Pap. Exot. ii, pl. 133, p. E. (1777).

Hypsa Alciphron, Moore, Catal. Lep. Mus. E. I. C. ii, p. 292, pl. 13, fig. 6, 6*a*.

Noctua Caricæ, Fabricius, Ent. Syst. iii, p. 27 (1793); Donovan, Ins. N. Holl., pl. 39, f. 2.

Hypocrita v. Caricæ, Hübner, Samml. Exot. Schmett., i, pl. 191, fig. 1—4 (1806).

Damalis Caricæ, Hübner, Verz. bek. Schmett., p. 172.

Hypsa (*Damalis*) *Caricæ*, Walker, Catal. Lep. Het. B. M. ii, p. 454.

Fore wing ochreous greyish-brown, veins ochreous-white; base of wing ochreous-yellow, and marked by five small black spots, two being on the costa and three below them; an ochreous-white spot at lower end of the cell; hind wing ochreous-yellow, with a black spot at end of the cell, two discal spots beyond, and a more or less perfect outer discal series decreasing to anal angle. Body ochreous-yellow; a black spot on tegulæ, and a slight spot at juncture with base of the wing; a more or less dorsal and lateral row of spots on abdomen; tip of first and second joints and entire third joint of palpi black; legs with black bands.

Expanse 2 to 2¼ inches.

Larva cylindrical; each segment with a few very slender scattered hairs. Black above, brownish beneath; two longitudinal white dorsal bands, a small ocellus on each segment, and lateral black spots; head red; front legs black; middle and hind legs reddish-brown. Pupa dark reddish-brown.

HYMENIA RECURVALIS, Fabr.

Plate II, Fig. 5, a *moth*, b *chrysalid.*

Specimens of a Pyralid caterpillar said to be destructive to "Choulai sag" (*Amarantus mangostanus*, Linn.) were brought under notice through one of the Museum collectors, who found them in a garden situated in the suburbs of Calcutta.

The finding of this insect is of some interest, as the plant, which is occasionally cultivated in the plains of Bengal, is eaten as a "pot herb" by almost all classes of natives in India, but more extensively among the poor.

The caterpillars pupated on the day of their arrival (the 12th of June 1894), the chrysalis being formed within an outer covering

made of the agglutinated leaves of the plant. On the 20th instant, eight days after, three moths made their appearance, which on examination proved to be identical with *Hymenia recurvalis*, Fabr.

The following is Moore's description of the moth :—

"*Phalæna recurvalis*, Fabricius, Syst. Ent., p. 407 (1775); Ent. Syst. iii, 2, p. 237 (1794).

Zinckenia recurvalis, Zeller, Lep. Micro. Caffr. Kongl. Vet. Akad. Handl., p. 55 (1853); Lederer. Pyral. Wien. Ent. Mon. vii, p. 437 (1863); Snellen, Tijd. voor Ent. 1872, p. 95; Meyrick, Tr. Ent. Soc. Lond. 1884, p. 308.

Spoladea recurvalis, Guénee, Delt. et Pyral., p. 225, pl. 8, fig. 5 (1854).

Hymenia recurvalis, Walker, Catal. Lep. Het. B. M. xvii, p. 396 (1859).

Phalena fascialis, Cramer, Pap. Exot. iv., pl. 398, fig. o (1782). stoll. *id.* v, pl. 36, fig. 13 (1791).

Phalæna angustalis, Fabricius, Mant. Ins., p. 309 (1787).

Hymenia diffascialis, Hübner, Verz. bek. Schmett., p. 361 (1825-7).

Hydrocampa albifascialis, Boisduval, Faun. Ent. Madag. Lep., p. 119, pl. 16, fig. 1 (1834).

? Phalæna nigrella, Linnæus, Syst. Nat. Ed. 13, iii App., p. 225.

"Dark vinaceous-brown; in some lights olivescent greyish-brown; fore wing with a short blackish-bordered white band from the costa before the apex, below and exterior to which are three small inwardly-curved superposed spots, which approach a dentate transverse white band extending from upper end of the cell to the posterior margin, this band being continued across the hind wing to near anal angle. Cilia with an interrupted brown inner line, alternated with white on fore wing, entirely white on hind wing. Bands on abdomen white; collar, front of head, base of palpi, and legs yellowish; tip of palpi and bands on fore legs blackish.

"Expanse $\frac{7}{10}$ to $\frac{9}{10}$ inch."

The Indian Museum possesses specimens from Karachi, Calcutta, Andaman Islands, Kulu, Nicobar Islands, Mergui.

EUMETA CRAMERI, Westw.

Plate III, Fig. 2, a *moth* ♂, b *larval case of the male with pupal case protruding from it.*

In August 1894 specimens of a Psychid moth, which proved to be identical with *Eumeta crameri*, Westw., were successfully reare-

in the Indian Museum from caterpillars found attacking an evergreen plant in Calcutta.

This species has been previously referred to in Indian Museum Notes, Volume II, No. 6, page 157, as defoliating tea bushes in Assam, Sikkim and Ceylon.

The following is Mr. Moore's description of the above :—

Oiketicus Cramerii, Westwood, Proc. Zool. Soc. Lond. 1854, p. 236, pl. 37, fig. 4.

Cryptothelea consorta, Walker, Catal. Lep. Het. B. M. iv, p. 970 (*nec* Templeton).

Eumeta Nietneri, Felder, Reise Novara, Lep. iv., pl. 83, fig. 21 (1868-74).

Male greyish-brown; fore wing with the median vein and subcostal branches and the sub-median vein black; interspaces between lower subcostal and the radials and between the forked upper medians hoary-white; the interspace between lower radial and upper median and below the sub-median being rufous-brown. Body brown, thorax with a few interspaced long fine black hairs; legs yellow, femora and tibiæ very laxly covered with fine long brown and black hairs.

Expanse $1\frac{1}{10}$ to $1\frac{2}{10}$ inch.

Larval case covered with slender twigs of irregular length, which are disposed longitudinally side by side in a somewhat spiral form.

Psychid caterpillar destructive to grass.

In June 1894 specimens of a Psychid caterpillar collected in Calcutta by one of the Museum collectors were brought in the Museum with the information that the insects were destructive to grass used for thatching houses.

According to the informations gathered from a ticket attached to an old specimen of the larval-case of this species, the insect attacks "*Jhalas*" grass growing on the banks of rivers, from the flower stems of which a fine string is made, the grass itself being used for thatching. The local name of the caterpillar is *Khati dhaka poka* = worm in sack.

The caterpillars that were bred in the Indian Museum transformed into pupæ about the middle of August, moths commenced to emerge on the 14th of September, and these proved to be new to the Indian Museum collection. Specimens were therefore submitted through Mr. F. Moore to Mr. J. F. Hampson, who kindly

identified them as belonging to a new species of *Mahasena*, which he is describing as *Mahasena graminivora.*

The figure which is given in plate III, fig. I, a, b and c, represents the male moth, aborted female moth, and larva.

The description of this new species has not yet been received from Mr. Hampson.

Caterpillar destructive to Himalayan spruce fir.

In July 1894 the Director of the Imperial Forest School, Dehra Dun, forwarded specimens to the Indian Museum, of the larva, chrysalis and perfect insect of a moth (*Microlepidoptera*) which has been doing considerable damage to the Himalayan spruce fir (*Abies smithiana*) in the Jaunsar forest. The moth appeared to be new to the Indian Museum collection, so has been sent to Europe for precise identification.

A single specimen of an Ichneumonid fly was also forwarded which may probably be parasitic on the caterpillars of this moth.

The following note has been furnished by Mr. C. G. Rogers, Deputy Conservator of Forests:—

"While in camp at Kanain in April last (1884), I noticed that the last year's shoots of small spruce saplings had been injured by something, as they had not developed at all. On examining several of these injured shoots I found the empty chrysalides of an insect which proved that the injury had been done by an insect and not by a fungus. The needles of the shoots were united by a silky tissue, and the points of such needles as were still on the branch were tied together by the silky threads above referred to. At Bodyar, in the beginning of June 1894, I noticed that some of the young shoots (this year's), which were just developing, were not normally developed, but that after developing in length for about ½ or 1 inch, the whole of the needles were formed into a pointed ovoid body, the free ends of the leaves being bound together so as to form a case. On examination it was found that the needles were bound together with silk threads, and that in the protective covering thus formed around the developing bud was the larva of an insect.

"The protective covering made of the needles, which have already developed, is on an average 2 inches long, ¼ inch broad at the centre, and has very tapering ends.

"One specimen of this protective covering is sent. The further development of the bud is prevented by the covering of needles, which surround it on all sides, and the larva feeds on the tender partially etiolated leaves, which are developed inside the covering of full-grown needles.

"A number of shoots containing larvæ were examined on the 7th June. The average length of 13 larvæ was 0·31 inches and the average width 0·05 inches.

"The colour of the larva is pale yellowish-white, the skin is transparent and the green colour of the young needles, which it has been eating, is very distinctly visible down the centre of the body of the insect. The larva is slightly hairy and very irritable when touched. It can give out a thin line of silk from its mouth

and can suspend itself by this when it wishes to do so. It unites the outer and furthest developed leaves of the young shoot by silk threads in order to form a protective covering for itself, and the developing bud on which it feeds. The eggs of the insect were not found, but with one exception only one larva was found in each case.

"The buds, as a rule, had grown about ½ inch or 1 inch in length and sometimes more before their further development was stopped by the larva.

"This seems to point to the egg being laid in the bud at the end of a terminal or side shoot in the rains or autumn; and to the egg (a solitary one) being laid in the middle of the bud, or at any rate not at the base. Some leaves are developed before the egg is hatched, and the larva emerges. It should be noticed that the bud scales, which form the protective covering of the bud, during the winter are pushed off as a whole by the developing bud, and thus keep the free ends of the needles together, and it is only when the young shoot has developed to some extent from 1 to 3 inches that the bud scales fall off or are pierced by the needles of the young shoot. This method of development no doubt helps the larva to make his protective covering.

"The chrysalides, which were gathered about the second week in June, developed into moths in the beginning of July. The exact dates cannot be given.

"One larva, which turned into a chrysalis on the night of the 7th-8th June, is not yet a moth (7th July), so that they probably take a month on an average to develop from the chrysalis to the moth.

"The chrysalides seem to be very constant in length. The average of five measured was 0·25 inches. The wing cases, antennæ, and eyes of the moth are clearly visible in the chrysalis.

"The wing cases are about half as long as the whole chrysalis, which is light yellow when young, but matures to a light brown.

"The abdominal portion of the chrysalis shows seven segments. Three of these lie between the wing cases and the remaining four are quite clear of the wing cases.

"Each segment has two rows of small prickle-like protuberances on the back of the chrysalis parallel to the segmental divisions of the body and close to the upper end (the one nearest the head) of the segment. One of the chrysalides examined on the 7th June was found to contain the chrysalis of a fly. It was 0·23 inches long and was transparent so that the fly could be seen inside.

"The fly was hatched during the night, and is sent in the tube with the larvæ and chrysalides.

"Afterwards several other protective coverings were found to contain the same flies. The flies emerge from their chrysalides before the larvæ of the moth are fully developed. The chrysalides of the flies are found attached to the upper end of the protective covering, while the chrysalides of the moth are attached by a silk thread to the lower end of the same covering. I could not discover that the flies interfered with the development of the larva of the moth. This moth seems common in the Jaunsar Forest Division, wherever the spruce fir is found, as signs of its presence were found at Deoban, Bodyar, Konain and Mandate.

"It does not confine its attacks to small trees, but attacks large trees as well as small poles and saplings, and together with the fungus *Æcidium abietinum* (Barclay) does very serious damage to the spruce.

"The fungus and moth are commonly found on the same tree, and at Bodyar I found a young sapling growing in the open, and therefore favourably situated

as regards the amount of light which is necessary for its normal development, very seriously injured by the larvæ of this moth. Nearly all the young shoots were attacked, including the leader, and nearly all the shoots which were not attacked by the moth were infested with the fungus above mentioned. The larva also attacks very readily small saplings of spruce in the advance growth and also saplings and poles which are suffering for want of light, and by so doing materially shortens their lives.

"The moth confines its attentions, so far as was observed, to the spruce only, and does not attack the Deodar or Silver fir (*Abies webbiana*) which are usually associated with it.

"In a pure spruce forest, more particularly a young one, this moth would undoubtedly develop into a very serious pest, and might endanger the very existence of the wood.

"It is at present very common in Jaunsar, and besides affecting the rate of growth and production of wood of the larger trees, does undoubtedly help to shorten the lives of saplings and poles, which are already dominated and suppressed. The direct effect of the larva of the moth on the growth of the tree and its increase in volume of course depends entirely upon the number of buds attacked; where only a few shoots are attacked, the effect is very small and probably inappreciable, but where the majority of the buds of a tree are attacked, the effect on the increase in volume of the tree and its general health and vigour cannot but be a serious matter."

Parasa lepida, Cram.

Specimens of a caterpillar, which proved to be the larva of the Limacodid moth, *Parasa lepida*, Cram., were received in the Indian Museum through Munshi Kasimuddin as very destructive to *Ashphal* tree (*Nephelium longana*, Camb.) in Calcutta.

According to the information furnished, the caterpillars were first observed about the middle of July, on the under-side of the leaves of the tree, but no notice was taken of them, as they were not numerous. In the latter part of the month, however, the tree became simply loaded with the insects, and steps were therefore taken to get rid of them. The method adopted, though somewhat tedious, proved effectual, namely, removing the caterpillars with tongs and burning them.

Out of the caterpillars received on the 30th July 1894, one specimen was preserved in alcohol, while the others were allowed to pupate, which they did on the 7th August 1894. The moth emerged on the 24th idem.

This species is the one referred to and figured in "Indian Museum Notes," Vol. III, No. 4, pp. 12 and 13, as destructive to tea and other plants.

"*Seni poka*" destructive to paddy.

In May 1894 specimens of caterpillars and some apparently living chrysalids were forwarded to the Museum, through the Director of Land Records and Agriculture, Bengal, from the Officiating Collector, Tippera, with the information that the caterpillars, which are locally known as "*Seni poka*," were said to be causing much damage to paddy fields by eating up the ears and the tender leaves of the paddy plants.

The specimens were found to be the larvæ and pupæ of a Noctues moth, probably belonging to one of the Leucaniidæ or Heliothidæ. The material, however, was insufficient for precise identification.

Some of the chrysalids that were received appeared to be alive at first sight, but on a careful examination they were found to be heavily parasitised by a dipterous insect pupæ, of which (some empty and some dead) were discovered in considerable numbers among the grass packing in the box. No imago form of the fly was, however, obtained.

Teak borer.

Specimens of caterpillar of a boring moth, together with pieces of teak wood bored by them, have been received from Mr. F. J. Branthwaite, Prome District, who wrote in December 1894:—

"When visiting some plantations of teak this morning planted in the Prome Division in 1892 in company with the Conservator, Pegu Circle, and the Deputy Conservator of Forests, Tharrawaddy, we noticed that several of the young trees were attacked by some larvæ, two specimens of which are herewith sent.

"Specimen No. 1 shows how entry is effected into the young tree. It is made at about one inch above the ground. Round the entrance was a heap of the excreta of the larvæ.

"Specimen No. 2 shows how the larva bores down the tap root.

"Both when found were alive and of a dirty cream colour with brown heads.

"The plantation where the larvæ were found was one planted in lines 12′ × 3′, the space intervening between the lines being overgrown with a fairly thick growth of various grasses."

It is quite impossible to identify this insect precisely from the specimens received, but it may probably be one of the Hepialidæ, a group of moths well known to contain numerous wood-boring species.

Caterpillar destructive to rape.

In April 1894 specimens of a caterpillar causing damage to rape crops (*Brassica rapæ*) near Berhampur, Lower Bengal, were forwarded to the Indian Museum through the Director, Land Records and Agriculture, Bengal, from the Deputy Collector on special duty, Berhampur.

The caterpillars proved to be the larvæ of a Pyralid moth, the material being insufficient for precise identification.

Caterpillar destructive to cress.

In April 1894 the same officer reported, through the Director, Land Records and Agriculture, Bengal, the appearance of innumerable black larvæ in a plot of cress in the Berhampur Jail garden.

The specimens forwarded to the Museum proved to be insufficient for precise identification, but they appeared to be the larvæ of a Pyralid moth. The Deputy Collector reports that the following remedy was applied successfully, and that every caterpillar was found dead in the morning after its application :—

" Four ounces of kerosine oil was thoroughly shaken up with four ounces of sour-milk and mixed with ten seers of water. The application of this mixture to the plants was done with an Eclair vaporiser. Evening was chosen for this application to avoid too quick evaporation of the liquid."

London Purple.

In April 1894 the same officer, through the Director, Land Records and Agriculture, Bengal, reported that the application of London Purple as a remedy against the caterpillars of the cosmopolitan moth *Agrotis suffusa* had proved successful in the case of an attack on seedling cauliflowers in the jail garden at Berhampur in September last. He writes :—

" One ounce of London Purple was mixed with one ounce of unslaked lime and three pounds of ashes. The three substances were powdered together very fine, put in a thin calico bag and dusted over the plants, the soil round them having been previously loosened."

RHOPALOSIPHUM DIANTHI, Schrank.

Plate III, Fig. 3, a *apterous viviparous female,* b *pupa,* c *winged viviparous female.*

In April 1894 the Deputy Collector on special duty, Berhampur, reported injury to a small extent to rape crops near his district by insects. Specimens of the pest were forwarded to the Indian Museum through the Director, Land Records and Agriculture, Bengal. These were found to consist of specimens of plant-lice (Aphid), which, however, proved to be new to the Indian Museum collection. Specimens were subsequently submitted to Mr. G. B. Buckton, who kindly examined them, and identified them to be the same as the common pest that injures rape crops in Europe, namely, *Rhopalosiphum dianthi*, Schrank.

The following account of the insect is taken from Mr. G. B. Buckton's Monograph of the British Aphides, Volume II, page 15 :—

" *Rhopalosiphum dianthi*, Schrank.

Aphis dianthi, Schr., Kalt., Walk.

——— *persicæ, Puceron du pecher*, Morren.

Aphis rapæ, also *A. floris rapæ* and *dubia* (?), Curt.
———*vastator*, Smee.
———*persicæcola*, Boisduval.
Rhopalosiphum dianthi, Koch.
———*persicæ*, Pass.

"*Apterous viviparous female.*

	Inch.	Millimetres.
Size of body . . .	0·080 × 0·040	2·02 × 1·01
Length of antennæ . .	0·060	1·52
„ cornicles . .	0·020	0·50

"Colour shining green, ochreous-yellow, or brownish-yellow. Skin finely punctured. Ovate pointed towards the apex. Head broad. Antennæ shorter than body, and placed on rather large frontal tubercles. Cornicles green, with black tips. Cauda green, about one-third the length of cornicles. Abdomen convex, and being transparent, often seen mottled with yellow young embryos.

The colour is, however, exceedingly variable. In autumn it is often of an ochreous red, and deeply furrowed or wrinkled.

"*Pupa.*

"Much like the larva. Wing-cases tipped with brown. Points of antennæ brown.

"*Winged viviparous female.*

	Inch.	Millimetres.
Expanse of wing . . .	0·340	7·62
Size of body . . .	0·080 × 0·040	2·02 × 1·01
Length of antennæ . . .	0·080	2·02
„ cornicles . .	0·017	0·19

"Head, thorax, and the band on prothorax black. Abdomen shining reddish yellow, with a broad black dorsal spot, and several dark lines. Four dark spots on each lateral fold. Legs ochreous. Antennæ black; as also are the femora, the tibial points, and tarsi. Cornicles brown. Wing-insertions and cubitus yellow. Stigma grey. Rostrum reaches to the second coxæ.

"Very common throughout the summer up to the end of October. The imago appears of various colours, such as green, ochreous, and even black.

"The larva may be called almost polyphagous. Walker says that it feeds on at least sixty known plants. Amongst those to which it is most destructive are the potato, the sweet turnip, and the swede;

but it also attacks *Brassica rapæ Dianthus caryophyllus, Amygdalus persicæ, Hyacynthus orientalis, Ranunculus bulbosus, Canna indica,* the tulip crocus, fuschia, oleander, tobacco, *Mesembrianthemum,* and numerous other plants."

Mango blossom Homoptera.

From the Secretary to the Municipal Committee, Amritsar, were received in April 1894 specimens of insects said to be causing immense damage to mango blossoms.

The specimens consisted of three species of Homopterous insects of the genus *Idiocerus,* viz., *Idiocerus niveosparsus,* Leth., *I. atkinsonii,* Leth., and *I. clypealis,* Leth., which have previously been reported as doing considerable damage to mango in Saharanpur and which are referred to in Volume I, pages 4-5 and 187-188 of these *Notes.*

London Purple, which had been previously tried against these insects with great success, was also recommended in this case. A packet of London Purple was accordingly despatched to the Secretary to the Municipal Committee, Amritsar, which, however, reached too late for any use, as the insects had all disappeared. The following note has been furnished by him :—

"The bug is known here as '*Thala,*' and it appears in seasons of excessive heat, or if rain falls, when the trees are in full blossom. The pest has been known to appear every fourth or fifth year, but no remedy has yet been tried by the natives. Gardens in which the mango crop sold last year for Rs. 600 have this year been sold for one-third and one-fourth the price. Should the bug appear next year, I will try London Purple and report results."

Leptocorisa acuta, Thunb.

Specimens of the rice sapper, *Leptocorisa acuta,* Thunb., which has previously been referred to in the pages of these *Notes,* were forwarded in October 1894, through the Director, Land Records and Agriculture, Bengal, from the Officiating Commissioner of the Orissa Division, as injurious to crops in the District of Angul, where it is locally called "*Mahna.*"

Orthezia nacrea, Buckton.

In publishing the description and figure of the Ceylon Coccid *Orthezia nacrea,* Buckton, in No. 3 of the preceding volume of these *Notes,* Mr. E. E. Green, who forwarded the specimens to the Indian Museum, points out some errors in the description of the insect furnished by Mr. G. B. Buckton, which errors he wishes to be corrected.

Mr. Green writes in May 1894:—

"I have just received No. 3, Volume III, of your 'Indian Museum Notes,' containing a description of the Ceylon Coccid named by Mr. G. B. Buckton *Orthezia nacrea*. Owing to the imperfect state of the specimens received by Mr. Buckton, one or two inaccuracies occur in his description, which it would be as well to correct.

"But first I must state my conviction (in which Mr. Maskell of New Zealand concurs) that the insect in question is really identical with *Orthezia insignis*, Dougl. (Ent. Month. Magazine, January 1888). I have specimens of *Orthezia, insignis* from England, and I can find no good points of distinction. The marsupium or ovisac is rather shorter than in our Ceylon insect, but that is of no importance specifically. The arrangement of the waxy appendages is identical in both forms.

"Mr. Buckton, from the examination of dead and dried specimens of the Ceylon insect, gives the colour of head and thorax as pale warm brown. The English insect is said by Mr. Douglas to be piceous black. The living insect in Ceylon is always dull olive-green. The most serious discrepancy in Mr. Buckton's description is in the proportion of the antennal joints. Mr. Buckton states, and shows in his figure, that the antennal joints gradually decrease in size to the tip. In all the specimens that I have examined I have found the terminal (8th) joint to equal or even exceed the previous three together. Mr. Buckton states that the Kew (English) insect is much larger than the Ceylon form. Mr. Douglas gives one mm. equal to 4 hundredths of an inch. My Ceylon specimens show a length of 5 to 6 hundredths (without ovisac or appendages), so that what difference there is appears to be in the opposite direction.

"Nor can I find the slightest difference in the arrangement of the thoracic laminæ.

"There is also rather an important error in Mr. Buckton's account of the reproduction of the insect. He states that 'twenty or thirty black eggs hatch within the dead body of the parent, and find therein a secure covering until they are sufficiently grown to migrate over the food plant.'

"As a matter of fact there appears to be a constant passage of eggs and young insects through the marsupium during the life of the parent. On opening the ovisac of a living female one finds, next the insect, the newly-deposited eggs, which are white. During their passage through the marsupium, packed in woolly secretion, they gradually become darker, first yellow, then orange, then pale green, and finally dark olive-green when the contained larva is ready to emerge. The extremity of the ovisac usually contains the young active larvæ, which soon find their way through the breach formed by the first comers.

"In apologising to Mr. Buckton for presuming to correct his description, I must excuse myself on the plea that I have had ample opportunity of examining the living insect in all its stages, except the male, which I have been unable to find."

Hispa ænescens, Baly.

Specimens of the Rice Hispa (*Hispa ænescens*, Baly), which has been referred to on page 37 of Volume I of these *Notes* as being very destructive to young paddy plants, have been forwarded to the Museum in August

1894, through the Officiating Director of the Department of Land Records and Agriculture, Burma, from the Superintendent of Land Records, Pegu, who reports :—

"It is called 'Phalanbyu.' It makes its appearance shortly after the paddy has been sown. It attacks the plants both on high and low lands. The insect commences to eat the paddy leaves at the top, working downwards. The yield or outturn of fields attacked by it is small. The stalks also are eaten till they become matured and hard. The specimens were obtained from Wet-la-kwin, Pagandaung circle."

Epilachna dodecastigma, Muls.

In September 1894 Mr. J. A. Mollison forwarded to the Indian Museum specimens of Brinjal leaves attacked by insects from the Poona Farm. He wrote :—

"The affected plants were found in the middle of a field, and the damage done is considerable. The damage is greater than the number of insects now present could account for. There are not many insects now on the plants. They might have been more numerous at one time. The attack was not noticed until considerable damage had been done, because confined to the middle of the field."

The brinjal leaves proved to be attacked by larvæ of a Coccinellid beetle. Out of a number of pupæ found on the leaves, only one imago emerged alive in the rearing cage; the others, which were found to be heavily parasitised by a minute chalcid fly, died from the effects of the attack, each pupa harbouring as many as eight parasites. The beetle appeared to be identical with the species *Epilachna dodecastigma*, Muls., as determined in the Indian Museum collection.

Sinoxylon sp.

In August 1894 some specimens of a Bostrichid beetle were sent to the Museum by Mr. A. Smythies, Officiating Conservator of Forests, Shillong, with the information that they were found boring into tea-box planks at Tezpur, where they are locally called "*Ghong.*"

The insect proved to be identical with the specimens named *Sinoxylon* sp., previously sent to the Museum, as infesting the wood of *Terminalia belerica.*

Vedalia fumida, var. *roseipennis*, Muls.

In the latter part of July 1894 numerous specimens of a Coccinellid beetle were found feeding upon the Coccids, *Icerya ægyptiacum*, Dougl., which had again made their appearance among the ornamental bushes in

the Indian Museum compound. From a batch of pupæ a considerable number of specimens of the beetle were reared in the Entomology room, but the insect proving to be new to the Museum collection, specimens were submitted to Mr. L. O. Howard, United States Entomologist, who writes—

"It is interesting to find that this Coccinellid is not distantly related to the well-known *Vedalia cardinalis*, Mulsant, which Mr. Albert Kœbele of this Department brought from Australia some years ago, and which destroyed *Icerya purchasi* on our western coast. It is Mulsant's *Rodolia rosepennis*, which according to Crotch's revision of the *Coleopterous* family Coccinellidæ, is a colour variety of *R fumida*, Muls. Accepting the nomenclature given by Crotch, the name of the insect is therefore *Vedalia fumida*, var. *roseipennis*, Muls. This is the dictum of my assistant, Mr. E. A. Schwarz, who is a most competent student of the *Coleoptera*."

Cerambycid larvæ destructive to *Robinia* and *Albizzia*.

In June 1894 specimens of a caterpillar found destructive to young seedlings of *Robinia* and *Albizzia* were forwarded by the Director of the Imperial Forest School, Dehra Dun, from the Divisional Forest Officer, Chenab, with the information that the caterpillar is said to live about nine inches below the ground, and cutting through the tap root of both species, feeds upon the pulpy portion of it.

The specimens proved to be the larvæ of a Cerambycid beetle, the material being insufficient for precise identification.

Cheroot borer.

The following are some further observations which have been furnished by Mr. J. Cleghorn on the life-history of the cheroot weevil, *Lasioderma testaceum*, Duft. This insect has been referred to in several places in the pages of these *Notes*.

"5th February 1894.—Full-fed grub commenced cell for laying up.
17th " " Formed into chrysalis.
22nd " " Commenced changing.
24th " " Completed change into perfect insect.
27th " " Made opening for leaving cell.
28th " " Left cell.
4th April " Died.

"In some cases I have had the weevil live for over two months.

"The grubs are most erratic in their development; changes in temperature will cause them to lay up or hybernate. I have made grubs lay up for eight days by the application of heat, but this interferes with their progress and development, after recovery, for an indefinite period. I can speak for delaying a full-fed grub turning into a chrysalis for 2½ months, the grub feeding and amusing itself as if there was nothing the matter.

"This is just the reverse of what takes place if grubs are made to hybernate by the application of cold ; in that case, on recovery they pass quickly through their remaining stages.

"It can therefore be seen that it would be very difficult to estimate the time for the grub stage. Under favourable conditions six weeks would be a fair estimate ; under unfavourable conditions it can take a year or more to develop into a perfect insect.

"My observations show that the egg must be allowed to hatch out in from eight to sixteen days, after which it cannot keep. The perfect insect can lay up or hybernate for two months, certainly not more. The chrysalis stage is like the egg; this stage cannot be made to go beyond eight days."

Hieroglyphus furcifer, Sauss.

From the Subdivisional Officer, Bettiah, were received in September 1894 some specimens of a grasshopper said to be destructive to sugarcane in his subdivision.

The insect proved to belong to the species *Hieroglyphus furcifer*, Sauss., which has previously been referred to in the pages of these *Notes* as destructive to crops in different parts of India.

Othoptera in Satara District.

In August 1894 specimens of Orthopterous insects were forwarded to the Museum by the Survey Commissioner and Director, Land Records and Agriculture, Bombay, from the Collector of Satara. The insects were reported to have caused a considerable amount of damage to the young jowari crops in the Tasgaon taluka of the Satara district, where they are locally called "*Tol.*"

The specimens consisted of the following species :—

(1) Thirteen specimens of larvæ of *Chrotogonus* sp. This insect has previously been reported in the pages of these *Notes* as doing injury to young crops of almost all kinds.

(2) Six specimens of larvæ of *Tryxalis turrita*, Linn., previously referred to in the pages of these *Notes*.

(3) Numerous specimens of larvæ, probably of *Atractomorpha crenulata*, Fabr., also previously reported in the pages of these *Notes*.

Insect pests from Khasi and Jaintia Hills.

In July 1894 specimens of insect pests which affect crops in the Khasi and Jaintia Hills, together with copies of reports from the Subdivisional Officer, Jowai, and the Extra Assistant Commissioner, Shillong, were

forwarded to the Indian Museum by the Director, Department of Land Records and Agriculture, Assam.

The specimens comprised the following:—

(1) "U. Njianguar," reported as attacking paddy:—consisted of empty cases of Psychid caterpillar. The material being insufficient for precise identification.

(2) "Njiaugbyruai," reported as destroying potato tubers and the roots of Indian corn:—consisted of specimens of larvæ of a Melolonthinid beetle. The specimens being insufficient for precise identification.

(3) "Puit," reported as attacking the tender leaves of the paddy plant:—proved to be the *Ácridid* (*Orthoptera*) *Oxya velox*, Burm., which has previously been referred to in these *Notes*.

(4) "Nyiang Saw Khlich," reported as destructive to potato leaves:—consisted of undeterminable larvæ of a beetle. The specimens received being in too poor a condition for identification.

(5) "Dykhiw Saw," reported as destroying roots of Jobstears, Khasia matikalai and white jit:—consisted of specimens of an ant which proved to be the cosmopolitan species—*Monomorium pharaonis*, Linn.

(6) "U. Nyiaugrieg," reported as injurious to young sugarcane:—consisted of specimens of the Chrysomelid beetle—*Haplosonyx elongatus*, Baly.

Potato tuber mite.

In December 1894 specimens of potato seed tuber said to be affected by insects were obtained from the Burdwan Farm by Mr. N. N. Banerjee, Assistant Director, and forwarded to the Indian Museum by the Director of the Department of Land Records and Agriculture, Bengal.

The specimens proved on examination to be suffering from the attack of very minute mites (*Acarina*) which are unlike any in the Indian Museum collection.

Millepede, injurious to agricultural crops.

In May 1894 specimens were forwarded to the Museum through the Director, Imperial Forest School, Dehra Dun, from Mr. H. O. Neill, of insects which

were said to be most destructive to vegetable and flower gardens in the Caber hills. Mr. H. O. Neill writes:—

"One specimen you will find in the bottle to be like pieces of thread, and it was with the greatest difficulty that they could be picked out of the earth. They crawl out of the ground at night and devour all the tender shoots and blossoms of flower and vegetable plants. They are also most destructive to potato crops. I have observed them attack wheat and garlic as well. This year they have destroyed fields of wheat and garlic on the upper Caber hills."

The insects consisted of numerous little millepedes of the Julid family, which, however, proved to be new to the Museum collection.

The millepedes are well known to live on decaying vegetable matter, and occasionally on decaying animal matter, but, so far as is known, they have never before been reported to be pests to agriculture in India. Indeed, the little that is known of them in relation to agriculture and forestry is favourable, as they are said to occasionally feed on slugs and snails. In consideration of these facts further particulars on this interesting subject are desirable. Specimens have been forwarded to Mr. R. I. Pocock for identification.

The figure which is given in plate III, figure 4, represents the millepede four times enlarged.

Locust reports.

The following are extracts which have been forwarded to the Indian Museum by the Government of India, Department of Revenue and Agriculture, regarding the destruction of locusts in 1893-94:—

Extract from the Rajputana Political Agency Diary for the week ending on the 1st September 1894.

"Forty-one maunds and thirty-two seers of young locusts were destroyed in the Suratgurh and four hundred maunds in the Mirzawala tahsils from the 29th July to the 4th August 1894. Some young locusts were destroyed in the villages of Sardar Shahr, Bahaderan, Rajgurh, Hanumangurh, Ralangurh and Nuhar tahsils."

Extract from the report on the Land Revenue Administration of the Punjab for 1892-93.

"Locusts were also observed in Isa Khel and Marwat. Occasional swarms passing from one direction to another were first seen and at last eggs were laid in May and June. Fortunately the rabi crops had then been cut and the fields had not yet been ploughed for either the extra rabi or the kharif, otherwise some damage to crops would have been inevitable. The zamindars had a very bitter experience in 1890-91, and at once responded to the call of the tahsil officials for help. The locust destruction scheme established in the past year was put into operation and the mischievous insects with their eggs were promptly destroyed without causing the least damage to cultivation."

EXTRACTS FROM REPORTS.

[NOTE.—The following extracts are taken from letters and reports which have been forwarded to the Indian Museum since the publication of the Conspectus of insects affecting crops in India.—*Ed.*]

Report from Baroda.

The following is taken from a report, dated 10th August 1894, by Mr. J. H. Middleton, Professor of Agriculture, Baroda College, forwarded by the Survey Commissioner and Director of Land Records and Agriculture, Bombay:—

"*Hymenoptera, Sawfly.*—The larva of a sawfly attacks cabbage and most of the other plants of this family. Specimens were sent to the Museum, but without the *imago* they could not be named. I have attempted several times to rear the insect, but the grubs are very delicate and I have not yet succeeded.

"The larva is greenish black and about $\frac{1}{2}$" long when full grown; it eats round the edges of the leaf and rapidly destroys seedlings.

"This pest appears in September and passing through successive generations lasts for six months or more. It is especially bad in cloudy weather.

"*Remedies.*—When the larvæ attack a seed-bed, ashes may be sprinkled on the seedlings; but unless the grubs are constantly picked off by hand, ashes will not save the young plants. Kerosine emulsion has been tried, but with little success in the case of seedling cabbages, as these plants are so easily destroyed. For half-grown turnips the emulsion proved to be a protection in one or two instances where it was tried."

This insect is referred to in Volume III, No. 5, page 69, of these *Notes*.

"*Aloa lactinea.*—The caterpillar of this moth known as *katra* to the natives is the most destructive insect pest on sandy soils round Baroda. The moth is a pretty white insect, which appears soon after the first burst of the monsoon. It may be seen fluttering about in the twilight, and attracted by the light it comes indoors after nightfall.

"The outer wings are white with one margin red, have a stretch of $1\frac{1}{2}$", and a few black dots scattered over them, one marked dot being near the insertion of the wing. The inner wings have a spread of about an inch and are white without a red margin, but the dots are larger and more pronounced than on the outer wings. The body is about $\frac{3}{4}$" long and the back is striped alternately black and red. In captivity I have found that the moth may lay over 300 eggs.

"The eggs seem to be laid in the hedges, for the *katras* invade a field from its borders, but they may sometimes be laid on weeds, etc., in a field, for I have seen very tiny larvæ in the soil at a considerable distance from a hedge. They take about a fortnight to hatch, and three weeks after rainfall the *katras* may be expected.

"The young larvæ are grey in colour, and for a week are not much in evidence; they seem to live about the hedges and field borders until the regiment is brought

up to strength; they then march out in line, clearing off everything they consider edible. If the field happens to contain a crop they appreciate, they do their work systematically, the ranks remain unbroken and there are very few stragglers; if, on the other hand, the crops they like are scarce, they break up and scatter all over the field in search of them. When first the larvæ begin to do damage they are about $\frac{3}{4}''$ long, reddish-brown in colour, and very active. In three weeks' time they grow into sluggish dark-brown (sometimes nearly black on the back) caterpillars $1\frac{1}{2}''$ long, $\frac{1}{4}''$ in diameter. They then disappear into the hedges in which they pupate.

"The pupa is ovate dark-brown, rather more than $\frac{3}{4}''$ long and less than $\frac{1}{2}''$ in diameter in the middle. The length of time before the moth emerges varies; in one case the insects appeared in two months, in another after ten months. The latter must be the usual time, for I have not seen either moths or larvæ in the cold weather.

"The great majority of the larvæ I have kept in captivity have died either just before or just after the pupa formed, and this heavy mortality seems to be due to a parasitic fly of which I reared several specimens (these have already been sent to the Museum). I was in hopes that this parasite was getting the better of the *katra*, for neither last year nor the year before was the attack so bad as it was three years ago. This year, however, *katras* have been worse than I have ever seen them. The present monsoon has been exceptionally wet, and that of three years ago was exceptionally dry, so that season does not seem much to affect the caterpillars; probably, however, the severity of the attack depends to a great extent on the character of the previous season.

"The *katra* defoliates a great many plants, both wild or cultivated; of the latter the following may be mentioned.

"*Gossypium herbaceum* (one variety of cotton, a perennial known as *Roji* related to *G. arboreum*, the *katra* does not damage seriously; the annual varieties it entirely destroys), *Crotalaria juncea*, *Phaseolus aconitifolius*, *Dolichos lablab*, *Cucumio sativa* (and several other Cucurbitaceæ), *Nicotiana tabacum* (seedlings), *Capsicum fructeocens* (seedings), *Solanum melongena* (seedlings), *Ricinus communis*, *Oryza sativa* and *Pennisetum typhoideum* (when very young only), *Zea mays*.

"These caterpillars were first seen near Baroda some dozen years ago and are said to have come from the country lying to the north-east. Until within the last twelve or fifteen years they were unknown to Gujarat cultivators. On the black soil immediately south of Baroda *katras* are known, but do little or no damage. This is not on account of lack of suitable food, for the whole country is covered with annual cotton, which the caterpillars eat, but it seems to be due to the absence of the hedgerows, which the moths frequent.

"*Remedies.*—Seed-beds may be protected by putting a quantity of the leaves of *Euphorbia neriifolia* round the borders. These leaves the *katras* eat and die, and if the seed-beds are carefully watched and intruders picked off, seedlings will escape with little damage.

"In the case of field-crops, where the foregoing remedy is impracticable, a number of *katras* may be killed under favourable circumstances (dry weather and a smooth field with a young crop) by rolling.

"*Mynas* destroy great numbers of the caterpillars, and, as already noted, parasites kill many, but when once they establish themselves in a field the crop in most cases is doomed. Prevention rather than remedy is required, and the evil might,

to a great extent, be prevented by the removal of the useless plants which crowd hedgerows and afford protection to the insect."

This insect is referred to in Volume III, No. 5, pages 57-58 of these *Notes*.

"*Heliothis sp.*—The common cotton boll-worm of Gujarat is a pinkish caterpillar about $\frac{1}{2}$" in length; from the caterpillar I reared a small grey moth, which may be *Heliothis armigera*. The boll-worm is always worst when there has been cloudy weather in November, a month or two before cotton ripens. It is one of the chief causes, but not the only cause, of 'stain' in cotton.

"*Diatræa saccharalis.*—I have reared several specimens of this insect. The moth differed from the description and plate of 'Museum Notes, Volume I,' in having a plumper body and much narrower inner wings.

"The sugar-borer has long been known in Gujarat, and when the monsoon rains are light, often proves a serious pest. Cane is planted in May, and the ravages of the borer are usually noticed about two months later, and continue throughout the growing season, although worst when the plants are young in July and August. The symptoms are withering of the terminal shoot of the cane, which on being pulled up comes away in the hand. If the shoot is examined, although the hole pierced by the borer may be seen in it, the borer itself is very seldom there (in 300 shoots examined I found two borers), but numerous small grubs, the larvæ of black and brown flies, will be found in the decaying matter. The borer itself soon after entering the stem seems to tunnel down into the solid cane of the lowest node, and if the cane be cut out below this node, and split open, one, and occasionally two, may be found. The sugarcane moth in captivity is very sluggish, and if this is its natural condition, and it does not migrate from or to distant fields, its ravages should be easily prevented.

"In Gujarat cane is seldom grown oftener than once in six years on the same soil, and in the district with which I am best acquainted the practice is for the cultivator never to plant cane sets from his own crop, but to purchase 'seed' in the neighbouring village. Whole canes stripped of leaves and tops are bought for seed, so that cane refuse or tops cannot be responsible for the introduction of the larvæ. From my own observations I think it most likely that the pest may be brought through the eggs of the moth sticking to the canes used for planting, because I have not found larvæ in large canes, but only in young canes. Late in the season borers are not found in the large canes, but in the shoots which spring from the base of the cane.

"In whatever way the pest gets into the field, it seems to reach the second generation before it makes itself apparent. The larvæ of the first generation either confine their attentions to the underground sets or, which seems to me more likely, they are few in numbers and their depredations among the young cane shoots pass unnoticed. For the past two years a careful watch has been kept for the first appearance of borer in the cane at the College Farm, but neither after planting nor at the usual time, two months later, did it make its appearance.

"*Remedies.*—If it is the case, as I take it, that this pest does not do serious damage until the second generation, and that except when cane fields are within a few hundreds of yards of each other, the cultivator need only fear the moths bred in his own field, prevention ought not to be very difficult. Efforts should be made to destroy the larvæ of the first generation. They may spend their lives in the sets where they would pass undetected, but, as I have not yet met with the borer

except in young cane shoots, I think it more likely that the eggs of the moths hatch when the cane germinates, and that the larvæ attack the young shoots, but are so few as to pass unnoticed. Many young cane shoots die from the attacks of white ants, and after planting, the ravages of these insects are so severe that a few borers would pass unnoticed unless carefully looked for. If these were found and destroyed in the end of May, there would be little fear of damage in July and August.

"Whenever the borer appears, early or late in the season, the affected shoots should be cut out as near as possible to the parent plant and burned.

"It might be practicable to prevent the attacks of both the borer and of white ants by dressing the cane sets with some insecticide before planting. The difficulty would be getting an insecticide strong enough to kill and keep off insects, but which would not injure the delicate roots and shoots of the young cane. Weak kerosine emulsion or some preparation of carbolic acid would perhaps be the most suitable insecticides to use. If the larvæ exist in the sets, the method mentioned by Miss Ormerod of steeping the sets for 48 hours in water might be tried.

"From the pupa of a borer I have reared a parasite, a brightly coloured insect like a minute wasp.

"I have not seen *Diatræa saccharalis* attack Sorghum or Maize.

"*Leucinodes orbonalis.*—A specimen of this insect was sent by me to the Museum.

"*L. orbonalis* is a small white moth, with red spots on the wings. The spread of the wings is about an inch, the length of the body less than half an inch.

"The larva is pinkish yellow and when full grown half an inch long. It bores in the stems and branches of the brinjal in the month of August. It has once been seen on the College Farm, but the affected shoots were at once cut off the brinjal plants and destroyed, and the borer did not do much damage. The pupa stage lasts eleven days."

This insect is referred to in Volume III, No. 5, page 64, of these *Notes*.

"*Homoptera.*—Specimens of a scale insect attacking sugarcane were sent by me to the Museum last September.

"This scale is a most destructive parasite in Gujarat; it may destroy half the crop and injure the quality of the remainder. It is known as *Masi* or *Mashi* by cultivators, and appears to belong to the genus *Aspidiotus*.

"The green young insects are seen on the cane in August, and in the same month scales appear, and in bad cases cover the back of the leaf until the crop is harvested in March. The pest is said to be worst in wet seasons, but last year it was very bad in some places, and the rainfall was not heavy. It is said also that it does not come through sets and that sets from an affected field of cane may safely be planted. Cultivators attribute the attack to the weather and some to heavy manuring with castor cake (a forcing nitrogenous manure). Most cultivators advocate the free use of manure to stimulate growth.

"The insects come in such myriads that it is difficult to think of any remedy. In the earliest stages spraying with 'Resin wash' might be effected, but even if the cultivator had a spraying apparatus large enough to deal with a crop of cane it is doubtful whether the remedy would be practicable.

"This scale insect injures the crop (1) by sucking the juices of the plants and (2) by covering the cane-stalks with a dirty powder, which gets into the juice during crushing, and destroys the colour of the jaggery.

"A scale insect locally known as *koaria* from its resemblance to koara (the seed of *Paspalum scrobiculatum*) does much damage to *Cephalandra indica*. The insect looks like a species of *Lecanium*. As the crop, which it attacks, is a valuable vegetable grown on a wooden trellis by market-gardeners, spraying with resin washes would probably be effective and profitable in this case."

The insect is referred to in page 53 of Volume III, No. 5, of these *Notes*.

"*Termes taprobanes*.—The white-ant is very destructive on the light sandy soil of Northern Gujarat.

"It attacks most crops after they are cut and stored, and hay, corn-stacks, etc., must be carefully watched. Corn is always threshed soon after it is cut for fear of white-ants entering the stack.

"Sugarcane suffers severely from white-ants. They burrow into and destroy the sets soon after planting, and eat through the junction between the young plant and the parent set, so that the latter withers off. The remedy always employed is castor-cake. Cultivators apply the powdered cake to the roots of the cane, two or three times between May and August. The total quantity given in a season is usually between 1,500 and 2,000 lb per acre. This large application of castor-cake is of course chiefly given as a manure, and not to keep off white-ants, but it serves two purposes very effectively.

"*Miscellaneous*.—In addition to the foregoing I have seen many insects damaging the crops.

"The following may be noticed :—

Cotton.—(1) A borer in the stem.
(2) A green caterpillar, $\frac{3}{4}$" long, which twists up and destroys the leaf when pupating.
(3) Weevils in the seed, especially when pods have been injured by the borer.

Tobacco.—(1) A small cream-coloured caterpillar, $\frac{1}{2}$" long, eating holes in the leaves.
(2) Two large crickets, one green, the other brilliantly coloured, eating the leaves.
(3) A borer in the apex of the stem.

Castor-oil.—(1) A borer in the upper stem and branches, the larva of a pretty white moth with black spots on the wings, and spread of wings of about one inch.

Cucumbers.—Small terra-cotta coloured beetle-like insects eating leaves. Body about $\frac{3}{8}$" long.

Rice.—Borer in the stalk, small white caterpillar, $\frac{3}{8}$" long."

Report from Kanara Range.

The following extract is taken from a letter dated August 1894, by Mr. E. H. Aitken, Assistant Collector of Salt Revenue, Kanara Range, forwarded by

the Survey Commissioner and Director, Land Records and Agriculture, Bombay:—

"*Oryctes rhinoceros*, Linn.—This beetle is very common in Kanara and does much mischief to cocoanut trees. It attacks the trees at the growing point and burrows downwards. In doing this it eats through the folded young fronds, so that, when they expand, they appear to have been cut in regular patterns. It would be difficult to find a tree in the district which does not bear this mark of the ravages of the insect. I have not ascertained whether the beetle enters the tree for the purpose of laying its eggs, or only to feed on the succulent parts. In the trees, which I have examined, I have only found beetles, but the natives say that they sometimes find large white grubs. This beetle is known in the district as *Bhowara*, a name commonly applied to any large droning insect.

The insect is referred to in these *Notes*, Volume III, No. 6, page 149.

"*Dinoderus sp.* (?)—Atleast one species of minute bamboo beetle is a troublesome pest in Kanara, seriously injuring bamboo furniture, walking-sticks, etc., and utterly destroying fixtures such as trellis-work and ceilings made of bamboo-matting. As far as I have observed, it is only while bamboos are comparatively fresh that they are liable to attack, and I believe that complete immunity is secured by soaking them in salt water for some time; but bamboos treated in this way are fit only for building purposes."

This insect is referred to in these *Notes*, Volume II, No. 6, page 150.

"*Calandra oryzæ*, Linn.—The grain weevil is common here as elsewhere.

"A large caterpillar of one of the wood-boring moths does much injury to guava trees in Bombay. It inhabits burrows in the principal branches and comes out at night to feed on the bark, making covered ways of its own excrement bound together with silk. I have never succeeded in rearing it or getting the moth. It is not met with so much in Kanara, where the guava is little cultivated.

"*Dacus ferrugineus*, Fabr.—Ripe mangoes are often unfit to eat in this district—especially after the rains set in—owing to the pulp having got black and rotten in parts close to the seed. On cutting open mangoes in this condition, I have found small, white, legless grubs possessed of a surprising power of springing. They are evidently dipterous, but I cannot say whether they belong to the species above named."

This insect is referred to in these *Notes*, page 165, Volume II, No. 6.

"*Dysdercus cingulataus*, Fabr.—This is not a cotton-growing district, but the pods of the silk cotton tree are infested at times with a red bug which I presume is this species, or are very closely allied. They suck the seeds, but I doubt their doing any damage to the fibre."

This insect is referred to in these *Notes*, Volume II, No. 6, page 167 :—

"One common insect is not mentioned in the conspectus which sometimes deserves a place among destructive pests—I mean the carpenter bee, *Xylocopa*. It makes its nests, as is well known, in dead wood, and in this district I have found it attacking the timbers of buildings, which are not regularly inhabited, such as travellers' bungalows and temples, in such numbers as to render them unsafe In the roof of an old bungalow which was recently pulled down, several of the beams were riddled through and through with holes, $\frac{3}{4}$ of an inch in diameter ; and I have been told that the roof of a public building in Karwar had to be renewed some time ago because the bees had weakened some of the beams so much that they were not safe. This is, of course, the insect that was employed by Hanuman to honeycomb the wood-work of the bed of a female demon, so that when Rama sat upon it, the whole bed fell to pieces and he was saved from being obliged to fulfil a rash vow. It is known here commonly by the same name as the Palm Beetle—*Bhowara*."

Report from Konkan.

The following is taken from a report, dated 21st June 1893, by Mr. E. Hearn, Acting Deputy Superintendent, Konkan Survey :—

2, "*Oryctes rhinoceros*, Linn. (Goliath beetle).—This beetle is a common pest of all cocoanut gardens throughout the Konkan coast. The Bhandari during his daily visit to tapped trees makes it a special duty to search for this beetle. If through neglect or mischance the beetle has worked down into a position whence it cannot be reached by hand, an iron hook is used for extraction. If the beetle effects a permanent lodgment in the heart of any tree that tree must die.

"The general name is 'Mobar' or 'Munga.'"

2. "*Rhynchophorus ferrugineus*, Oliv.—When a tree is attacked there is a fœtid oozing from the outer trunk of the cocoanut palm, which withers and dies. When cut down and opened out, the larvæ are found in masses of white, fleshy, legless grubs showing few signs of activity. The natives of the villages near Nerur of the Kudal Petha, Sawantwadi State, informed me that the disease may be arrested by boring a hole about one inch in diameter through the palm tree at the seat of the oozing, and thus destroying the grub by introducing ventilation into that part of the tree. The disease was said to occur in trees planted in recent silt deposits near rivers.

"I observed this particular pest in the year 1874-75 and cannot now recall the name of the insect, which I have not met with since."

3. "*Chienaspis Aspidistræ*.—The insect has been for a number of years ravaging the gardens at Shriwardhan, Janjira State. A scientific report upon the pest, dated 11th May 1891, was made by Mr. Woodrow of the College of Science. The remedial measures suggested therein have not been consistently carried out by the people, and the disease has a firm root among the gardens."

Report from Poona.

The following is taken from a letter, dated 17th August 1894, by Mr. G. M. Woodrow, Lecturer in Botany and Agriculture, College of Science, Poona, forwarded by the Survey Commissioner and Director of Land Records and Agriculture, Bombay :—

"*Bhunga.*—Applied to several large flying insects; for example, the mango weevil, the cocoanut beetle (*Oryctes rhinoceros*, Linn.). It is also applied to the gram weevil.

"*Mova* or *Mava.*—Applied to Aphides, to scale.

"*Alee* or *Alai.*—Applied to caterpillars varying in length from half an inch to one inch, generally green, attacking different field crops, as *Brassica oleracea, Cajanus indicus, Cicer arietinum*, cucumber, *Dolichos lablab, Vigna catiang*, etc. The same name is applied to larvæ of some insects attacking stored grain, as bajree (*Pennisetum typhoideum*), rice (*Oryza sativa*), etc.

"*Sonda-kida, Sonda* or *Pore-kida.*—Applied to the wheat and rice weevil (*Calandra oryzæ*, Linn.).

"*Tol.*—Applied to different species of locusts attacking various crops

"*Udhai Valvee.*—Applied to the common white-ant, which is very destructive to inferior timber and other dried vegetable matter."

Report from Gujarat.

The following is a report by the Sub-Assistant Superintendent, Gujarat Revenue Survey, on insect pests in his district, forwarded through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, in October 1894 :—

"*Morkhai.*—Morkhai is a disease which attacks the seedlings of cotton, tur, and jowari. The seedlings look healthy to all outward appearance, but when plucked they come off easily. The roots are cut clean off by a grub about an inch beneath the surface soil. Rows and rows of seedlings are thus destroyed, necessitating in severe cases a second sowing. In case of jowari the damage done is not great, as offshoots spring up after the main stem withers away. The damage done by this grub to crops attacked by it is not great. The grub lives underground and is not often observed by the cultivators.

"*Salo.*—In addition to *Morkhai*, which attacks jowari seedlings, as described above, another insect attacks jowari causing a disease called "Salo" in a similar manner when the plants are half matured. The growing axis is eaten off by the insect, destroying the main stem. Fresh offshoots spring up immediately afterwards. The fresh offshoots, however, take a long time to come to maturity, and the crop is delayed in harvesting beyond the usual period. The produce and size of the grain are also reduced by about half. This disease appears but once in eight or ten years, and is not considered to cause a heavy damage all over the district.

"*Sunga.*—Bajri is similarly attacked by an insect called 'Sunga.' The insect sucks the milk out of the tender corn, thus reducing the yield of grain both in quality and quantity.

"*Tur.*—In cloudy weather 'Tur' is attacked by an insect which decreases the yield of the crop considerably all over the district. It burrows into the ovary of the flower, and into the tender pods which are just forming. The flowers so attacked fall off without producing fruit; the pods after the attack remain empty and do not fill up.

"No kinds of remedial measures are known or practised by the cultivators in case of all the diseases described above. They are all attributed to changes in weather."

G. I. C. P. O.—No 43 R. & A.—10-3-96.—1,000—A. M'L.

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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:
6th April 1896.

CONTENTS.

EXPLANATION OF ILLUSTRATIONS.

PLATE IV—

FIG. 1. PEMPHIGUS NAPÆUS, (*a*) Apterous female, or foundress; (*b*) Pupa; (*c*) Imago, or winged female; (*d*) Antenna of the Apterous female; (*e*) Rostrum of the Apterous female; (*f*) Antenna of the imago; (*g*) Tarsi of the imago; (*h*) Gall.

„ 2. PEMPHIGUS IMMUNIS, (*a*) Pupa; (*b*) Imago, or winged viviparous female; (*c*) Antenna of the imago; (*d*) Galls.

PLATE V—

FIG. 1. THOSEA RECTA, Hampsn. *a*, larva and cocoon on tea twig; *b*, *c*, moths ♂ and ♀.

„ 1 d. Ichneumonid, parasite of Thosea recta (twice enlarged).

„ 2. XYLOBORUS FORNICATUS, Eichhoff. *a*, larva; *b*, pupa; *c*, *d*, imagos ♂ and ♀; *e*, affected tea stem.

„ 3. CARTERIA DECORELLA, Mask. *a*, adult females in tests on twig; *b*, tests of second-stage, females and males, on twig; *c*, tests of adult females, enlarged; *d*, test of male, enlarged; *e*, adult male; *f*, antenna of male (after Maskell).

4. SYNCLERA MULTILINEALIS, Guen. Moth, natural size.

„ 5. DACTYLOPIUS LONGIFILIS, Comstock. Female, enlarged (after Comstock).

PLATE VI—

FIG. 1. PODONTIA 14-PUNCTATA, Linn. *a*, larva; *b*, pupa; *c*, imago; *d*, earthen pupa cell.

„ 2. ASPIDIOTUS FICUS, (Riley) Comstock. *a*, scales on leaves of orange, natural size; *b*, scale of female, enlarged; *c*, scale of male enlarged; *d*, young larva, enlarged; *e*, adult male, enlarged (after Comstock).

„ 3. ARGAS REFLEXUS, Fabr. Upper, under, and side views, enlarged.

Vol. IV.] NOV 22 1897 [No. 2.

AN EXHIBIT COLLECTION OF ECONOMIC INSECTS IN THE INDIAN MUSEUM.

By EDWARD BARLOW.

The collection here noticed has been prepared for exhibition in the Indian Museum, with a view to illustrate the life histories of some of the more important "economic" insects, both injurious and useful, in the various stages of their development. It refers solely to Indian species, and is as complete as it has been possible to make it from the materials, and within the limits of space available, in the Museum.

The insect pests are arranged not in any natural order, but in accordance with the plants which they attack: thus the insects that attack tea and coffee are placed together, then those that attack cereals, and so on.

Wherever necessary, the actual exhibits have been supplemented by enlarged illustrative drawings.

The collection is exhibited temporarily in a series of cases running the whole length of the southern side of the Bird Gallery.

The following is a list of the exhibits :—

I.—Insects and mites that attack tea and coffee plants.

1. *Andraca bipunctata*, Wlk.=*trilochoides*, Moore (Bombycid moth).—Reported as defoliating tea bushes both in Cachar and in Jorhat.

2. *Clania crameri*, Westw. (Psychid moth).—Defoliates tea bushes in Assam, Sikkim, and Ceylon.

3. *Clania variegata*, Snell=*Sikkima*, Moore (Psychid moth).—Attacks tea plants in Sikkim.

4. *Zeuzera coffeæ*, Nietn (Cossid moth).—Tunnels into tea and coffee stems in Cachar and Ceylon.

5. *Thosea recta*, Hamps. (Limacodid moth).—Reported as attacking tea bushes in Ceylon.

6. *Thosea cotesi*, Swinh. (Limacodid moth).—Defoliates tea bushes in Darrang.

7. *Parasa lepida*, Cram. (Limacodid moth).—Attacks tea and coffee plants in Ceylon.

8. *Dasychira thwaitesi*, Moore (Lymantrüd moth).—Defoliates tea and sâl in Assam.

9. *Agrotis segetis*, Schiff. (Noctuis moth).—Destructive to coffee plants both in Southern India and in Ceylon.

10. *Xyleborus fornicatus*, Eichhoff (Scolytid beetle).—Reported as drilling holes on tea stems in Ceylon.

11. *Xylotrechus quadripes*, Chev. (Cerambycid beetle).—The coffee borer of Southern India.

12. *Helopeltis theivora*, Moore (S. Ord. Heterop.; Fam. Capsidæ).—Known as the "Mosquito blight." It does a great deal of damage to tea plants in India.

13. *Chlorita flavescens*, Fabr. (S. Ord. Homop.; Fam. Jassidæ).—Known as "The green fly blight." It attacks tea plants both in Sikkim and in Assam.

14. *Phromnia marginella*, Oliv. (S. Ord. Homop.; Fam. Fulgoridæ).—Reported as infesting tea plants in Assam.

15. *Aspidiotus theæ*, Maskell.—Reported as attacking tea plants both in the Kangra Valley and in Ceylon.

16. *Chionaspis theæ*, Maskell (S. Ord. Homop.; Fam. Coccidæ).—Reported as attacking tea plants both in the Kangra Valley and in Ceylon.

17. *Tetranychus biocultus*, W. Mason (Mite).—Known as the "Red spider." It does a considerable amount of damage to tea plants both in India and in Ceylon.

II.—Insects destructive to cereals and other Agricultural crops.

1. *Hispa ænescens*, Baly. (Chrysomelid beetle).—Known as the "Bengal Rice Hispa." It has been reported as very destructive to paddy crops in India.

2. *Calandra orysæ*, Linn.—The wheat and rice weevil of India.

3. *Leptocorisa acuta*, Thunb. (Heteroptera; Fam. Coreidæ).—Known as the "Rice sapper." It is most destructive to paddy crops in Bengal, the North-Western Provinces and Assam.

4. *Heliothis armigera*, Habn.—The caterpillar of this moth attacks almost all kinds of agricultural crops in all parts of India.

5. *Agrotis suffusa*, Fabr.—This cosmopolitan moth does a great deal of damage to almost all kinds of agricultural crops in India.

6. *Maruca testulalis*, Gayer=*aquatilis*, Boisd. (Heterocera.; Fam. Margaronidæ).—Destructive to beans (Dolichos lablab) in Bengal.

7. *Sphenarches caffer*, Zeller. (Heterocera.; Fam; Pterophoridæ).—Destructive to beans (Dolichos lablab) in Nagpur.

8. *Leucinodes orbonalis*, Guen. (Heterocera.; Fam. Asopidæ).—The Brinjal (Solanum melongena) borer of Bengal.

9. *Diatræa succharalis*, Cotes. (Heterocera.; Fam. Crambidæ).—The sugarcane borer moth.

10. *Rhopalosiphum dianthi*, Schrank.; (Homoptera; Fam. Aphidæ).—Destructive to rape crops in Bengal.

11. *Sphenoptera gossypii*, Kerre. (Buprestid beetle).—Tunnels into cotton (Gosypium herbaceum) plants in Nagpur.

12. *Julodis atkinsoni*, Kerre. n. sp. (Buprestid beetle).—Attacks cotton and melon crops in the district of Dehra Ismail Khan.

13. *Oxycarenus, lugubris*. Motsch. (Heteroptera.; Fam. Lygæidæ).—Attacks cotton plants in Seringapatam and in Ceylon.

14. *Dysdercus cingulatus*, Fabr. (Heteroptera.; Fam. Lygæidæ).—Reported as attacking cotton in Seringapatam, bottle gronds in Cawnpore, and musk-melon and cabbages in Cossipore.

15. *Tanymecus indicus*, Faust. (Curculionid beetle).—This small weevil has been reported as attacking opium seedlings in Ghazipur.

16. *Gibbum scotias*, Fabr. (Ptinid beetle).—Attacks the outer portion of opium cakes in Behar.

17. Grass-hoppers (Fam. Acrididæ) destructive to agriculture, *viz.*, *Acridium peregrinum*, Oliv. (The locust of North-West India); *Acridium succinctum*, Linn., *Acridium melanocorne*, Serv.; *Acridium æruginosum*, Burm.; *Osya velox*, Burm.; *Pachytylus cinerascens*, Fabr.; *Hieroglyphus furcifer*, Sauss.; *Chrotogonus trachyterus*, Blanc.; *Epacromia dorsalis*, Thunb.; *Atractomorpha crenulata*, Fabr.; *Oedalus marmoratus*, Linn.; *Pœcilocera picta*, Fabr., and *Tryxalis turrita*, Linn.

18. Crickets (Gryllidæ) destructive to agriculture.—*Schizodactylus monstruosus*, Drury. (Mole cricket); *Brachytrypes achatinus*,

Stoll.; *Liogryllus bimaculatus*, Degeer., and *Gryllodes melanocephalus*, Serv.

III.—Insects infesting fruit trees.

1. *Chryptorhynchus mangiferæ*, Fabr.—The mango (Mangifera indica) weevil.

2. *Psylla cistellata*, Buck., n. sp. (Homoptera.; Fam. Psyllidæ).—Destructive to mango shoots.

3. *Papilio erithonius*, Cramr. (Papilionid butterfly).—Destructive to young orange and lemon trees in different parts of India.

4. *Aspidiotus ficus*, Comstock (Scale insect).—Reported as very destructive to orange and lime trees in Khandalla.

5. *Anonæpestis bengalelle*, Rogt. (Phycitid moth).—The custard apple (Anona squamosa) pest in Bengal.

6. *Virachola isocrates*, Fabr.—The caterpillar of this butterfly bores into loquat, guava and pomegranate fruits in Bengal.

7. *Carpomyia parctalina*, Bigot (Muscid fly).—Destructive to melons in Baluchistan.

8. *Lampides elpis*, Godart (Lycænid butterfly).—Destructive to cardamom seeds in Ceylon.

9. *Gangara thyrsis*, Fabr. (Hesperid butterfly).—Destructive to the leaves of the cocoanut palm in Malabar.

IV.—Insects injurious to timber and other forest trees.

1. *Trochilium ommatiæforme*, Moore (Sesiid moth).—Reported as tunneling into the stems of Poplar trees in Baluchistan.

2. *Lucanus lunifer*, Hope (Lucanid beetle).—Reported as tunneling into Oak trees in Naini Tal.

3. *Psiloptera fastuosa*, Fabr. (Buprestid beetle).—Said to attack Teak trees in Malabar.

4. *Diapus impressus*, Janson (Scolytid beetle).—Reported as tunneling into oak stumps in the North-West Himalayas.

5. *Neocerambyx holosericeus*, Fabr. (Cerambycid beetle).—Reported as attacking Sâl (*Shorea robusta*) and Saj (*Terminalia tomentosa*) in the North-West Provinces, and Teak (*Tectoma grandis*) in Kulsi, Assam, also Farash and other trees in Dera Ismail Khan.

6. *Celosterna scabrator*, var. spinator, Fabr. (Cerambycid beetle).—Said to cause considerable injury to babul (*Acacia arabica*) plants in Berar.

7. *Melasoma populi*, Linn. (Chrysomelid beetle).—Destructive to *Salix elegans* trees in Deoband.

8. *Pemphigus edificator*, Buckton (Homoptera; Fam. Aphidæ).—Forms galls on stems of *Pistacia terebinthus* trees in Baluchistan.

V.—Ware-house pests.

1. *Trogosita mauritanica*, Linn. (Trogositid beetle).—Attacks stored wheat in Bengal.

2. *Silvanus surinamensis*, Linn. (Cucujid beetle).—This is a common ware-house pest in India. It attacks ship's biscuits, dried fruits in Calcutta, and cholum seed in Madras.

3. *Anthrenus vorax*, Waterh. (Dermestid beetle).—The larva attacks skins and leather of all kinds in India.

4. *Æthriostoma undulata*, Mots. (Dermestid beetle).—Destroys stored wheat (*Triticum sativum*) in Delhi.

5. *Dermestes vulpinus*, Fabr. (Dermestid beetle).—Reported as destructive to stored silk cocoons in Rajshahi. Destructive to badly-preserved skins.

6. *Rhizopertha pusilla*, Fabr. (Ptinid beetle).—A common ware-house pest. It attacks stored wheat, cholum seed and ship's biscuits in India.

VI.—Insect destructive to grass.

1. *Mahasena graminivora*, Hamp. n. sp. (Psychid moth).—Destructive to grass plants used for covering thatched houses in Calcutta.

VII.—Insect destructive to books.

1. *Sitodrepa panicea*, Linn. (Ptinid beetle).—The book-worm.

VIII.—Insects and mites that attack Domestic Animals.

1. *Chrysops dispar*, Fabr. (Tabanid fly).—Reported as attacking cattle in Baluchistan.

2. *Simulium indicum*, Bechr. (Simulid fly).—Known as the "Potu fly." It is said to attack both man and cattle in the North-West Himalayas.

3. *Culex* sp.—A very troublesome mosquito in Bengal.

4. *Argas reflexus*, Fabr. (Tick).—Reported as killing fowls in Bombay.

IX.—Beneficial insects.

1. *Calosoma orientale*, Hope. (Carabid beetle).—Reported as useful in destroying young locusts of the species *Acridium peregrinum*, Oliv.

2. *Cicinaela sexpunctata*, Fabr. (Tiger beetle).—It has been reported as very useful in destroying the rice sapper (*Leptocorisa acuta*) in Champaran.

3. *Anthomyia peshawarensis*, Bigot. (Muscid fly).—Parasitic upon the eggs of the locust (*Acridium peregrinum.*) Olivr.

4. *Carteria lacca*, Sign. (Scale insect).—The lac insect of Southern Asia, out of which shell-lac and lac-dye of commerce are obtained.

2. ORIGINAL COMMUNICATIONS.

The original communications received during the year are the following :—

(i) Description and figures of *Julodis atkinsoni*, a Buprestid beetle, reported as hurtful to cotton and melons in the Dehra Ismail Khan District ;

(ii) A Preliminary Note on two new species of Gall-Aphid from the North-West Himalayan region ;

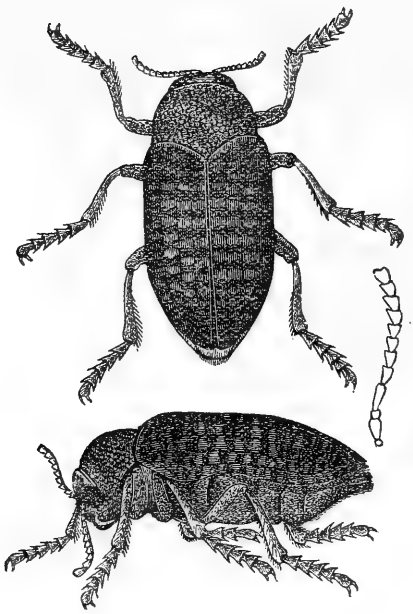
(iii) Description and figures of *Aleurodes eugeniæ*, a Coccid-like bug, reported as destructive to Jambul trees at Poona ;

(iv) A note on the well-known "Pipsa" fly of the lower slopes of the Himalayas.

1. JULODIS ATKINSONI.

A NEW SPECIES OF (*Buprestid*) BEETLE.

By C. Kerremans.



Julodis Atkinsoni, nov. sp.— ♀ *Oblonga, convexa, apice subattenuata, supra viridi obscura, nitida, elytrorum fossulis thoracisque punctis aeneo-viridibus ; subtus viridiaenea, segmento abdominis 2°, 3°, 4° que nigro coerulei cinctis, ultimo irregulariter nigro-vermiculato ; pedibus aeneis, antennis nigris ;—capite granuloso, fronte antice subrugosa, vertice longitudinaliter rugata ;—pronoto convexo, transverso, grosse punctulato, punctorum, intervallis elevatis et irregulariter vermiculatis ; utrinque in angulis anticis vage fossulato, fossulaque magna media prescutellata instructo ;—elytris convexis, utrinque quadricostatis, longitudinaliter impressis, impressionibus subquadratis, in seriebus tribus regularibus instructis, harum intervallis transversim vermiculatis et grosse punctatis.*

Subtus subtile rugosa, segmento abdominis 2°, 3°, 4° que posticis, lævibus, ultimo vermiculato ; pedibus grosse et confertim punctatis. —Long., 37 ; lat., 14 mm.

Oblong, convex, posteriorly attenuate ; thorax and elytra dull green, thoracic punctures and foveæ of elytra bronzy ; beneath bronzy, edges of abdominal segments cyaneous black ; antennæ black ; legs bronzy.

Head finely rugose between the eyes, the top finely and longitudinally wrinkled. Pronotum convex, at its base not quite twice as broad as long, anterior margin slightly sinuate, sides arcuate above the posterior angles, then straight ; posterior angles, subacute ; base with a large median and angular lobe surmounted by a large fovea ; surface rugose, the rugosities punctured and irregularly vermiculated ; on each side of it at the anterior margin, in the anterior angles, is a small fovea. Elytra convex, much wider than the thorax at the shoulders, nearly twice as long as wide, very largely and rugosely punctured, each with four raised lines and four rows of foveæ, of sub-quadrangulate form ; a fifth row, of small and more numerous foveæ, occurs between the fourth raised line and the lateral margin ; sides slightly sinuate above the middle, apex rounded, base with a large fovea. Beneath finely rugose, pubescent in irregular patches the last abdominal segment rugosely vermiculated. Legs densely and rugosely punctured. Length, 18 ; breadth, 7 lines.

Habitat :—District of Dehra Ismail Khan ; very destructive to melon and cotton crops.

I dedicate this very beautiful species, which is to be placed near *J. æneipes*, Saund., to the memory of the late and regretted Mr. Atkinson.

[The specimens from which this species is described, were furnished, in June 1895, by the Deputy Commissioner, Dehra Ismail Khan, through the Director, Land Records and Agriculture, Punjab, as causing considerable damage to Cotton and Melon crops in the Lieah Tahsi of Dehra Ismail Khan.—E. B.]

2. NOTE ON TWO NEW SPECIES OF GALL-APHIDS FROM THE NORTH-WESTERN HIMALAYAN REGION.

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

With one plate—No. IV.

Pemphigus napæus, n. sp.

This homopterous insect forms smooth rounded galls on the twigs of the Poplar tree growing at an elevation of 9,000 feet in the Valley of the Yasin river, near the Darkot Pass.

The galls have a shining green surface, slightly veined with brown, and variegated with yellowish patches.

They are mostly roundish ; but some occur of irregular shapes, about 1·10 × 0·50 inches in measurement.

When cut open, they show a single chamber tenanted by 20, or more, insects, some of which are in the pupal and others in the winged form. The alate insects are of two sizes, one being about twice the bigness of the other. A much larger female, which is blind and apterous, may be also found.

She is the foundress of the colony, and originally produced the first walls of the gall structure.

An aperture at the side affords an exit for the winged females when they are matured.

The winged female may be thus described :—Body robust. Head and thorax, both above and below, shining black. Abdomen pale, greenish yellow, smooth, and immaculate. Antennæ black, and about the length of the abdomen. First two joints globose, third joint ringed and about equal to the fourth and fifth taken together, the sixth ending in a blunt nail, and equal to the fifth. Eyes large, with the usual superimposed tubercle. Nectaries, none. Legs black, with rather long tarsi. Upper wings ample, with rounded tips. Veins, fine and black, with a conspicuous dark stigma. The neuration approaches that of a Schizoneura, inasmuch as the third vein does not meet the cubital. Notwithstanding this peculiarity, I regard this insect as a Pemphigus, and nearly allied to P. spirotheca of Koch, which in Europe also forms globular galls on the poplar (*Populus nigra*).

The expanded winged female measures 0·36 × 0·11 inch. The rostrum is short and equal to the width of the thorax. The smaller-winged forms, I believe to belong to an earlier brood, as they did not appear to be males.

Pupa entirely yellow; size, 0·15 inch. Foundress globose, shining yellow. Antennæ very short, black, and obscurely five-jointed. Rostrum stout and short. Eyes none, legs black. Size 0·11 × 0·09 inches.

Pemphigus immunis, n. sp.

This insect forms rather large galls,—1·20 × 1·10 inches, on the Aspens growing at Bunji on the road to Gilgit. Specimens gathered at an elevation of 4,600 feet, and preserved in alcohol, show a hard woody exterior. Sometimes they have a rough surface, like that of a walnut shell; whilst others show a quasi imbrication, as seen in the figure. The interior is thrown into smooth but deep furrows. The aperture near the apex has rough corrugated edges, or lips, like the excrescences made by *P. bursarius* of Europe. The galls made by *P. immunis* are much larger than those made by *P. napæus*, the last described species, and they differ in several particulars from those made by *P. bursarius*.

Winged viviparous female. Head and thorax more or less shiny piceous brown, not black. Abdomen green, mottled with yellow; head rather narrow. Antennæ short, black, five or obscurely six-jointed, the third joint hardly at all ringed; the last joint often dilated at the tip. The wing veining is much like that of *P. napæus*, but much paler, and the stigma faintly brown. All the upper side of the thorax brown; but this tint is confined to a saddle shaped dark spot on the sternal aspect. Eyes rather small, legs black.

The whole insect is more slender and more ovate than is seen in *P. napæus*. In the colour of the thorax and abdomen, it also differs from *P. bursarius*. These characters, coupled with the different habitats, and the appearance of the gall structures, justify a separation from either of these species.

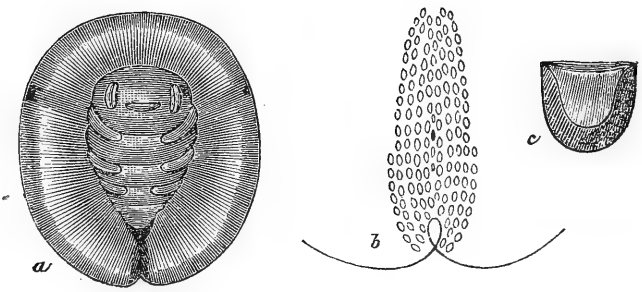
The pupæ are stout, ovate, greenish yellow, with short wing-cases and dark legs. They are numerous in the interior of the galls. Size, 0·08 × 0·04 inch.

3. ALEURODES EUGENIÆ,

A new species of Bug.

BY W. M. MASKELL.

[The specimens from which this species is described, were forwarded to the Museum in February last, by Mr. Marshall Woodrow, from Poona, where they are said to be doing serious injury to Jambool trees (*Eugenia jambolana*). The examples received consisted of only larvæ and pupæ, which, however, proved quite sufficient for identification. Mr. Maskell notices that the adult form is likely to be a small white fly, the wings of which will be more or less floury, and possibly slightly spotted.—E. B.]



Larva elliptical, very slightly convex dorsally, flat beneath: colour dull white; length about 1 mm. = $\frac{1}{25}$ inch. A faint indication of the enclosed insect may be made out through the waxy covering, but in this stage it is not conspicuous.

Pupa elliptical, slightly convex dorsally, flat beneath: colour of waxy test very pale, dull yellow; the enclosed insect is dark brown, and its outline may be made out beneath the wax; length of test about $\frac{1}{20}$ inch. Dorsally, the test is very finely striated, the striations being most distinct near the margin. There is no marginal fringe. On turning over the test, the rudimentary feet may be clearly seen,

folded inwards, and the antennæ much more faintly: and the abdomen tapers posteriorly to the usual vase-shaped orifice, normal of the genus. When examined by transmitted light, there appear three radiating patches, two from the thorax to the spiracular lateral depression of the test, and one from the abdominal orifice to the posterior, minute cleft in the test; these patches are narrow and formed of numerous small irregular cells in a lace-like pattern.

Adult form unknown as yet.

Habitat in India, on Jambool (*Eugenia jambolana*), Poona.

A species differing slightly from *A. proletella*, Linn., and *A. melicyti*, Maskell. The absence of a marginal fringe and the three radiating lace-like patches are distinctive characters.

EXPLANATION of figures: —*a*, Pupa, ventral view; *b*, lace-work patch; and *c*, abdominal orifice,—all enlarged.

4. NOTE ON THE "POTU" OR "PIPSA" FLY.

(*Simulium indicum*, *Becher*.)

By Lionel de Nicéville, F.E.S., C.M.Z.S., &c.

In the Journal of the Asiatic Society of Bengal, Vol. LIII, Part 2, pp. 199, 200, pl. XIV (1884), is a technical description of the female of *Simulium indicum*, from Assam, by Dr. Edward Becher. In the November Proceedings of the same Society, No. X, 1884, pp. 161, 162, is a note by Prof. Dr. Brauer on the habits of the allied species of *Simulia* found in Europe. Lastly, in *Indian Museum Notes*, Vol. III, n. 5, pp. 39—41 (1894), is a note by Mr. E. C. Cotes on the "Potû" fly, as found in the Himalayas. As, however, Mr. Cotes does not give references to the previous literature on the subject as regards the Indian species, nor refer to the remedies against the effects of its bite recommended by Dr. Brauer; and further, the present writer has been able to gather some additional information as to its habits it has been thought well to record this further Note.

The remedies advocated by Dr. Brauer are as follows:—

"All plans to diminish the number of these flies [in Europe] have been hitherto without success, as they cannot be exterminated in the [running] water [in which the larvæ develop], or only to a limited degree. Smoke is a protection against them, and it is produced by putting live coals into heaps of dung, leaves, hay, and the like. Another protection against their bites is an embrocation of tobacco decoction or of kerosine oil. For cattle, an ointment is made in the following way,—2 lbs. of tobacco leaves are boiled in 20 lbs. of water; the decoction is evaporated to the consistency of honey, then to this extract is added 1 lb. of lard and ¼ oz. of kerosine oil. The resulting ointment is rubbed into the skin of the cattle, and has the effect of keeping the flies off. It has to be applied especially near the openings of the body, on the belly and genitals, and the application must be repeated every third day.

"Against the bites of the fly, and their consequences, on the recommendation of Schönbauer, people apply fomentations of luke-warm milk, warm poultices of linseed and water, fresh linseed oil or fresh butter, which diminish the smarting pains very much and prevent swelling, if they are used early enough. Finally, luke-warm softening baths are recommended; also internally, cooling drinks, and in convulsions, opiates.

"Besides this, washing with diluted Goulard-water, vinegar, and ammonia is recommended. Aqua plumbic. grm. 400, externally. Or—

Acidi carbolici, grm. 8.
Olei olivarum, grm. 80.
On lint.

"Moistening the wounds with alcohol, water, and vinegar."(Proc. A. S. B., l. c.)

There is very little doubt, I think, that the Assamese, Sikkim and

Western Himalayan *Simulia* belong to one and the same species. Mr. Vincent A. Mackinnon has been so good as to collect a large number of the perfect female flies for me, which are now deposited in the Indian Museum, Calcutta, and has given me the following notes on them, based on his experiences of this pest at Mussooree, in the Western Himalayas. It would be advantageous to collect specimens in Sikkim (so far, I have not succeeded in doing this, but am still endeavouring to do so), and send them with the Western Himalayan examples to Dr. Becher for specific determination.

At Mussooree it is very plentiful in the spring, but small numbers can be found at all seasons. In the Western Himalayas it occurs at Mussooree, Chakrata, and thence, northwards, as far as the Niti Valley, near the snows. The Balti people say that it is well known in their country (Baltistan). It is found both in forests and in open grass-covered downs, and at all elevation, from 3,000 to 10,000 feet. At the latter elevation, Mr. Mackinnon was once so badly bitten, that he had to lay up from the effects for two days. The effects of the bite vary greatly in different people : to some it causes but little apparent inconvenience, a small black spot only being visible where the insect has bitten ; in other people it causes intense irritation, which, when the itching places are scratched, raise large lumps beneath the skin ; these may be some days before they disappear. Animals suffer as well as men—a tame deer (Kakhur), which Mr. Mackinnon possessed, nearly died from the effects of the bites. The fly chiefly attacks the ears, entering the external orifice in large numbers. They also attack the region of the eye orbits very largely. When the Chakrata-Saharanpur road was being constructed, numbers of the work-people were reported as having died from the effects of the bites. In the Western Himalayas, the fly is called *Potú* in Hindustani, *Phisniari* in Pehari, and *Phisho* in Balti.

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

BY EDWARD BARLOW.

1. TEA PESTS.

1. *Thosea recta.*, Hampsn.

(Sub. ord. Heterocera ; Fam. Limacodidæ.)

Plate V, fig. I—a, larva and cocoon on tea twig ; b, c, moths ♂ and ♀ ; 1 d, Ichneumonid parasite of Thosea recta, twice enlarged.

Aphendala recta, Hampson. Ill. Het., pt. IX, p. 71, pl. 160, fig. 3.

On the 6th May 1895, Mr. E. E. Green of Punduloya, Ceylon, forwarded to the Indian Museum specimens of the moth and cocoon of the species *Thosea recta*, Hampsn., also specimens of a Hymenopterous insect belonging to the family Ichneumonidæ, said to be parasitic on the caterpillars of the moth, with the information that the caterpillars had proved a serious pest to tea plants in Ceylon. He wrote :—" Mr. W. D. Holland, of Balaugoda, tells me that it has completely defoliated the trees over several acres of tea on his estate, and that the ground is quite black with their droppings. Fortunately a species of *Tachina* * preys freely upon them, and eventually reduces their numbers. Mr. Willisford, of Blackwater Estate,sent me specimens,and stated that they had stripped the bushes of everything but the youngest shoots over a field of 50 acres."

The following particulars are taken from a note furnished by Mr. E. E. Green :—

Larva : Colour bright yellowish green with a quadrate saddle-shaped spot occurring on the middle of the bag ; a chain of smaller red spots on the median line in front, and two or three similar spots behind. Oval ; convex above, a marginal and two dorsal series of conical spinous tubercles.

Cocoon, compact, oval, dull green, fixed to tea leaves or stem.

* Not a *Tachina*, but a species of Ichneumonid fly.—*E. B.*

2. *Xyleborus fornicatus*, Eichhoff.

(Ord. Coleoptera, Fam. Scolytidæ.)

Plate V, fig. 2—a, larva ; b, pupa ; c, d, imagos ♂ and ♀ ; e, affected tea stem.

Xyleborus fornicatus, Eichhoff. Berl. Ent. Zeitschr., p. 151 (1868).

On the 28th January 1895, specimens of a small beetle, together with pieces of tea stems riddled by them, were sent to the Indian Museum through Mr. E. E. Green, of Ceylon, from Mr. G. Alston, Superintendent of Tea Estate, Craighead, Nawalapituja.

The insect proved, on examination, to belong to a species of Scolytid beetle, which has not previously been reported to attack tea plants in India. Specimens were therefore forwarded to Mr. W. F. H. Blandford, who very kindly examined them and identified them as belonging to the species *Xyleborus fornicatus*, Eichhoff, a form closely allied to the often destructive species *Xyleborus dispar*, of Europe and North America.

The following is an extract from a letter furnished by Mr. G. Alston :—

"The pest appears mostly in patches, but has spread very considerably since I first observed it in any numbers three years ago. There is no evidence of any previous disease in attacked trees. Most of the trees attacked show no outward sign of the pest, except when almost every branch is attacked, when they turn rather yellow and stop flushing. Young trees about two years old, before they are topped, often snap off at the spot where the borers have made holes for their entrance or exit. Strong vigorous trees in good soil seem to be very little affected by it, and throw out good red wood even from badly bored stems. On the other hand, poor plants on ridges or poor soil seem to naturally feel the effect of it quickly, though in no case have I seen a tree *killed* by it. Isolated branches die off, but new branches come out in their place. As a rule, you can only tell an attacked tree (except in the case of young plants, when the stems snap off) on pruning it, when the holes in the wood are very apparent. It (the beetle) does not attack the cut surface after pruning, but makes its entrance through the bark. In the case of young red wood it very generally goes straight down the pith : in older branches I have often seen the wood riddled as if a charge of snipe-shot had been fired into it, with only one or two minute holes in the bark for exit or entrance. And yet in the case of vigorous trees, they seem to thrive notwithstanding. Since 1893 the pest has spread very much, and become more general, though I cannot say that I see much difference in the fields that were attacked then."

The writer, in the foregoing account of the pest, practically suggests the remedy—namely,—either not to plant in poor soil, or, if

the soil is poor, to improve it, and thus to strengthen the plant against the attack—the great object of all medical treatment everywhere.

To prevent the spread of the disease, the affected branches should be cut off and burnt.

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3. *Carteria decorella,* Mask.

(Sub-Order Homoptera ; Fam. Coccidæ ; Group Brachyscelidæ.)

Plate V, Fig. 3—a, *adult females in tests on twig;* b, *tests of second stage females and males on twig ;* c, *tests of adult females enlarged ;* d, *test of male enlarged ;* e, *adult male enlarged ;* f, *antenna of male enlarged.*

This species is a late addition to the list of Indian insect pests. It was sent to the Museum during the latter part of February 1895, by Mr. J. Lancaster, Secretary, Agricultural and Horticultural Society of India, as attacking tea and forest trees in Northern India.

Mr. W. M. Maskell, who kindly assisted in the identification of the species, reported that the insect has been hitherto considered as a strictly Australian form, and it was somewhat of a surprise to him to find it also occurring in India.

The following is Mr. Maskell's description of the species, published in *Tran. N. Z. Inst.*, Vol. XXV, p. 249 :—

Carteria decorella, sp. nov.—Adult female covered by a waxy test, which, at first single and separate, becomes later on aggregated in masses on the twig. The normal form of a test is subcircular rather convex ; the colour is yellowish-brown ; the diameter would average about $\frac{1}{6}$ in. if separated at full growth. The centre of the dorsal portion is occupied by a small elongated narrow red or purple lamina of wax, transversely corrugated, and evidently the remains of the test of the early second stage : from this to the margin radiate a number of narrow ridges and depressions, which give a corrugated appearance to the whole test ; at the posterior extremity of the small central lamina there is a minute orifice. When detached from the twig, the underside of the test is seen to be nearly solid, with a small orifice in the middle, so that the insect is almost entirely enclosed. The female insect is dark red, of the normal globular form of the genus, prolonged posteriorly in a short subcylindrical

"tail." Antennæ and feet absent. The usual large spine is present just above the abdominal process. The lac-tubes are, as usual, situated on the thoracic region: they are prominent, sub-cylindrical, and bearing groups of excretory glands. The body of the insect is very inconspicuously segmented, and on each margin of a segment is a group of very small subcircular spinneret-orifices.

Female of the second stage, covered by a waxy test, which at first is elliptical and very slightly convex, but later becomes subcircular, with a central small elongated and narrow corrugated lamina, from which depressions radiate to the margin. These depressions are comparatively more conspicuous than in the adult tests producing a more deeply corrugated appearance. Usually the median region is reddish or orange-coloured, the marginal corrugations whitish or yellowish; but the difference between a late second test and an early adult are not easy to make out. These second-stage tests average about $\frac{1}{25}$ in. in diameter in the early stage. The enclosed insect is at first elongated-elliptical, gradually assuming a subglobular form, colour red. I have not been able to satisfy myself as to the antennæ, or feet; but probably both are absent.

I have not observed any larvæ after emergence; but in some adult specimens examined there were a great number of embryonic larvæ; these were red, elliptical, tapering posteriorly, the abdomen ending in two divergent and conspicuous anal tubercles, each bearing a long seta and some short hairs. The antennæ and feet were not sufficiently developed for observation.

Male pupa, covered by a test of red or yellowish red wax. The form of the test is elongated-elliptical, convex above, the median region moderately rough and frequently simulating the form of the elliptical segmented enclosed pupa; the margin is corrugated as in the case of the female. Length of the test about $\frac{1}{20}$ in. At the posterior extremity there is a flat-hinged plate, on lifting up which the adult escapes. The enclosed pupa is dark-red.

Adult male dark-red, the wings hyaline with red nervures. Length of the body about $\frac{1}{30}$ in. exclusive of the spike. Antennæ of ten joints, the first two short and tubercular, the next five long and slender but diminishing somewhat to the seventh; the eight and ninth shorter and thicker, the tenth as long as the fifth, very thick and sub-elliptical: all the joints bear several hairs. Feet long and slender, but with no special character. The abdominal spike is straight and rather long, being nearly as long as the abdomen. The terminal abdominal tubercles bear each two setæ, from which spring moderately long cottony "tails."

For this pest, as also for the pest next mentioned, an emulsion of soft soap and kerosene oil would probably be efficacious.

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4. ***Chionaspis prunicola,*** Mask var. ***theæ.***

(Sub-Order Homoptera, Fam. Coccidæ.)

In May last a number of blighted tea leaves were forwarded to the Indian Museum by Mr. J. Lancaster, Secretary, Agricultural and Horticultural Society of India. The leaves were found to be covered with a number of little scale insects. Mr. Lancaster did not state the locality of the insect, but reported that it comes on or gets worse in the dry season, and was spreading and causing great destruction in a tea garden. The pest proved to be new to the Indian Museum Collection, so specimens were submitted to Mr. W. M. Maskell for examination. Who wrote—

"I am sorry that on this occasion I cannot as yet give you a definite identification of this insect. It very clearly belongs to the *Diaspidinæ*, but I am a little puzzled by its affinities. It approaches so very closely to *Chionaspis prunicola*, in almost every character, that I am in much doubt. The only differences are that the adult female is more elongated than *C. prunicola*, and the puparium of the male is apparently not carinated. This latter character would, indeed, *if certain*, relegate the insect to the genus *Mytilaspis ;* but I am not quite sure about it. The elongation of the female is less important. In the anatomical characters of the female pygidium the two insects are almost, if not quite, identical. Under these circumstances, I am obliged to suspend my judgment.

"Although *Chion. prunicola* was found in the Sandwich Islands on a Japanese plant, that is by no means any obstacle to its being also in India : more especially as tea is not, I believe, indigenous in India, and grows also in Japan. I have frequently avowed a disbelief in the theory that a Coccid is necessarily confined to one food plant. Therefore, there is not the least reason on such grounds why your insect should not be identical with that from the Sandwich Islands. Still, there are slight differences, and I will not decide positively at present."

Mr. Maskell, however, after a further careful examination of the specimens, subsequently wrote that he has decided to attach the species to *Chionaspis prunicola*, under the name *C. prunicola*, Mask. var., *theæ*.

MISCELLANEOUS TEA PESTS.

5. *Tineid caterpillar.*—On the 25th of April 1894, from Messrs. Finlay, Muir & Co., were received some specimens of a caterpillar, said to be very destructive to tea plants in the Mookhamcherra Tea Estate, Sylhet.

The specimens proved to be the larvæ of a still unknown (Tineid) moth, and similar caterpillars were reported in 1891 to have damaged tea bushes in Jorhat.

6. *Limacodid caterpillar.*—In July 1894, Messrs. Finlay, Muir & Co. forwarded to the Museum some specimens of a caterpillar, reported to be doing a considerable amount of damage to the tea bushes at Rungamuttee Garden, in Sylhet.

The examples sent were insufficient for precise identification, but they were larvæ of a Limacodid moth.

7. *Psychid caterpillar.*—In August 1894, specimens of an insect, reported to be attacking tea bushes in Assam, were forwarded to the Museum, through the Manager, Planters' Stores and Agency Company.

The insects proved to be the larvæ of a Psychid moth, the material being insufficient for precise identification.

To summarise : four species of moth-caterpillars, one species of beetle and two species of scale-insects have been reported during the year as doing extensive damage to growing tea-plants in India.

None of these are mentioned in Mr. Cotes' " Insects and Mites Destructive to Tea, " and must therefore be added to the list there given.

As regards remedial measures, in the case of the caterpillars, drawings of the parent moths and of the cocoons were forwarded to the parties interested, in order that the pest might be searched for, recognised and destroyed.

In the ships of the Indian Marine, it is, we believe, found possible to keep down even such nocturnal animals, as cockroaches, by setting boys to catch them, and there seems to be no reason why the same plan should not be successful in the case of such large tea-pests as caterpillars, cocoons, etc.

II.—INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

1. THE RICE HISPA.

Hispa œnescens, Baly.

Specimens of this common rice beetle (Chrysomelid) were received in the Indian Museum from the undermentioned officers, as very destructive to paddy crops during the year 1895.

(*a*) Through the Superintendent, Government Central Museum, Madras, from the Collector of Malabar, who wrote in September 1895 :—

"The insects are said to have caused damage to the paddy crop in Ponan Taluk. 1,280 acres of land in 10 Amsams are reported to have been affected, and the loss is estimated at 20,000 *paras* of paddy, worth about Rs. 10,000."

(*b*) Through the Director, Land Records and Agriculture, Punjab, from the Deputy Commissioner of Kangra, in May 1895, who reported :—

"I am getting complaints of damage to growing rice by a black insect, bigger than a bug. I am sending you some of them....."

2. ***Agrotis suffusa,*** Fab.

INFESTING HOP PLANTS.

In July 1895, specimens of a moth in all its stages of development, were forwarded to the Indian Museum by Captain J. L. Kaye, Settlement Officer, Kashmir, through the Officiating Secretary to the Government of India, Department of Revenue and Agriculture, with the information that it had been very destructive to hop plantations in the Kashmir State. Captain Kaye wrote :—

"The State hop garden, which for the last two years has been in a flourishing condition and giving good returns, has this year been devoured and destroyed by a green caterpillar, called here the 'mohru,' and although we have tried sprinkling the plants with various solutions of sulphur, tobacco and native drugs, no means of destroying the insect has been discovered.

"The 'mohru' attacked a corner of the garden last year, and the destruction of wheat and barley, not to mention certain trees, by this insect, is nothing new.

"If rain falls soon after the caterpillars appear, slight damage only is done. The insect falls from the hop vines, etc., directly rain commences, and is devoured by crows and other birds.

"This spring has been an abnormally dry and hot one, and the 'mohru' has consequently done an unusual amount of harm."

The specimens proved to be a Noctues moth, belonging to the cosmopolitan species, *Agrotis suffusa*, of Fabr., which has previously been reported in the pages of these Notes, as very destructive to almost all kinds of Agricultural plants in India.

It is interesting to find that, in favourable circumstances, insectivorous birds are capable of exterminating this pest for a season, and it is hoped that the record of this natural remedy may lead those interested in insect pests to encourage insectivorous birds, by protecting them and their young from their natural enemies.

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3. ***Synclera multilinealis,*** Guen.

COTTON PEST IN BARODA.

Plate V, fig. 4, Moth.

In April 1895, some specimens of a Pyralid moth, said to be injuring cotton in Baroda, were forwarded to the Indian Museum by Mr. T. H. Middleton, of Baroda College.

According to the statement furnished, the larvæ of the moth injure cotton plants by twisting up the leaves when about to pupate, glabrous forms of cotton being often entirely defoliated in this way. Mr. Middleton reported that the moths were reared from a batch of larvæ that pupated between the 23rd and 27th September 1894, the imagos appearing on the 3rd October.

The moths were identified with *Synclera multilinealis* of Guen, a species hitherto unknown as a pest to Agriculture. Mr. Moore describes the species thus :—

Botys multilinealis,	Guen., *Delt. et Pyral.*, p. 337, No. 380, pl. 8, fig. 11 (1854).
„ „	Walker, *Cat. Lep. Het. B. M.*, xviii, p. 661, (1859).
„ „	Leder., *Wien. Ent. Monat*, vii, p. 375, pl. 11, fig. 3 (1863).
„ „	Moore, *Proc. Zool. Soc., Lond.*, 1867, p. 96; and 1877, p. 619.
Zebronia salomealis,	Walk., *loc. cit.*, xvii, p. 476 (1859); and xxxiv, p. 1348, (1865).
„ „	Swinhoe, *Proc. Zool. Soc.*, 1885, p. 870.
Botys annuligeralis,	Walker, *loc. cit.*, xxxiv, p. 1424 (1865).

Notarcha multilinealis, Meyrick, *Trans. Ent. Soc.*, London, 1884, p. 312.

Synclera multilinealis, Moore, *Lep. Ceyl.* iii, p. 315 (1886).

Very pale olivaceous-yellow, opalescent in some lights : fore-wing with some olive-brown basal spots and streaks, a transverse curved antemedial line, an irregular postmedial denticulated line, and a submarginal denticulated line ; an oval orbicular and reinform mark, and a mark below the cell ; hindwing with two irregular discal, and a submarginal denticulated line, a mark at end of the cell, below which is a short streak, a marginal line and an interciliary line olive-brown. Thorax with olive-brown spots, abdomen with paler bands, and a penultimate black spot ; palpi and legs whitish ; palpi and fore-legs with brown bands.

Expanse $\frac{9}{10}$ to $1\frac{1}{10}$ inch.

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4. ***Heliothis armigera,*** Hübn.

Examples, which proved to be the larvæ and chrysalids of the well-known destructive Noctues moth (*Heliothis armigera*, Hübn.) have been received in the Indian Museum from the undermentioned officers, as affecting agricultural crops during the year 1895.

(*a*) Destructive to gram crops in Dehra Dun, forwarded in April 1895 by Mr. W. F. Dobbie, who wrote :—

"We had beautiful gram crops here this 'Rabi ;' but they have been spoilt by caterpillars. They make a hole in the pod, eat the gram seeds, and then come out of the pod leaving it perfect, with the exception of the one hole."

(*b*) Damaging gram plants in Chhindwara District, forwarded by the Settlement Officer, Chhindwara, who reported in March 1895 :—

"I forward by parcel post the chrysalids of a caterpillar commonly found in this district on ordinary gram plants. The caterpillar is green and smooth-bodied. A brown variety is also found. It feeds by day, and its appearance in numbers is associated with cloudy weather."

(*c*) Reported to cause damage to paddy crops in the Malabar District : forwarded through the Superintendent, Government Museum, Madras, from the Collector of Malabar, in July 1895.

Remedies for this pest were recommended in *Indian Museum Notes*, Vol. I, pp. 50 and 97, but no reports as to the results of these recommendations have been received.

5. CUCUMBER BEETLE.

Aulacophora abdominalis, Fabr.

In April 1895, the Deputy Collector on special duty, Berhampore, forwarded, through the Director, Land Records and Agriculture, Bengal, specimens of an insect said to be injurious to leaves and fruits of Cucumber vines in Berhampore.

The examples proved to be a Chrysomelid beetle (*Aulacophora abdominalis*, Fabr.) which has previously been reported as destructive to Cucumber and several other plants in India; *vide Indian Museum Notes*, Vol. I, No. 2, pp. 92 and 93, pl. IV, figs. 5 *a* and *b*.

As regards the treatment adopted against this insect, the Deputy Collector reported, that application with a mixture of 1 part of kerosene oil, 1 part of sour milk and 100 parts of water, proved an effectual remedy in exterminating the pest.

6. THE LOCUST.

Acridium peregrinum.

On the 24th May 1895, some specimens of the migratory locust (*Acridium peregrinum*, Olvr.) were forwarded to the Indian Museum, by the Survey Commissioner and Director, Land Records and Agriculture, Bombay. According to the information furnished, the flight of locusts was reported to have come on the 3rd instant from the Shikarpur Taluka, in the south, and settled on "Kirir" (*Copparis aphylla*) trees in the Thul Taluka of the Upper Sind Frontier, and after three days' stay, the swarm seemed to have moved northwards to the Khan of Kelat's Territory. No injury was done to the crops.

7. MISCELLANEOUS INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

(1) In April 1895, specimens of several kinds of insects, said to be destructive to agricultural crops in Berhampore, were forwarded to the Indian Museum through the Director, Land Records and Agriculture, Bengal, from the Deputy Collector on special duty, Berhampore. The specimens comprised as follows :—

(*a*) Insects destructive to bean leaves (*Dolichos bengalensis*) consisted of numerous specimens of a young caterpillar of a moth, the material being insufficient for precise identification.

The Deputy Collector writes that treatment with a mixture of 1 part of kerosine oil, 1 part of sour milk and 100 parts of water had the effect of killing the larvæ and restoring the vigorous growth of the plants.

(*b*) A phial containing examples of the brinjal stalk and leaf parasite, consisted of three different kinds of insects, *viz.*, numerous *imagines* and larvæ of a Coccinellid beetle, *Epilachna*, sp ; five specimens of a Cetonine beetle, *Glycyphana*, sp.; and a few larvæ of an unknown moth.

The Deputy Collector on special duty reported that dusting the plants through a calico bag, with a mixture of 1 ounce of London purple, 1 ounce of quick lime and 3 pounds of cowdung ashes, powdered together very fine, proved an effective remedy, and the brinjal plants that were denuded of their leaves put forth new shoots afterwards, and produced almost the normal quantity of fruits.

(*c*) Specimens of a black beetle destructive to chrysalids of the wild mulberry silk cocoons (*Theophilla huttoni*) consisted of specimens of a Chrysomelid beetle, *Chrysomela*, sp.

(*d*) Insect known as the "Kuji fly," reported as parasitic on the mulberry silkworm of commerce, consisted of a single specimen of a Dipterous insect in too poor a state of preservation for identification.

The Deputy Collector reports as follows regarding the insect :—

"The fifth is the "Kuji fly" of Maldah : a Tachinid parasite found only in May and June in Maldah. They are parasitic to the Mulberry silkworm, in the same way as the *Trycolyga bombycis*, from which they differ both in appearance and in their manner of attacking silkworms. The "Kuji fly" is smaller than the ordinary silkworm fly, and it has an arched back (Kuji, meaning hunch-backed). They also differ in their behaviour from the ordinary silkworm fly, as they make a silent and a direct dash at the silkworm trays, instead of buzzing about in the vicinity of rearing houses, and moving about openly among silkworms and depositing eggs upon them, as the *Trycolyga* does. Being also an annual insect and rather rare, it is difficult to secure a large number of specimens."

(2) In August 1895, specimens of moths, said to be causing serious damage to Joar, Makai, and Lucerne, on the Karachi Sewage Farm, were forwarded to the Indian Museum from the Superintendent, Municipal Gardens, Karachi, through the Reporter on Economic Products to the Government of India.

The examples proved, on examination, to consist of two species of moths, which belong to two widely different families, namely,

two specimens of a Noctues moth, *Leucania loreyi*,* Dup., and eleven specimens of a Microlepidopterous moth, belonging to the family Crambidæ.

(3) In May 1895, some specimens of cabbage leaf infested by insects were forwarded by the Sub-divisional Officer, Alipur, Duars, through the Director of Agriculture, Bengal.

The leaves arrived in the Museum in such a bad state of preservation that nothing could be made of them; they, however, appeared to be attacked by caterpillars of some kind. The following is an extract from a letter from the Sub-divisional Officer, Alipur, Duars:—

"Insects have proved very injurious to vegetables such as cauli-flowers, beet-roots and cabbages. Mr. Basu, Assistant Director of Agriculture, who visited this sub-division during the year under report, was of opinion that the use of dung manure favoured the generation of these insects. I send you a few specimens of the insect, and some vegetable leaves destroyed by them for your inspection in a separate cover. Mr. Basu says that the use of bone manure will reduce the number of the insects, very considerably, but there is strong prejudice amongst the Hindus against the use of this kind of manure. Mr. Sunder, while Settlement Officer of the Western Duars, tried his best to introduce bone manure, but the people would not use it."

(4) In September 1895, specimens, were forwarded to the Museum, by the Director, Land Records, North-Western Provinces and Oudh, of a species of Curculionid beetle, which has proved injurious to Egyptian cottons crops at the Government Experimental Farm, Cawnpore.

The specimens appeared to be new to the Museum collection, so have been sent to Mons. Desbrochers des Logus for identification.

(5) Specimens of two kinds of insects destructive to Arhar crop have been received from the Director, Land Records, North-Western Provinces and Oudh, in April 1896. They consisted, as follows:—

(a) Numerous larvæ and chrysalids of a Microlepidopterous moth; (b) Specimens of a Noctues caterpillar, the materials being insufficient for precise identification.

(6) In May 1894, specimens of insects were forwarded to the Indian Museum through the Officiating Director, Department of Land Records and Agriculture, Burma, from the Superintendent of Land Records, Mandalay, with the information that they were doing damage to agricultural crops in the Mandalay District.

* This moth has previously been referred to in *Indian Museum Notes*, Vol. 1, p. 51, as very destructive to paddy crops in Sambalpur, Central Provinces.—*E. B.*

The specimens comprised, as follows :—

(*a*) "Poti-gaung," reported as destructive to sugarcane roots, consisted of larvæ of a Melolonthine beetle (cock-chaffer), the examples being insufficient for identification.

(*b*) Caterpillars, reported as injurious to Sessamum plants, peas and beans, proved to be the larvæ of an unknown moth.

(7) In March 1895, the same officer forwarded, through the Director, Department of Land Records and Agriculture, Burma, specimens of a dark brown caterpillar said to be very common in the month of January in the alluvial lands of Mandalay district, on the banks of the Irrawaddy River. They were reported to be very destructive, by ripping the roots and lower stems of the following plants,—maize, tobacco, onions, chillies, peas, and beans of kinds, coriander, brinjal, roselle and cabbages, etc.

The specimens proved to be insufficient for precise identification, but they appeared to be the larvæ of a moth probably belonging to the family Noctuidæ or Leucaniidæ, which mainly consist of pest to agriculture.

III.—INSECTS INFESTING FRUIT TREES.

1. THE HOG-PLUM BEETLE.

Podontia 14.—punctata, Linn.

Plate VI, Fig. 1—a, *larva ;* b, *pupa ;* c, *imago ;* d, *earthen pupa cell.*

Linn. *Syst. Nat.* ed. XII, p. 599.—Fab. *spec. Ins.* I, p. 117.—Oliv. *Ent.* v, p. 539, *t.* 4, *f.* 42.—Baly., *Journ. of Ent.* I, 1862, p. 451.

In the early part of October 1895 specimens of this chrysomelid beetle in all its stages of development were received in the Indian Museum through Mr. C. O. Bateman, with the statement that they were devouring the leaves of a Hog-plum tree (*Spondias mangifera*) growing in the compound of his house in Calcutta.

According to the information gathered, the beetles make their appearance on the tree, almost every year, about the time when the tree is in full foliage, in the months of July and August, and disappear in the latter part of October. The injury done is only confined to the leaves on which they feed, and a tree that has been

badly attacked may be easily recognised by its denuded appearance, and the total absence of the leaves.

The larva, in which stage the insect is mostly injurious, is about three-fourths of an inch in length, and of a dirty yellowish colour. It is soft and of a flesh-like consistency, about three times as long as thick, with the body much wrinkled transversely. The head and the neck is black and shining. Three pairs of legs are placed anteriorly upon the breast, and are of the same shining black colour with the head. It usually hides itself by covering its body with its own excrement, and in this state, it so exactly resembles like the dropping of a bird that it is frequently mistaken for such, and thus it is able to escape detection from its numerous aërial enemies. This curious habit of covering the body with its own excrement is no doubt a case of true "protective resemblance." The time the larva takes to change into the pupa state is not known, but it transforms, by descending into the ground in a rough earthen cell, oval in shape and about the size of a hazel nut.

The beetle is a common and widely distributed species in the East and equally variable, the spots are as frequently united and form broad, dentated transverse bands of brown or black. It measures a little over one-half of an inch in length, is of an oblong form, and of a yellowish-brown colour. It feigns death when alarmed or captured.

The Indian Museum possesses specimens from Calcutta, Murshidabad, Sikkim, Shillong, and Andaman Island.

2. ORANGE SCALE INSECT.

2. ***Aspidiotus ficus*** (Riley), Comstock.

Plate VI, Fig. 2—a, *scales on leaves of orange, natural size ;* b, *scale of female, enlarged ;* c, *scale of male, enlarged ;* d, *young larva, enlarged ;* e, *adult male, enlarged.*

In October 1894, Mr. Marshall Woodrow, Director of Botanical Survey, College of Science, Poona, forwarded to the Indian Museum specimens of orange leaves infested by scale insects, with the information that they were seriously injuring orange and lime trees at Kachaldara House, Khandalla.

The orange leaves proved to be attacked by a species of scale insect (Coccid) not previously reported from India. Specimens were

therefore submitted to Mr. W. M. Maskell, of New Zealand, who has very kindly examined them and identified them as belonging to the species *Aspidiotus ficus* (Riley), Comstock. This identification is most interesting, as this pest is primarily American, and has not hitherto been reported from Asia.

The following is the description of the insect as furnished by Mr. Maskell :—

Puparium of female circular, flattish, dark-reddish brown in colour : diameter averaging 2 mm. The pellicles are central and lighter coloured than the rest.

Puparium of male nearly similar in form to that of the female, but slightly elliptical : not carinated.

Adult female pale yellow or whitish in colour, of the normal peg-top form of the genus : the abdominal region is small and tapering, and ends in six distinct lobes, of which the two median are slightly larger than the rest and the two outer ones slightly the smallest : between these lobes are some broad scaly hairs with serrated ends. There are four groups of spinnerets on the pygidium : the two anterior groups have usually eight orifices, and the two posterior groups usually four each.

Adult male, light orange-yellow : length, about 1 mm. The thorax bears a brownish transverse band, and the abdomen ends in a spike (sheath of the penis) which is about as long as the abdomen.

Habitat—in North America (Florida, California) on Orange and lemon trees : in Australia on the same trees : and it will probably extend to every country where these are grown.

The Americans call this "The red scale of Florida," and it is considered to be a dangerous enemy to *citrus* trees of all kinds. It is stated by Comstock to have first come from Cuba : but it is by no means easy to decide upon the original home of any of these pests.

The following extract taken from Mr. H. G. Hubbard's report on "Insects affecting Orange" is of great interest, as it deals with the several stages of development of the insect.

"*Development of the Insect and formation of the Scale.*—The development of this insect from the egg to the adult state was followed through five generations. I give, however, only the substance of a part of the notes taken on a single brood (the second one observed) as that will be sufficient for our purpose. The observations were made upon specimens which were colonized on small orange trees in pots in my office in Washington. The rate of the development of the insects was probably slower than would have been the case in the open air in Florida.

"April 12th, 1880, specimens of orange leaves infested by this scale were received from Mr. G. W. Holmes, Orlando, Fla. At this date males were found both in the pupa and adult state. The females also varied in size, and some of them were ovipositing. Eggs were placed on an orange tree for special study.

"April 13th, the eggs began to hatch.....The young larvæ are quite active, but they settle soon after hatching. Some settled the same day that they hatched.

"April 14th, it was found that the young lice, although only twenty-four hours old, had formed scales which completely concealed them from sight. These scales resembled in appearance the fruiting organs of certain minute fungi. They were white, circular, convex, with a slightly depressed ring round the central portion; their texture was quite dense, and they were not firmly attached to either the insects or the leaf, a slight touch being sufficient to remove them without disturbing the larvæ. The larvæ had not changed in appearance, and were able to move their legs and antennæ.

"April 15th, the lice had not changed perceptibly. The scales had become higher and more rounded.

"April 16th, the lice had contracted considerably, being now nearly circular, at least as broad as long; in other respects there was no apparent change. The scales were found to vary somewhat; those most advanced having the central portion covered with a loose mass of curled white threads.

"April 17th, there was apparent no further change in the larva, but the mass of threads covering the central part of the scale was found in some specimens to have greatly increased in size, equalling in height three or four times the width of the scale. This mass is cottony in appearance, and in those specimens where it is largest is more or less in the form of a plate twisted into a close spiral.

"April 19th, not much change was apparent in the larva, but the mass of cottony excretion upon some of the scales had increased enormously; so that in some cases it extended in a curve from the scale to a point five times the width of the scale above the leaf and down to the leaf.

"April 20th, no important change was observed either in the larvæ or scales.

"April 21st, it was observed that the larvæ had become more or less transparent, and marked with large irregular yellow spots near the lateral margin of the head and thorax, and with a transverse

row of similar spots across the base of the abdomen; the tip of the abdomen is very faintly yellow.

"April 22nd, no important change was noted.

"April 23rd, it was observed that the scales appeared faintly reddish in colour with the centre white; the reddish colour, however, was due in part to the body of the larva, which is now orange-red, showing through the scale. It should be noted that in only a part of the specimens did the cottony mass become enlarged. The greater part of the scales remained until this date of the form, and the cottony spirals have now disappeared, probably having been blown away.

"April 24th, some of the larvæ had become deep orange in colour.

"April 26th, most of the scales had become deep orange in colour with the central part white; some had at the centre a small nipple-like protuberance; others still preserved a short tuft of a cottony excretion. This tuft is either removed by wind or otherwise, or it becomes compact, melted, as it were, to form the nipple-like projection referred to above.

"April 28th, the insects appeared as they did two days ago; the scales had become very tough, and it was with difficulty that they could be removed from the insect.

"April 30th, the insects still remained apparently unchanged. Some of the scales were only about one-half as large as others, and still remained perfectly white; these proved to be male scales. All the scales at this date had an elevated ring on the disc with a central nipple.

"May 3rd, many of the larvæ began to show that they were about to molt, the form of the next stage being visible through the skin of the insect.

"May 5th, nearly all the larvæ had molted; they were now orange-yellow, with the end of the body colourless. The last abdominal segment now presents the excretory pores which are represented in the drawing of the corresponding segment of the adult female. The molted skin adheres to the inside of the little scale, and therefore cannot be seen from the outside. The scales are now pink, or rose colored, with the centre white.

"May 14th, the insects had become a somewhat paler yellow, with the anal segment slightly darker. Most of the scales were now dark purple. On removing an insect a very delicate round white plate was observed adhering to the leaf where the mouth parts were inserted.

"May 18th, the male scales were fully grown. At this stage they were dark reddish-brown in colour, with the centre white, and the posterior side, which is elongated, grey. At this date some of the males had transformed to pupæ; others were still in the larva state; these larvæ were covered with roundish, more or less confluent yellow spots, leaving only the margin colourless; the end of the body was pale orange. The newly-transformed pupæ resembled in markings the larvæ just described. None of the females had yet molted the second time; their colour was deep orange.

"May 21st, nearly all of the males had changed to pupæ. It was observed that the last larval skin is pushed backwards from under the scale, to the edge of which it frequently adheres.

"May 24th, none of the male pupæ had transformed to the adult state.

"May 29th, it was found that during the five days previous more than one-half of the males had issued, and the remainder, though still under the scales, were in the adult state. It was now forty-seven days from the time the larvæ hatched.

"June 2nd, no males could be found; the females were about one-half grown, and were whitish with irregular yellow spots.

"June 9th, eggs were observed within the body of a female.

"June 17th, it was found that one of the females had deposited nine eggs, of which six had hatched. This is sixty-six days from the hatching of the egg, and probably about twenty days after impregnation of the female.

"The insect of this brood continued to oviposit until July 1st.

"*Number of generations per year.*—This insect, living on orange trees in a room on the north side of a building in Washington, passed through five generations in less than one year; the average time occupied by a single generation was a little less than seventy days. It is probable that in the open air in Orange County, Florida, there are at least six generations each year.

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3. THE MANGO WEEVIL.

Cryptorhynchus mangifera, Fabr.

On the 18th June 1895, Surgeon Major K. R. Kirtikar forwarded

to the Indian Museum specimens of mango (*Mangifera indica*) fruit affected by an insect from the district of Satara. He wrote:—

"A parcel I am sending to-day to your address contains six mangoes grown in Wâi (Satara District). They all come from one and the same tree. The stone contains a peculiar insect, probably a weevil. The pulp is never seen to contain any such insect. The points of interest are:—(1) that although there are several other mango trees close by, the tree, from which the mangoes I send you are obtained, is the only one of which the fruit is affected from year to year; (2) that possibly the eggs of the weevil are carried with the pollen to the ovary, and it is there that the mature insect develops as ovary develops into the drupaceous fruit. The mango takes about six months to mature into a perfect fruit from the first appearance of blossom. During this time the insect, it would appear, assumes its perfect form, living, after it assumes its perfect form, on the substance of the Cotyledons of the seed."

The insect proved to be identical with *Cryptorhynchus mangifera*, Fabr., the common mango weevil of Bengal and Sylhet. Accounts of it may be found in *Indian Museum Notes*, Vol. I, No. 1, pp. 45—46, pl. IV, fig. 1.

IV.—FOREST PESTS, ETC.

1 *Gall fly* (*Cynipid*).—The Director, Imperial Forest School, Dehra Dun, forwarded to the Indian Museum in July 1895, specimens of an insect said to attack teak trees in the Malghat Forest of the Ellichpur Division. The specimens consisted of dead chrysalids of a minute *Hymenopterous* insect belonging to the family *Cynipidæ* (Gall flies), the material being insufficient for identification.

The following note has been furnished by the Pandurang Narayan, Forest Ranger:—

"Some teak trees were observed to present a knotty appearance just below the growing node of the leading shoots and branches in compartment No. 3 of the Chourakund Circle. To this attention was drawn by the Conservator of Forests, Hyderabad Assigned Districts, and observations were ordered to be made. These knotty portions when cut transversely showed that in the middle small eggs were laid for the future insect. These eggs have been found to be laid in four groups along the four-sided stem of the teak, and each group to contain from 12 to 24 eggs.

"These eggs were hatched during the beginning of July and the insect in its larva stage bored its way out. Some of the borings possess the coat cast out by the insect while undergoing the metamorphosis."

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2 *Pentatomid bug*.—In December 1895 the same officer sent to

the Indian Museum specimens of an insect said to be destructive to Babul tree (*Acacia arabica*) in Jerruck Forest, Sind.

The examples proved to be the immature form of a bug belonging to the family *Pentatomidæ*, the material being insufficient for precise identification. The following short note is furnished by the Deputy Conservator of Forests, Jerruck, Sind :—

"I am sending you by post a small insect which I removed from between the bark and wood of a Babul (*Acacia arabica*) tree yesterday morning. This insect evidently does a great deal of damage to Babul, judging from its attack on the particular tree. The bark was discoloured and it was commencing to fall off.

"The larvæ of the insect weave a sort of web in the interstices of the bark, and I presume they subsequently bore into it and gradually make it drop off."

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3 *Stag-beetle.*—In March 1895 a specimen of a large beetle was received in the Museum from Major G. H. Leathem with the information that it was taken at the western end of the Kashmir valley where it is found in large numbers in dead maples, and the grub of which is a favourite food of the brown bear.

The specimen proved to be a female of a stag-beetle, probably belonging to the genus *Dorcas*; it however appears to be new to the Museum collection.

It is interesting and suggestive to find the brown-bear thus appearing as a *friend* to foresters.

INSECT INFESTING CROTON PLANTS.

Dactylopius longifilis, Comstock.

Plate V, fig. 5 female enlarged.

On the latter part of October 1894 a number of ornamental crotons in the Museum Quadrangle were found to be badly infested by a species of scale insect (*Coccid*). Several of the plants attacked were showing signs of decay, while a few were already dead.

The "scales" were collected and carefully examined, but they proved to be new to the Indian Museum collection, and hitherto unknown in India. Specimens were forwarded to Mr. W. M. Maskell, who kindly identified the species as the same as *Dactylopius longifilis* of Comstock. The following is the description of the insect which he has furnished :—

Dactylopius longifilis, Comstock, Rep. of Entomologist, United State Department of Agriculture, 1881, p. 344.

Adult female, light dull-yellow in colour, feet and antennæ somewhat darker. Length 4 mm. to 5 mm. Form elongated, elliptical, tapering slightly posteriorly, distinctly segmented. Margin bearing at each side about seventeen cottony tassels which are rather long at the sides and the two last on each side very long, equalling, if not surpassing, the length of the whole body. Dorsum sparsely covered with white meal. Antennæ of eight joints; the eighth the longest, then the third, then the second, then the fifth: the fourth, sixth and seventh the shortest and sub-equal. Torsal digitules slender, with very small knob, digitules of the claw short and thick. Epidermis at margins bearing many tubercular spinnerets and some conical spines. Anal ring with six hairs.

Larva similar in colour to the adult. Antennæ of six joints, all sub-equal except the sixth, which is as long as any three others.

Adult male light olive-brown, length about one mm. Antennæ of ten slender joints. Feet hairy. Anal lobes bearing two long setæ which carry long "tails" of white cotton.

Habitat.—On many greenhouse and hothouse plants in North America, principally upon *Crotons* and *Ferns*.

It has been found also out-of-doors in Australia and is evidently a tropical or sub-tropical form.

This species is very closely allied to the common European (and practically cosmopolitan nowadays) "mealy-bug"—*Dactylopius adonidum* (Linn.) Signoret. Indeed, the characters separating *D. adonidum* from several others of the genus are only very minute and not altogether as yet thoroughly worked out.

This coccid is noticed at full length, not because it has hitherto, so far as is known, done any damage to agriculture, but because it belongs to a destructive family and may possibly therefore extend its ravages to useful plants, and because it is new to the Indian Museum.

V.—PESTS OF DOMESTIC ANIMALS.

Tick infesting fowls

Argas reflexus, Fabr.

Plate VI, fig. 3.

On the 14th April 1895 numerous living specimens of a tick were forwarded to the Indian Museum by Mr. H. M. Phipson with the

information that they were infesting fowls to the extent of killing them, in the neighbourhood of Bombay. The ticks proved to be new to the Indian Museum collection, so specimens were submitted to Mr. A. D. Michæl for his examination. Mr. Michæl in a letter dated 6th May 1895 wrote:—"The ticks which you send are the common *Argas reflexus* of Fabricius. I think the *Argas persicus* of Fischer of Waldheim is really the same species; if there be any distinction, probably your specimens would be considered to be *A. persicus*, but I do not believe that there is. The species seems to be distributed practically over all temperate and tropical countries where the pigeons, fowls, etc., on which it lives, are present. It is quite possible that it kills the fowls if it be numerous; the bite is bad, particularly in hot countries; the Persian specimens were once supposed to be capable of killing human beings, which is probably incorrect; still it is quite possible that the bites inflame seriously in great heat."

"The *Argas* is a difficult thing to get rid of, as it is most tenacious of life, and it is far from easy to kill it without killing the fowl; probably sulphur or carbolic acid would be the best chance. Those you sent alive were still alive and quite well when I opened them."

VI.—REPORTS OF RESULTS OF REMEDIES, ETC., TRIED DURING THE YEAR.

1. TAR, CHALK, BIRD-LIME USED AGAINST ANTS.

In a letter dated 23rd September 1895, forwarded by the Officiating Director of Land Records and Agriculture, Assam, the Manager of the Rajpur Estate and Trading Company reports the destruction of lac (*Coccus lacca*) by ants.

The remedies tried against the ants appear to have given no good results, were painting a ring of tar or tar and oil or chalk or bird lime round the stems of the trees to prevent them from climbing up the tar, and tar and oil rotted the bark and killed the trees, while the other substances did no good.

A heap of fine dry sand round the base of the tree would probably have been found useful as impeding the progress of the ants.

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2. KEROSINE EMULSION AGAINST SCALE-INSECTS.

In the case of the scale-insect (*Aspidiotus ficus*) (see pp. 69-73) which attacked the orange and lime trees at Kachaldara House, Khandala, in October 1894, Mr. Marshall Woodrow in a subsequent letter reported that the application of kerosine emulsion as a remedial measure against the insect had proved effectual in exterminating the pest.

This is quite in accord with experience in other parts of the world.

REPRINTS AND MISCELLANEOUS NOTES.

INDIAN "FOREST FLIES."

Hippobosca (Ægyptiaca?,) Macq.

(Reprint of a report published in *The Veterinary Record*, by Miss Eleanor A. Ormerod, F. E. S., etc., in August 1895.)

On the 26th ultimo I received from Messrs. R. S. Hart, the eminent veterinary surgeons of Calcutta, a liberal supply of "Forest flies" with the mention that they were "common in Bengal and in other parts of India." From details given these *Hippobosca* were shown to be very similar in habits to the kind which we have in this country, also that although they infested dogs, it was to horses that they were most troublesome. It was noted "some horses are driven mad even by the presence of a single fly, and in driving along not unfrequently start kicking most violently, kicking over the traces and shafts, and frequently running away with the carriage," etc. The locality of the infestation on the horses was noted as the same as with us, and the specimens sent me were certainly "Forest flies," that is of the genus *Hippobosca*, but differed from the *Hippobosca equina*, our too well known species, in being rather larger and also in the neuration of the wings; also in the back (the thorax entomologically) being very much more marked with small yellowish patches, and the *scutellum* (the small portion of the hinder part of the thorax immediately above the abdomen) having a central pale yellow marking and two side ones on a dark ground, instead of as with the *equina*, only one central pale marking.

As the precise identification of these Forest flies was of considerable importance in connection with such valuable notes as those of Messrs. Hart, I forwarded a good supply of specimens to one of the entomologists at the *Museo Civico* at Genoa, where I was aware that there were trustworthy types of various of the exotic species of *Hippobosca*, and he was good enough to compare Messrs. Hart's specimens for me.

These, he told me, were certainly *not* of *Hippobosca equina*, nor of *canina*, nor of *bactriana*, nor *camelina*, but they greatly resembled the *Hippobosca Ægyptiaca*, Macq., of which he was good enough to give me a type specimen (identified by Professor Rondani himself) for my own comparison. After the most minute and careful examination which I have been able to make I cannot find any point of specific difference between this type specimen and those sent from Calcutta. They correspond quite precisely in the peculiar neuration of the wings which differs markedly from that of the

Hippobosca equina, and of which Professor Rondani says in his notes on the "Muscaria Exotica *Musei Civici Januensis*" (p. 15 of the separate issue) that by this the *Hippobosca Ægyptiaca*, Macq., may be "easily distinguished from all its congeners." Also there was absolute similarity in the elaborate markings on the thorax and in every point in which I was able to make comparison, excepting that the Indian specimens were of rather a darker shade of colour, and also (or consequently) the markings on the hinder legs were more noticeable in those than in *Ægyptiaca*.

This matter of difference of shade of colour cannot, I think, however, be at all considered to amount to a distinction in species. I find varieties of tint in the numerous specimens of our *Hippobosca equina* lately sent me, and also it is exceedingly likely that soaking, for some weeks in preservative fluid during transmission, may have affected the depth of the colour.

But looking at the similarity in other respects, also that the Indian specimens have the peculiar wing neuration by which Professor Rondani states the *Ægyptiaca* is distinguishable from "all others" of the *Hippobosca*, it appears to me that we may safely consider this kind so common in Bengal and other parts of India as the *Hippobosca Ægyptiaca*, Macq., or if presently we find there is a permanently darker shade of colouring, perhaps it may be distinctively named by Dipterists as the *Hippobosca Ægyptiaca*, Macq., var. *Bengalensis*. The species was first recorded in Egypt, but since then has been found in Persia.

To the above it may be of interest to add that in the course of my own continued investigations, I find that the large curved claw of our Forest fly has beneath it a saw-like edge with grooves down the lower part of the side of the claw, so that each groove runs to the notch between each tooth, the claws when laid side by side thus forming a most powerful grasping instrument. This is very noticeable when the claw is got into the right position with a good side light, and examined as a dry object in natural condition, but in balsam or glycerine the grooves are—to me at least—invisible.

I trust that the above may be considered of some interest.

COCCIDS PREYED UPON BY BIRDS.

BY R. NEWSTEAD, F.E.S.,

Curator of the Grosvenor Museum, Chester.

(Reprinted from *The Entomologist's Monthly Magazine*, 2nd series, Vol. VI, 18A.

To do justice to this subject, I think it only right that the entire contents of each stomach, found to contain *Coccidæ*, should be given; as it is only by such means that an adequate idea may be obtained as to whether the birds were able to obtain other, and what we should consider more nourishing, food. I have pleasure, therefore, in enclosing the result of my *post mortem* examinations in winter and spring of two species of birds (*Parus cæruleus* and *Acredula caudata*) taken from my report to the Cheshire County Council on "The Amendment of the Wild Birds Protection Act."

The finding of *Coccidæ* in birds' stomachs is certainly of very great interest and economic importance. I am not quite sure, but believe that hitherto nothing of the kind has been recorded; if so, the matter should be of some value.

I have records of three species of *Coccidæ*, viz., *Aspidiotus zonatus*, Fd., *Mytilaspis pomorum*, Bouché, and *Asterodiaspis quercicola*, Bouché; and in my MS. notes there is a record of an immature ♀ *Lecanium*, also from the stomach of one of the *Paridæ*.

Aspidiotus zonatus may be quite as eagerly sought for as the *Asterodiaspis*, but it is a much rarer species. High Legh is the only known habitat in Cheshire, and this locality is many miles from where the blue tit (*Parus cæruleus*) had no doubt taken the insects. These birds must have keen eyes to distinguish this species, for it is well protected both in colour and texture. The central red-brown speck in the scale is the only indication of its presence, and altogether it may be considered the best protected of any of our British *Coccidæ*.

Mytilaspis pomorum.—Although only four specimens of this injurious species were found, I am fully convinced that it is readily devoured by birds. Many times have I seen, with the aid of field-glasses, the tree-creeper (*Certhia familiaris*) collecting this species during winter and spring; and from what I have seen of the marsh tit (*P. palustris*) and the blue tit (*P. cæruleus*), they, too, are fond of the species. One has only to examine a tree infested with this "scale" to find, in very many instances, only the white mealy outline of the insect on the bark. To get such a result the scale must be

removed by some agency, and I am pleased to credit it to our feathered friends, the useful tits and the tree-creeper.

Asterodiaspis quercicola.—I firmly believe this species is eagerly sought for by various species of tits. Here, in Cheshire, the characteristic little depressions made in the twigs of the oak by this species are to be found in thousands. Rarely is it that the *Coccids* are found in them. This fact, for many years, led me to suspect the birds had taken them. It was not until 1894 that the matter was placed beyond doubt. The May record is of the greatest interest, as at that time there would be a good selection of bird-food. It proves, therefore, that the species is a selected item in the dietary of two species of birds.

Lecanium genevense.—This was one of the earliest species which came under my investigation when first I became a student of the *Coccidæ*. At that time a large colony of these insects infested a short thorn hedge, growing hard by a city foot-path leading to this Museum, where they afforded every opportunity for investigation. The hatching of the larvæ, the hibernation of the young ♀, and the emergence of the ♂ in May, went on without any apparent losses. But when the females had become fat and plump, and ready to lay their eggs, then it was that they began rapidly to disappear, until very few remained. At first I could not account for the loss, but one day a small flock of sparrows (*Passer domesticus*) were busily engaged in the hedge-row, and as I saw them subsequently in the same place I attributed the disappearance of the *Coccids* to these omnivorous birds. A *post mortem* examination would have settled the matter, but the birds could neither be trapped nor shot in such a public thoroughfare.

Summary of contents of nine stomachs of blue tit and long-tailed tit examined:— *Aspidiotus zonatus*, many, in February; *Asterodiaspis quercicola*, numerous, in February and May; *Mytilaspis pomorum*, a few, in February; larvæ of *Diptera*, many; small moths and larvæ, many; *Coleoptera*, various, chiefly weevils; *Cynips*, many; and bud-scales. These occurred in different proportions in the various stomachs.

It is of interest also to know that *many* specimens of *Phyllotreta undulata* and *P. nemorum* were found in *four* stomachs of the tree-creeper.

THE COMMON CROW OF THE UNITED STATES AS AN ENEMY TO INSECTS.

[Reprint of a report by W. B. Barrows and E. A. Schwarz, published in Bulletin No. 6, United States, Department of Agriculture, Division of Ornithology and Mammalogy, 1895.]

The matter of the Crow's utility as an insect destroyer is one of prime importance; in fact, it is the crucial test of the bird's value. The material available for the decision of this question consists of the insect contents of 909 stomachs, taken at various places and times, the great majority during the warmer half of the year.

Most of the older ornithologists recognized the fact that Crows ate insects in considerable numbers, but ignored the fact that many insects are beneficial; and moreover they took no pains to determine what proportion of the Crow's diet consists of insects. Even at the present time these points are very generally overlooked, and to the best of our knowledge there is nowhere a record of the carefully identified contents of a dozen Crow stomachs taken in summer. A few naturalists have put on record the results of more or less thorough examinations, but in too many cases we find only such general statements as 'contents consisted of seeds, berries, and insects' or possibly of 'grain, carrion, and beetles,' without any attempt to determine the kind or amount of each.

Eight hundred and one out of 909 stomachs examined contained insect remains in quantities varying from the merest trace to 100 per cent. The following table shows the number of Crows' stomachs collected during each month, the numbers which contained insect remains, and the average percentage of such remains for the whole number of stomachs in each month :—

Table showing average percentages of insect material contained in 909 Crow stomachs, arranged by months.

Month.	Number examined.	Number containing insects.	Percentage of insect contents.
January	53	21	2·2
February	23	10	3·3
March	26	16	5·8
April	42	36	49·2
May	364	357	47·1
June	165	157	4·0
July	45	42	26·5
August	24	24	35·6
September	44	40	24·6
October	46	42	16·7
November	18	17	25·8
December	59	39	4·7
Total	909	801	23·5

It appears from this table that the average quantity of insect material in these 909 stomachs was almost 24 per cent. A moment's examination of the table shows, however, that the number of stomachs examined in different months is very unequal, and also that the percentage varies widely according to season. The average percentage represents the proportion of insects to the whole stomach contents, but from 7 to 10 per cent. of the stomach contents is sand or gravel. Throwing out this mineral element, it appears that on the average 26·17 per cent. of the Crow's food for the year is made up of insects. In the same way it is found that even in January, when the smallest proportion is eaten, insects form almost 3 per cent (2·71) of the food, while the maximum is reached in April with almost 53 per cent. (52·75). In May, insects constitute about 49 per cent. (48·97) of the food, and in June about 41½ per cent.

During the months of May and June 529 stomachs were collected, insects formed 46·7 per cent. of all food in these stomachs. Since these two months cover the larger part of the time when Crows are rearing young, this large proportion of insect food perhaps is not surprising, especially as 396 stomachs were those of young Crows taken from the nest. The insect food in the stomachs of these nestlings averaged 49·6 per cent., while the average amount in the stomachs of 120 adult Crows taken during May and June was only 36·4 per cent. This shows conclusively that young Crows while in the nest eat more insects than the adults, the difference in this case amounting to more than 13 per cent. of the entire food; or to put the matter in another form, nestling Crows eat at least one-third more insects than the adults. It is of great importance, however, that the character of this insect food be carefully determined, so that we may know positively whether its consumption is or is not of benefit to the agriculturist. Fortunately, this has been done. After the preliminary examination of the contents of each stomach and the determination of the percentages of the several kinds of food contained the insect material was referred to Professor C. V. Riley, then Chief of the Division of Entomology, under whose direction it was thoroughly studied by Mr. E. A. Schwarz. The following reports contain the results of this examination :—

Report on the insect food of the crow. By E. A. Schwarz, Assistant, Division of Entomology.

The examination of the contents of about 600 stomachs of Crows[1]

[1] The insect contents of 801 Crow stomachs were submitted to Professor Riley for examination, but in several cases where many stomachs were collected on the same day and at the same place, under precisely similar circumstances, it was not thought necessary that all should be examined critically. In such cases half or more were thoroughly examined and the results tabulated, while the remainder were passed over with a simple inspection.—W. B. B.

submitted by Dr. C. Hart Merriam to the Division of Entomology, was intrusted to me by Dr. C. V. Riley, then United States Entomologist. Owing to the large bulk represented by the majority of the stomach contents, and more especially to the comminuted condition of the insect remains, the work of examining and determining was much more tedious and progressed much slower than was anticipated. In the often-times difficult determination of minute fragments I have been greatly assisted by the other members of the Division of Entomology, and more especially by Messrs. William H. Ashmead and Theo. Pergande.

A detailed list of the contents of each stomach has been prepared, enumerating systematically the various species of insects found and giving the number of specimens. This list forms the basis of the following generalizations regarding the food habits of *Corvus americanus* so far as the insects are concerned:—

1. The insect food of Crows is almost exclusively composed of terrestrial species, *i.e.*, such as are found on the surface of the ground, or hide during the day time at the base of plants or under the various objects lying on the surface, or such as live in the dung of domestic animals, in decaying vegetable and animal matter, or underground.

There is not the slightest indication that Crows catch any insects while on the wing, and the almost complete absence of the numerous arboreal insects of all orders, *i.e.*, such insects as are to be found on or which live on the trunks, limbs, or leaves of trees and shrubs, indicates that the birds when setting or resting on trees do not pick up insects.

The almost constant presence of coprophagous insects in the stomachs indicates that Crows preferably frequent dry pasture lands, dry meadows, or very open woods, where cattle or horses are grazing. In many instances the presence of certain species of *Chlænius*, water beetles, or an occasional aquatic Hemipter or a *Gryllotalpa*, or *Corydalus*, etc., shows that the birds frequent the margins of ponds or streams, while in a number of other instances the presence of the larvæ of Lachnosterna, Elateridæ, etc., proves that the Crows have followed the plough of the farmer. Many of the terrestrial insects eaten by Crows abound during the warmer season in cultivated fields more especially in corn and clover fields, and have no doubt been picked up by the birds in such localities.

2. The insect food of the Crow consists only of large or mediumized insects; small species are only rarely, if ever, picked up. The smallest insects found are certain species of *Aphodius*. Ants form

a marked exception to this rule, as small, or very small, species are frequently found in many stomachs.

3. The Crow appears to prefer insects with a hard covering to the more soft-bodied ones. Thus the number of the hard imagos of Carabidæ, Elateridæ, Scarabæidæ, Curculionidæ, and Acridiidæ enormously exceeds that of the Coleopterous, Lepidopterous, and Dipterous larvæ found in the stomachs, and no soft-bodied imagos (a few Diptera excepted) seem to be eaten. In many instances, however, this peculiarity may be explained by the fact that the larvæ, as a rule, live in more hidden situations and are more difficult to find than the imagos. But Crows derive a great deal of their food from the insects living in dung heaps and dead animals where Dipterous and other larvæ abound; still these are but rarely met with in the stomachs. A marked exception to this rule is the frequent occurrence of spiders, and more especially species of the family Lycosidæ, or ground spiders.

4. It would seem that Crows have a predilection for insects possessing a pungent or otherwise strong taste or odour. This is exemplified by the prevalence of Carabidæ (among them the often recurring genus *Chlænius* possessing a peculiar odour), coprophilous or necrophagous Coleoptera (Silphidæ, Histeridæ and Scarabæidæ Laparosticti), ants, and more especially by the almost constant occurrence of certain species of the Heteropterous family, Pentatomidæ.

5. Finally, as a peculiarity of very little importance, may be mentioned the fact that insects of a bright, and more specially golden, colour are apparently very attractive to Crows and are eagerly picked up by them. Thus *Calosoma calidum*, with its bright golden elytral spots, is met with in a large number of stomachs from various localities.[1] Very often only little elytral fragments of this species are found which would seem to indicate that the birds even pick up the elytra of dead beetles. Another striking illustration is furnished by the frequent occurrence of *Euphoria fulgida*, with its peculiar golden-green colour. Other examples are the Cicindelidæ, *Pterostichus sayi*, *Geotrypes splendidus*, *Phanæus carnifex*, and others.

If we now proceed to a consideration of the insects eaten by the Crow it is at once evident that a mere list of them, comprising as it does several hundred species, is only bewildering and misleading. If all the numerous species which occur only once or at best in a

[1] No traces of our common and bright-colored *Calosoma scrutator* and *C. wilcoxi* have been found in the stomachs, but this is easily explained from the habits of these species which live in the woods and are more or less arboreal, whereas *C. calidum* is strictly terrestrial and frequents pastures and fields.

small number of stomachs and in limited numbers are eliminated, and only those species are taken into consideration which occur in a large number of stomachs, and most of which are represented by a very large number of specimens; finally, if we divide the latter class of insects into several convenient groups, each defined by similarity in food habits, we arrive at a certain number of clearly established and characteristic features in the food habits of the American Crow. The writer confidently asserts that, while an examination of several hundred additional stomachs would no doubt greatly increase the list of insects eaten by Crows, it would not alter, in the least, nor materially add to, the characteristic features now arrived at.

It is possible that in the extreme Southern States, as well as in the Far West, some other features in the food of the Crow would appear besides those enumerated below; for only a single stomach from Florida and one from Oregon were among those submitted for[1] examination. There were also only a few stomachs from Kansas and Nebraska. Since all the other stomachs were collected at various places in the region extending from Virginia to Maine, and west to Iowa and Wisconsin, we should expect that the difference in the faunal regions would produce a corresponding difference in the food supply of the Crow. But these differences are of slight importance, and with a single exception the main features of the food of this bird remain wonderfully uniform throughout this whole region.

The following groups of insects representing the principal food supply of the Crow are arranged according to their relative importance, but this sequence might undergo some changes if an equal number of stomachs from all parts of the country were available for examination. Of the stomachs submitted, those from Virginia, the District of Columbia, and Maryland greatly outnumber those from all other localities combined:—

1. *Grasshoppers* (Acridiidæ).—During the months of May and June, *i.e.*, during the May beetle (*Lachnosterna*) season, grasshoppers, mostly of the genus *Tettix*, occur in the vast majority of stomachs, but with few exceptions in moderate numbers only. With the disappearance of the May beetles (towards the end of June) specimens of the typical locusts (grasshoppers—*Melanoplus* and allied genera) increase in number, until in the month of August, and

[1] Since this was written 21 additional stomachs from Kansas have been examined by Mr. Schwarz, but without essentially modifying his conclusions.—W. B. B.

throughout the fall they constitute by far the greatest part of the insect food, often occurring in astonishing numbers, and often forming the only insect food. Grasshoppers are also largely picked up in winter, evidently on warm days and when there is no snow on the ground.

2. *Dung-beetles.*—Under this heading the following Coleoptera are comprised: Species of *Silpha* and *Hister*, the Scarabæid, genera *Copris onthophagus*, *Aphodius*, and allied genera. Certain species of *Staphylinus* are also included here, which, although insectivorus, confine their operations to the droppings of domestic animals. Dung-inhabiting dipterous larvæ or their pupæ were, however, met with in only a few stomachs, and the same may be said of the larvæ of dung-beetles. A larger or smaller number of these dung-beetles, and more especially of the scarabæid genera just mentioned, or at least single specimens thereof, occur in most of the stomachs from all localities and throughout the whole year, and in many instances comprise the greater bulk of the insect food.

3. *Ground-beetles* (Carabidæ).—These occur likewise in the vast majority of stomachs from all localities and throughout the year, and the list of the species thus found is a very extended one. The genera most frequently present are: *Calosoma*, *Carabus*, *Chlænius*, *Pterostichus*, *Harpalus*, and *Anisodactylus*. It will be noted, however, that none of the species are ever represented by any considerable number of specimens in a single stomach. Thus the bulk represented by the Carabidæ is much inferior to that of the grasshoppers and May beetles, and probably also smaller than that of the dung-beetles. Carabidous larvæ were found only in two or three isolated instances.

4. *May beetles* (*Lachnosterna*).—During a short period of the year, commencing, in the latitude of Washington, D.C., at the end of April, and in Maine and Michigan about a fortnight later, and extending towards the end of June, these beetles furnish, as regards bulk, number of specimens, and frequency of occurrence, the principal insect food of the Crow. In fact, there are only a few stomachs during this season that do not contain traces of Lachnosternas, while frequently large numbers of specimens are found in a single stomach, and this often to the exclusion of other insect food. This habit prevails throughout the whole region,[1] and would occupy the

[1] Even the single stomach from Kansas, collected in May (No. 15249), contains nothing except a number of Lachnosternas.

foremost rank in this enumeration, but for the fact that it is restricted to two months of the year.

The fact that the Lachnosterna season coincides with the breeding period of the Crow deserves to be emphasized, and the principal, but by no means exclusive, insect food of the nestlings may thus be said to consist of these Lachnosternas.

Lachnosternas are above ground only at night, when they feed on the foliage of trees and shrubs; they hide during the day under ground. In determining the economic status of the Crow as an insectivorous bird it would seem to be of some importance to ascertain how and where the birds find these beetles. It may be that only those are eaten which during their nocturnal flight had been half eaten by bats and other nocturnal enemies of Lachnosterna or which had been otherwise disabled; or it may be that only those specimens are eaten which have fallen into lakes or streams during the night and which are then washed ashore in a drowned or half-drowned condition; finally, it may be that the Crows are able to discover and to dig out the beetles during the day from their subterranean retreats. No direct observations on these points seem to have been made, but I have no hesitation in accepting the latter alternative, for the reason that it is an undeniable fact that the Crows find an enormous number of other insects that hide during the day under sticks, clods of earth, and other objects (*e.g.*, many of the Carabidæ), or in the ground at the base of plants (*e.g.*, the Curculionidæ presently to be mentioned). Many of the coprophagous insects, and more especially the genera *Copris* and *Geotrypes*, are evidently dug out from their holes beneath cattle and horse dungs. This, of course, does not entirely exclude the other alternatives, and in fact, the often recurring presence of small ants in the stomachs seems to indicate that the Crows also pick up dead or wounded Lachnosternas which are frequently covered with ants.

Larvæ of Lachnosterna (white grubs) were, contrary to expectation, met with in a comparatively small number of stomachs (about 20 in all, including a few where determination is doubtful), all of which were collected in the District of Columbia and adjacent parts of Maryland during the months of April and May. If a larger number of stomachs from other localities could have been examined, it is possible that white grubs would play a more important rôle in the food habits of the Crow. The absence of Lachnosterna larvæ in all stomachs collected during the fall ploughing season is easily explained by the great abundance of grosshoppers at this season. The few Scarabæid larvæ found in stomachs collected in the fall all belong to coprophagous species.

5. *Ground spider* (Lycósidæ).—The only soft-bodied insects that occur in a very large number of stomachs from all localities and throughout the warmer seasons are various species of Lycosid spiders, which are so commonly met with on the ground in pastures and near water. The larger female specimens, carrying their egg sacs, appear more especially to form an attractive morsel to the Crows. The spiders are often represented in considerable numbers in the stomachs, occasionally forming the greater bulk of the insect food. Spiders of other families were but rarely met with in the stomachs, and never in large numbers.

6. *Weevils* (Rhynchophora).—Two species of weevils, *Epicærus imbricatus* and *Phytonomus punctatus* both often referred to in Economic Entomology, occur abundantly in a large number of stomachs. They would play a very prominent rôle in the food supply of the Crow, but for the fact that this habit is locally restricted on account of the distribution of the two species. *Epicærus imbricatus* does not extend into the Northern and North-Western States, and the clover weevil (*Phytonomus punctatus*) is a comparatively recent importation from Europe, occurring from New York to Virginia and gradually spreading into the North-Western States.[1] Both species are terrestrial during the day and hide in the ground at the base of plants. Other weevils possessing similar habits are not infrequently found in the stomachs, more especially various species of *Sphenophorus* (bill bugs of economic importance), and in less numbers *Tanymecus confertus*, species of *Sitones*, *Macrops*, etc. Various other non-terrestrial weevils occur only occasionally, the most abundant among them being *Lixus concavus*.

7. *Cutworms* (larvæ of Noctuidæ).—Considering the enormous number of cutworms that occur, especially in the spring and the earlier part of summer, in pastures, dry meadows, and open fields, and considering further that cutworms hide during the day at the base of plants, under leaves, sticks, clods of soil, etc., in short, in just such places as are preferably investigated by Crows in search of food, it is remarkable that they do not constitute the largest portion of the insect food. Even if we include all other Lepidopterous larvæ and pupæ found in the stomachs, this food does not by any means rank among the most prominent features. The only explanation of this fact that occurs to me has been mentioned before, *viz.*, that the Crows greatly prefer insects with hard bodies. Still, the bulk represented by the Lepidopterous food is by no means an

[1] It was never noted in Michigan prior to 1892, and it is interesting to find that there is a specimen in one of the stomachs (No. 15884) from that State, collected on May 8th, 1892.

inconsiderable one, and the largest part is made up of Noctuid larvæ, or cutworms. These occur in many stomachs, usually singly or in very small numbers, rarely forming the bulk of the food in any one stomach and never the entire food. Noctuid pupæ were found only in isolated cases. Larvæ of the Pyralid, genus *Crambus*, which live in silken tubes at the base of grasses, clover, etc., belong to the family next best represented in number of specimens, and occur in large numbers in a few stomachs. Bombycid larvæ, and especially Bombycid cocoons, come next, represented usually by single specimens. The rest of the Lepidopterous families are represented only by isolated specimens. Single imagos of Lepidoptera were found in only a few instances, and most of these are evidently specimens which had not yet issued from the chrysalis.

8. *Soldier bugs* (Pentatomidæ).—Although by no means representing a considerable portion of the insect food, the constantly recurring presence of various species of soldier bugs constitutes a characteristic feature in the food habits of the Crow. There are many species representing various families of true bugs (Heteroptera) that occur commonly on or near the ground, but, with the exception of these soldier bugs, only a few isolated specimens of a few species were found in all the stomachs. It seems probable that the strong odour or taste of these soldier bugs is the reason why they are so eagerly sought by Crows. The condition in which the specimens are found in the stomachs is also peculiar; for while the Crows generally have the habit of crushing and breaking into fragments all the hard insects they eat, these soldier bugs are almost always broken up in extremely minute particles which in the well filled stomachs are often liable to be overlooked. Owing to the condition the exact determination of the species, as well as the determination of the number of specimens, is impossible in most cases.—The soldier bugs thus found belong to *Podisus*, *Euschistul*, and allied genera.

9. *Ants* (Formicidæ).—As in the case of the soldier bugs, ants form only a small proportion of the bulk of the insect food, but their frequent occurrence in the stomachs suggests the explanation that they are relished by the Crows on account of their peculiar acid taste. Quite a number of species of various genera are represented, the largest species, *Campanotus pennsylvanicus* and various species of *Formica*, being most frequent. The presence of very small species of ants is, in many instances, probably due to accident, as has been mentioned on page 85.

The following enumeration of insects, arranged according to

orders, comprises those which occurred only in a moderately large number of stomachs and usually only as single specimens, or only in a few stomachs in large numbers. Some of the insects of this class have already been mentioned.

Click beetles (Elateridæ).—A tolerably large number of species were found, but none of them represented by any considerable number of specimens. The most abundant of these species are *Limonius plebejus*, *Corymbites cylindriformis*, *Agriotes mancus* Elaterid larvæ (wire-worms) were found only in a few isolated instances.

Lamellicorn beetles: Lucanid beetles (*Lucanus*, *Passalus*) occur occasionally, while various species of the Scarabæid genera, *Serica*, *Hoplia*, *Anomala*, *Aphonus*, *Euphoria*, and others, form in the aggregate a not inconspicuous portion of the insect food. The prevalence of *Euphoria fulgida*, or at least of little fragments thereof, in quite a number of stomachs has been already alluded to.

Tenebrionidæ.—Some specimens of the genus *Eleodes*, found in the few stomachs from Nebraska and Kansas, lead to the supposition that if a larger number of stomachs from that region could be examined, specimens of this and allied genera would be found well represented. These beetles so characteristic to the fauna of the arid region of the West, fulfill most of the requirements of insect food preferred by the Crows; they are terrestrial, large, hard, and possess a strong, offensive odour.

Ants, Bees and Wasps (Hymenoptera).—Besides Formicids only a very moderate number of species and specimens were found, most of them belonging to the fossorial families, Crabonidæ and Eumenidæ (genus *Odynerus*). Quite a number of *Polistes* also occur in various stomachs.

Flies (Diptera).—The whole order is comparatively poorly represented, and only the following families deserve mention:—

Crane flies (Tipulidæ).—These are much less frequently found than one would expect from their great abundance on meadow land. Still, eggs, larvæ, and much more rarely pupæ and imagos occurred in a moderate number of stomachs. In a few instances eggs were found without any trace of the imago.

March flies (Bibionidæ).—Larvæ of this family were found only in a few stomachs, but in very large numbers. They live gregariously under decaying vegetable substances.

Muscidæ.—The very small number of the various larvæ and puparia, all presumably belonging to Coprophagous or Necrophagous species, found in the stomachs, is in striking contrast with their

enormous abundance in the excrement of horses, cattle, etc., or in dead animals. Imagos of these Diptera were found only in exceptional instances.

Crickets (Gryllidæ).—Excepting the Acridiidæ, the whole order of Orthoptera is very poorly represented; the only other representatives which occur in a moderate number of stomachs are ground crickets of the genera *Gryllus* and *Nemobius*.

The orders hitherto omitted, *viz.*, the Homoptera and Neuroptera (in the old sense), are so poorly represented as to deserve no special mention. The same may be said of the order Myriapoda, of which a few specimens of a *Julus* were found.

In order to complete this picture of the food habits of the Crow, it is important to mention briefly those families, or even single species, of insects which are of economic importance, being either injurious or beneficial, but which were not found in the stomachs examined. Only such insects are mentioned here as occur on or near the ground and of which one might expect that the Crows, at least occasionally, would pick up specimens. Some of the orders or families unrepresented or but poorly represented, have been mentioned before, and are not here repeated.

Among the Coleoptera the absence of the useful ladybirds (Coccinellidæ) deserves special mention (only in a single elytron of one species has been found). Still more striking is the absence of the large family of leaf beetles (Chrysomelidæ) including the notorious Colorado potato beetle (*Doryphora 10—lineata*). In fact, only four species of Chrysomelidæ were found in all the stomachs (two elytra of *Paria canella*, one elytron of *Colaspis brunnea*, and a few specimens of the aquatic *Donacia flavipes*). Chrysomelid larvæ are entirely absent. Finally, the soldier beetles of the genera *Chauliognathus* and *Telephorus* in the family Lampyridæ are not represented, and only two larvæ of a *Telephorus* were found in a single stomach.

In the Hymenoptera no injurious (Phytophagic) families are represented, but on the other hand, the immense host of beneficial (parasitic) species is also almost entirely absent, only a few isolated specimens having been found. The Crow is not one of the destroyers of the honey-bee, for only a single bee occurred in all stomachs.

In the Lepidoptera, which practically do not contain any beneficial species, the absence of all cabbage worms larvæ of (*Pieris rapæ*, *Plusia brassicæ*, *etc.*), excepting a solitary specimen, deserves

mention ; also the absence of the various Sphingid larvæ, and their pupæ, which infest potatoes, sweet potatoes and tobacco. The corn worm (larva of *Heliothis armigera*) is here especially mentioned because it is said that the Crows pull out and injure the ears of corn only for the purpose of getting at the corn worms. This species has not been recognized, but it is possible that a few specimens are among the unidentifiable Noctuid larvæ.

In the Diptera the most injurious species is the Hessian fly (*Cecidomyia destructor*), but the small size of the larvæ and pupæ, as well as their mode of occurrence, make it improbable that the Crows ever feed upon this insect, and no trace of them were found in the stomachs. The beneficial Diptera, *viz.*, larvæ of Syrphidæ, and the family Tachinidæ are absent.

The complete, or almost complete, absence of the injurious Heteroptera forms a very striking feature. In all the stomachs examined only a single specimen of the notorious chinch bug (*Blissus leucopterus*) was found, and unless we assume that this insect is too small, no explanation is offered why the Crow does not feed extensively upon the chinch bug, which possesses a strong odour and is more or less terrestrial in its habits. Excepting the Soldier bugs (Pentatomidæ), the insectivorus species of Heteroptera are hardly represented, the Phymatidæ are entirely absent (no doubt on account of their non-terrestrial mode of life), and of the Reduviidæ only a few specimens of a terrestrial species were found.

In the Homoptera the stomachs submitted for examination offered no opportunity for ascertaining whether or not the Crow feeds extensively upon the periodical Cicada, but from the fact that in a small number of stomachs pupæ and imagos of another species of Cicada were found, as well as from previous records and observations, there can be no doubt that this insect is not refused. The more or less injurious leaf hoppers (families Jassidæ, Cercopidæ, Fulgoridæ, Membracidæ), many species of which are frequently found, on or at least near the ground, are not represented in the stomachs (excepting a single larva of a Fulgorid).

The only beneficial (insectivorous) family among the Orthoptera, *viz.*, the Mantidæ, is represented in our Fauna by only a few species, and none have been found in the stomachs.

No specimens of white ants (Termitidæ), the only injurious family of the old order Neuroptera, occurred in the stomachs, while of the eminently beneficial families, only a single specimen of a mosquito hawk (Æschnidæ) and a single specimen of a lacewing fly (Hemerobidæ) were found.

All the families of spiders are insectivorous, but only a few are really useful to man, *e.g.*, the Thomisidæ and the orb-weavers (Orbitelariæ). These are almost entirely absent, and the only family which is well represented (Lycosidæ) has no economic importance.

No ticks (Ixodidæ) were found in the stomachs.

The insectivorous myriapods are not represented, being probably protected by their mode of life.

It will be seen from the foregoing remarks that among the principal insect food of the Crow there are only two classes of eminently beneficial insects, *viz.*, the ground beetles (Carabidæ), and the soldier bugs (predaceous Pentatomidæ). The ground spider (Lycosidæ) and the ants are, in the opinion of the writer, to be classed among the neutral or innoxious insects, which class also includes the dung insects, many of the Lamellicorn beetles, and a great many of the other insects found in smaller numbers in the stomachs. All the rest belong to the injurious insects, notably the grasshoppers, May beetles (including some allied genera), the click beetles (Elateridæ), the weevils (Rynchophorous Coleoptera), the cutworms (in fact all Lepidoptera) and the crane flies (Tipulidæ).

It is evident that the percentage of the three groups of insects forming the chief insect food of the Crow cannot be determined, from the number of species, nor from the bulk represented by the aggregate of each species, but must be determined by the number of specimens. It is difficult to give exact figures on this last point for two reasons, *viz.*—

(1.) While it is easy to determine the number of specimens of a given species where there are but few in the stomach, it is often impossible to do so where the number is great, and the specimens are in the decomposed condition in which insects are usually found when in such numbers. In most instances the number could only be approximated by the number of heads or mandibles, as the remainder of the body has been essentially destroyed by digestion.

(2.) A large proportion of the stomachs submitted are those of nestlings, and it follows that the mere fragment of any given insect is counted in such a case as a specimen, while it is probable that a single specimen may have been given in fragments or portions by the parent to several of the nestlings, so that combined they represent but one single individual. Nevertheless the difficulties do not, in my judgment, invalidate the general conclusions arrived at, which are, that the sum total of specimens of those insects which are emphatically injurious to agriculture vastly outnumbers these

which may be considered beneficial, and that it also surpasses the number of beneficial and innoxious species combined.

The facts on the whole overwhelmingly speak in favour of the Crow, and taken alone would be at variance with the prevalent opinion hitherto held, and yet held, regarding the economic status of the Crow as an insectivorous bird.

How far these general conclusions may be modified by the indirect nature of the food examined, *i.e.*, by the habit of the Crow of feeding upon toads and frogs and even small birds and other insectivorous animals, I am in no position to determine. It is probable, however, that only a small proportion of the insect food of the Crow is derived in this indirect manner, and that in so far the conclusions as to its economic status are not to be modified.

A complete list of the insects contained in each one of the six hundred or more stomachs critically examined would not only make the present bulletin too bulky, but the constant repetition of names would only mislead and bewilder the reader, if indeed any enthusiast would care to read it all. It is better, therefore, to omit the detailed statement of the insect remains found in each stomach and give only the general results.

Testimony from correspondents respecting the insect food of the Crow.

During the past ten years the Division of Ornithology has received statements from more than a thousand observers respecting the food habits of the Crow. So far as the insect food is concerned, most of these statements are of little value, because from the nature of the case it was impossible to tell what species of insects were eaten. Aside from such sweeping and groundless assertions as "Crows eat no insects at all" and "Crows eat insects of all kinds" scores of statements were received which were obviously incorrect, although evidently made with perfect sincerity. On the other hand, it is of interest to note how fully many of the more explicit statements are confirmed by the examination of stomachs. For example, the habit of catching grasshoppers was observed and reported by many correspondents, and the same is true of the May beetle or June beetle (*Lachnosterna*) and its larva, the white grub. The Crow's habit of following the plow was noticed more than a hundred years ago, and the principal error made by many of our correspondents lies in the assumption that the bird devours indiscriminately all the different insects thus exposed. Among the most common mistakes

may be mentioned the case of the Colorado potato beetle (*Doryphora 10-lineata*), upon which the Crow was reported to feed by many observers. The fact that not a single trace of this beetle was found in any of the 909 stomachs, 500 of which were collected at times and places favouring its capture, must be taken as proof positive that the Crow rarely, if ever, touches the pest. The further fact that only four species (each represented by one or two individuals) belonging to the same family as the potato beetle (Chrysomelidæ) were found in the stomachs shows clearly that insects of this kind are thoroughly disliked by the Crow.

Following are a few examples of the voluminous testimony received from correspondents:—

California, *San Bernardino.*—F. Stephens: The Crow is in the habit of following the plow, picking up cutworms, white grubs, larvæ, etc., sometimes in large quantities (1885).

Canada, Ontario, *London.*—W. E. Saunders: Last summer (1885) I watched a flock of probably 2,000 Crows catching grasshoppers.

Connecticut, *East Hartford.*—Willard E. Treat: Worms and grasshoppers are destroyed by Crows; they eat large quantities of grasshoppers and the large white grub usually found in cornfields, especially in August 1885.

South Woodstock.—Mrs. G. L. F. Stoddard: The Crow has been observed to feed upon cutworms and grubs that live just beneath the surface, and are more readily exposed by the pulling up of the corn, which the cutworms and grubs would destroy (1886).

Indiana, *Brookville*—A. W. Butler: The Crow feeds on the seventeen-year cicada (1885).

Medora.—Charles Eshorn, Jr. I have noticed them every season walking over a meadow just after the hay has been cut, catching grasshoppers, but I have never noticed them hunting insects in a meadow after the grass was 2 or 3 inches high, and of course from that time until it is cut is the time that insects damage it most (1892).

Nebraska.—J. D. Kuster: Crows have fed extensively on locusts this year (1885).

Iowa, Wapello, D. C. Beaman: It will feed on all kind of grubs and worms which are thrown out by the plow (1886).

Louisiana, *Abbeville.*—W. W. Edwards: I have not observed them eating any insects except the larvæ and grubs, on which they feed extensively in the spring on fresh-plowed ground. I am not able to say what larvæ they feed on (1886).

Bayou Goula.—W. C. Percy: It has been observed to eat locusts, but I have never been able to find any other insect in its stomach except grubs, etc. (1885).

Maine, *North Livermore.*—George H. Berry: The Crow eats grasshoppers, potato bugs, and *Clisiocampa* larvæ (1886).

Massachusetts, *Amherst.*—Hubert L. Clark: I believe that the Crow is largely insectivorous. It frequents marshes and open fields in search of food in large flocks, where it destroys large quantities of grubs, particularly those of the common June bug (*Lachnosterna fusca*), grasshoppers, and locusts. It also destroys cutworms (1885).

East Templeton.—Charles E. Ingalls: I have seen the Crow eat grasshoppers and have also seen it feed on a large white grub taken from the ground in old fields (1885).

Michigan, *Hudson.*—A. H. Boies: I have often observed it seeking for grubs and other larvæ in the spring, and know that it is a great destroyer of such when other forage is scarce (1885).

Lickleys Corners.—A. H. Carver: I have known them to follow the plow in the spring and pick up cutworms and the large white grub (1886).

Thornville.—John S. Caulkins: The following statement relative to Crows eating cutworms was given me by a friend, William B. Sutton, of Lapeer. He said he had plowed and dragged a piece of old sod and noticed that a flock of Crows were frequenting it. Sharing to some extent the hostility the farmers generally feel toward the Crows on account of the damage they do to corn, he concealed himself with his loaded shot-gun in a corner of the fence, close to where the Crows worked, thinking to shoot a few and hang them up as a terror to the rest. When the Crows came he distinctly saw them turn over the sods, shake them to pieces, and eat the cutworms that fell out. He came away without shooting, and since then has been the professed friend of the Crow (1886).

Nebraska, *London.*—George A. Coleman: In May and June we find him following the plow, seeking earthworms, insects, and mice. His favourite food is the larvæ of the June bug (*Lachnosterna fusca*), which he finds in great abundance (1888).

New Hampshire, *Webster.*—Charles F. Goodhue: At this season Crows are of some benefit to the farmer, as they feed mostly on grasshoppers. To-day (August 22, 1885) a flock of nearly 100 were observed in a pasture badly infested with grasshoppers, upon which they were evidently feeding.

New Jersey, *Merchantville.*—Edward Burrough: The Crow ought not to be condemned for it is one of our best insectivorous birds. It eats the June bug and the larvæ of any insect plowed up in the spring, such as white grubs and cutworms (1886).

New York, *Alfred Center.*—F. S. Place: Crows destroy insects. Several specimens taken by me last spring (1886) had their stomachs filled with insects, mostly Coleoptera.

Boonville.—Morris M. Green: Near Boonville I have seen the Crow feeding on grasshoppers during the summer months. Some fields seemed to be fairly black with the birds pursuing the grasshoppers in every direction. One day noticing a flock of Crows frequenting a particular field, I visited the place and found that the roots of the grass had been completely eaten away, so that the sod or turf could be rolled up like a rug or carpet. A farmer living in the vicinity told me that the Crows visited the place every day to feed upon the grubs that destroyed the turf. The grubs or larvæ were about three-fourths of an inch in length; body whitish, with some dull plumbeous underneath; head blackish. I think these are the kind so often found in corn hills and which do much damage to the corn. If so, this speaks a good word for the Crow (1887).

Waverly.—S. J. Wolcott: Crows in the spring time feed largely on cutworms, both on sod lands and after the same have been plowed. I have known them to work on cutworms in my tobacco field. After setting, when the worms are cutting the young plants, the Crows are there every morning, and no doubt destroy great numbers of them. They have been reported to eat potato bugs to some extent, but I am not prepared to verify the statement, 1892.

North Carolina, *Pittsboro.*—E. T. Adney: It eats a great many insects, particularly grasshoppers (1885).

Ohio, *Wakeman.*—W. B. Hall: Crows are decidedly insectivorous if domestication does not alter their habits. At different times I have kept Crows which were taken from the rest when nearly full fledged. They became very tame, so that I had a chance to watch their actions and manner of feeding. I find that they are not particular in their diet as to whether the insect is injurious or beneficial. They feed greedily on the different species of cutworm (*Agrotis*) and on the white grub (larva of *Lachnosterna fusca*). When plowing they will follow in the furrow and pick up every grub or beetle in sight, and when their appetites are satisfied, they fill their beaks with insects and hide them under sticks, leaves or stones. I have often taken the pains to look up their hiding-places and count the insects thus hidden, and I have been astonished at their

numbers. They kill predaceous beetles, but do not often eat them, I think, on account of the peculiar odour most of them emit. For the sake of experiment, I have taken the Crows to a board or stone which, on being removed, exposed many black beetles (mostly Galerita). They would pounce on a beetle, give it a pinch through the head or thorax, drop it, and seize another with such rapidity that but few, if any, escaped. I could not on any condition tempt their appetites with Colorado beetles, squash bugs, cucumber bugs, or any of the soldier bugs or lady birds (*Coccinella*). I had a male Crow that would eat the cabbage caterpillar (*Pieris rapæ*) with evident relish, while his mate disdained such plebian diet. They would kill the sow bugs (*Oniscus*) and species of Myriapoda, but would not eat them.

Wauseon.—Thomas Mikesell: It feeds on cutworms, May beetles, white grubs, chinch bugs, and eggs of grasshoppers. These form its principal food (1885).

Waverly.—H. W. Overman: It is a lover of grasshoppers and destroys great numbers of them, especially in the fall (1885).

Oregon, *Dilley.*—George S. Johns: It feeds extensively on grasshoppers and crickets (1885).

Pennsylvania, *East Brook.*—T. Scott Fisher: I watched a pair of Crows follow me day after day last spring (1886) while plowing sod, and have seen one Crow pick up 25 to 40 white grubs, cutworms, and wireworms at one time, and then fly to the woods for an hour or so, then back again.

Philadelphia.—J. Percy Moore; When the seventeen year Cicada appeared this summer (1885) the Crow fed extensively on both its pupæ and imagos. The young were fed, to some extent, on the pupæ (May 30, 1885). As they had not at this time appeared above the ground, I suppose the Crows obtained them in plowed fields. On June 17, I noticed them feeding on the adults. I have seen Crows feeding in plowed fields before the grain was planted (March 10, 1885), and I think they were feeding on the larvæ of the June bug or other beetles which live on the ground. I have also seen them eat large ants which live on trees and burrow into the wood (July 1) and other species of insects which I was not able to identify from a distance.

Vermount, *Hydeville.*—A. I. Johnson: Crows catch countless numbers of crickets and grasshoppers after the hay is cut. They can be seen almost any time of day on the meadows catching grasshoppers. I observed one pair of old Crows this summer, when I was haying, that were feeding their young almost entirely on grass-

hoppers; the old Crows would alight on the mown land within 8 or 10 rods of me, and after catching a hopper or two would fly to their young that were on a fence and there feed them. Of all our birds, the Crow, I think, is the most extensive feeder on grasshoppers (1885).

West Pawlet.—Frank H. Braymer: It has been observed to feed to a certain extent on the cankerworm, cutworm, various kinds of grasshoppers, and small beetles. Probably the benefit derived from the destruction of insects is considerable (1885).

Virginia, *Birdsnest.*—C. R. Moore: Crows follow the plow in the spring and eat many cutworms, and probably other insects, but I only know positively of cutworms (1886).

Drewrys Bluff.—A. R. Bellwood: During at least ten months of the year in this part of the country large numbers congregate on the pasture fields, meadows, and plowed land, and remain for hours searching for larvæ and insects (1891).

Fork Union.—J. B. Underhill: As to the insect diet of the adult I cannot testify, having never examined the gizzards. The gizzards of two young which were taken from the nest were filled to overflowing with grasshoppers, and each contained one or two kernels of corn (1886).

Lich Run.—J. G. Paxton: The Crow has been destroyed by poisoning until it is now nearly exterminated, and there is a noticeable increase of insects of every kind. It eats insects more or less, except the Colorado potato beetle (1885).

Wisconsin, *Clinton.*—C. N. Crotensburg: I have never known the Crow to refuse any insect except bees, of which it is exceedingly shy.

ON HAWKS AND OWLS AS ENEMIES TO INSECTS.

The Report of the Ornithologist, Dr. Hart Merriam of the United States, Department of Agriculture, for the year 1887, contains a most interesting and suggestive statistical account, by Dr. A. K. Fisher, of the Food of Owls and Hawks.

The stomachs of 1,072 of these birds were examined, and of 963 stomachs that contained food, 528, or nearly 55 per cent., contained mice, and 255, or nearly 27 per cent., contained insects, chiefly grasshoppers, locusts, and beetles.

It frequently happened that from fifty to seventy of these insects would be taken from a single stomach.

Certain species such as the swallow-tailed Kite, Pigeon hawk, and Burrowing Owl were found to feed almost exclusively on insects (locusts and grasshoppers). Others, such as the marsh hawk, red-shouldered hawk, Swainson's Hawk, Sparrow hawk, Barn Owl and Screech Owl were found to feed very extensively on these insects.

These data are quite sufficient to show that Owls and the smaller Hawks, besides destroying mice, can be of great service in keeping down certain very destructive insects, and are quite sufficient to encourage the opinion that these birds should be specially protected for this purpose.

It may also be added that many of the stomachs examined contained reptiles, and some of them snakes, including adders.

ON THE FORMATION OF NEW COLONIES BY *Termes lucifugus.*

(Reprint of a translation of report by Pérez published in the *Annals and Magazine of Natural History*, 6th Series, Vol. 15, No. 87, 1895, p. 283. The original article appeared in *Comptes Rendus*, tome CXIX, No. 19 (Nov. 5, 1894), pp. 804—806.)

Although the biology of the European and exotic Termites has engaged the attention of numerous Zoologists, some of whom are of the highest rank, the origin of the societies of these insects still remains enveloped in complete obscurity. Neither de Quatrefages nor Lespès has observed the swarms of sexual individuals which at certain periods escape from the galleries, and to which has been attributed the mission of founding new colonies. Fritz Müller even goes so far as expressly to deny that they perform such a function. He writes as follows :—"As to the males and females of *Calotermes*, I will not absolutely refuse to admit that they possess the capability of continuing to exist by themselves and of commencing a new settlement. In the case of all species of *Termes*, *Eutermes*, and *Anoplotermes*, however, with whose mode of life I am to some extent acquainted, a winged pair would undertake the foundation of a new colony with precisely the same success as a pair of new-born children deposited upon a desert island."
('*Jenaische Zeitschrift*,' Bd. VII, 1873, p. 458, note 1).

In spite of so absolute a denial on the part of the eminent Zoologist just quoted, it is, I think, evident that a social species, devoid of the faculty of disseminating itself at a distance, would be doomed

to fatal and early disappearance. Dissemination must and does exist in the Termites.

When a nest has furnished a swarm of winged males and females, there are always to be found in the proximity of the colony, or even about the orifice of exit, a few stray individuals which have lost their wings. They go, as a rule, in pairs, the one following the other very closely. The leader is invariably a female, while her follower is a male. When these couples are captured, they speedily perish, unless they are kept under natural conditions, which apparently has never been done.

My own method of proceeding is as follows:—In a large jar containing a certain quantity of earth is placed a block of old dead wood, it matters little whether of oak, fir, or elm. More earth is then added, so as to surround the lower part of the wood to a height of several centimetres. One or more pairs of Termites, which are then placed upon the wood, quickly creep between it and the earth, and take up their abode in some depression, either underneath or upon the sides of the buried portion of the wood. A few drops of water added from time to time, so as to restore the moisture which is lost by evaporation, are sufficient to keep everything in its proper condition. The jar should remain open, to avoid mould. The insects, moreover, never make the slightest attempt to escape.

Under these conditions the Termites live very well. At the end of from two to three weeks it may be seen that they have selected a domicile between the earth and the wood, and that they have also been feeding. Their abdomens, which were formerly flat, are now slightly convex. They are very lively and extremely active. The narrow space wherein they are living, closed on every side, contains a little fine woody powder, coming from the wood the surface of which has been attacked. Later on they have attacked it more directly at some point or other, and have commenced to excavate in it the commencement of a gallery.

Some pairs obtained on April 29th, in the present year, were alive and in perfect health on July 4th. They had manifestly increased in size, and in their swollen and distended abdomens the intersegmental membranes appeared as fine white borders separating the black disks of the segments. The bulkier abdomens of certain specimens clearly distinguished them as females.

On August 30th the Termites were still thoroughly alive, but somewhat difficult to discover, since they have penetrated deeper into the wood, and were lodged in a globular chamber, to which access was given by a narrow orifice in connection with the

surrounding earth. The white abdominal rings were broader, and the black disks were entirely separated one from another.

On October 15th I found in one of my jars six sexual Termites assembled in the same cavity, which a slight splitting of the wood had revealed. With them were two young workers, which had very recently emerged, since they were of very small size, especially one of them, whose transparent body showed no ingested matter in the alimentary canal. At one point of the wall was attached a large egg. As for the adults, they were still in perfect condition, but were less active than formerly, and obstinately shunned the light. The females, however, appeared scarcely more distended than in the month of August, and their abdomens were still far from the monstrous proportions observed in the case of the normal queens of the old nests. This difference is easily explained by the as yet moderate development of the ovaries, which, at the outset of their functional activity, are capable of furnishing only a very limited number of eggs.

Be this as it may, it is already proved by this experiment that the winged Termites issuing from the swarms are perfectly capable of living without the assistance of workers of their own species, and that their pairs develop into king and queen, the founders of a new colony. Thus is to be explained the fact that the winged individuals are always sexually immature, and have never been seen *in coitû*: they do not arrive at sexual maturity until after a somewhat lengthy interval, the duration of which my observations enable me to fix at five or six months.

G. I. C. P. O.—No. 96 R. & A.—1-4-97—W. B. G.

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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 leanes 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 dicussing 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;
21st October 1897.

CONTENTS.

EXPLANATION OF ILLUSTRATIONS.

PLATE VII—

FIG 1. CRYPTOPHLEBIA CARPOPHAGA, Wlsm. n. sp., *a*, larva; *b* and *c*, moths ♂ & ♀; *d*, pod of *Cassia fistula* with chrysalis skins protruding from it.

„ 2. EREUNETIS? SEMINIVORA, Wlsm. n. sp., *a*, larva; *b*, chrysalis; *c*, moth ♀; *d*, pod of *Cassia occidentalis* with a chrysalis skin protruding from it.

PLATE VIII—

FIG. 1. MYLLOCERUS MACULOSUS, Desbr. de Loges, n. sp., *a* and *b*, weevil dorsal and side views (enlarged); *c*, weevil natural size; *d*, antenna (enlarged).

„ 2. MYLLOCERUS SETULIFER, Desbr. de Loges, n. sp., *a* and *b*, weevil dorsal and side views (enlarged); *c*, weevil natural size; *d*, antenna (enlarged).

„ 3. LEUCOMIGUS ANTENNALIS, Faust, *a* and *b*, weevil, dorsal and side views; *c*, antenna, (all enlarged).

PLATE IX—

FIG. 1. Strawson's "Coronette."

„ 2. Vermorel's "Torpille."

„ 3. „ "Eclair."

„ 4. Strawson's "Notus."

„ 5. „ "Antipest."

„ 6. Chiswick Co.'s Sprayer.

PLATE X—Coolie using Vermorel's "Eclair."

PLATE XI—

FIG. 1. ACANTHOPSYCHE (BRACHYCYTTARUS) SUBTERALBATA, Hamps., *a*, larva-case; *b*, moth ♂.

„ 2. Leptispa pygmæa, Baly, *a* & *b*, beetle, dorsal and side views (enlarged).

„ 3. ARÆOCERUS FASCICULATUS, Degeer, *a*, larva; *b*, pupa; *c* and *d*, beetle, dorsal and side views.

„ 4. ADORETUS CARDONI, Brensk., *a* and *b*, beetle, dorsal and side views; *c*, antenna (enlarged).

PLATE XII—

FIG. 1. ALEURODES BARODENSIS, Mask., *a*, larvæ, pupæ, and eggs on leaf (enlarged); *b*, larva, dorsal view; *c*, diagram of larva, showing arrangement of pores; *d*, margin of larva and pupa; *e*, vasiform orifice, operculum, and lingula.

„ 2. ALEURODES EUGENIÆ, var. aurantii, Mask., *a*, pupæ on leaf; *b*, pupa-case, showing enclosed insect; *c*, diagram of pupa-case, showing radiating patches; *d*, one of the radiating patches, enlarged; *e*, margin of pupa-case; *f*, vasiform orifice, operculum, and lingula (diagram).

„ 3. ALEURODES COTESII, Mask., *a*, larvæ and pupæ on leaf; *b*, larva, dorsal view, enlarged; *c*, margin and dorsal pores of larva; *d*, pupa-case, dorsal view, enlarged; *e*, margin of pupa-case; *f*, pupa-case, side view; *g*, vasiform orifice operculum, and lingula (diagram).

ORIGINAL COMMUNICATIONS.

i.—Description of two new species of Tineina from Bengal. By the Right Hon. Lord Walsingham, M. A., F.R.S., etc.

Plate No. VII.

Tineina.

Tortricidæ.

Olethreutinæ.

Cryptophlebia, Wlsm., gen. n.

1. Type ***Cryptophlebia carpophaga,**** Wlsm.

Antennæ ♂ moderately stout, simple, about half the length of the forewings. *Palpi* short, stout, projecting scarcely half their length beyond the head, apical joint short, depressed; second joint thickly clothed above and below with closely packed scales, giving a somewhat triangular appearance. *Head* thickly clothed above. *Thorax* stout. *Forewings* about twice as long as broad, costa scarcely convex, termen oblique, tornus rounded, dorsum somewhat abruptly angulated near the base. *Neuration* 12 veins, 2 from a little beyond middle of cell; 3, 4, and 5 closely approximate at the lower angle of cell; 7 and 8 separate enclosing the apex. *Hindwings* (♂) about as broad as the forewings, triangular, apex depressed, abdominal margin shortened, very hairy, with a pouch-like fold along vein 2 containing a thick tuft of scales on the upper side, accompanied by some strongly curved scales on the underside along the margin. *Neuration* 8 veins, vein 2 concealed in the tuft of scales, 3 and 4 connate (or very closely approximate), 5 closely approaching 6 at the outer margin, 6 and 7 normal, but somewhat bent downwards at their origin, 8 free. *Abdomen* densely hairy above. *Legs:* all the tibiæ thickly tufted, first tarsal joints of the hindlegs also tufted.

This genus comes into the same group as *Platypeplum*, Wlsm. (=*Platypeplus*, Wlsm. *laps. cal.*)

---

* The examples from which this species is described, were reared in the Indian Museum from pods of both *Cassia fistula*, Linn., in Calcutta (1894), and *C. occidentalis*, Linn., from Hooghly (1895). The specimens of pods were brought to the Museum by one of the Museum Collectors, E. B.

Cryptophlebia carpophaga, Wlsm., sp. n.

Antennæ pale tawny. *Palpi* tawny, paler on their inner sides, shaded with fuscous externally. *Head* tawny, shaded with reddish fuscous above. *Thorax* blackish, tegulæ tawny tipped with tawny fuscous. *Forewings* tawny, with a blackish patch extending over the whole space beneath the fold from the base to the tornus, a slight admixture of bone-grey scales towards the latter and with a small triangular ill-defined patch at its outer end (the base resting on the dorsum), in the tornal region the tawny scaling blends into bone-white · along the costa are alternate broad and narrow oblique vinous streaks, and the apex is cut off by an outwardly curved, but not well-defined band of fuscous and purplish scales extending from below the outer third of the costa to a point somewhat below the middle of the termen ; a small bone-white spot is situated at the end of the cell, preceded and followed by a few blackish and purplish scales ; cilia dark purplish on the upper two-thirds of the margin, bone-whitish below, with a purplish parting streak running through them at the tornus. *Exp. al.* 18mm. ♀ 17 mm

Hindwings brownish fuscous; cilia greyish with an iridescent tinge, a narrow pale parting line running along their base. *Abdomen* greyish with a slight ochreous tinge, a black tuft above the anal segments which are distinctly vinous beneath. *Hindlegs* bone-grey with the tufts on the tibiæ strongly iridescent dark purplish on the upper sides.

Type ♂ ♀ Mus. Wlsm.

Hab. INDIA, Calcutta (1894) ; Hooghly (1895). Larva in pods of *Cassia fistula* (1894) and of *C. occidentalis*, L. (1895). Moths emerged 4th January 1895.

The structure of the ♀ is conspicuously different in the absence of the tufts on the hind legs, which are, however, somewhat hairy, and the smooth abdomen and perfectly normal neuration of the hindwings which show but little sign of the pouch-like fold in the neighbourhood of the abdominal margin.

The forewings are reddish—tawny, the space beneath the fold and about the tornus sprinkled with bone-white, a small inconspicuous patch of the reddish ground-colour extending to the dorsum across the middle of the fold, and a conspicuous clearly defined rich reddish-tawny spot immediately before the tornus, far more conspicuous than in the ♂, the vinous streaks along the costa are scarcely noticeable, being absorbed into the more similar general

colouring of the forewings. There will probably be found to be some variation in the ground-colour of these in both sexes.

TINEINA.

TINEIDÆ.

Ereunetis, Meyr.

2. *Ereunetis ? seminivora,* * Wlsm., sp. n.

Antennæ (♂) somewhat stout; whitish ochreous. *Palpi* somewhat thickly clothed above and beneath so as to appear triangular; dark chocolate-brown: apical joint very short, depressed, ochreous. *Head* whitish ochreous above, face dark chocolate-brown. *Thorax* whitish ochreous above, tegulæ and a narrow band across the front dark chocolate-brown. *Forewings* narrow, elongate, acuminate, somewhat widened at the middle; dark chocolate-brown, rather shining; a narrow whitish ochreous dorsal line from base to apex reverting a little around the apex at the base of the dark brown costal cilia, the upper edge of this line is somewhat irregular and throws up a small dentate excrescence at two-thirds from the base; terminal and dorsal cilia pale ochreous. *Exp. al.* 16mm. *Hindwings* narrower than the forewings, acuminate, the base of the costa ciliate, the dorsum evenly rounded; bronzy purplish, cilia very pale ochreous. *Abdomen* brownish ochreous. [*Hindlegs* missing.]

Type ♀ Mus. Wlsm.

Hab. INDIA.—Hooghly. Larva in pods of *Cassia occidentalis* Linn. (1895), moths emerged 2nd January 1895.

This appears to approach Meyrick's Australian genus *Ereunetis*, but until I have a series of specimens before me, including males, I am unable to make a satisfactory structural examination. I have described it for the convenience of the authorities of the Calcutta Museum, as I understand they desire to refer to it in connection with some economic report. Further specimens would be acceptable.

* This species is described from specimens reared in the Museum in January 1895, from pods of *Cassia occidentalis*, Linn., collected in Hooghly by the Entomological Artist, Indian Museum, E. B.

ii. On the possible utilization of the "Green Bug" of Calcutta as food for birds, etc.

By F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

Residents in Calcutta must frequently have been struck by the often inconvenient abundance of a small Homopterous insect of the Jassid family in the early part of the "cold weather." These "green bugs," about the size of a very full-fed mosquito, fly in swarms round lamps, and are found often in large quantities, dead beneath these in the morning.

It struck me some time ago that these insects, so easily obtainable in bulk, could very well be utilized as food for various cage-birds needing constantly or occasionally an insect diet, now supplied by fanciers in the form of the so-called "ant's eggs" (in reality ant's cocoons) of the trade.

Having procured in 1895 (I think) a small quantity I let them dry, and offered them as food to various more or less insectivorous birds at the Zoological Gardens here, and found that they were taken very well. Last year Mr. Barlow, of the Museum staff, kindly had a larger quantity collected for me, with which I again experimented both with birds of my own and with those at the Zoological Gardens, and again with encouraging results.

I also forwarded samples of a pound each to two well-known English amateurs of cage-birds, Dr. A. G. Butler of the British Museum, and Mr. Reginald Phillips; and also to the Superintendent of the London Zoological Gardens and to Spratt's Patent Company.

From the two latter I have received as yet no reply, but some time ago I received very courteous answers from the two amateurs above named.

Dr. Butler says:—"I have tested the insects as food for birds and find that they are eaten greedily, both dry and mixed with soft food, not only by insectivorous birds, but also by such almost strictly granivorous birds as canaries.

We have for years past had an European representative of the *Jassidæ* sold in the bird-market as food under the name of 'dried flies!' It is a much larger species than yours, being equal in size to our British 'Frog hoppers' and is doubtless Eurcpean. The Indian species, however, evidently attracts birds by its bright green colouring, whereas the so-called 'dried flies' are whity-brown like ant's cocoons.

If the Indian insect could be imported in such quantities and at such a rate that it could be sold in the market at from 1*s.* to 1*s.* 6*d.* a pound, it would be a great boon to aviculturists; for at some seasons ant's cocoons are almost unprocurable whilst they are often dear. (I am now paying 1*s.* 9*d.* per pound for them.)

The Indian insect has one great advantage over ant's cocoons in that there is little rubbish intermingled with the mass; it is all edible."

The reply sent by Mr. Phillips is not quite so favourable in character. He says:—"At present I have but few insectivorous birds, and these mostly of a large size, the smallest being a Nightingale.

The ant's cocoons I have always given to the birds mixed with other insectivorous food; since the receipt of your dried insect, I have substituted the latter for the ant's cocoons, and occasionally supplied it more plentifully to the Nightingale. All my insectivorous birds were in perfect health at the commencement of the change, and remain so now, so there is not anything to be proved on that score.

The Nightingale at first ate your dried insect rather freely, but seemed to tire of it after a while, and the quantity supplied to him had to be considerably reduced; now he gets on with it very well.

Personally, before I used the food regularly for my birds in lieu of ant's cocoons, I should require to know something more about it:—What insect is it? How has it been prepared? On what food did it feed or what are its habits, to give it the present green colour? . . . . A few kinds of dried flies have been brought into the English market from time to time; some have been condemned, some ignored, only one or two taken up, but by so few aviculturists that it can hardly pay to import them; so I fear your chances of success are not encouraging.

Ant's cocoons are the fashion; some of the samples imported are very bad; and the good are offered at an exorbitant price; there may therefore perhaps be an opening here—if you can show that your insects are as good as ant's cocoons, and if you can persuade the obstinate Britisher to make any change in what it has been his custom to do."

Taken into conjunction with the silence of the Zoological Gardens and Messrs. Spratt, this does not seem very encouraging.

My own experiments, however, convinced me that the "green bug" is a really good article for feeding birds. By its use, an insectivorous bird causes no more trouble than seed-eater, if one

gives the insects dry, as I did. Wild birds eat them, so the food is a perfectly natural one. The insects could be collected, during their short period of abundance each year, in any quantity with the very smallest amount of labour. A coarse open umbrella suspended under a lamp would catch quantities; and they will dry readily indoors, if spread thinly and turned over frequently.

I cannot believe that the "ant's eggs" can be obtained and rendered marketable with as little expenditure of labour as this; and therefore, in spite of the cost of carriage from India to Europe, I have no doubt that the Indian bird-food could be offered at a cheaper rate than the European, to which it is moreover superior in purity, as remarked by Dr. Butler. In fact, if collected as I suggest, there need be no rubbish in it at all.

Were the utility of this product to be limited to the feeding of cage birds, the sale might be too small to justify any attempt to make it a commercial article, though many who do not keep insectivorous birds would be very glad of insect food for those seed-eaters, which, like many finches, need such nourishment for rearing their young. It might even, I should think, be used for rearing canaries.

But it is in the rearing of young game-birds, and very possibly trout also, that the "green bug" would, I believe, be found most valuable. It would be a most excellent and natural food for pheasant chicks, and I see no reason why trout fry should not take it as readily as gold-fish do the dried "ants' eggs".

Dried locusts have been suggested by Dr. Günther * as food for cage and game-birds, but these would be far more troublesome to prepare, and I am inclined to think that for *small species* and young birds, for which artificial food is most difficult to provide, the "green bugs" would be better. At any rate they are worth a careful trial.

* See Dr. Günther's very interesting notes in Mr. E. C. Cotes' paper on this subject [The Agricultural Ledger No. 2, 1893 (Entomological Series, No. 1)], from which it appears that there is a large opening for dried insects of some sort as food for birds.

iii.—Description of three new species of Indian Coleoptera of the family Curculionidæ.

By Mons. J. Desbrochers des Loges.

Plate No. VIII.

1. *Myllocerus maculosus,* [1] n. sp.

Myllocerus maculosus. Long. 8-9 mill.—*Oblongus, viridi-glauco-cæruleo pallide squamosus, vix distincte setulosus, antennis tibiis tarsisque piceis. Caput subplanum, fronte sulcata, oculis majoribus, oblongis, paulo prominulis. Rostrum breviter subquaratum, sulcatum profunde triangulariter apice emarginatum, apice albo-setosum. Antennæ longiores, scapo modice curvato, funiculi articulis 2-primis longitudine sub æqualibus, illo vix breviore, 3-7 oblongis, sublinearibus, clava fusiformi. Prothorax brevis, basi valde constrictus, angulis posticis divaricatis, acutis, lateribus ad tertiam anticam partim impressis, basi bisinuatus lobo medio reflexe, parce punctatus et albosetulosus. Elytra thorace basi valde latiora, humeris rotundatim elevatis, in ♂ paulo in ♀ magis postice ampliata, minus dense punctato-striata, interstitiis planis, nigro inordinatim parce maculata. Pedes sat elongati, femoribus acute dentatis, tarsorum articulis 2-primis valde elongatis, 3° dilatato-lobato. Subtus punctis nigris setigeris sparsus.*

2. *Myllocerus setulifer,* [2] n. sp.

Myllocerus setulifer. Long. 4-4 mill.—*Oblongus, modice elongatus, niger, viridi-luteo squamosus, antennis pedibusque testaceis albo tenuissime setulosus. Caput convexum, oculis latioribus sub-oblongis, non prominentibus. Rostrum brevissimum, impressum, longitudinaliter sulcatum, apice denudatum triangulariter emarginatum. Antennæ graciles, modice elongatæ, scapo valde arcuato, thoracis marginem anticam superante, funiculi articulis 2-primis valde elongatis illo longiore, sequentibus brevioribus ultimis latitudine*

[1] Destructive to Egyptian cotton at the Government Experimental Farm, Cawnpore. The specimens were furnished by the Director, Land Records, North-West Provinces and Oudh, in September 1895. (See page 67 of Vol. IV., No 2 of *Indian Museum Notes.*)

[2] Specimens of this minute weevil were received in the Indian Museum in April 1896 from J. S. Gamble, Esq., Director of the Imperial Forest School, Dehra Dun, as found devouring rose-flowers in the Forest School Garden.—E. B.

non longioribus, clava angusta, fusiformi. Prothorax brevissimus, basi et apice subtruncatus, antice et postice constrictus, medio anguste dilatatus, margine antico valde impresso, punctis denudatis nigris. Elytra thorace basi valde latiora, quadruplo longiora, humeris elevatis, lateribus sub-parallelis striis tenuibus, punctatis interstitiis planis, setis brevibus reclinatis seriatis. Pedes sat graciles, femoribus clavatis infuscatis spinula minuta intus armatis, tibiis rectis, tarsis articulo 1° 3-4-quentibus longitudine subæquale, 3° lobato. Subtusnigro-punctatus.

Hab.—Dehra Dun, North-West Provinces.

3. *Leucomigus antennalis*,[1] Faust.

LEUCOMIGUS ANTENNALIS, Faust i. l. Long. 13-1 mill.—*Oblongo-ovatus, niger, cinereo-pubescens. Caput latum, oculis depressis. Rostrum validum subrectum, tricarinatum, carina media antice abbreviata, basi biramosa. Antennæ obscure-ferrugineæ, articulis 2-primis obconicis, illo breviore, cæteris subquadratim transversis, clava elliptica vix inflata. Prothorax subtransversus á latere postice subparallus, post medium antice attenuatus, seu constrictus, lateribus vittaluta sinuata albida ornatis, angulis posticis subrectis, grosse sparsim punctatus ac rugatus, ante apicem vage impressus medio obsolete carinatus, basi bisinuatus, medio vix lobatus. Elytra basi obtuse subanguatim emarginata, a latere modice arcuata, postice vix distincte callosa, apice obtusa, striis profundis inæqualiter punctata, interstitiis elevatis, valde inæqualibus, brunneo obsolete sinuatim bifasciatis, posterius macula majore guttisque niveis ornata. Pedes tomentosi, tibiis intus ciliatis, tarsis elongatis, subtus spongiosis, articulis 2-primis sublinearibus, illo longiore, unguiculari longo, ciliato. Abdomen segmentibus 3-5 a latere profundissime foveatis.*

Hab.—Palamcottah, Tinnevelly District.

[1] Examples of this insect were forwarded to the Museum in November 1895, through the Manager, "Indian Agriculturist," Calcutta, from the Assistant Collector, Tinnevelly District, a doing damage to young cotton and gram shoots.

iv.—Some comparative trials of insecticide pumps[1] in relation to the treatment of tea blights, and experiments in the treatment of red spider.

By W. J. FLEET, F.H.A.S.

Plates—Nos. IX and X.

The following notes were derived from observation of the practical use of insecticide sprayers on various descriptions and forms of tea-bushes on an extensive garden, and at more than one season of the year. The machines were all of the knapsack form, and supported on the back by means of straps. Having been brought into working order they were placed in the hands of coolies, whose work, however, was under constant supervision. The pumps were utilised in the application of various descriptions of insecticides and fungicides, the active principle in some being in solution and in others in a state of suspension.

Powder Diffusers :—

1. Strawson's "Coronette."[2]
2. Vermorel's "Torpille."[3]

Liquid Sprayers :—

3. Vermorel's "Eclair."[3]
4. Strawson's "Notus."[2]
5. „ "Improved Antipest."[2]
6. Chiswick Co.'s Sprayer.[4]

1. Strawson's "*Coronette.*"—A well-constructed diffuser for sulphur and powdered preparations. The bellows are placed at base of the machine in a protected position and are worked by a side lever. The powder meets with the blast from the bellows after passing from the body of the knapsack through a fine grating on which oscillates a brush. The density of the spray can be regulated by a feed-slide.

2. Vermorel's "*Torpille.*"—This is very similar in principle to the preceding and did equally good work. The bellows are placed

[1] Most of the pumps in use were supplied by the Trustees of the Indian Museum for the purpose of experiment.

[2] Obtainable from Messrs. Strawson & Co., 77, Queen Victoria Street, London, E.C.

[3] Sold by Messrs. Charles Clark & Co., 20, Great Saint Helen's, London, E.C.

[4] Can be procured through their Calcutta Agents.—The Planters' Stores and Agency Company, Limited, 3 Mission Row, Calcutta.

on the top of the knapsack. Three moving rods act instead of a brush to feed the material to the grating.

3. VERMOREL'S "*Eclair.*"—This sprayer did excellent work, working throughout all experiments without choking or any hitch. Power is applied by means of a side lever. The spray is fine, of considerable force, and can be directed as desired by means of a moveable nozzle.

4. STRAWSON'S "*Notus.*"—This sprayer, of a useful size, is specially suited to insecticides containing matter in suspension, as owing to the presence of two moving blades or stirrers the liquid is kept in a continual state of agitation. A series of nozzle caps permit of regulating the fineness of the spray.

5. STRAWSON'S "*Improved Antipest.*"—A well-constructed and finished sprayer. Possesses the advantage that all working parts are exterior to the knapsack containing the insecticide. A side lever works an air-pump. Two tubes connecting the nozzle to the machine, carry the one the insecticide, the other the compressed air. The air acting on the liquid at the point of junction at the nozzle mouth, produces a spray of varying form. The latter is regulated by two stop-cocks, one controlling the flow of liquid, the other the supply of air. The sprayer, owing to the want of means for agitation, is only suited to insecticides in a state of solution.

6. CHISWICK CO.'S *Sprayer*—Gives a large and powerful spray, and can be used for insecticides both in states of solution and suspension. Worked by a top lever and handle on the thrust and pull principle. This was found to be much more fatiguing when in continuous use than machines fitted with side levers in which the weight of the arm is utilised in the stroke.

EXPERIMENTS IN THE TREATMENT OF RED SPIDER (*Tetranychus bioculatus*).

The experiments now to be described were commenced on the 29th April. This apparently late date of the application of the insecticides was due to two causes. First, Red spider this year came into evidence on the gardens later than usual; secondly, the object of the experiments was not to prove the value of sulphur, or preparations containing sulphur, in the treatment of Red spider (this being now a generally acknowledged fact, and taken advantage of by a yearly increasing number of gardens), but to make a comparagive trial of several insecticides that have been recommended or suggested. For this reason it was necessary to delay application

until a considerable area of garden was attacked, to allow of the selection of a series of plots of an even character.

An extent of old tea, heavily pruned some six years previously, was selected for the uniformity of the attack.

In addition to the marking out of the plots, numerous individual bushes in each plot were numbered and memoranda made of the condition of each. The garden immediately surrounding the plots was sprayed with soft soap and sulphur to prevent, as far as possible, the spread of Red Spider from the surrounding area to that of the plots.

Insecticide No. 1. Sulphur.
„ *2.* Strawson's "Tea Velos."
„ *3.* Soft Soap and Sulphur.
„ *4.* Kerosene Emulsion.
„ *5.* Chiswick Compound.
„ *6.* Strawson's "M" Insecticide.
„ *7.* „ "C. S." „

The special preparations in the above list were applied according to the directions supplied by the makers. These latter being also the manufacturers of sprayers, their machines were made use of, as far as possible, in the application of each insecticide.

Nos. 1 and 2. "Tea Velos" is a fine powder and both it and the sulphur were applied by means of diffusers in the early morning when the dew was on the foliage and so admitted of the adherence of the dressing.

No. 3—was prepared as follows :—

* Sulphur	2 lbs.
* Soft Soap	2 „
Water	3 gals.

The sulphur and soft soap were gradually added to each other in a metal bowl, being worked the while by a strong iron spoon, until they were rubbed down to an even paste. This was then mixed with boiling water till the soap had dissolved. For application, dilute with 10 times the quantity of water, having first stirred the compound to cause the necessary suspension of the sulphur in the liquid.

No. 4—was made according to a standard formula :—

Kerosene	2 gals.
Soft soap	1 quart.
Water	1 gal.
Sulphur	*q. s.*

* The sulphur was procured direct from Italy ; the soft soap obtained from the North-West Soap Company, Calcutta.

Dissolve the soft soap in boiling water and add to the kerosene. Then by working a small force pump in the mixture it can be readily churned into an emulsion. Any one possessing the Chiswick sprayer may unscrew the pump from the knapsack and use it for this purpose.

The emulsion, which is complete by five minutes use of the pump, is milk-like in appearance and thickens on cooling and standing. It may be kept some days without fear of deterioration. For use it is diluted with 9 to 25 parts water, and in these experiments 15 parts was the quantity chosen. The sulphur was added in the proportion of 1 oz. to a gallon.

No. 5.—The makers give some latitude in the final dilution. The proportion used was one to ten of water.

Nos. 6 and 7.—These were diluted according to the accompanying instructions of the makers.

Dry weather favoured the application of the insecticides and no rain fell till 6th May.

The plots were examined on 1st May and reported on as follows:—

Plot No. 1. No live spider to be found.
„ *2.* „ „
„ *3.* About 90% dead; a few weak and struggling.
„ *4.* Slightly superior to No. 3.
„ *5.* Similar to No. 3.
„ *6.* Inferior to Nos. 3 and 5.
„ *7.* Similar to No. 6, excepting bushes that were rather liberally sprayed.

Examined 5th May. No rain since last examination. Plots all much the same, but No. 4 seems to have fallen behind Nos. 3 and 5.

Examined 10th May. Heavy rain has fallen since last date.

Plots Nos. 1, 2, 3, 4. Practically free from spider.
„ *5, 6.* Less so.
Plot No. 7. Spider numerous.

Examined 15th May:—

Plots Nos. 1, 2.—Excellent.
„ *3, 4, 5.*—All good.
Plot No. 6.—Defective.
„ *7.*—Red Spider fairly noticeable.

Examined 15th June :—

Plots Nos. 1, 2.—Practically no Red Spider, only one or two leaves found by careful searching.
Plot No. 3.—Nearly as good.
Plots Nos. 4, 5.—Bushes here and there showing little spider.
Plot No. 6.—Not so good as the two previous.
" 7.—Still more Red Spider visible.

The plots and surrounding four rows easily distinguished at a glance from rest of garden.

Examined 15th July. Heavy rain has brought on vigorous flushing and the plots and surrounding garden are uniform in appearance.

It was intended to redress all the plots at the expiration of three weeks' time, but a continuance of showery days made this impracticable.

An interesting point brought forward in the foregoing experiments, is the success attending the application of such an inexpensive insecticide as dry sulphur. All preparing and mixing of ingredients is done away with, a great saving of labour is effected as water carriers are not required, and the sprayers are much less apt to choke and get out of order than those containing a liquid.

Some extent of garden was dressed by women shaking bags of sulphur over the bushes. The bags were formed from squares of dammer.* A large area can in this manner be rapidly got over, but very much more sulphur is required than when using the sprayers

Sulphuring to be effective should be done in the early morning when the dew is on the leaves. The sulphur then forms a thin coating over the surface of the leaf. This result is not so well secured after rain, as the latter tends to collect in drops on the smooth surface of the leaf, causing an unequal adhesion and distribution of the sulphur.

With regard to liquid preparations of insecticides, allowing the drawbacks previously mentioned, they possess the advantage of being applicable throughout the day.

* Obtainable from the Elgin Mills Company, Cawnpore.

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

BY E. BARLOW, ASSISTANT IN CHARGE OF ENTOMOLOGY.

I. TEA PESTS.

1. *Acanthopsyche (Brachycyttarus) subteralbata.*

(Sub-ord. Heterocera, Fam. Psychidæ.)

Plate XI, fig. 1, a, *larva-case*, b, *moth* ♂.

Hampson. Fauna of British India, Ceylon and Burma, Moths, vol. 1, page 295, No. 627. Ill. Het. IX, ined., pl. 159, fig. 23, pl. 176, fig. 12 (larva-case).

In September 1896, Mr. J. Lancaster, Secretary to the Agricultural and Horticultural Society of India, forwarded to the Indian Museum specimens of bag-worms (Psychidæ) from the Chittagong district, where they were said to be defoliating tea and other plants. The following note which appeared in the *Indian Agriculturist* proves without doubt the destructive nature of the insect:—

"The troubled planter of Chittagong has set the members of the Agricultural and Horticultural Society of India and those interested in natural history, both from a scientific and practical point of view, a task in the way of investigation and observation. He has recently forwarded some specimens of leaf-worms which the reports are working great havoc among the tea-gardens in that district just now. From observation of the insect's movements it appears that it begins by attacking the most tender leaves and shoots and gradually eating up all the leaves upon the tree. Not only is this insect possessed of a voracious appetite, but there is much method in its system of securing a food supply. Having demolished all the choice leaves on one tree it goes on to the next. These insects commenced by attacking an avenue of Poinciana trees, and they have now spread to palms and fruit trees."

The examples which consisted of larva-cases and imagos proved to be new to the Museum Collection, specimens were therefore forwarded to Sir G. F. Hampson, who very obligingly identified the insect as belonging to the species *Acanthopsyche* (*Brachycyttarus*) *subteralbata*, Hamps., a species previously recorded from Ceylon. He describes the insect thus:—

Male: Head, thorax and abdomen dark brown, wings dark brown, the underside of the hind wing shining bluish white.

Larva-case covered by comminuted leaves and suspended by a silken thread.

Exp. 15 Millim.

2. *Aspidiotus dictyospermi*, Morgan.
var. *arecæ*, Newstead.

(Sub-order Homoptera, Fam. Coccidæ.)

In January 1896, specimens of a scale-insect affecting tea plants were received in the Indian Museum from Dr. G. Watt, Reporter on Economic Products to the Government of India, with the information that they were sent to him as samples of *Lecanium* on tea. On examination of the scales, they, however, proved without doubt to belong to the genus *Aspidiotus*, but unlike any of the same genus in the Indian Museum collection. To ascertain the correct specific identity of the insect, specimens were submitted to Mr. W. M. Maskel who kindly determined them as belonging to the species *Aspidiotus dictyospermi*, Morgan, var. *arecæ*, Newstead, both the type and the variety being originally described from Demerara.

The following is the description of the type by A. C. F. Morgan published in the Entomologist's monthly Magazine, Vol. XXV p. 352.

Aspidiotus dictyospermi— ♀ scale greyish-white, with exuviæ in the centre, depressed, of an elongate oval shape, about 1·2 mm. longest diameter. The centre of the larval skin is of a dark orange colour, whilst the exuviæ are of a light yellow.

♀ insect has three pairs of lobes. The median pair is the largest, notched on the outer lateral margin; the second lobe is similar to the first in shape, but smaller, and the third lobe is still smaller, with the outer lateral margin serrated. Two simple plates between the median lobes, two between the first and second lobes and three between the second and third. The third is followed by two long plates, serrated on the outer lateral margin. Anterior to the last plate the margin is serrate up to the commencement of the next visible segment. The lateral margins of the first and second lobes are thickened at the base. Four small spines situated as usual. Four groups of ventral glands, the anterior group consisting of three or four, and the posterior of two glands. The anus is situated just above the base of the median lobes. There is a considerable similarity between this species and *A. ficus*, but the plates are different, and the scale is completely different, the one oval greyish-white and flat, the other almost black, convex and circular.

Found on *Dictyospermum album* from Demerara.

Mr. Newstead describes the variety thus :—

A. dictyospermi, Morgan, var. *arecæ*, Newstead:—Scale of the ♀ circular, exuviæ central, or nearly so; the first exuviæ in the form

of a "nipple-like prominence" (Comstock), covered with white wax in fresh specimens, but red-brown or golden red-brown in denuded specimens; nipple surrounded by a circular depression; following this is a strong circular ridge, which, in many specimens, is covered with the same white material as the nipple; these are situated on a distinct circular prominence, or boss, with nearly perpendicular sides; below this the scale becomes very flat and wide, and is of a rich orange-brown, varying to ochreous-brown.

Diameter 1—1½ mm.

Scale of the ♂ of the same colour, and has the same structure at apex as the ♀.

Found on leaves of *Areca triandra* from Demerara.

Undetermined Pests.

(3) Moths.— *Hyposidra* sp.—In November 1896 Mr. W. J. Fleed forwarded to the Indian Museum a single specimen of a Geometrid moth said to be attacking tea bushes both in the Borghat and in the new Salonah gardens in Assam.

The moth appeared to be new to the Museum collection, but it was identified as belonging to the genus *Hyposidra*. Further specimens of the moth are required to enable the insect to be specifically determined. Mr. Fleet, who reared the moth from caterpillars, collected by him from the tea gardens, has furnished the following notes :—

"*15th June 1896.*—Caterpillars feeding on leaves of tea plants in Borghat and New Salonah Gardens, Geometrid: dark or chocolate brown, with seven white dotted transverse lines, one being at head, another at caudal extremity. Three placed in breeding cage.

19th June.—Two added; one pale brown, length $\frac{4}{10}$ inch, increasing.

24th June.—Two of the caterpillars have parasitic grubs coming out; some have formed cocoons.

26th June.—One of the caterpillars died, some ten grubs spinning themselves cocoons. Cocoons in clusters on under-side of leaf; white and woolly, length about $\frac{1}{10}$ inch.

27th June.—Second caterpillar host died; cocoons complete; removed to box.

29th June.—Third caterpillar died. Flies[1] in box, came out.

1st July.—Fourth caterpillar died. Fifth caterpillar changed into chrysalis in soil, and the moth emerged 13th idem.

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[1] Examples of the parasitic fly have been sent to the Museum by Mr. Fleet. It is a minute Hymenopterous insect of the family Chalcididæ, and new to the Museum collection.

(4) *Tineid caterpillar.*—From the Officiating Reporter on Economic Products to the Government of India were received in September 1896 specimens of insects said to be attacking tea leaves in Burma. No particulars accompanied the specimens which consisted of some larvæ of an unknown moth belonging to the family Tineidæ.

(5) *Beetles.*—In September 1896 specimens of insects said to be more or less directly injurious to tea plants in Assam were forwarded to the Museum through Mr. D. Hooper, Officiating Reporter on Economic Products to the Government of India.

No special report accompanied the insects which comprised the following :—

(*a*) A Chrysomelid beetle of the species *Diapromorpha melanopus*, Lacord.

This insect has been previously recorded in the pages of these *Notes* as attacking tea plants in Sibsagar, Assam. It is commonly known among the tea planters as the "orange" beetle.

(*b*) A Chrysomelid beetle probably belonging to the species *Criocerus impressa*, Fabr.

(*c*) A Chrysomelid beetle identified with *Oides bipunctata*, Fabr.

II.—INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

1. *Leptocorisa acuta*, Thunb.

The Rice Sapper.

Reports and specimens of this common rice bug were received in the Indian Museum from the undermentioned officers as being very destructive to paddy crops both in the Bengal and Madras Presidency during the year 1895-96.

A full account of the pest may be found in *Indian Museum Notes*, Vol. I, No. 1, pp. 1 to 4.

(*a*) Through the Director, Land Records and Agriculture, Bengal, from the Manager, Court of Wards, Backergunge, who wrote on 3rd December, 1895 :—

"I have the honour to forward some "Mewa" insects which are doing damage to the paddy crops in some parts of the Dakhin Shabazpur Purgana."

(*b*) From the Deputy Director of Land Records and Agriculture, Madras, who reported on 25th February 1896 :—

"I have the honour to advise you of the despatch to-day of a small box containing insects which, I am informed, do a good deal of damage to paddy in

Malabar. My informant states that the local name is *Chazhi*, and that last year they did an immense amount of damage to the paddy here in places, very much more as far as I can make out than has ever been known before."

(*c*) Through the Director, Land Records and Agriculture, Bengal, from the Collector, Cuttack Collectorate, who wrote :—

"I have the honour to forward herewith some specimens of insects which are destroying the *Laghu* rice to a certain extent in this district.

Enquiry is being made as to how far the ravages committed by these insects extend, and what is the best means of getting rid of them. I have directed the Sub-Deputy Collector in charge of the enquiry to endeavour to get ryots try the experiment of smoking the fields by burning weeds, etc., to windward."

(*d*) Through the Superintendent, Government Museum, Madras, with a report from the Collector of Ganjam, dated 8th November 1896 :—

"That in the paddy fields of some villages in Goomsur division, winged insects of a peculiar sort have appeared, and that they are sucking up the milk out of the paddy ears.

Similar insects were not, it is reported, even before seen in Goomsur."

(*e*) The Director, Land Records and Agriculture, Bengal, from the Sub-Divisional Officer, Bhola, who wrote :—

"The general character of the insects herewith sent is that they thrust their long lips into the paddy, and suck the milk in its immature state after its ears shoot out . . . . The present insects are very expert in flying, and they will fly away in flock at once at the approach of man. The invasion of insects is reported to be greater on the Iazumaddi side. They invade the crop both on the high and low land."

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2. *Leptispa pygmæa*, Baly.

(Ord. Coleoptera, Fam. Chrysomelidæ, Sub-fam. Hispinæ.)

Plate No. XI, fig. 2, a and b, beetle, dorsal and side views.

In December 1896 specimens of an insect causing damage to paddy stalks in the Malabar district were forwarded to the Museum through the Superintendent, Government Museum, Madras, from the Special Assistant Collector, Malabar, who wrote :—

"That a good deal of harm is being done to the existing paddy crop by a peculiar kind of flies of which I forward some specimens in a bottle.

These flies sit in numbers on the stalks of growing paddy and when they do so, the stalks begin to wither and gradually decay. Complaint is heard on all sides of this pest, and if any remedy against its attack can be suggested, it will be of

great use to the cultivators, who will take measures to destroy it, and guard against its attack in future. The cultivators do not know what kind of flies these are, and know nothing about their habits and propensities."

The insect proved to be the same as *Leptispa pygmæa*, Baly, a minute Chrysomelid beetle which has previously been recorded in a short article in the pages of these notes as attacking sugarcane in Poona.

The following is the description of the insect taken from the Catalogue of Ceylon Hespidæ by Joseph S. Baly, M. E. S., etc.

Leptispa pygmæa. L. elongata, angustata, cylindrica, læte viridi-ænea, subtus nigra; thorace subquadrato minus crebre punctato, lateribus antice rotundatis; elytris punctato-striatis, ad apicem subsulcatis; antennarum articulo basali compresso, apice truncato, extrorsum dilatato.

Long. 2 lin.

L. narrow, elongate, cylindrical, deep metallic green. Head slightly flattened above, covered with irregular punctures; basal joint of antennæ compressed and dilated externally at its apex truncate. Thorax subquadrate; 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.

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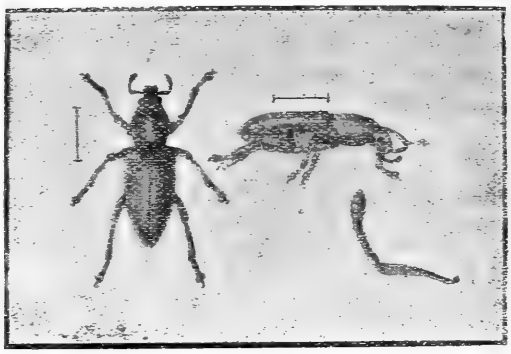
3. *Tanymecus indicus*, Faust.

(Ord. Coleoptera, Fam. Curculionidæ.)

Injurious to poppy, wheat, etc.

This insect was first brought to our notice in December 1891 when it was reported from Ghazipur as doing injury to the seedlings of the Poppy (*Papaver somniferum*) plant. Notes on the pest were published at the time in *Indian Museum Notes*, Volume III, No. 1, pages 12 and 118.

In November 1895 the Director of Land Records and Agriculture, North-West Provinces and Oudh, forwarded to the Indian Museum specimens of this insect, with the information that they were attacking wheat and gram crops, etc., in his provinces. About the same time specimens, which proved to be of the same species, were also sent to the Museum through Mr. J. Lancaster, Secretary to the Agricultural and Horticultural Society of India, as causing great damage to *rubbi* crops, *mangels* and *sweeds* in Behar.



The following report has been furnished by the Director of Land Records, North-West Provinces and Oudh :—

"The insect known throughout the eastern districts as "godela" and identified on reference to the Superintendent, Indian Museum, as belonging to the family Curculionidæ, genus *Tanymecus*, species *indicus*, has this year attracted special attention by extensive attacks on the newly-germinating spring crops, more particularly wheat, peas, and gram, and sometimes but less frequently barley. It has long been known well by poppy cultivators, its attacks in ordinary years being directed almost exclusively to newly germinated poppy plants. To these it has this year been specially fatal, having made no less than three sowings necessary, in many villages. The attacks of the "gadela" on young crops cease as soon as the temperature falls to a certain degree, and the cultivators believe that its special activity this year is due to the unusual continuance of a high temperature into the month of November. In connection with this point the normal temperature during each week in November at Allahabad is compared below with the actual

Temperature.	November 1895.			
	1st week.	2nd week.	3rd week.	4th week.
Actual	73·4	74·2	71·8	66·3
Normal	71·6	69·2	67·4	65·0

temperature this year. Its widespread ravages have this year attracted the attention of cultivators of casts and tracts by whom and in which poppy is not grown, and a crop of new names have therefore been bestowed on it. It is known as "Shaikh Chillis," "Sher Bahadur," "Bahadura," "Bajpai" and possibly by other

names recently invented. The name "Shaikh Chilli" appears to have taken a firm hold in Sultanpur and "Bahadura" in parts of Fyzabad and Azamgarh.

The insect, a small grey weevil, makes its home amongst the loose clods and soil of newly-sown fields. It is reported that it is attracted by the smell of *Kaitha* and *Bel* fruit and collects in large numbers near fragments of such fruit when strewn over a field. It is then collected and destroyed by the cultivators. Irrigation has this year been largely resorted to to destroy it often at so early a stage on the growth of the crop that the young seedlings, especially of peas, have been hurt. It is said never to appear again in irrigated land or after the cold weather has fully set in. The young poppy is now springing up freely in fields on which earlier sowings were destroyed.

The damage done by this insect to poppy is so constant and extensive that the discovery of a suitable insecticide for it would be a most valuable one. The insecticide should probably be applied to the soil before the germination of the young plants, as after germination they would be likely to be destroyed by the application of an arsenical preparation or kerosene emulsion. Kerosene as procurable everywhere would be a suitable insecticide to experiment on. Cultivators of the valuable poppy plant would no doubt be glad to devote a considerable amount of labour and to incur some small expenditure in kerosene and soap to secure their sowings against damage, but the purchase of expensive apparatus is not possible for them. If the Superintendent of the Indian Museum could suggest some simple way of applying a kerosene emulsion or arsenical preparation to the soil or even to the young plants, measures will be taken next sowing season to experiment with them. Expensive measures are useless to the cultivators, and the Department of Agriculture is itself not in a position to incur any large expenditure."

As regards preventative and remedial measures against this destructive insect the suggestions made were (1) deep ploughing of the field in the summer to destroy or expose pupæ that lie near the surface; (2) searching for the pupæ and destroying them; (3) attracting the perfect insects to fires of dry wood or of refuse material from the fields, since insects are known to be readily attracted by light; (4) sowing only seeds selected from plants that have resisted the attack.

Two force pumps and a small supply of "London purple" were also despatched to the Director, Land Records and Agriculture, North-West Provinces and Oudh, for experimental use against the pest.

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4. *Araeocerus fasciculatus,* Degeer

(Ord. Coleop. Fam. Anthribidæ.)

The areca-nut Beetle.

Plate No. XI, fig. 3, a, *larva*; b, *pupa*; c *and* d, *beetle, dorsal and side views.*

In January 1895, specimens of Betel-nut (*Areca catechu*) were received in the Indian Museum from Babu G. C. Chuckerbutty, Entomological Artist of the Museum, with the information that they had been seriously damaged by insects on being stored in the house, and consequently they were unfit for human consumption. The *Areca* nut, according to McCullock's Dictionary of Commerce and Commercial Navigation, is one of the indispensible ingredients which enter into the preparation of the *pan* or betel-leaf, which is chewed so universally by natives of all classes, and is therefore of great commercial value throughout India.

On making a superficial examination of the affected nuts they were found to be badly drilled on all sides by minute holes and somewhat discoloured in appearance. Splitting open into halves some of the nuts, beetles, in different stages of development, were found inside, which proved to belong to the family Anthribidæ. As the Museum collection of this group of insects is very incomplete, the identification of the pest could not be locally made. Examples were, however, submitted to Mons. A. Fauvel of France, who very willingly examined the insect and determined it as belonging to *Arræocerus fasciculatus*, Degeer, a cosmopolitan species, probably originating in India, which has previously been reported as attacking coffee berries, ginger, Chinese figs, etc.

The following is a description of the species, by T. Vernon Wollaston, M.A.,F.L.S., published in the Ann. and Mag. of Natural History, Vol. V, p. 18, 1870.

"ARÆOCERUS FASCICULATUS. A. *breviter ovalis, crassus, brunneo-piceus, pube brevi squamæformi demissa cinerea griseaque vestitus necnon in elytris plus minus obsoletissime* (*sc. in interstitiis alternis*) *longitudinaliter tessellatus; capite prothoraceque* (*subter pube*) *opacis, densissime et rugose punctatis, illo in medio tenuiter carinulato oculis maximis prominentibus, hoc subconico, postice lato bisinuato, costa transversa in marginem basalem coëunte necnon utrinque marginem lateralem* (*usque ad medium lateris ductum*) *efficiente, angulis posticis subrectis; elytris apice truncato-rotundatis,* (*subter pube*) *subopacis, densissime et rugose granulatis ac leviter crenulato-striatis; antennis pedibusque elongatis et* (*præcipue illis*) *gracilibus, illis rufo-testaceis clava obscuriore, his rufo-ferrugineis, tarsorum art° 1mo. longissimo.*"

Long. *corp. lin.* 2-2⅓.

Two examples of an *Arræocerus*, which were taken at St. Helena by Mr. Melliss, I feel almost confident are referable to the *A. fasciculatus* (which is usually known in collections as the coffeæ of Fabri-

cius), though I have thought it desirable to give a careful diagnosis of them, in the event, perhaps, of their being identified hereafter with some cognate form. The insect, however, is evidently a variable one; and there are individuals in the British Museum, bearing the label "*coffeæ*", which seem in no way to differ from the pair now before me; whilst the fact that the species (the larva of which appears to subsist within various seeds and berries which are used as articles of food) has become naturalized, through the medium of commerce, in most of the warmer countries of the civilized world would go far to render it probable that the St. Helena one is the true *fasciculatus*, and has been established in the island (as elsewhere) by indirect human agency.

The synonyms of the species as given in Dr. Gemminger et B de Harold, Catalogus Coleopterorum, are as follows:—

Aræocerus fasciculatus, Degeer. *Ins.* V, 1775. p. 276, t. 16, f. 2
" " Wollast *Ann. nat. Hist.*, V., 1870, p. 18.—Lucas. *Ann. Fr.*, 1861. p. 399.
" *cacao* Fabr. *Syst. Ent.*, p. 64.—Oliv *Ent.* IV, 80, p. 15 t. 2. f. 21. a-b.
" *capillicornis*, Say. *Journ. Ac. Phil.*, V, 2, 1827, p. 249.
" *moestus*, Lec. *Ann. Lyc.* I, p. 172.
" *cassiæ*, Winthem., *Dej. Cat.* 3 ed., p. 259.
" *coffeæ*, Fabr. *Syst., El.* II, p. 411.—Gyll. *Schh. Gen. Curc.* I, p. 175.—Labr. et Imh. *Gen. Curc.* I., nr. 55.
" *crassicornis*, Fabr. *Ent. Syst.* suppl., p. 159; *Syst El.* II, p. 399.
" *griseus*, Steph. *Ill. Brit.*, IV, p. 211, t. 21, f. 2. (forte)
" *japonicus*, Thunb. *Nov. Act. Ups.* VII, p. 122.
" *peregrinus*, Herbst. *Kaf.* VII, p. 168, t. 106. f. 9.
" *saltatorius*, Falderm. *in litt.*
" *var. sambucinus*, Boisd. *Voy. Astrol.* II, p. 299 (forte) —MacLeay. *Dej. cat.* 3 ed., p. 259.

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5. *Acridium peregrinum*, Oliv.

"Locust."

The following reports regarding the appearance of locusts, have been received in the Indian Museum during the year 1896:—

(*a*) Through the Survey Commissioner and Director of Land

Records and Agriculture, Bombay, from the Assistant Collector, Karachi, who wrote, dated 7th July 1896 :—

"To forward specimens of locusts that passed over Tatta on the morning of the 5th July 1896, and went into the Kohistan on the following day. The Mukhtyarkar of Tatta states that they have laid eggs in the Kohistan, but as the cultivation has not yet begun, no damage has been caused by their visit there. They have, however, damaged the Charkhi crops in Dehs Kotri, Ghulam Hussein, Chato Chand and Bao Purandas.

"The Mukhtyarkar is taking measures to have the eggs destroyed."

The specimens that accompanied the report proved to be the "Locust" *Acridium peregrinum*, Oliv.

(*b*) Forwarded through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, from the Political Agent, Mahikantha, dated 31st October 1896 :—

"A specimen of locusts which were seen passing here yesterday at about 5-30 P. M. The flight passed continuously for about an hour from a westerly direction and went away towards Chhala (Baroda) in the East where it is said to have halted for the night."

Specimens received were identified with *A. peregrinum*, Oliv.

(*c*) From the Resident, Western Rajputana States, who wrote in November 1896 :—

"To advise the despatch by parcel post of a tin containing some samples of locusts which have recently visited certain parts of the Jaisalmir State."

Specimens received in the Museum were identified as above.

(*d*) From the Collector of Bankura, dated 16th November 1896 :—

"A swarm of locusts appeared in out-post Indpur of the Khotra Thana of this district on the 21st October last, and left towards Thana Ouda on that day. They visited several villages and wherever they alighted, devoured the rabi crops then on the ground, *viz.*, pulses, Surguja (*Guizotia abyssinea*), etc. The extent of injury done to these crops by these insects in the jurisdiction of Thana Khotra is estimated at 2 annas in the villages where they alighted.

(2) The insects then alighted in certain villages of Thana Ouda and made attacks on the rabi crops. The extent of injury done to the crops in the affected villages in Ouda is estimated at 8 annas.

(3) They then left the district after visiting out-post Simlapal on their way, but did not injure any crops there. Their appearance in no other part of the district was heard of.

(4) As there was no important rabi crop then on the ground and as the insects left the "Amondhan" and sugarcane untouched, the loss caused by the invasion was comparatively trifling.

(5) No specimens of the insect could be sent to the Trustees of the Indian Museum as the Police did not send any nor could I obtain any specimen as the appearance of the insects was brought to my notice after their departure from this district.

Extracts from the weekly season reports of the Bombay Presidency, which contain information on the appearance of locusts during the months of June to December 1896.

The season reports have been forwarded to the Museum through the Under-Secretary to Government, Revenue Department, Bombay.

Week ending 23rd June 1896.—Shikarpur,—locusts appeared in Kakar and Nashirabad, but caused no serious damage. Hyderabad,—locusts appeared in Moro, but caused no damage,

Week ending 30th June 1896.—Karachi,—locusts in the talukas of Karachi, Manjhand, and Sehwan; no damage caused by them. Shikarpur,—locusts passed over Mehar taluka causing no damage.

Week ending 7th July.—Karachi,—locusts in taluka Kotri, causing no damage. Hyderabad,—locusts in the district, causing no damage. Thar and Parkar,—locusts having caused slight damage at Sanghar, are moving southwards.

Week ending 14th July.—Karachi,—locusts in Katri taluka, causing some damage to cultivation. Hyderabad,—locusts in Guni causing no damage.

Week ending 21st July.—Karachi,—locusts in Deh Kohistan in Tatta taluka causing no damage. Thar and Parkar,—locusts appeared in Umarkot, Khipra and Chachra talukas causing no damage.

Week ending 28th July.—Karachi,—locusts in taluka Mirpur Batora, causing no damage. Shikarpur,—locusts in four talukas, causing slight damage in one taluka. Upper Sind Frontier,—locusts passed over Thal on 23rd, causing slight damage.

Week ending 4th August.—Karachi,—locusts in talukas Mirpur and Sakro, damaging grass and bajri crops. Shikarpur,—locusts in six talukas causing no damage. Hyderabad,—locusts appeared in four talukas, causing damage in two dehs of Naushahro taluka. Thar and Parkar,—locusts in desert.

Week ending 11th August.—Karachi,—locusts in talukas Mirpur, Sakro, Manjhand, and Kohistan, damaging grass and bajri crops. Shikarpur,—locusts appeared in eight talukas, damaging crops in part of one taluka only. Hyderabad,—locusts appeared in Shahdadpur and Hala talukas, causing no damage.

Week ending 18th August.—Karachi,—locusts in Manjhand, Kohistan, Tatta and Sakro talukas. Thar and Parkar,—locusts throughout desert talukas, causing slight damage in the tapa of Umarkot; they are breeding in desert; steps taken to destroy them.

Week ending 25th August.—Karachi,—locusts in Karachi, Kohistan, Tatta and Sakro Talukas. Shikarpur,—large flight of young locusts passed over Ubauro and Mirpur, causing no damage. Hyderabad,—locusts appeared in three talukas, causing no damage. Thar and Parkar, early millet in ear but slightly damaged by locusts in desert portion of Umarkot and Khipra.

Week ending 1st September.—Karachi,—locusts in Kotri, Kohistan, Karachi and Tatta talukas. Hyderabad,—locusts in four talukas, causing slight damage in two. Thar and Parkar,—locusts in six talukas, causing slight damage in three (indigo in Sanghar and tilseed in Khipro slightly damaged by insects).

Week ending 8th September.—Karachi,—locusts in Manjhand and Kotri talukas, damaging crops. Shikarpur,—locusts in Ubauro taluka. Hyderabad,—locusts in six talukas, causing slight damage in five.

Week ending 15th September.—Karachi,—crops slightly damaged by insects in Ghorabari, Ketibandar, Shahbandar, and Jati talukas. Locusts in Kotri and Kohistan talukas. Hyderabad,—locusts have caused slight] damage in two talukas. Thar and Parkar,—locusts in six talukas, causing slight damage.

Week ending 22nd September.—Karachi,—locusts in Kotri, Kohistan, and Manjhand talukas. Hyderabad,—locusts have caused slight damage in Hyderabad taluka.

Week ending 30th September.—Karachi,—locusts in Kotri and Kohistan talukas. Hyderabad,—locusts in Hyderabad taluka, causing slight damage. Thar and Parkar,—locusts still in four desert talukas.

Week ending 6th October.—Karachi,—locusts have caused damage to crops in Sahro, Kohistan, Kotri, and Manjhand talukas. Thar and Parkar,—locusts in four talukas.

Week ending 13th October.—Karachi,—crops damaged by locusts in Kotri and Kohistan talukas. Shikarpur,—locusts passed over Shikarpur taluka in an easterly direction without doing damage. Thar and Parkar,—locusts have caused slight damage in Khipra taluka.

Week ending 20th October.—Karachi,—crops damaged by locusts in Sakro. Shikarpur,—locusts passed through five talukas, causing slight damage in two. Hyderabad,—locusts in five talukas, causing slight damage. Upper Sind Frontier,—locusts in four talukas, causing slight damage. Thar and Parkar,—locusts in three desert talukas, causing serious damage to gardens, trees, til and mung in Nagar Taluka.

Week ending 27th October.—Karachi,—crops damaged by locusts in Sakro. Shikarpur,—large flights of locusts settled in four talukas, causing slight damage. Hyderabad,—locusts in Sakrand taluka damaging crops.

Week ending 3rd November.—Karachi,—crops damaged by locusts in Manjhand and Kohistan. Shikarpur,—flights of locusts visited seven talukas, causing slight damage in five. Hyderabad,—locusts in three talukas, causing slight damage. Baroda,—locusts have appeared in parts of Sidhpur taluka and have damaged standing crops.

Week ending 10th November.—Karachi,—crops damaged by locusts in Tatta, Kohistan, Karachi, Joti ,and Shahbandar. Hyderabad,—locusts in Guni Taluka causing slight damage. Thar and Parkar,—locusts in two talukas causing slight damage. Ahmedabad,—standing crops damaged by locusts in a few villages of the Dhandhuka taluka. Kaira,—locusts have injured the cereal crops in some of the villages of Mehmadabad and Borsad talukas.

Week ending 17th November.—Karachi,—locusts appeared in seven talukas. Shikarpur,—locusts in four talukas, causing slight damage in one taluka. Ahmedabad,—locusts in certain villages of Dhandhuka taluka.

Week ending 24th November.—Karachi,—sprouting seeds damaged by locust, in Dadu, Sakro, and Shahbandar talukas. Hyderabad,—cultivation damaged by locusts in the talukas.

Week ending 1st December.—Karachi,—locusts appeared in six talukas. Shikarpur,—locusts appeared in Kambar taluka, but caused no damage. Hyderabad,—cultivation damaged by locusts in one taluka.

Week ending 8th December.—Karachi,—locusts appeared in six talukas, but did no damage. Shikarpur,—locusts appeared in four talukas and caused slight

damage in two. Upper Sind Frontier,—locusts appeared in Thul and Kashmor talukas, causing slight damage.

Week ending 15th December.—Karachi,—kharif crops slightly damaged by locusts in Sehwan, Kohistan, and Sakro talukas. Shikarpur,—locusts appeared in one taluka but caused no damage.

Week ending 29th December.—Upper Sind Frontier,—mustard crops damaged by locusts in Thal taluka.

6. Other undetermined insects destructive to paddy.

a. Noctues caterpillar.—Specimens of a caterpillar said to be injurious to paddy crops were received in the Museum from Mr. F. C. Parsons, Special Settlement Officer, Malabar and South Canara, who wrote on the 29th March 1896 :—

"I only know of it as a pest in the cultivation of rice in backwater swamps which takes place in Malabar in the hot weather (February to May). A plot of swamp is surrounded by a bund, the water is baled from the interior, the rice is transplanted, and when the seedlings have been in the ground about a month, this pest appears, often covering several acres in the course of a week, and eats away the young blades of the rice plant. The pest does not appear until the surface soil is getting a little dry from the action of the sun, but the drought is very shallow, for the water all round the outside of the bund is higher generally by four or five feet than the surface of the cultivated area inside the bund.

On cutting the bund and letting in water the grub disappears at once and may not be seen again, but of course this means that the ryot has to bale the water out again and his seedlings are damaged. The same result follows a shower of rain which, however, but rarely falls at this time of the year. Sometimes the grubs are swept up with a broom and so prevented from destroying the whole crop."

The specimens owing to their being immature could not be precisely identified, but they appeared to be not unlike the larvæ of the Noctus moth *Helothis armigera*, Hubn, which is a well-known pest to agriculture.

b. Microlepidopterous larva.—Specimens of an insect injurious to paddy plants in the vicinity of Poonamalli, were received on the 10th January 1896, from the Board of Revenue, Madras, through the Superintendent, Government Central Museum, Madras.

The insects were found to be the larvæ of a Microlepidopterous moth, which cannot precisely be determined without the examination of the imago.

The following is a report on the pest furnished by the Agricultural Inspector :—

"*Local name.*—The insect whose attack on paddy crop was the object of inspection, is a worm locally known as "Urappuchchi."

Extent of damage done.—The existence of this pest was known to the Deputy Tahsildar, Revenue Inspector, and the ryots generally. The former, however owing to the very limited sphere of the attack, did not consider it necessary to be shown in the season reports. The pest is not one peculiar to this year, but seems to have been in existence for several years. As may be evident from the description of its characteristics to be said further on, the insect appears to be peculiar to the wet crop of paddy. The attack is found on crops transplanted, and not those sown, on tender and not mature crops. The reason why the attack is not extended to crops of paddy sown and those mature may be that in the former case, the crop is comparatively dry, and coming up earlier, becomes over-matured for the insect to do any harm, and in the latter case, the plants become too hairy and hard for the insect. It was therefore not an unusual thing to see side by side fields in which some were attacked and some not. The usual time of appaarance is the months of November and December. At the time of my visit, any visible sign of attack was confined to a few stray fields of those that were transplanted late in the season. As I was informed, there were, however, evident signs that some time back the attack was much wider-spread, and since the late rains the affected crops have mostly recovered. The damage done is usually only temporary, as the attack itself is only temporary, and during the succeeding period the effect of damage is greatly minimised, and under favourable circumstances, as when there is plenty of rainfall, the damage done is only inappreciable. The ryots attribute the appearance of the pest to deficient rainfall in October.

Description and characteristics of the insect.—" Urappuchchi," as locally known, is a small sized green larva, about $\frac{3}{4}$ of an inch long.....The crop subject to its attack, presents a grey and ashy appearanoe. The worm is not easily made out, for it lives in a tubular coat with which it provides itself. The coat is about $\frac{3}{4}$ of an inch long, made up of a doubled piece of paddy leaf, in which both ends are cut clean. The doubled leaf is connected together at the sides by means of a gummy excretory matter and a hole is bored at the point of doubling, where its head is always to be found, thus forming a tube, in which the worm lives. The worm, while ascending, juts out its head and gets up holding the plant with its front pair of feet. It is usually to be found in the lower portion of the plant above water, where it securely connects the coat with the plant by gummy matter. When in any way disturbed, it shrinks itself well into the coat and at other times thrusts out its head to feed on the fine juicy shoots springing up. If by chance the coat is detached and with it the worm is thrown on the water, the coat serves as a float to enable the worm from sinking down and for laying hold of any plant or leaf it may come across. To give motion to the float, the larva protrudes its heads and a portion of its body into the water, and gives a few jerks rightwise and leftwise by which the float is moved about, and when its headside comes in contact with a plant or a leaf dipping in water, it ascends as stated before. This instructive provision shows that the pest is a peculiar one to paddy, for I removed some of the larvæ from their coats and dropped them in water when they were not able to help themselves and all their jerks did not serve to keep them afloat or to lay hold of a plant.

The process of feeding does not consist in nipping off the leaves which would necessitate frequent change of position and result in considerable damage to the crop, but, as appeared to me, feeding on the sap of fine leaves springing up confined ordinarily to one locality, with the result that the top leaves appear deprived of green colour and soon dry up and wither.....

Measures of relief adopted.—The measure of relief usually adopted is to stop the irrigation of the crop for a few days, so that by partially drying up the crop a check is given to the free feeding of the worms, and the crop is said to have some relief. Some ryots appear to flood the field with irrigation water and drain it off now and then. Some years before there was a practice of sticking the twigs of a tree known as *Uramande* here and there in the field affected, and the bitter taste of the leaves had some good effect against the pest. But the ryots say that neither the twigs are available nor the remedy anywhere adopted....."

III.—INSECTS DESTRUCTIVE TO FRUIT TREES.

1. *Mango tree borer.*—On 25th June 1896 Mr. S. Srinivasalu Naidu, Extra-Assistant Conservator of Forests, Amraoti District, forwarded to the Indian Museum, specimens of an insect said to be doing a good deal of damage to young mango trees in his district. The insect proved to be the immature form of a Cerambycid beetle, which cannot be precisely identified without the examination of the imago.

The following extract is taken from the report accompanying the specimens:—

"The specimens, I regret, are not very good, but while I am trying to secure better ones, I thought it best to send up what I could get without loss of time. I examined the affected trees last month, and found the injury to have been done in two ways :—(1) The stem of the plant commencing from the base is attacked by the grub, which devours the living bark and to a certain extent some wood to the form of a spiral or in large irregular patches. These patches in the case of almost all the trees attacked practically girdle the trees and at once seal their doom. The grub reduces the bark and wood, it devours to a felt-like mass that exactly fills the groove made by the removal of bark, etc., by the grub, and serves to hide its destructive action from view.....(2) Small tunnels varying with the size of the beetle found inside them are to be seen on the stem and branches. The tunnel extends well inside and takes up the substance of the stem or branch either in the form of rings bearing a thin column of wood in the centre or in numerous longitudinal tunnels, in both of which cases the portion above dies and can be broken at the diseased part with hardly any pressure. Excepting the hole, which is the entrance of the tunnel and which generally is too small to attract attention, there are no outward signs for suggesting causes for damage.

The trees attacked are about 10 years in age and vary in girth from 8" to 14" and in height average about 9 feet. The attack was first noticed in January last, and the specimens of insects were collected at the end of last month."

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(2) *Orange tree pests.*—Specimens in alcohol, of the following insects, said to be doing great damage to orange trees in the

Moulmein District, have been received from the Reporter on Economic Products to the Government of India, in December 1896 :—

Bottle No. 1 contained two caterpillars of a Geometrid moth, and one larva of a Noctues moth. These are reported as attacking the leaves of the orange tree.

Bottle No. 2 consisted of fourteen specimens of a Microlepidopterous larva in different stages of development. Reported as destroying the bark and the wood of the orange tree.

Bottle No. 3 contained three larvæ of a Cerambycid beetle, and one specimen of a Lucanid beetle of the genus *Œgus*. These are reported to attack both the bark and the wood of the orange tree.

IV.—FOREST PESTS.

Beetles, etc.—A rough report dated 20th July 1896, together with some specimens of forest-insects, have been received in the Indian Museum from Mr. E. Stebbing, Officiating Conservator of Forests in charge Tista Division, Darjeeling District.

With one exception, these insects have not been previously reported as affecting forest trees in India, and it is therefore desirable that further particulars should be obtained regarding them for record in the pages of these *Notes*.

The following are the insects mentioned in the report :—

No. 1.—Consists of pupæ cases of a Curculionid beetle, which cannot be further identified without the examination of the imago. Mr. Stebbing writes "that on stripping off the bark from some felled Kadam (*Anthocephalus cadamba*) trees the rough cocoons were disclosed situated between the bark and the wood, a small portion of the latter being in many cases gnawed away (presumably by the larva) to form a slight cavity over which a rough collection of chips of wood and fibre had been put together by the larva to form a cocoon.

The pupæ-cases were found on the 14th April 1896 in Tista Valley. Elevation about 1,100 feet."

No. 2.—Specimens of an insect found riddling the wood of Siris (*Albizzia stipulata*) tree,—consist of undeveloped imagos of a Curculionid beetle in a poor state of preservation for precise identification.

No. 3.—Specimen of a calcareous egg-like case found in a newly fallen Amara (*Spondias mangifera*) tree, proves to be a pupa-case

of the Cerambycid beetle, *Plocederus obesus* Gahen (=*P.pedestris*, Cotes). This insect has previously been reported as tunnelling into sál (*Shorea robusta*), jangham (*Odina wodier*), and into dhah (*Butea frondosa*).

No. 4.—Specimens of a Lucanid beetle taken from felled trees, namely Sauer (*Betula cylindrostachys*), Musré Katús (*Castanopsis rufescens*), and Kharani (*Symplocos theæfolia*) in the Loolagaon forest. These appear to belong to the species *Basilianus cantori*, Hope.

No. 5.—Specimens of a large black cockroach found associating with the Lucanid beetle (mentioned above). These appear to be the immature forms of *Salgonea morio*, Burn.?.

No. 6.—Specimen of a hornet found in the centre of a decaying stump of Musré Katús (*Castanopsis rufescens*) in Loolagaon forest. This insect is unrepresented in the Museum Collection, but it belongs to the genus *Vespa*.

No. 7.—Consists of an insect taken from a decaying Sauer tree in the Loolagaon forest. This is a beetle of the family Scarabaeidæ, sub-family Dynastini. It is new to the Museum collection.

No. 8.—Consists of a Cerambycid beetle which is unrepresented in the Museum collection. It was found tunnelling into the Sauer, tree in the above-mentioned forest.

No. 9.—Consists of a Curculionid beetle belonging to the genus *Odoiporus*. This insect was found dead in its burrow in a Lepchaphal (*Phoebe attenuata*) tree in the Loolagaon forest.

No. 10.—Consists of a Buprestid beetle probably belonging to the species *Melanotus fuscus*, Fabr. No information has been received as to the injury done by this insect, beyond the report that it was found excessively numerous in the forest.

No. 11.—Specimen of a Curculionid beetle of the genus *Odoiporus*. It was found on the Preng bamboo.

V.—DETERMINATION OF SOME INSECT PESTS.

Referring to previous years.

1. The bamboo insects, (beetles of the family Bostrichidæ) referred to *Indian Museum Notes*, Volume I, No. 1, page 43, have been determined by Mons. P. Lesnez as belonging to the species *Dinoderus pilifrons*, Lesne. and *Dinoderus minutus*, Fabr.

2. Scarabaeid beetle (sub-fam. Rutelini) injurious to rose-trees and *Cannas* in Calcutta, identified by Herr Ernst Brenske as belonging to *Adoretus cardoni* (see pl. XI, fig. 4), a species which he has described in the *Annales de la Societè Entomologique de Belgique*, Tome XXXII, 1893. The specimens were sent to the Museum by Surgeon-Major G. Ranking of Calcutta.

3. Dipterous parasite bred from the larvæ of the moth *Trabula vishnu*, destructive to castor oil-seed tree in Calcutta. This was kindly identified by Mr. F. M. vander Wulf as being the male of *Crossocosmia sericariæ*, Rondani, the same species which is parasitical on silk-worms and other moths (see *Indian Museum Notes*, Volume III, No. 5, page 8). He reports that it seems to be a very common species in Japan, British India, Java, etc., as it is found in nearly every collection of Diptera from the oriental regions.

4. Dipterous parasite bred from the larva of *Enome ampla*, Walk., destructive to Peepul tree in Calcutta. Specimens sent to Mr. F. M. vander Wulf were in too bad a condition to be recognized with any certainty. He, however, reports that the insect seems to be a species of the genus *Masicera*.

5. Aphids infesting the leaves of Crysanthemum plant in Calcutta, identified by Mr. G. B. Buckton as belonging to the species *Aphis crysanthemi*, Koch.

VI.—REPORTS OF RESULTS OF REMEDIES, ETC., TRIED DURING THE YEAR 1895-96.

(1) PARIS GREEN, BORDEAUX MIXTURE, AND KEROSENE EMULSION, etc.

In a letter dated 27th May 1895 the late Lieut.-Colonel G. Gaisford, Political Agent, Quetta, reported:—"I am experimenting with Paris green and Bordeaux mixture combined. So far I do not see any good has resulted. This is the more strange as we have had no rain, and the poisons are certainly still on both leaves and branches. I will let you know if any results likely to be of general benefit, accrue.

The kerosene emulsion I find a great success. I used it on a bellow sprayer, for the Aphis on my rose-buds, for young twigs on fruit trees, which are affected. I use an old fruit can full of the emulsion. A man just dips each twig in (and the Aphis are only

found on the young tender leaves). He goes round with a light bamboo-legged table, about 4 feet high, and with the aid of this he can reach most of the affected twigs.

Last winter I washed or rather scrubbed all my fruit trees with a mixture consisting of 1lb. soap dissolved in 8 quarts of water, by boiling, to which, when removed from the fire, was added 1 quart of crude carbolic acid.

This undoubtedly had a most excellent effect. The trees look clean, and fresh, and healthy, and all eggs, larvæ, etc., etc., were got rid of.

We are much troubled, too, with bark-lice, which tap most of the trees. To such an extent is this sometimes done that the ground below the tree looks as if it had been varnished. This pest, however, is easily kept down in a garden as I think I once before told you. They are always on the under-side of the branch, and so easily seen. A cooly goes round and examines each tree, with a tin of kerosene emulsion and a rag in his hand. When he sees the lice he rubs them to death with his fingers. He then washes the place with the wet rag, and any insect that may have escaped his fingers is killed with the emulsion.

I keep the emulsion in use right through the summer, and I used to wash out my fowl house and to cleanse any dirty thing there may be.

I have a force pump, and a plentiful supply of London purple.

We ought to grow as good fruit as any in California, in these elevated valleys. The peaches I raise from imported trees could not well be beaten, and all other fruits might well be grown."

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2. LOCUSTS AND ARSENIC (1).

Experience in Experiments.

The Inanda Division Agricultural Association (Victoria County, Natal) at their last meeting authorised the Locust Committee to draw up a report on the present aspect of the locust pest, recommending such remedial measures as the experience of the division during the past two years has shown to be most effective. The Committee met on the 21st instant, and after a careful consideration of the evidence before them, submit the following for general information.

The Committee have information that in certain localities, principally along the immediate coast belts, there has been a large deposit

(1) Reprint of a Report by Mr. Leonard Acutt, President of the Inanda Division Agricultural Association, Victoria County, Natal.

of eggs, but that, taking the division generally, the Committee are assured that the deposit is considerably less than it was last year, and that of the eggs which have been laid, a much larger percentage will be destroyed by maggots, ants, etc., than was the case last year.

All measures taken for the destruction of locusts in past seasons were only partially successful, with the exception of the plan of poisoning with arsenic, and this met with the most absolute and unqualified success. Although every publicity was given at the time to the success of the use of arsenic, very little seems to be known generally of this important fact, and the principal object of the Association in authorising a report is to give as full information as possible as to the effectiveness, cheapness, and safety of dealing with the young locusts by poison.

The evidence before the Committee was so conclusive that they consider it to be established beyond doubt that the "hoppers," however numerous, can be destroyed in a few days by the judicious use of arsenic. Crops, therefore, need not suffer for months from the ravages of the "hoppers," and should the winged locusts from other districts swoop down later in the season, the crops will be vigorous, and so be in a better condition to withstand any attacks. Again, arsenic is effective in destroying flying locusts, but not to the same extent as with the "hoppers", for the reason that the "flyers" come suddenly, feed, and are gone before the poison can be put down; still it should be kept ready for use, and put down upon any appearance of a locust flight.

The following testimony will be of interest. One man says:—"Last season on 400 acres I spent over £300 in driving the winged locusts to prevent, if possible, their depositing their eggs, in destroying eggs, and in digging trenches, and driving the young locusts, all with only partial success. Towards the end of the season I tried arsenic, and cleared my fields in a few days. This year I have let them feed, let them deposit their eggs, and let them hatch, secure in the knowledge that by the use of arsenic I can kill all that hatch on my land, and prevent any which may come from adjoining lands from ever getting beyond my boundary clearings or firebreaks."

Mr. Wilkinson, of Ottawa Estate (who was the first to use arsenic with any success, and to whom the thanks of the Colony are due) says:—"I had all hands killing locusts, and did very little good and, from the time I began to use arsenic, an average of six men per diem at a cost of 7*s.*, with a few shillings for chemicals for the season, cleared my place (700 acres) in 10 days, and kept it clear from inroads of locusts from adjoining lands."

The mode of application is as follows:—Take 1lb arsenic, 1lb caustic soda. Take four gallons of water, bring to boiling point, add the caustic soda; when dissolved, add the arsenic, stir well and boil for a few minutes, care being taken not to inhale the fumes. Keep this mixture under lock and key. Take as required half a gallon of this mixture and add four gallons of hot or cold water and 10lb of brown sugar. Dip bagass, grass, or mealie stalks in this liquor and place along roads, in cane-fields, or anywhere about grass or low-growing crops, or splash with a whitewash brush on to anything which the locusts may be observed to have a taste for. Locusts will come from a hundred yards or more, attracted by the smell of the sugar; they eat and die, and are eaten by other locusts, and, if they are taking the poison freely, in three or four days' time will be seen covering the ground with their dead bodies, or will be found where they have crept under grass or other cover to die. Some people recommend a much stranger solution than the above, which is that used by Mr. G. Wilkinson and is the weakest in use, and of course if it is found to be equally effective with the stronger solutions it is safer to use.

With regard to the safety with which this poison may be used, if the liquor is kept under lock and key, and the due precautions are taken not to leave the sweetened liquor where any human being can get at it, but to take it direct to the fields, it will be seen that, once applied as directed, there is no chance of any human person being poisoned and the small amount of poison in a piece of grass, bagass, or mealie stalk is not enough to injure stock of any kind; even fowls have been known to feed on the arsenic-destroyed locusts without hurt. Should any information with regard to the use of arsenic be required, any enquiries addressed to the Secretary of the Inanda Division Agricultural Association, Verulam, will receive attention.

The Committee, in conclusion, would record their appreciation of the public service rendered by Mr. Arnold Cooper by his scientific researches into the diseases which are undoubtedly attacking the locusts in this Colony, and they look with interest for his promised paper on the results of his further investigations.

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(3) Storage of cereals into pits, etc., as a preventive measure against weevil.

The following report of experiments regarding the storage of cereals into pits, etc., as a preventive measure against weevil, has

been received in the Museum, in August 1896, from the Commissary-General of the Punjab Command. The results of these experiments, however, show more or less the failure of the methods adopted for protecting grain, etc., from weevil :—

Peshawar District.—*Result of storage in pits.*—The pit was built in the following manner. A depth of 5 to 6 feet was dug out and with the earth so excavated a *kutcha* mud wall of the same height built up so as to give a total depth of about 12 feet.

Two feet of charcoal was placed at the bottom of the pit and the sides lined with a wall of bhoosa about 2 feet thick, 2,000 maunds barley were stored in April 1894. On opening the pit in October 1894 the barley was found to be in very good preservation, but next to the walls of the pit to a breadth of about 4 inches, the barley had become damped, probably through damp communicated through bhoosa from the surrounding soil. There was a good deal of heat, but no sign of weevil.

Results of storage in Towers.—The tower was built on the same principle as the loose bhoosa towers, *viz.*, circular earthen enclosure roofed over with mud, but with charcoal at the bottom, bhoosa at the sides and matting at top.

Barley was stored in this tower in April 1894. On opening the tower in October 1894, it was found to be in perfect preservation. No sign of weevils, no damping, no deterioration in any way, but there was a good deal of heat which was due to the moisture natural to the grain itself.

A further experiment was made during the rainy season (winter months). The tower was opened on 2nd March 1895, the grain was perfectly dry at the top and sides; a small proportion appeared to have been eaten, but the presence of weevils was confined to the top only, the grain in the middle and at the bottom was free.

Rawalpindi District.—*Result of storage in a pit.*—The pit made was of the following dimensions :—Depth 12 feet, diameter 20 feet, at bottom, 3 inches charcoal was well beaten down, over which 20 inches white bhoosa was placed and covered with *chatai* matting. At the sides there was *chatai* matting next to the grain, then 2 feet bhoosa between the *chatai* and the walls, well trodden down. The top was first covered with *chatai*, then a layer of coarse *churrie*, over that about 3 feet dry earth, and finally three times plastering.

It was filled with 2,000 maunds wheat on the 19th February 1894, and on being opened on the 13th February 1895 white ants were found to have penetrated through the earth at top, and the grain for about 6 inches from top surface was found caked from damp and honey-combed in places with earth carried in by white ants, and also contained a species of small weevils. Eighteen inches below the top surface of grain, the temperature was 74°, and from the centre to bottom of pit it was 91° to 95°.

Damp had penetrated on one side of the pit from 6 inches to 13 inches and continued right down to the bottom and slightly for about 2 feet down in one place on another side.

The wheat had a musty smell, but this diminished as the men got further down and the grain at the bottom was found to be the best preserved.

Result of storage with Napthaline.—An experiment was made with one pound of wheat with Napthaline placed in it.

The result is a failure, the Napthaline did not prove to be a safeguard against the attack of weevils.

Result of storage in thegs.—Thegs are made of gunny in the shape of a cylinder like the rum vats but of equal circumference in both ends.

In the thegs put up at Rawalpindi weevils germinated in large numbers.

LAHORE DISTRICT.—*Result of storage in pits.*—At Ferozepore a pit was constructed in which gram was stored on 31st December 1894. It was opened about the end of March 1895, and the gram was found to be in a good state of preservation, except a small quantity at the sides, which had become mouldy, apparently through rain getting in.

At Mian Mir, 1,810 maunds gram was placed into a pit 6 feet below ground level and 6 feet above; 1 foot bhoosa laid at bottom and at top and round sides; top, sides and bottom were tarred inside.

The pit was filled with gram on 29th and 30th June 1894 and opened on 10th April 1895. On opening, noxious smell and considerable heat was perceived. One foot to 1¼ foot of gram at top was weevil eaten; at sides to 3 inches at bottom, sides and bottom to 6 inches the gram was mildewed; otherwise the gram was sound with no marks of eggs, etc., in it,

Result of storage in a Kaloti.—"Kaloti" is a small circular hard sun-baked mud tower about 8 feet high, constructed gradually in circular layers of 2 feet each, 1½ inches thick, with 6 inches bhoosa at bottom.

It was filled with 63 maunds gram on 27th and 29th August 1894 and opened on 25th April 1895. On opening, no smell or heat was perceptible, and the gram was to all intents and purposes practically sound and even better than that in the pit. Dryage or less found on weighing out 2 maunds 38 seers or 7·3 per cent. per annum. The kalotis hold a very small quantity of grain.

Note.—No report of loss by weevils has been recorded.

Result of storage in thegs.—One thousand maunds gram, 2nd sort, were stored in 4 thegs at Mooltan, but the experiment resulted in a loss to the State.

SIRHIND DISTRICT.—*Result of storage in a pit.*—Two thousand maunds new wheat taken direct from the fields was placed in a pit which was made by enclosing one end of the verandah of a godown. The pit was filled in on 30th May 1895 and opened on 31st May 1896. The loss due to damages by weevil amounted to 11·13 per cent. per annum. The wheat stored in this pit was of the "Kutha" (hard) kind.

Result of storage in a wooden vat.—A wooden vat in which rum used to be stored, was utilized for storing wheat, 407; maunds wheat was put into it on the 2nd July 1895. The pit was opened after 253 days and the wheat was found to be very much weevil eaten. The wheat stored in the vat was of the "Pissia" (soft) kind.

Result of storage in a masonry theg.—The masonry theg was made by building up one corner of a godown and 20 maunds wheat was put into it on the 21st July 1893 in the following manner:—A thick layer of bhoosa at the bottom and sides, then a layer of wheat, next a layer of bhoosa, and then the 2nd layer of wheat, and so on. On top there was a layer of bhoosa.

It was opened on the 4th May 1894 with the following result:—

Good wheat	1,295¾ lbs.
Weevil-eaten wheat	159¼ „
Less	145 „

With reference to the above, a trial might be made of storing some samples of wheat in a pit lined throughout, and finally covered over with a layer of *neam* leaves, and floored with a layer of quick-lime. The quick-lime should, of course, not come into actual contact with the grain.

To give this experiment a fair trial it should be undertaken with properly dried grain and in dry weather.

REPRINTS AND MISCELLANEOUS NOTES.

I. DESCRIPTIONS OF THREE SPECIES OF INDIAN ALEURODIDÆ.*

By W. M. Maskell.

Plate No. XII.

[Note.—The first and second insects described here have been previously referred to in *Indian Museum Notes*, Vol. III., No. 5, p. 53. The third has been found to infest rose trees in Quetta ; specimens were forwarded to the Museum by the Deputy Conservator of Forests, Quetta, Baluchistan, in July 1893.—E. B.]

(1) *Aleurodes barodensis*, Maskell.

Eggs orange-coloured, rather large, oval, pedunculated ; length about $\frac{1}{160}$ in. The eggs and empty shells are found in large numbers on the leaf.

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-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,

* Reprinted from the Transactions of the New Zealand Institute, 1895.

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.

Hab.—In India, on *Saccharum officinale.* My specimens were sent by Mr. Cotes, late of the Indian Museum, Calcutta, from Baroda. He informed me they were rather damaging to the sugar-cane in those parts.

The very elongated form is distinctive, besides the black colour.

(2) ***Aleurodes eugeniæ,*** Maskell. var., ***aurantii.***

Larva very pale-yellow, sometimes almost white; form roundly elliptical, flattish; length about $\frac{1}{40}$ in. Dorsum striated, but the striations are very faint, except near the margin. Margin not at all thickened, finely fluted and crenulated, bearing no hairs or fringe. There are three small marginal depressions and three dorsal patches, as in the pupa.

Pupa-case very pale-yellow, roundly elliptical or sub-circular, flattish and thin; length about $\frac{1}{24}$ inch, reaching sometimes as much as $\frac{1}{16}$ in. The enclosed pupa is only faintly discernible dorsally, rather darker than the case, the abdominal segments moderately distinct; on turning over the case the rudimentary organs are less confused than in *A. eugeniæ.* Dorsum of the case very finely marked with radiating striæ, which are a little more conspicuous near the margin. Margin not thickened, almost entire, divided by deep narrow channels into segments narrower than those of *A. eugeniæ.* There are three marginal depressions, two opposite the rostrum and one at the abdominal extremity, and three radiating patches terminating at these depressions; the patches end (as in the type) in crenulated circular orifices, but are composed of great numbers of very minute circular pores or dots, which do not form a lace-work pattern. Vasiform orifice subtrapezoidal or subelliptical, broader than long, operculum nearly fitting the orifice; lingula very short, cylindrical with a dilated end, sometimes obsolete.

Adult form unknown.

Hab.—In India, on *Citrus aurantium.* Mr. Cotes, late of the Indian Museum, Calcutta, sent me some orange-leaves from North-West Himalayas thickly covered with this insect.

I attach this as a variety to *A. eugeniæ* on account of the similarity in several respects, notably in the dorsal radiating patches, though it differs in some others. It has none of the marginal or dorsal characters of *A. citri,* Riley and Howard.

(3) ***Aleurodes cotesii,*** Maskell.

Larva yellow, the median region darker than the margin; form elliptical; length about $\frac{1}{40}$ inch. In the earliest state only very faint indications of the insect itself appear, and the whole is very thin and flat; later on the enclosed future pupa begins to be visible, and the ventral surface becomes more convex; the eyes also appear. The larval integument becomes too small for the growing insect, and splits longitudinally; and in the early pupal state it may be seen attached along the dorsal edges of the pupa-case. Margins somewhat thickened, the adjacent tubes forming minute crenulations, and within it the dorsum bears numbers of very small circular pores; from these and from the marginal tubes is produced a quantity of white waxy matter, some of which covers the dorsum in scattered patches, and the rest spreads out round the larva in a very long fringe of delicate threads, frequently much longer than the insect itself. This waxy matter is very brittle, and, as a rule, the whole surface of a leaf is powdered over with the fragments, making the leaf look as if mildewed.

Pupa-case, in the earliest state, scarcely distinguishable from the late larva; afterwards, as the insect grows, it becomes much thicker. The form remains elliptical; the length reaches about $\frac{1}{30}$ inch. The dorsal disk is slightly convex, flattened towards the margin; it is larger than the ventral disk, and slightly overlaps the sides, which are vertical. The hollow thus formed is covered by a ring of thin white wax, and there is also a plate of wax beneath the ventral surface; portions of this ring and of the plate are frequently seen amongst the long threads of the larva. The pupal margin is crenulated but bears no fringe, and the dorsum has no pores or wax. The outline of the enclosed pupa may be made out indistinctly on the dorsum, and the rudimentary organs ventrally on turning over the case. Vasiform orifice subconical, with regularly convex sides, the anterior edge concave, operculum sub-elliptical; lingula very short, not extending beyond the operculum.

Adult form unknown.

Hab.—In India, on *Rosa*. My specimens were sent by Mr. Cotes, late of the Indian Museum, Calcutta. They came from Quetta, Baluchistan. I have named the species after him.

The overlapping of the sides by the dorsal disk of *A. cotesii is* found also in a New Zealand species, *A. fagi*, Maskell, 1889; but that insect has no fringe, and the margin bears twenty-four hairs.

II. THE BOT-FLY OF THE INDIAN ELEPHANT.

At a meeting of the Mathematical and Natural Science Section of the Imperial Academy of Sciences of Vienna held on 2nd July 1896, a communication was made by Professor Friedr. Brauer to the effect that, in conjunction with Herr Anton Handlirsch and with the courteous co-operation of Herr Alois Kraus, Inspector of the Imperial Menagerie at Schönbrunn, he had succeeded in breeding out the œstrid of the Indian elephant (*Cobboldia elephantis, Cob.*), which was hitherto known only in the larval state. Since it is the intention of Professor Brauer to furnish fuller details later in a special memoir, he contents himself with giving the following short diagnosis of the genus and species in the perfect condition :—

Genus *COBBOLDIA*, Brauer.

Head vesicular, with strongly projecting front. Antennæ extremely prominent, owing to the large hatchet-shaped third joint with fine and bare arista. Beneath the antennæ a very broad and deep heart-shaped antennary pit, without a septum, extending to the oral margin; therefore the facial ridge very short between the facial angles ("Vibrissenecken"). Oral cavity deep, the rudiment of the proboscis fairly well developed, as in *Cephenomyia*, with large claviform palpi. Face and cheeks shining, bearing tubercles ("schwielig"). Ocelli present, eyes bare. Thoracic suture complete. Wings large. Apical transverse vein present, posterior transverse vein nearer to the angle of the third vein than to the small transverse vein; angle of the third vein V-shaped, without projecting stump; first posterior cell open. Alula of moderate size, squamæ very large. Clavi and pulvilli moderately large. Legs slender, short; first tarsal joint as long as all the others put together. Abdomen elongate, oval, in the male with forceps-shaped hypopygium tucked under it; in the female the ovipositor straight, telescopic, chitinous, divided into four segments (when protruded half as long as the body). Ventral plates triangular, separated from the dorsal ones by a broad membrane. Fifth plate cleft in the male. Macrochætæ absent. Hypopleuræ with a row of hairs.

Spec. ***Cobboldia elephantis***, Cob.

Gastrophilus elephantis, Cob. olim (from the larva), Trans. Linn. Soc., 1881.

Cobboldia elephantis, Brauer (from the larva), Wien. ent. Z 1887.

Black, short and thickly clothed with hair; head and antennæ reddish yellow; proboscis and palpi black. Wings dark, blackish blue, metallic; basal cells, alulæ, and squamæ snow-white. Halteres and legs black. On the head and on the margins of the abdominal segments silvery white reflexions. In general appearance resembling a *Pharyngomyia*. Female with the front broader and the ovipositor black; otherwise precisely like the male.

Length of body 12-14 millim.

Length of wing 10-11 millim.

The larvæ leave the host in the early hours of the morning, pupate in from one to two days, and the imago appears sixteen days after the exit of the larvæ.

Copulation takes place immediately.—*Sitzungsb. kais. Akad. der Wiss. Wien*, Jahrg 1896, No. XVII, pages 180-182.

III. FOOD OF WOODPECKERS OF THE UNITED STATES.

(*Reprint of a report by F. E. L. Beal, Esq., published in Bulletin No. 7, United States, Department of Agriculture, Division of Ornithology and Mammalogy, 1895.*)

GENERAL REMARKS.—With the possible exception of the crow, no birds are subject to more adverse criticism than woodpeckers. Usually no attempt is made to discriminate between the numerous species, and little account is taken of the good they do in destroying injurious insects. The name 'Sap-sucker' has been applied to two or three of the smaller kinds, in the belief that they subsist to a great extent upon the juices of trees, obtained from the small holes they make in the bark. There can be little doubt that one species, the Yellow-bellied Woodpecker (*Sphyrapicus varius*), does live to a considerable extent upon this sap. Observation does not show that other species have the same habit, but it is a difficult point to decide by dissection, as fluid contents disappear quickly from the stomach.

Many observers have testified to the good work these birds do in destroying insects, while others have spoken of harm done to fruit or grain. Both are correct within certain limits.

Field observation on the food habits of birds is attended with so many difficulties as to render it a very unreliable source from which to draw general conclusions. The most conscientious and careful person is often deceived, not only as to the quantity of a

particular kind of food eaten by a bird, but as to the fact that it is eaten at all. The further difficulty of keeping a number of birds, or even a single one, under constant observation makes an estimate of relative proportions of different kinds of food impossible. When much mischief is done the fact is apparent, but there is no way to find out how much good is done during the same time. For these reasons it often happens that reports on food habits, based on observations of wild birds, not only conflict with each other but also disagree with the results obtained from stomach examinations. This last method must be taken as the court of final appeal, and it is evident that a collection of stomachs covering every month in the year, and as nearly as may be all points of the bird's range, becomes more and more trustworthy as it increases in size; in other words, the more stomachs examined the nearer correct will be the result as to the bird's annual diet.

The present paper is merely a preliminary report, based on the examination of 679 stomachs of Woodpeckers, and representing only seven species—all from the Eastern United States. These species are the Downy Woodpecker (*Dryobates pubescens*), the Hairy Woodpecker (*D. villosus*), the Flicker or Golden-winged Woodpecker (*Colaptes auratus*), the Red-headed Woodpecker (*Melanerpes erythrocephalus*), the Red-bellied Woodpecker (*Melanerpes carolinus*), the Yellow-bellied Woodpecker (*Sphyrapicus varius*), and the great Pileated Woodpecker (*Ceophlœus pileatus*). Examination of their stomachs shows that the percentage of animal food (consisting almost entirely of insects) is greatest in the Downy, and grades down through the Hairy, Flicker, Pileated, Red-head, and Yellow-bellied to the Red-bellied, which takes the smallest quantity of insects. Professor Samuel Aughey stated that all of these species, except the Pileated (which was not present), fed upon locusts or grasshoppers during the devastating incursions of these insects in Nebraska. The vegetable matter, of course, stands in inverse order. The greatest quantity of mineral matter (sand) is taken by the Flicker, somewhat less by the Red-head, very little by the Downy and Hairy, and none at all by the Yellow-bellied and Pileated.

The stomachs of all of the seven species except the Red-head and the Red-bellied contained the substance designated as 'cambium' in the accompanying list of vegetable food. This is the layer of mucilaginous material lying just inside of the bark of trees, and from which both bark and wood are formed. It is supposed by many to be the main object sought by woodpeckers. Except in the case of a single species the stomach examination does not bear out this

view, since cambium, if present at all, was in such small quantities as to be of no practical importance. The Yellow-bellied Woodpecker, however, is evidently fond of this substance, for in the stomachs examined it formed 23 per cent. of the whole food of the year. It was found in 37 stomachs, most of which were taken in April and October. Of 18 stomachs collected in April, 16 contained cambium, and one of the remaining contained no vegetable food whatever. Moreover, as the true cambium is a soft and easily digested substance, it is probable that what is usually found in the stomachs is only the outer and harder part, which therefore represents a much larger quantity. The extent of the injury done by destroying cambium must depend on the quantity taken from individual trees. It is well known that woodpeckers sometimes do serious harm by removing the outer bark from large areas on the trunks of fruit trees. The rings of punctures often seen around the trunks of apple trees are certainly the work of the Sapsucker, though sometimes attributed to the Downy and Hairy Woodpeckers. But the bird is not sufficiently numerous in most parts of the country to do much damage. It is a difficult task to summarize the results of the investigations herein detailed, more especially if an attempt is made to decide as to the comparative merits or demerits of each particular species. The stomach examinations do not always corroborate the testimony received from observers, and many no doubt will be inclined to think they have seen more harm done by some members of this family of birds than is shown by the data here published. If birds are seen feeding repeatedly on a certain kind of food the inference is that they are particularly fond of it, but the truth may be that they are eating it because they can find nothing they like better, and that a collection of their stomachs from many localities would show only a small percentage of this particular food.

In reviewing the results of these investigations and comparing one species with another, without losing sight of the fact that comparative good is not necessarily positive good, it appears that of seven species considered, the Downy Woodpecker is the most beneficial. This is due in part to the great number of insects it eats, and in part to the nature of its vegetable food, which is of little value to man. Three-fourths of its food consists of insects, and few of these are useful kinds. Of grain it eats practically none. The greatest sin we can lay at its door is the dissemination of poison ivy.

The Hairy Woodpecker probably ranks next to the Downy in point of usefulness. It eats fewer ants, but a relatively larger percentage of beetles and caterpillars. Its grain-eating record is trifling;

two stomachs taken in September and October contained corn. For fruit, it seeks the forests and swamps where it finds wild cherries, grapes, and the berries of dogwood and Virginia creeper. It eats fewer seeds of the poison ivy and poison sumac than the Downy.

The Flicker eats a smaller percentage of insects than either the Downy or the Hairy Woodpecker, but if eating ants is to be considered a virtue, as we have endeavoured to show, then surely this bird must be exalted, for three-fourths of all the insects it eats, comprising nearly half of its whole food, are ants. It is accused of eating corn; how little its stomach yields is shown on another page. Fruit constitutes about one-fourth of its whole fare, but the bird depends on nature and not on man to furnish the supply.

Judged by the results of the stomach examinations of the Downy and Hairy Woodpecker and Flicker it would be hard to find three other species of one common birds with fewer harmful qualities. Not one of the trio shows a questionable trait, and they should be protected and encouraged in every possible way. Fortunately, only one, the Flicker, is liable to destruction, and for this bird each farmer and land-owner should pass a protective law of its own.

The Redhead makes the best showing of the seven species in the kinds of insects eaten. It consumes fewer ants and more beetles than any of the others, in this respect standing at the head, and it has a pronounced taste for beetles of very large size. Unfortunately, however, its fondness for predaceous beetles must be reckoned against it. It also leads in the consumption of grasshoppers; these and beetles together forming 36 per cent. of its whole food. The stomachs yielded enough corn to show that it has a taste for that grain, though not enough to indicate that any material damage is done. It eats largely of wild fruit, and also partakes rather freely of cultivated varieties, showing some preference for the large ones, such as apples. In certain localities, particularly in winter, it feeds extensively on beechnuts. No charge can be brought against it on the score of injuring trees by pecking.

The Red-bellied Woodpecker is more of a vegetarian than any of the others. In certain localities in Florida it does some damage to oranges, but the habit is not general. On the other hand, it eats quantities of ants and beetles.

The Yellow-bellied Woodpecker seems to show only one questionable trait, that of a fondness for the sap and inner bark of trees. Both field observations and the contents of the stomachs prove this charge against it, but it is not probable that forest trees are extensively injured, or that they ever will be, for aside from the fact that

the bark of many trees would be unpalatable, an immense number of birds would be required to do serious damage. But with fruit trees the case is different. Their number is limited, and there are no superfluous ones as in the forest. In localities where the bird is abundant considerable harm may be done to apple trees, which appear to be pleasing to its taste.

The Pileated Woodpecker is more exclusively a forest bird than any of the others, and its food consists of such elements as the woods afford, particularly the larvæ of wood-boring beetles and wild fruits. The species is emphatically a conservator of the forests.

In describing the stomach contents of the different woodpeckers a quantity of material is classed under the term "rubbish." The great bulk of this stuff is rotten wood and bark, picked up in digging or insects in decayed timber, and apparently swallowed accidentally with the food. If the six woodpeckers which had eaten rotten wood are compared with respect to the quantity of this material contained in the stomachs, it is found that the Hairy Woodpecker stands at the head with 8 per cent., the Downy next with 5, the Flicker with 3, the Red-head and Yellow-bellied with 1 per cent. each, and the Pileated with only a trace. From this it appears that the Hairy Woodpecker is preeminently a *woodpecker*, while the Red-head and Yellow-bellied do much less of this kind of work. The difference in habit is obvious to the most casual observer. The Red-head is ordinarily seen upon a fence post or telegraph pole hunting for insects that alight on these exposed surfaces, and watching for others that fly near enough to be captured in mid-air. Unlike other wood-peckers, he is seldom seen digging at a rotten branch except in spring, when he prepares a home for the family he intends to rear. The Yellow-bellied, as will be shown presently, does much wood (or bark) pecking, but of another kind.

The following tables show the food percentages of the stomachs examined :—

Percentages of food of seven species of woodpeckers.

Name of species.	Number of stomachs examined.	Percentage of stomach contents.			Percentage of different insects.						
		Animal.	Vegetable.	Mineral.	Hymenoptera (ants).	Coleoptera (beetles).	Lepidoptera (caterpillars).	Orthoptera (grass-hoppers).	Hemiptera (bugs, plant lice).	Diptera (flies).	Spiders and myriapods.
Downy Woodpecker (*Dryobates pubescens*) .	140	74	25	1	23	24	16	3	4	1	3
Hairy Woodpecker (*Dryobates villosus*) . .	82	68	31	1	17	24	21	Trace.	2	...	4
Flicker (*Colaptes auratus*)	230	56	39	5	43	10	1	1	Trace.	Trace.	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	50	47	3	11	31	1	5	1	...	1
Red-bellied Woodpecker (*Melanerpes carolinus*)	22	26	74	Trace.	11	10	4	Trace.	Trace.	...	Trace.
Yellow-bellied Sapsucker (*Sphyrapicus varius*) .	81	50	50	...	36	5	2	1	1	3	2
Pileated Woodpecker (*Ceophlæus pileatus*) .	23	51	49	...	30	15	2	Trace.	4	Trace.	Trace.

Relative proportions of larval and adult beetles (Coleoptera) in stomachs of seven species of woodpeckers.

Name of species.	Number of stomachs examined.	Number containing adult Coleoptera.	Number containing larval Coleoptera.	Percentage of whole number.		Percentage of stomach contents.	
				Adult.	Larvæ.	Adult.	Larvæ.
Downy Woodpecker (*Dryobates pubescens*) . .	140	50	60	38	43	11	13
Hairy Woodpecker (*Dryobates villosus*) . . .	82	27	46	33	56	6	18
Flicker (*Colaptes auratus*) .	230	67	18	25	8	8	2
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	83	...	82	...	31	...
Red-bellied Woodpecker (*Melanerpes carolinus*) .	22	6	4	27	18	7	3
Yellow-bellied Sapsucker (*Sphyrapicus varius*) .	81	15	1	19	1	5	Trace.
Pileated Woodpecker (*Ceophlœus pileatus*) . .	23	4	12	17	52	2	1

DOWNY WOODPECKER.

(*Dryobates pubescens.*)

This little woodpecker is the smallest, not only of the seven species under consideration, but of all those inhabiting the United States. He is also one of the most familiar, being no stranger to the shade trees about houses and parks, while his fondness for orchards is well known. He is so quiet and unobtrusive that the first notice one has of his presence may be a gentle tapping or scratching on the limb of a tree within two or three yards of one's head, where our diminutive friend has discovered a decayed spot inhabited by wood-boring larvæ or a colony of ants.

One hundred and forty stomachs of the Downy Woodpecker have been examined. They were collected during every month in the year and in 21 States, the District of Columbia, Ontario, and New Brunswick. A few of the western sub-species (*Dryobates pubescens gairdneri*), from British Columbia, have been included. The stomachs contained

74 per cent. of insects, 25 per cent. of vegetable matter, and 1 per cent. of mineral matter or sand. The insects belong to the following orders: Ants (*Hymenoptera*), beetles (*Coleoptera*), bugs (*Hemiptera*), flies (*Diptera*), caterpillars (*Lepidoptera*), and grasshoppers (*Orthoptera*). Spiders and myriapods were also present. While all of these were eaten to some extent, they appear in widely different proportions. The ants constitute almost one-third of all the animal food, or about 23 per cent. of the whole, indicating a very decided taste for this rather acid and highly flavoured article of diet. Beetles stand a little higher in order of importance, amounting to about one-third of the entire insect food, or somewhat more than 24 per cent. of all. Many of these belong to the family of May beetles, a few were the predaceous ground beetles, but by far the greatest number were wood-boring larvæ, a fact showing that this little bird while securing his dinner is doing good work for the forest. One-fifth of the animal-food, or 16 per cent. of the total, consists of caterpillars, many of which apparently are wood-boring species; others are kinds that live on stems and foliage. Among insects the most interesting are the bugs (*Hemiptera*), which are represented in the stomachs by several species, notably by plant-lice (*Aphides*), which in several instances were found in considerable quantities, amounting to 4 per cent. of the whole food. From the minute size and very perishable nature of these insects, it is evident that they must disappear from the stomach in a very short time, and it is fair to infer that many more were eaten than shown by the food remains. Spiders, including harvestmen or daddy longlegs, were eaten freely, and amounted to nearly one-tenth of the whole. A few bits of snail shell were found in one stomach.

Eleven Downy Woodpeckers from Kansas collected in winter (December), deserve special notice. Eight of them had eaten the eggs of grasshoppers to an average extent of 10 per cent. of all their food. This, besides being in itself a good work, emphasizes the fact that this bird resorts to the ground for food in case of necessity.

Professor Samuel Aughey examined four stomachs of the Downy Woodpecker in Nebraska, all of which contained grasshoppers.

The late Dr. Townend Glover, Entomologist of the Department of Agriculture, states that the stomach of a Downy Woodpecker shot in February "was filled with black ants." He states further, "On one occasion a Downy Woodpecker was observed by myself making a number of small rough-edged perforations in the bark of a young ash tree, and upon examining the tree

when the bird had flown it was found that wherever the bark had been injured the young larvæ of a wood-eating beetle had been snugly coiled underneath and had been destroyed by the bird." [1]

In the matter of vegetable diet, the taste of the Downy Woodpecker is varied, prompting him to eat a little of a good many things rather than a large quantity of any one.

The following is a list of the vegetable substances that were identified :—

GRAIN—
Indeterminable.

FRUIT—
Dogwood berries (*Cornus florida*), (*C. alternifolia*) and (*C. asperifolia*).
Virginia creeper berries (*Parthenocissus*[2] *quinquefolia*).
June or service berries (*Amelanchier canadensis*).
Strawberries (*Fragaria*).
Pokeberries (*Phytolacca decandra*).
Apples.
Unidentified.

MISCELLANEOUS—
Poison ivy seeds (*Rhus radicans*).
Poison sumac seeds (*Rhus vernix*).
Harmless sumac seeds (*Rhus sp. ?*).
Mullein seeds (*Verbascum thapsus*).
Hornbeam seeds (*Ostrya virginiana*).
Nut, unidentified.
Flower petals and buds.
Galls.
Cambium.
Seeds, unidentified.
Rubbish.

Material believed to be fragments of grain was found in two stomachs, but the quantity was so small that it may be dismissed without further comment. Fruit is by far the largest item of vegetable diet, forming one-tenth of the whole food. Strawberry seeds were found in only one stomach, apple pulp was supposed to be identified in two, and the other varieties mentioned in the table were distributed in about the same proportion ; so that no great economic interest can attach to this part of the birds' diet. The seeds and other things included under the head "Miscellaneous" constitute about one-twelfth of the total food. Seeds of poison ivy were found in twenty stomachs and poison sumac in one. These plants, far from being harmful to the birds, seem to form a very agreeable article of diet, and are eaten by many species. Unfortunately these seeds are protected by a hard, horny covering which successfully resists the action of the stomach, so that they pass through the alimentary canal uninjured. It is probable that we owe to birds, more than any other agency, the presence of these noxious plants beside fences, copses, and hedge rows. The remaining vegetable food, about 5 per cent. was classed as rubbish, and will be discussed in connection with some of the other woodpeckers.

1 United States Agricultural Report for 1865-1866, pp. 37 and 38.

2 Commonly called *Ampelopsis*. See (List of Pteridophyta and Spermatophyta) prepared by a committee of the Botanical Club of the A. A. A. S., 1893-94, which has been followed in all questions of botanical nomenclature.

No beechnuts were found in any of the stomachs examined, but Dr. Merriam informs me that in Northern New York they feed extensively on this nut, particularly in fall, winter and early spring. On April 5th, 1878, Dr. Merriam "shot four Downy Woodpeckers all of whose gizzards were full of beechnuts and contained nothing else. The birds were often seen on moss-covered logs, and even on the ground, searching for the nuts exposed by the melting snow." Dr. Merriam states also that he has seen this woodpecker in the fall eat the red berries of the mountain ash.

HAIRY WOODPECKER.

(*Dryobates villosus.*)

This woodpecker is as common as the Downy in most parts of the United States, and to the ordinary eye can only be distinguished by its greater size, its colour and markings being almost exactly the same. The Hairy is a noisier bird, however, often making his presence known by loud calls and obtrusive behaviour and by rapid flights from tree to tree. Like the Downy, he has been accused of depredations on fruit, but the stomachs examined do not show that cultivated varieties form any considerable part of his fare. Beside the general resemblance between the two birds there is also a remarkable similarity in their food habits, as shown by the stomach contents; the greatest difference being that the Hairy eats a smaller percentage of insects than the Downy. Eighty-two stomachs have been examined, collected during every month in the year, except February; and coming from nineteen States, the District of Columbia, Ontario, New Brunswick, and Nova Scotia, though most were from the Northern United States. The proportion of different kinds of food is as follows:—Animal 68 per cent.; vegetable 31 per cent.; mineral 1 per cent. The insect material was made up of ants, beetles, caterpillars, bugs, and grasshoppers. Spiders and myriapods also were present. An inspection of the percentages shows that ants are not so highly prized by the Hairy as by the Downy, since they constitute only about 17 per cent. of the whole food, or one-fourth of the insect portion. Beetles, both larval and adult, stand relatively higher than in the case of the Downy, comprising 24 per cent. of all food, or more than one-third of the insect matter. Caterpillars were eaten in greater quantities, both actually and relatively, amounting to 21 per cent. of the whole food, or more

than one-third of all the insect material. Spiders are well represented, and aggregate nearly 6 per cent. of the entire food. Among the miscellaneous insects were a few aphids or plant lice. Grasshoppers were found in only 1 stomach, but Professor Aughey found them in 4 out of 6 stomachs examined by him in Nebraska.

Mr. F. M. Webster states that he has seen a Hairy Woodpecker successfully peck a hole through the parchment-like covering of the cocoon of a Cecropia moth, devouring the contents. On examining more than 20 cocoons in grove of boxelders he found only 2 uninjured.

The Hairy Woodpecker selects a somewhat larger variety of vegetable food than the Downy, though of the same genera, character. The following list of fruits and seeds found in the stomachs does not indicate that the bird visits orchards and gardens for fruit so much as swamps and thickets, where wild grapes, woodbine, and dogwood abound.

GRAIN—
- Corn.

FRUIT—
- Dogwood berries (*Cornus florida and C. asperifolia*).
- Virginia creeper berries (*Partheno cissus quinquefolia*).
- June or service berries (*Amelanchier canadensis*).
- Spice berries (*Benzoin benzoin*).
- Sourgum berries (*Nyssa aquatica*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries, (*Prunus virginiana*).
- Wild grapes (*Vitis cordifolia*).

FRUIT—*contd.*
- Black-berries or rasp-berries (*Rubus*).
- Pokeberries, (*Phytolacca decandra*).
- Unidentified.

MISCELLANEOUS—
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus glabra*).
- Barngrass seeds (*Chamæraphi* sp. ?).
- Hazelnuts.
- Seeds, unidentified.
- Cambium.
- Spruce foliage (*Picea*).
- Rubbish.

The only grain discovered was corn, which was found in two stomachs. In one case it was green corn in the milk, but this is hardly sufficient to prove the habit of eating corn. Fruit aggregates a little more than 11 per cent. of the food of the species, and is fairly distributed among all the items in the above list. Since blackberries are the only kind of cultivated fruit found in the stomachs, and since they grow wild in abundance, it is evident that the Hairy Woodpecker does not at present cause any great damage by his fruit-eating habits. The substances in the miscellaneous list form about 11 per cent. of the whole food, and are practically of the same character as in the case of the Downy. Poison

ivy seeds were eaten by seven birds, and poison sumac by only one, so that not so many seeds of these undesirable shrubs are distributed by the Hairy as by the Downy. The weed seeds in the stomachs were few in number, but in Iowa both the Hairy and the Downy Woodpeckers feed largely on weed seeds in winter, stomachs taken then containing little else. Rubbish amounts to about one-twelfth of all their food, which is the largest percentage shown by any species.

Dr. Merriam informs me that in Northern New York the Hairy Woodpecker, like the other woodpeckers of the Adirondack region, feeds largely on beech-nuts. In late fall, winter, and early spring following good yields of beech-nuts, the nuts form the principal food of the woodpeckers.

FLICKER.

(*Colaptes auratus.*)

This bird, one of the largest and best known of our woodpeckers, is more migratory than either the Hairy or Downy, in winter being scarce or absent from its breeding range in the Northern States, when it is very abundant in summer and early fall. The Yellow-shafted Flicker is distributed throughout the United States, east of the Rocky Mountains. In the West it is replaced by the Red-shafted Flicker, which may be considered the same so far as food habits are concerned. Under one or the other of its various titles of Flicker, Golden-winged Woodpecker, High-holder, Yellow-hammer, Pigeon Woodpecker, and Hairy-wicket, it is known to every farmer and schoolboy and, unfortunately to certain so-called sportsmen also, for this is the one woodpecker that is often seen in city markets. In most places it is a much shyer bird than either of the preceding, and while it frequents the farm and approaches buildings freely, it keeps more in the tops of the trees and does not allow so near an approach of its greatest enemy, man. This is particularly true in the north-eastern part of the country, where large bags of Pigeon Woodpeckers are annually made among the wild cherry trees in which the birds feed. The Flickers soon learn whom they have to fear, and such knowledge seems to be hereditary. They are very prolific, rearing from six to ten young at a brood, and so keep reasonably abundant in most parts of the country. The Flicker is the most terrestrial of all the woodpeckers, in spite of his high-perch-

ing and high-nesting proclivities, and may often be seen walking about in the grass like a meadow lark.

In the investigation of its food habits 230 stomachs were examined, taken in every month of the year, although January and February have but 1 each. They were collected in 22 States, the District of Columbia, and the North-West Territory, and are fairly well distributed over the region east of the Rocky Mountains. They contained 56 per cent. of animal matter, 39 per cent. of vegetable, and 5 per cent. of mineral. It will be seen that the quantity of animal or insect material is less than in either of the preceding species, and the mineral matter somewhat greater. The following orders of insects were represented: Ants (*Hymenoptera*), beetles (*Celeoptera*), bugs (*Hemiptera*), grasshoppers and crickets (*Orthoptera*), caterpillars (*Lepidoptera*), Mayflies (*Ephemerida*) and white-ants (*Isoptera*). Spiders and myriapods also were present. An inspection of this insect matter shows the rather remarkable fact that more than three-fourths of it, or 43 per cent. of the whole food, consists of ants. If the mineral matter is thrown out as not being properly food, we find that more than 45 per cent. of the Flicker's food for the year consists of ants. Among the stomachs examined several contained nothing but ants. In two of these the actual number of ants present in each stomach exceeded 3,000. These were mostly small species that live in burrows in the earth, so that it is evident that when Flickers are seen upon the ground they are usually in search of ants, although the other insects found in the stomachs account in part for this ground feeding habit. Professor Samuel Aughey examined eight stomachs of Flickers in Dixon Country, Nebr., in June 1865. All of them contained grasshoppers, and the number in each stomach varied from 15 to 48.

As a large part of the food of the seven woodpeckers studied consists of ants, the question may be asked whether the birds are doing good or harm by destroying them. There are so many different species of these insects, and they have such widely different habits, that it is difficult to make any assertion that will apply to all, but it is safe to say that many kinds are decidedly harmful, because they attend, protect and help to spread plant, root and bark lice of various species. These lice are among the worst enemies of plant life, and everything which tends to prevent their destruction is prejudicial to the interests of agriculture. Other species of ants destroy timber by burrowing in it; still others, in warmer climates do much harm to fruit trees by cutting off the leaves and undermining the ground. Many species infest houses and buildings

Appreantly, then, birds do no harm in destroying ants, but on the contrary probably do much good by keeping within bounds these insect pests, whose greater abundance would be a serious injury to man. The Flicker takes the lead in this work, eating ants to the extent of nearly half of his whole food.

Next in importance to ants are beetles, which form about 10 per cent. of all the food, less than half the quantity eaten by the Hairy and Downy Woodpeckers. Among these were May beetles and their allies, a few snapping beetles, but the greater number were Carabids or predaceous ground beetles. Most of these were in the adult form, but some larvæ of tiger beetles were identified. As these last live in burrows in the sand, and as Carabids live upon the ground, their presence in the stomachs again points to the terrestrial habits of the bird. The same is true of the grasshoppers and crickets. None of the other insects mentioned were eaten to any great extent, the whole aggregating only about 3 per cent. Two stomachs contained each a single bed bug. Where they were obtained it is as difficult to surmise as it is to understand what motive could prompt the bird to swallow such an insect. Five stomachs contained each a few bits of a snail shell.

In the matter of vegetable diet the Flicker has the most extensive list of any of the 7 woodpeckers, and many of the articles of food can only be obtained on the ground or among low bushes. Following is a list of all the vegetable substances identified in the Flicker's stomachs :—

GRAIN—
- Corn.
- Buckwheat.

FRUIT—
- Dogwood berries (*Cornus florida* and *C. asperifolia*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Hack berries (*Celtis occidentalis*).
- Black alder berries (*Ilex verticillata*).
- Sourgum berries (*Nyssa aquatica*).
- Cat or greenbrier berries (*Smilax glauca*).
- Blue berries (*Vaccinium*, sp.).
- Huckleberries (*Gaylussacia*, sp.).
- Pokeberries (*Phytolacca decandra*).
- June or service berries (*Amelanchier canadensis*).
- Spiceberries (*Benzoin benzoin*).

FRUIT—*contd.*
- Elderberries (*Sambucus canadensis* and *S. pubens*).
- Mulberries (*Morus*).
- Wild grapes (*Vitis cordifolia*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.
- Black berries (*Rubus*).
- Unidentified.

Miscellaneous—
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus copallina* and *R. glabra*).
- Waxberries or bayberries (*Myrica cerifera*).
- Juniper berries (*Juniperus virginiana*).

Miscellaneous—*contd.*

- Knotweed or smartweed (*Polygonum convolvulus, P. persicaria, P. lapathifolium*).
- Clover seed (*Trifolium repens*).
- Grass seed (*Phleum*).
- Pigweed seed (*Chenopodium*).
- Mullein seed (*Verbascum thapsus*).
- Ragweed (*Ambrosia*).
- Magnolia seed (*Magnolia grandiflora*).
- Acorns (*Quercus*).
- Seed unidentified.
- Cambium.
- Rubbish.

Of the two kinds of grain in the above list, corn was identified in 5 stomachs, buckwheat in 1. One of the stomachs containing corn was taken in March and the bird had made a full meal of it, probably because he could get nothing else. Three of the others were collected in September, and the corn was evidently "in the milk." The fifth was taken in October, and is of a somewhat doubtful nature.

The Department of Agriculture has received a number of reports that implicate woodpeckers in damage done to crops. The only one of any consequence is from Dr. E. S. C. Foster, of Russell County, Kans., who states that the Red-headed and Golden-winged Woodpeckers damage corn in the roasting ear by tearing open the husks. He does not say for what purpose the husks are torn open, though some observers have declared that the object is to obtain the grub which sometimes infests the ear. The testimony furnished by the stomachs does not indicate that the Golden-wing has much to do with corn stealing, for it appears that out of 98 stomachs taken in September and October, the season of harvest, only 4 contained corn at all, and these in quantities ranging from 4 to 30 per cent. of the stomach contents. The buck-wheat was eaten in September. The Flicker has a rich and varied list of fruit, embracing at least 20 different kinds, nearly all of which are wild.

The two items of grain and fruit together constitute about 25 per cent. of the whole food, the grain, however, being of little consequence. With all this fruit-eating the Flicker trespassed upon man preserves for cherries only, and these were found in only 1 stomach. Several observers, however, have testified that some damage is done. T. J. Parrish, of Cooke County, Tex., states that the Yellow-hammers and small woodpeckers feed on peaches, plums, grapes, and cherries.

Miscellaneous vegetable substances aggregate a little more than 10 per cent. of the whole food of this bird, and like the fruit list, consist of a variety of elements. Poison ivy seeds were found in 20 stomachs, poison sumac in 5, and bayberries in 14. All these seeds are coated with a white substance resembling wax, and while the quantity is small compared with the size of the seeds, it is probably rich in nutritive properties, for the seeds are a favorite article of

winter diet with many birds. A number of weed seeds were found, and if eaten in considerable quantities would be a great argument in the bird's favour, but unfortunately they occurred in only one or two stomachs each, and so may be considered as merely picked up experimentally in default of something better. It is possible that a series of stomachs taken in the winter months might show a larger percentage, as has been observed in the case of other species of birds, including at least 2 woodpeckers. The mineral element of the stomach contents is larger in the Flicker than any of the others, forming 5 per cent. of the whole, and consisting principally of fine sand. It was noticed that the greatest quantity was present in stomachs containing ants, showing that the sand was picked up accidentally in gathering the ants from their hillocks.

RED-HEADED WOODPECKER.

(*Melanerpes erythrocephalus.*)

The handsome Red-head inhabits suitable localities throughout the United States, east of the Rocky Mountains, but is only casual in New England. He is a familiar bird on telegraph poles and fence posts, and seems to prefer these rather unpicturesque objects to other apparently more fruitful hunting grounds. He feeds largely on insects found upon these bare surfaces, but the vegetable matter in his stomach shows that he forages in other pastures also.

Fifty years ago Giraud stated that on Long Island the Red-headed Woodpecker arrives early in April, and during the spring "subsists chiefly on insects. In the summer it frequents the fruit trees, ripe cherries and pears seeming to be a favorite repast. In the fall it feeds on berries and acorns, the latter at this season forming a large portion of its food."[1]

In its fondness for mast it resembles its relative, the California Woodpecker, whose habit of storing acorns is one of its most conspicuous traits. In the northern parts of its range, where the oak is replaced by the beech, the Red-head makes the beech-nut its principal food. Dr. C. Hart Merriam has given much testimony under this head.[2] He states that in Northern New York, where it is one of the commonest woodpeckers, it subsists almost exclusively on beech-nuts during the fall and winter, even picking the green nuts before they are ripe and while the trees are still covered with leaves. He has shown that these woodpeckers invariably remain throughout the winter after good nut yields and migrate whenever the nut crop fails.

[1] Birds of Long Island, by J. P. Giraud, Jr. 1844, page 180.

[2] Birds of Connecticut, 1877, page 66; Bull-Nuttall Ornith. Club, Volume III, 1878, age 124; Mammals of the Adirondacks, 1884, page 226.

He says: "Gray squirrels, Red-headed Woodpeckers, and beech-nuts were numerous during the winters of 1871-72, 1873-74, 1875-76, 1877-78, 1879-80, 1881-82, 1883-84, while during the alternate years the squirrels and nuts were scarce and the woodpeckers altogether absent;" and adds that in Lewis Country, New York, "a good squirrel year is synonymous with a good year for *Melanerpes*, and vice versâ." In early spring, following nut years, when the melting snow uncovers the ground, they feed on the beech-nuts that were buried during winter. On April 5, 1878, at Locust Grove, New York, he shot six whose gizzards contained beech-nuts and nothing else.

In an interesting article in the Auk[1], Mr. O. P. Hay says that in Central Indiana during a good beech-nut year, from the time the nuts began to ripen, the Red-heads were almost constantly on the wing, passing from the beeches to some place of deposit. They hid the nuts in almost every conceivable situation. Many were placed in cavities in partly decayed trees, and the felling of an old beech was certain to provide a feast for the children. Large handfuls were taken from a single knot hole. They were often found under a patch of raised bark, and single nuts were driven into cracks in the bark. Others were thrust into cracks in gate-posts; and a favorite place of deposit was behind long slivers on fence-posts. In a few cases grains of corn were mixed with beech-nuts. Nuts were often driven into cracks in the ends of railroad ties; and the birds were often seen on the roofs of houses pounding nuts into the crevices between the shingles. In several instances the space formed by a board springing away from a fence was nearly filled with nuts, and afterwards pieces of bark and wood were brought and driven over the nuts as if to hide them from poachers.

In summer Dr. Merriam has seen the Red-heads "make frequent sallies into the air after passing insects, which were almost invariably secured." He has also seen them catch grasshoppers on the ground in a pasture.

Dr. A. R. Fisher saw several Red-headed Wood-peckers feeding on grasshoppers in the streets at Miles City, Mont., in the latter part of July 1893. Several of the birds were seen capturing these insects near the hotel throughout the greater part of the forenoon. From a regular perch on top of a telegraph pole or cottonwood they descended on their prey, sometimes eating them on the ground, but more often returned to their former post to devour them. The following interesting observation was made by Dr. G. S. Agersborg, of Vermillion, S. Dak[2]:—

Last spring in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young

[1] Auk. Volume IV, 1887, pages 194, 195.

[2] Bull-Nuttall Ornith. Club, Volume III, 1887, page 97.

grasshoppers. One of them, which had its head-quarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house, commenced to use his stores and to-day (February 10), there are only a few shrivelled-up grasshoppers left.

Mr. Charles Aldrich, of Webster City, Iowa, states that he saw a Red-headed Woodpecker catching grasshoppers on the prairie half a mile from timber. In Nebraska grasshoppers were found in four out of six stomachs examined by Prof. Samuel Aughey.

Besides depredations upon fruit and grain, this woodpecker has been accused of destroying the eggs of other birds and even of killing the young; and from Florida comes a report that it enters poultry houses and sucks the eggs of domestic fowls. Mr. Charles Aldrich, of Webster City, Iowa, says that a Red-headed Woodpecker was seen to kill a duckling with a single blow on the head, and then to peck out and eat the brains.[1] In view of such testimony remains of eggs and young birds were carefully looked for in the stomachs examined, but pieces of egg-shell were found in only one stomach of the Flicker and two of the Red-head.

A very unusual trait has been recorded by Dr. Howard Jones, of Circleville, Ohio. Dr. Jones says he has seen the Red-headed Woodpecker steal the eggs of eave swallows, and in cases where the necks of the nests were so long that the eggs were out of reach, the woodpecker made a hole in the walls of the nest and so obtained the contents. In a colony of swallows containing "dozens" of nests, not a single brood of young was raised. One of the woodpeckers also began to prey upon hen's eggs, and was finally captured in the act of robbing the nest of a sitting hen.[2]

No traces of young birds or of any other vertebrates were discovered in the stomachs of any of the seven species under consideration, except bones of a small frog which were found in the stomach of a Red-bellied Woodpecker (*Melanerpes carolinus*) from Florida.

The Red-head has been accused of doing considerable damage to fruit and grain, and both charges are fairly well sustained. In Northern New York, Dr. Merriam has seen it peck into apples on the tree, and has several times seen it feed on choke cherries (*Prunus virginiana*).

Mr. August Jahn, of Poke County, Ark., writes that it has damaged his corn to the amount of $10 or $15. and Dr. J. R. Mathers,

[1] Am. Nat. Volume VI, No. 5, May 1877, page 308.

[2] Ornith. and Oologist, Volume VIII, No. 7, 1883, page 56.

of Upshur County, W. Va., says that the same species feeds on cherries, strawberries, raspberries, and blackberries, and that its depredations are sometimes serious. According to Mr. Witmer Stone, of Germantown, Pa., Red-headed Woodpeckers have been observed to strip a blackberry patch of all of its fruit. Mr. W. B. McDaniel, of Decatur County, Ga., also reports that the Sap-sucker and Redhead eat grapes and cherries, the loss being sometimes considerable. These examples show the nature of the evidence contributed by eye-witnesses, the accuracy of whose observations there is no reason to doubt. That the stomach examinations do not reveal more damaging points against the species is not surprising, for a person seeing a bird eating his choice fruit, or in some other way inflicting damage, is more impressed by it than by the sight of a hundred of the same species quietly pursuing their ordinary vocations. Thus an occasional act is taken as a characteristic habit.

One hundred and one stomachs of the Redhead were examined from specimens collected throughout the year, although the bird is not generally abundant in the Northern States during the winter months. The specimens were taken in 20 States, the District of Columbia and Canada, and are fairly well distributed over the whole region east of the Rocky Mountains. The contents of the stomachs consisted of animal matter, 50 per cent.; vegetable matter, 47 per cent.; mineral matter, 3 per cent. The animal and vegetable elements are nearly balanced, and the mineral element is larger than in any except the Flicker. The insects consist of ants, wasps, beetles, bugs, grasshoppers, crickets, moths, and caterpillars. Spiders and myriapods also were found. Ants amounted to about 11 per cent. of the whole food, which is the smallest showing of any of the seven species under consideration, and is in harmony with the habits of the bird, which collects its food upon exposed surfaces where ants do not often occur. Beetle remains formed nearly one-third of all food, the highest record of any one of the seven woodpeckers. The families represented were those of the common May beetle (*Lachnosterna*) which was found in several stomachs, the predaceous ground beetles, tiger beetles, weevils, and a few others. Among the May beetle family is a rather large, brilliant green beetle, known to entomologists as *Allorhina nitida*, but commonly called by the less dignified name of 'June bug.' It is very common during the early summer in the Middle and Southern States but less so at the North. This insect was found in 11 stomachs, and 5 individuals were identified in a single stomach, which would seem an enormous meal for a bird of this size. Another large beetle eaten by this woodpecker is the fire-ground beetle (*Calosoma*

calidum), a predaceous beetle of large size and vile odor. *Passalus cornutus*, one of the staghorns, a large insect, was also found, as well as a pair of mandibles belonging to *Prionus brevicornus*, one of the largest beetles in the United States. A preference for large beetles is one of the pronounced characteristics of this woodpecker. Weevils were found in 15 stomachs, and in several cases as many as 10 were present. Remains of Carabid beetles were found in 44 stomachs to an average amount of 24 per cent. of the contents of those that contained them, or 10 per cent of all. The fact that 43 per cent. of all the birds taken had eaten these beetles, some of them to the extent of 16 individuals, shows a decided fondness for these insects, and taken with the fact that 5 stomachs contained Cicindelids or tiger beetles forms a rather strong indictment against the bird.

Grasshoppers and crickets formed 6 per cent. of the whole food, a larger percentage than in any of the other seven species. The aggregate for all other insects is 4 per cent. and the most important kinds are wasps and their allies. As this bird has often been seen capturing insects on the wing,[1] it is probable that the wasps were taken in that way.

The vegetable food of the Redhead presents considerable variety, and shows some points of difference from that of the other woodpeckers. The following, is the list of substances identified:

GRAIN:—
- Corn.

FRUIT:—
- Dogwood berries (*Cornus candidissima and C. florida*).
- Huckleberries (*Gaylussacia*).
- Strawberries (*Fragaria*).
- Blackberries or raspberries (*Rubus*).
- Mulberries (*Morus*).
- Elderberries (*Sambucus*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.
- Wild grapes (*Vitis cordifolia*).

FRUIT—*continued.*
- Apples.
- Pears.
- Unidentified.

Miscellaneous:
- Sumac seeds (*Rhus copallina* and *R. glabra*).
- Ragweed seeds (*Ambrosia*).
- Pigweed seeds (*Chenopodium*).
- Acorns (*Quercus*).
- Seeds unidentified.
- Galls.
- Flower anthers.
- Rubbish.

Corn was found in 17 stomachs, collected from May to September inclusive, and amounted to more than 7 per cent. of all the food. While it seems to be eaten in any condition, that taken in the late summer was in the milk, and evidently picked from standing ears. This being the largest percentage of grain shown by any of the seven species corroborates some of the testimony received, and indicates

[1] See Merriam, Bull. Nuttall Ornith. Club, Volume III, July 1878, page 126; also Forest and Stream, Volume IX, January 17, 1878, page 451.

that the Redhead, if sufficiently abundant, might do considerable damage to the growing crop particularly if other food was not at hand. While the fruit list is not so long as in the case of the Flicker, it includes more kinds that are, or may be, cultivated; and the quantity found in the stomachs, a little more than 33 per cent. of all the food, is greater than in any of the others. Strawberries were found in 1 stomach, blackberries or raspberries in 15, cultivated cherries in 2, apples in 4, and pears in 6. Fruit pulp was found in 33 stomachs, and it is almost certain that a large part of this was obtained from some of the larger cultivated varieties. Seeds were found in but few stomachs, and only a small number in each.

RED-BELLIED WOODPECKER.

(*Melanerpes carolinus.*)

The Red-bellied Woodpecker is a more southern species than any of the others treated in this bulletin. It is not known to breed north of the Carolinian fauna, and is abundant in Florida and the Gulf States. Curiously enough it sometimes migrates north o its breeding range to spend the winter.

Only 22 stomachs of this species have been obtained by the division. These were collected in nine States, ranging from Florida to Michigan and from Maryland to Kansas, and in every month, except April, June, and July. An examination of their stomachs shows animal matter (insects) 26 per cent. and vegetable matter 74 per cent. A small quantity of gravel was found in seven stomachs, but was not reckoned as food. Ants were found in 14 stomachs, and amounted to 11 per cent. of the whole food. Adult beetles stand next in importance, aggregating 7 per cent. of all food, while larval beetles only reach 3 per cent. Caterpillars had been taken by only two birds, but they had eaten so many that they amounted to 4 per cent. of the whole food. The remaining animal food is made up of small quantities of bugs (*Hemiptera*), crickets (*Orthoptera*), and spiders, with a few bones of a small tree frog, found in one stomach taken in Florida.

Dr. B. H. Warren states that the stomachs of three Red-bellied Woodpeckers captured in winter in Chester and Delaware counties, Pa., contained black beetles, larvæ, fragments of acorns, and a few seeds of wild grapes. The stomachs of eight adults from the St. John's River, Florida, contained red seeds of two species of palmetto, but no

insects. Two additional stomachs from the same locality contained palmetto, berries, fragments of crickets (*Nemobius* and *Oracharis saltator*), a palmetto ant (*Camponotus escuriens*) and numerous joints of a myriapod, probably *Julus*.[1]

Dr. Townend Glover found in the stomach of a Red-bellied Woodpecker killed in December "pieces of acorns, seeds, and gravel, but no insects. Another, shot in December, contained wing-cases of *Buprestis*, and a species of wasp or *Polistes*, acorns, seeds, and no bark. A third, shot in May, was filled with seeds, pieces of bark and insects, among which was an entire *Lachnosterna*, or May bug."[2]

The vegetable food of the Red-bellied Woodpecker contained in the 22 stomachs examined by the division consisted of the following seeds and fruits:—

GRAINS—
Corn.

FRUIT—
Mulberries (*Morus rubra*).
Wild grapes (*Vitis cordifolia*).
Virginia creeper (*Parthenocissus quinquefolia*).
Elderberries (*Sambucus canadensis*).
Rough-leaved cornel (*Cornus asperifolia*).

FRUIT—*continued.*
Saw palmetto (*Sabal serrulata*).
Holly (*Ilex opaca*).
Wild sarsaparilla (*Aralia nudicaulis*).
Bayberries (*Myrica cerifera*).
Pine (*Pinus echinata*).
Poison ivy (*Rhus radicans*).
Ragweed (*Ambrosia* sp.).

Corn was found in only two stomachs. The other items were well distributed, and none of them appear to be specially preferred, unless it may be the poison ivy, which was found in six stomachs, and amounted to nearly 12 per cent. of the whole food. Although eight of the 22 birds were collected in Florida, no trace of the pulp of oranges was discovered, but that oranges are eaten by them is shown by the following interesting notes.:—

Dr. B. H. Warren states that in Florida the Red-bellied Woodpecker is commonly known as 'Orange Sap-sucker' and 'Orange borer.' Dr. Warren collected 26 of these woodpeckers in an orange grove near Volusia and found that 11 of them contained orange pulp. Three contained nothing else; the others had eaten also insects and berries.

Corroborating Dr. Warren's account, Mr. William Brewster states that at Enterprise, Fla., in February 1889, he saw a Red-bellied Woodpecker eating the pulp of a sweet orange. Mr. Brewster states that the woodpecker attacked the orange on the ground, pecking at it in a slow and deliberate way for several minutes. On examining the orange it was found to be decayed on one side. "In the sound portion were three holes, each nearly as large as a silver

[1] Birds of Pennsylvania, 2nd. ed., 1890, pp. 174, 175.
[2] U. S. Agricultural Report for 1865, 1866, p. 38.

dollar, with narrow strips of peel between them. The pulp had been eaten out quite to the middle of the fruit. Small pieces of rind were thickly strewn about the spot." Upon searching closely he discovered several other oranges that had been attacked in a similar manner. All were partially decayed and were lying on the ground. He was unable to find any on the trees which showed any marks of the woodpecker's bill.[1]

Mr. Benjamin Mortimer, writing of the same bird at Sanford, Fla., says:

During February and March 1889 while gathering fruit or pruning orange trees, I frequently found oranges that had been riddled by this woodpecker, and repeatedly saw the bird at work. I never observed it feeding upon fallen oranges. It helped itself freely to sound fruit that still hung on the trees, and in some instances I have found ten or twelve oranges on one tree that had been tapped by it. Where an orange accidentally rested on a branch in such a way as to make the flower end accessible from above or from a horizontal direction, the woodpecker chose that spot, as through it he could reach into all the sections of the fruit, and when this was the case there was but one hole in the orange. But usually there were many holes around it. It appeared that after having once commenced on an orange the wood-pecker returned to the same one repeatedly until he had completely consumed the pulp, and then he usually attacked another very near to it. Thus I have found certain clusters in which every orange had been bored, while all the others on the tree were untouched. An old orange grower told me that the "Sap-suckers," as he called them, never touch any but very ripe oranges, and are troublesome only to such growers as reserved their crops for the late market. He also said that it is only within a very few years that they have shown a taste for the fruit; and I myself observed that, although Red-bellies were very common in the neighbourhood, only an individual, or perhaps a pair, visited any one grove.[2]

YELLOW-BELLIED WOODPECKER OR SAPSUCKER.

(*Sphyrapicus varius.*)

This species is probably the most migratory of all our woodpeckers, breeding only in the most northerly parts of the United States, and in some of the mountains farther south. In the fall it ranges southward, spending the winter in most of the Eastern States. It is less generally distributed than some of the other woodpeckers, being quite unknown in some sections and very abundant in others. For instance, Dr. C. Hart Merriam states that in the Adirondack region during migration it outnumbers all other species of the family together, and throughout the summer is second in numbers only to the Hairy Woodpecker; and at Mount Chocorua, New

[1] The Auk, Vol. vi, 1889, pp. 337—338.

[2] The Auk, Vol. vii, 1890, p. 340.

Hampshire, Mr. Frank Bolles found it the most abundant species. In Minnesota also it is very common. On the other hand, near my home in Massachusetts only two or three were observed each year; and during a residence of eight years in Iowa it was noted only three or four times.

It is to this species that the term "Sap-sucker" is most often and most justly applied, for it drills holes in the bark of certain trees and drinks the sap. It feeds also on cambium, insects, and wild fruits and berries.

In writing of the habits of these woodpeckers in northern New York in 1878, Dr. Merriam states:—

They really do considerable mischief by drilling holes in the bark of apple, thorn-apple, and mountain ash trees in such a way as to form girdles of punctures, sometimes 2 feet or more in breadth (up and down) about the trunks and branches. The holes, which are sometimes merely single punctures, and sometimes squarish spaces (multiple punctures) nearly half an inch across, are placed so near together that not unfrequently they cover more of the tree than the remaining bark. Hence, more than half of the bark is sometimes removed from the girdled portions, and the balance often dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die, and mountain ash are much more prone to do so than either apple or thorn-apple trees, due, very likely, to their more slender stems. The motive which induces this species to operate thus upon young and healthy trees is, I think, but partly understood. It is unquestionably true that they feed, to a certain extent, both upon the inner bark and the fresh sap from these trees, but that the procurement of these two elements of sustenance, gratifying as they doubtless are, is their chief aim in making the punctures I am inclined to dispute. As the sap exudes from the newly-made punctures, thousands of flies, yellow jackets, and other insects congregate about the place, till the hum of their wings suggests a swarm of bees. If, now, the tree be watched, the woodpecker will soon be seen to return and alight over the part of the girdle which he has most recently punctured. Here he remains, with motionless body, and feasts upon the choicest species from the host of insects within easy reach. In making each girdle they work around the trunk, and from below upwards, butt hey may begin a new girdle below an old one. They make but few holes each day, and after completing two or three remain over the spot for some little time, and as the clear fresh sap exudes and trickles down the bark, they place their bill against the dependent drop and suck it in with evident relish—a habit which has doubtless given rise to the more appropriate than elegant term Sap-sucker, by which they are commonly known in some parts of the country. I have several times watched this performance at a distance of less than 10 feet, and all the details of the process were distinctly seen, the bird looking at me, meanwhile, 'out of the corner of his eye.' When his thirst is satisfied he silently disappears, and as silently returns again, after a few hours, to feast upon the insects that have been attracted to the spot by the escaping sap. This bird, then, by a few strokes of its bill, is enabled to secure both food (animal and vegetable) and drink in abundance for an entire day; and a single tree, favorably situated, may suffice for a whole season.[1]

[1] Bull. Nuttall Ornith. Club, Vol. IV, Jany. 1879, pp. 3—5.

The late Frank Bolles has published some interesting detailed observations respecting the food habits of the Sap-sucker. His conclusions are:—

That the Yellow-bellied Woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap, and in some cases parts of the cambium layer; that the bird consumes the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to anything like the extent to which sap-drinking occupies it; * * * * that the forest trees attacked by them generally die, possibly in the second or third year of use; that the total damage done by them is too insignificant to justify their persecution in well-wooded regions.[1]

Mr. Bolles shot eight Sap-suckers in July and August 1890. Their stomachs "were well filled with insects." Some of these were examined by Mr. Samuel H. Scudder, who states:—

The insects in the different stomachs are in all cases almost exclusively composed of the harder chitinous parts of ants. In a cursory examination I find little else, though one or two beetles are represented, and No. 4 must have swallowed an entire wasp of the largest size, his heads and wings attesting thereto.[2]

In a subsequent article Mr. Bolles gives the result of an attempt to keep several young Sap-suckers alive on a diet of dilute maple sirup. Unfortunately for the experiment, the birds obtained and greedily devoured numerous insects attracted to the cage by the sirup. How many of the insects were eaten was not known, but all of the birds died within four months. Examination of their bodies showed fatty degeneration of the liver—a condition said to be usual in cases of starvation. Mr. Bolles states:—

The most probable cause of this enlargement of the liver, which seems to have been the reason for the death of the three Sap-suckers, was an undue proportion of sugar in their diet. In a wild state they would have eaten insects every day and kept their stomachs well filled with the chitinous parts of acid insects. Under restraint they secured fewer and fewer insects, until, during the last few weeks of their lives, they had practically no solid food of any kind.[3]

Mr. Bolles has thus proved by experiment that concentrated sap (saturated with sugar) is not sufficient to sustain life, even with the addition of a small percentage of insects. The logical inference is that sap, while liked by the birds and consumed in large quantities holds a subordinate place as an article of food.

The Yellow-bellied Woodpecker is represented in the collection by eighty-one stomachs, distributed rather irregularly through the year. None were taken in February, March, or November, and only

[1] The Auk, Vol. VIII, July, 1891, p. 270.
[2] The Auk, Vol. VIII, July, 1891, p. 269.
[3] The Auk, Vol. IX, April, 1892, p. 119.

a few in January, June, and December; the great bulk were collected in April, August, September, and October. They were obtained from fifteen States, the District of Columbia, and Nova Scotia. All were from the Northern States, except a few from North Carolina, Virginia and the District of Columbia. Unlike any of the preceding species the vegetable element of the food here exactly equals the animal part. The insect matter was made up of ants, wasps, beetles, flies, bugs, grasshoppers, crickets, and Mayflies. Some spiders also were present. Of the whole food, 36 per cent. consisted of ants, a higher percentage than in any other woodpecker except the Flicker. Beetles amounted to 5 per cent. and do not appear to be a favourite food. Flies (*Diptera*) in various forms were eaten in larger numbers than by any of the others. Among them were several long-legged crane flies (*Tipulids*). Spiders were eaten to a small extent only, and most of these were phalangers or "daddy-longlegs," which, taken with the crane flies, would indicate a slight preference for long-legged prey. Bugs, wasps, caterpillars, crickets, and mayflies collectively amount to about 6 per cent., no one of them reaching any very important figure. Professor Samuel Aughey examined five stomachs of the Yellow-bellied Woodpecker in Nebraska, all of which contained grasshoppers. The number in each stomach varied from 15 to 33.

Mr. William Brewster states that at Umbagog Lake, Maine, "After the young have hatched, the habits of this Yellow-bellied Woodpecker change. From an humble delver after worms and larvæ, it rises to the proud independence of a fly-catcher, taking its prey on wing as unerringly as the best marksman of them all. From its perch on the spire of some tall stub it makes a succession of rapid sorties after its abundant victims, and then flies off to its nest with bill and mouth crammed full of insects, principally large Diptera."[1]

The vegetable food of the Sapsucker is varied. The following fruits and berries were found in the stomachs:—

FRUIT—

- Dogwood berries (*Cornus florida*).
- Black alder berries (*Ilex verticillata*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Wild black cherries (*Prunus serotina*).
- Black berries or raspberries (*Rubus*).
- Unidentified.

MISCELLANEOUS:—

- Poison ivy seeds (*Rhus radicans*).
- Mullein seeds (*Verbascum thapsus*).
- Juniper berries (*Juniperus virginiana*).
- Buds.
- Seeds unidentified.
- Cambium.
- Rubbish.

[1] Bl. Nuttall Ornith. Club., Vol. I, 1876, No. 3, page 69.

The quantity of fruit found in the stomachs formed 26 per cent. of the entire food, but the only kinds identified that might possibly be cultivated were blackberries and raspberries, and these were in only two stomachs. Unidentifiable fruit pulp was found in 12 stomachs. Miscellaneous seeds to the amount of 5 per cent. complete the list of substances eaten by this species. Poison ivy seeds were found in only one stomach, and most of the other things were distributed in about the same proportion.

Dr. Merriam informs me that in the fall in northern New York the Sap-suckers feed on ripening beechnuts, the small branches bending low with the weight of the birds while picking the tender nuts.

GREAT PILEATED WOODPECKER.

(*Ceophlæus pileatus.*)

Excepting the Ivory Bill this is the largest woodpecker in the United States, where it inhabits most of the heavily-wooded districts. It is shy and retiring, seldom appearing outside of the forests, and difficult to approach even in its favourite haunts. Its large size, loud voice, and habit of hammering upon dead trees render it conspicuous. Its strength is marvellous, and one unacquainted with it can scarcely credit a bird with such power of destruction as is sometimes shown by a stump or dead trunk on which it has operated for ants or boring larvæ.

Only 23 stomachs of the Pileated Woodpecker have been obtained; all taken in the months of October, November, December, and January, and collected from six states, the Districts of Columbia and Canada (including New Brunswick). Fifty-one per cent. of the contents of these stomachs consisted of animal matter or insects; 49 per cent. of vegetable matter. The insects were principally ants and beetles, with a few of some other orders. The ants were mostly of the larger species that live in decaying wood. A large proportion of the beetles were in the larval form, and all were of the wood-boring species. There were also a few caterpillars, also wood-borers, a few plant lice, several cockroaches, of the species that live under the bark of dead trees, a few white ants, and a few flies, with one spider.

The gizzard of a Pileated Woodpecker, shot by Dr. Merriam in the Adirondacks, April 25, 1882, contained hundreds of large ants

and no other food. Six stomachs, collected by Dr. B. H. Warren on the St. Johns River in Florida, contained numerous palmetto ants (*Campanotus escuriens*), and remains of other ants, several larvæ of a Prionid beetle (*Orthosoma brunnea*), numerous builder ants (*Cremastogaster lineolata*), one larva of *Xylotrechus*, and one pupa of the white ant (*Termes*). The insects were determined under Professor C. V. Riley.[1]

Seeds and berries of the following plants were found in the stomachs examined by the division :—

Sourgum (*Nyssa aquatica*).
Flowering dogwood (*Cornus florida*).
Black haw (*Viburnum prunifolium*).
Cassena (*Ilex cassine*).
Hackberry (*Celtis occidentalis*).
Persimmon (*Diospyros virginiana*).
Wild grapes (*Vitis cordifolia*).
Virginia creeper (*Parthenocissus quinquefolia*).
Greenbrier (*Smilax rotundifolia* and *S. glauca*).
Sumac (*Rhus copallina*).
Poison sumac (*Rhus vernix*).
Poison ivy (*Rhus radicans*).

In addition to the seven species of woodpeckers whose food has been already discussed, fifty-seven stomachs have been examined, belonging to twelve species and sub-species, mostly from the southern and western parts of the United States and British Columbia, as follows :

	Stomachs.
Nuttall's Woodpecker (*Dryobates nuttalii*)	7
Red-cockaded Woodpecker (*Dryobates borealis*)	12
Baird's Woodpecker (*Dryobates scalaris bairdi*)	3
Gilded Flicker (*Colaptes chrysoides*)	3
Red-shafted Flicker (*Colaptes cafer*)	11
North-Western Flicker (*Colaptes cafer saturatior*)	5
California Woodpecker (*Melanerpes formicivorus bairdi*)	1
Lewis's Woodpecker (*Melanerpes torquatus*)	3
Gila Woodpecker (*Melanerpes uropygialis*)	1
Red-breasted Sapsucker (*Sphyrapicus ruber*)	1
Arctic Three-toed Woodpecker (*Picoides arcticus*)	7
Alpine Three-toed Woodpecker (*Picoides americanus dorsalis*)	3

With such a small number of stomachs it is hardly worth while to discuss the food of each species. The Three-toed Wood peckers (*Picoides*), however, deserve passing notice, since their food contains a larger percentage of wood-boring larvæ than any other wood pecker examined. As the food of the two species is practically the same, they may be considered together. The contents of the ten stomachs consist of animal matter, 83 per cent.; vegetable matter, 17 per cent. It is a question whether this should not all be considered as animal, for the vegetable portion consisted almost entirely of rotten wood and similar rubbish, probably taken accidentally, and is not in any proper

[1] Birds of Pennsylvania, 2nd. ed., 1890, p. 177.

sense food, the exception being in one case where a little cambium had been eaten by one individual of the Arctic Three-toed Woodpecker (*Picoides arcticus*) and a few skins of some small fruit by one Alpine Three-toed Wood-pecker (*P. americanus dorsalis*). The animal food consisted of 63 per cent. of wood-boring Coleopterous larvæ (beetles), 11 per cent. of Lepidopterous larvæ (caterpillars), probably also wood-borers, and 9 per cent. of adult beetles, ants, and other Hymenopterous insects.

G. I. C. P. O.—No. 564 R. & A.—7-2-99—100.—C. V. P.

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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;

18th July 1898.

CONTENTS.

EXPLANATION OF ILLUSTRATIONS.

PLATE XIII—

IG. 1. HOLOTRICHIA IMITATRIX, Brensk. n. sp., *a* and *b*, beetle dorsal and side views (natural size); *c*, antenna (enlarged).

„ 2. HOLOTRICHIA ANDAMANA, Brensk. n. sp., *a* and *b*, beetle dorsal and side views (natural size); *c*, antenna (enlarged).

„ 3. SERICA CALCUTTÆ, Brensk. n. sp., *a* and *b*, beetle dorsal and side views; *c*, antenna (enlarged).

„ 4. SERICA ASSAMENSIS, Brensk. n. sp., *a* and *b*, beetle dorsal and side views; *c*, antenna; *d*, hind leg (all enlarged).

PLATE XIV—

FIG. 1. EUPROCTIS LATIFASCIA, Walk., *a*, larva; *b* and *c*, moths ♂ and ♀.

„ 2. THOSEA CERVINA, Moore, *a* and *b*, larva dorsal and side views *c*, cocoon; *d* and *e*, moths ♂ and ♀.

„ 3. THOSEA DIVERGENS, Moore, *a* cocoon; *b* and *c*, moths ♂ and ♀.

„ 4. BELIPPA LOHOR, Moore, *a*, cocoon; *b* and *c*, moths ♂ and ♀.

PLATE XV—

FIG. 1. CREMASTOGASTER ROGENHOFERI, Mayr., *a*, ant; *b*, nest (quarter natural size).

„ 2. PLUTELLA MACULATA, Curt., *a* and *b*, larva dorsal and side views; *c*, chrysalis; *d*, moth; *e*, piece of cauliflower attacked by larvæ.

„ 3. ERIOCOCCUS PARADOXUS, var. indica, Mask., piece of twig covered with larva scales.

1. ORIGINAL COMMUNICATION.

Diagtnoses Melolonhidarum novarum ex Indiâ Orientali: by Ernst Brenske.

1. *Serica (Autoserica) Calcuttæ* n. sp.

Plate XIII, *fig.* 3.

Long. 8, Lat. 5 mill. ♂. Calcutta.

Sericæ carinifronti similis, sed interstitiis elytrorum magis convexioribus ; Femoribus posterioribus usque ad apicem dilatatis, Tibiis posticis valde dilatatis. Antennis decem articulatis, flabello trifoliato stipiti paulo breviore.

2. *Serica (Autoserica) nagana* n. sp.

Long. 10, Lat. 5·5 mill. ♂. Naga Hills.

Elongato-ovata, nitida, brunnea ; Antennis decem articulatis, flabello trifoliato, stipiti longitudine. Clypeo antice angustato, densissime leviter ruguloso punctato, fronte subtilissime punctata, leviter carinata ; thorace lateribus antice leviter rotundato, subtiliter punctato, angulis posticis rectis ; elytrorum interstitiis parum convexis.

3. *Serica assamensis* n. sp.

Plate XIII, *fig.* 4.

Long. 6-6·8, Lat. 4-4·3 mill. ♂ ♀. Duars, Assam.

Flava, capite thoraceque flavo-rubris, opalinea. Clypeo leviter tridentato, lato minus angustato, subtiliter punctato, brevissime spinoso, linea media longitudinaliter leviter carinata. Thorace lato, transverso, lateribus antice paulo rotundato postice recto, angulis posticis obtusis. Elytris seriatim striatis, interstitiis parum convexis.

Femoribus tibiisque posticis minus dilatatis. Antennis decem articulatis articulis 2-7 brevissimis, flabello trifoliato in utroque sexu brevissimo, maris vix longiore.

[This beetle is destructive to tea plants in Duars, Assam.]

4. ***Hoplia viridula*** n. sp.

Long. 4·5-5·5, Lat. 2, 5-3 mill. Khasi Hills.

H. viridissimæ similis. Supra viridi, subtus aurantiacio vel argentio squamulosa ; nigra, pedibus fuscis subtiliter squamosis. Thorace basi gibboso, clytris planis, Pygidio plano apice leviter impresso ; tibiis anticis tridentatis ; unguibus anticis apice fissis, posticis simplicibus.

5. ***Schizonycha rhizotrogoides*** n. sp.

Long. 13, Lat. 6 mill. ♂. Senafe (Abyssinia).

Lurida ; antennis *novem* articulatis, tibiis anticis tridentatis, unguiculis apice fissis. Clypeo rotundato, sutura fovliter, vertice subtiliter carinato ; thorace laxe punctato, *ciliato*, scutello ciliato ; elytris subtilissime setosis. Pygidis glabro disperse ciliato, pectore villoso Clava trifoliata, stipite longitudine.

6. ***Brahmina shillongensis*** n. sp.

Long. 14, Lat. 6 mill. ♀. Shillong.

Br. cardoni similis, sed major, clypeo profunde emarginato, densius punctato. Thorace lateribus minus rotundato, angulis anticis valde porrectis, elytris magis ruguloso punctatis, Pygidio acuto-rotundato, convexo ; subtus opaco ; pectore haud piloso.

7. ***Holotrichia Alcocki*** n. sp.

Long. 23, Lat. 12 mill. ♀. India Orient.

Opaca, parum nitida, pruinosa. Clypeo parum sinuato ; profunde et grosse punctato, fronte foveolato punctato, pilis sat elongatis ; thorace brevissimo, margine posteriore valde calloso, lateribus crinulatis, disco disperse punctato, linea impunctata media vix distincta ; elytris ad apicem parum latioribus, angulo suturali acuto ; Pygidio, parvo, plano, laxe punctato, apice piloso. Antennis decem articulatis, clava brevissima ; tibiis anticis tridentatis. Holotrichiæ cavifronti affinis et subsimilis sed fronte haud impressa.

8. ***Holotrichia imitatrix*** n. sp.

Plate XIII, *fig.* 1.

Long. 20, Lat. 10 mill. ♀. Sikkim.

Nitida, flavo-brunnea, capite thoraceque obscurioribus, subtus abdomine parce pectore dense flavo pilosio. Clypeo antice profunde sinuato, fronte fortiter carinata, dense punctato. Thorace parum transverso, antice angustato, angulis anticis acutis, lateribus glabris postice rotundatis, angulis posticis sat rotundatis, disco densissime punctato ruguloso. Elytris dense punctatis, haud costatis. Pygidio ruguloso punctato. Antennis *novem* articulatis.

Brahminæ phytaloidi colose et statura similis, sed tarsis medio dentatis, fronte carinata.

9. ***Holotrichia scrobipennis*** n. sp.

Long. 23, Lat. 12 mill. ♂. India or.

Opaca, parum nitida. Holotrichiæ scrobiculatæ valde affinis et similis, capite latiore, clypeo antice parum dimidiato fronte dense, rugoso punctato, thorace densissime ruguloso punctato haud piloso. Pygidio fere rotundato.

10. ***Holotrichia problematica*** n. sp.

Long. 16, Lat. 8 mill. ♂ ♀. Srinagar.

H. singhalensis similiter, opaca, subtus dense pruinosa; antennis decem articulatis; a genere Brahmina differt præsentim unguibus medio dente armatis. Clypeo medio valde emarginato, fronte densissime ruguloso-punctato. Thorace lateribus magis, angulatim dilatato, densissime subtiliterque ruguloso punctato, elytris leviter costatis, haud dense punctatis. Pygidio rotundato acute punctato.

Ad Sectionem Hol. eurystomæ.

11. ***Holotrichia andamana*** n. sp.

Plate XIII, *fig.* 2.

Long. 17, Lat. 9·5 mill. ♂ ♀. Andaman Island (W. Davidson).

H. eurystomæ similis, supra glabra subtus pruinosa; lata, fere plana; clypeo breviter sed distincte emarginato, hic et fronte dense

rugulosa punctatis; thorace transverso, densissime, subtiliterque ruguloso punctato, lateribus modice rotundatis, angulis posticis obtusis; elytris dense rugoso-punctatis, vix costatis, pectore medio breviter piloso. Pygidio densissime ruguloso punctato.

12. ***Holotrichia singhalensis*** n. sp.

Long. 17, Lat. 8·5 mill. ♂, Ceylon.

Præcedenti similis, minus plana longior, et supra parum irides-cens. Clypes breviter inciso, fronte densissime ruguloso-punctato, thorace parum transverso, dense ruguloso-punctato, angulis posticis, obtusis; pectore glabro. Pygidio punctato Ad Sectionem H. eurystomæ Burm.

13. ***Melolontha (Schönherria) rangunensis*** n. sp.

Long. 20·5, Lat. 10 mill. Rangoon. Unicam ♂ in Indian Museum. Picea, compressa, subparallela; antennarum clava septem-foliata, prima abreviata; capite, thorace elytrisque rugoso, punctatis, disperse setoso-squamulosis, pygidio lato densius flavo setoso, abdomine lateribus haud maculatis. Tibiis anticis tridentatis, unguibus basi dentatis. Mesosterno subtiliter producto, noduloso.

14. ***Gymnogaster indica*** n. sp.

Long. 20, Lat. 10 mill. ♂. N. Khasi hills, Unicum in Indian Museum.

Habitus Polyphyllidarum; antennis decem articulatis flabello quin-quefoliato elongato-curvato, articulo secundo tertioque brevibus, quarto paulo, quinto magis transverso; tibiis anticis tridentatis, abdomine glabro, pectore hirsuto. Clypeo parvo antice angustato, sutura elevata, fronte carinata; thorace lateribus antice angustato angulis posticis late rotundatis; disco densissime punctato. Elytris minus densius, fortiter punctatis, haud costatis. Pygidio parvo rugulose.

Haec distinctissima species a genere typico Gymnogaster paulo differt; tibiis anticis tridentatis.

NOTES ON INSECT-PESTS FROM THE ENTOMOLOGICAL SECTION, INDIAN MUSEUM :

By E. Barlow, Assistant in charge of Entomology.

1. TEA PESTS.

1. *Euproctis latifascia,* Walker.

(Sub-ord. Heterocera, Fam. Lymantriidæ.)

Plate XIV, *fig.* 1,—a, *larva;* b, *and* c, *moths* ♂ *&* ♀.

Euproctis lactifascia, Wlk. *Cat.* IV, p. 831; C. and S. No. 945 Hamp. *Faun.B. Ind. Bur. and Ceyl. moths.* I. p, 472. No. 1056.
„ *antica,* Wlk. *Cat.* IV, p. 835; C. and S. No. 933.
„ *postica,* Wlk. *Cat.* XXXII, p. 348 ; C. and S. No. 950.
„ *abdominalis,* Moore, *P. Z. S.* 1888, p. 398 ; *Butl. Ill. Het.* VII, pl. 123, figs. 4, 5.

In March 1897, from Messrs. Andrew Yule & Co., were received some living specimens of a caterpillar which had been doing a great deal of damage to tea plants in the Darjeeling district. The caterpillars were said to be in millions and to be quite stripping the bushes of their old leaves.

The caterpillars forwarded were evidently full-grown specimens, as immediately on their arrival in the Museum, when transferred to a rearing cage, they began to transform themselves into chrysalids. The moths which emerged after about twelve days, were identified as belonging to the species *Euproctis latifascia* of Walker, who describes the female as follows :—

White. Antennæ with testaceous branches. Abdomen brown, white at the base, luteous at the tip. Length of the body 6 lines ; of the wings 20 lines.

Hab.—Nepaul.

According to Sir G. F. Hampson, the species is identical with Walker's *Euproctis antica* and *E. postica,* and Moore's *E. abdominalis,* which have been described thus :—

Euproctis antica, Wlk. ♂ and ♀. White. head, palpi, fore part of the thorax and fore legs luteous in the male, testaceous in the female.

Female.—Abdomen and fore wings with a very slight testaceous tinge. Length of the body 5-7½ lines; of the wings 12-18 lines.

Hab.—Nepaul, Hong Kong, India.

Euproctis postica, Wlk. ♂. White. Palpi porrect, smooth, hardly extending beyond the head; third joint conical, not more than one-fourth of the length of the second. Antennæ very broadly pectinated. Abdomen brown above; apical tuft, small, white. Legs pubescent; hind tibiæ with four long slender spurs. Wings rather short. Fore-wings rounded at the tipes; exterior border convex, very slightly oblique. Length of the body 6½ lines; of the wings 14 lines.

Hab.—Hindostan.

Euproctis abdominalis, Moore, ♂ and ♀. Cream-white; abdomen blackish; anal tuft ochreous; legs white.

Expanse, ♂ $1\frac{1}{10}$, ♀ $1\frac{3}{10}$ inch.

Hab.—*Dharmsala.*

Allied to *E. postica*. Wings comparatively longer and narrower.

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2. *Thosea cervina*, Moore.

(Sub-ord. Heterocera, Fam. Limacodidæ.)

Plate XIV, *fig.* 2—a *and* b, *larva dorsal and side views*; c, *cocoon* d *and* e, *moths* ♂ & ♀.

Thosea cervina, Moore *An. Mag. Nat. His.* XX. 1877, p. 348; id. *Lep. Ceyl.* II, pl, 129, figs. 2, 2a (larva); C. and S. No. 1275 Hamp. *Fauna B. Ind. Ceyl.* and *Burm. Moths*, Vol. 1 p. 379, No. 832.

„ *duplexa*, Moore, *Lep. Ceyl.* II, p. 130, pl. 131, fig. 3 ♀; C. and S. No. 1276.

In July 1894[1] were received from Messrs. Finlay, Muir & Co. specimens of live cocoons, the caterpillars of which were reported to have done a good deal of damage to tea plants on the Rungamuttee garden in Jalpaiguri.

From the cocoons, two moths, a male and female, were successfully reared in the Museum; these, however, proved to be unrepresented in the Museum Collection, but they were so far identified as

[1] The account of this pest should have appeared in the preceding number of *Indian Museum Notes*, but owing to the delay in ascertaining the identity of the species it was withheld. —Ed.

belonging to the genus *Thosea*. For more precise determination, the female moth was sent to Sir G. F. Hampson of the British Museum who very kindly identified it as *Thosea cervina*, Moore. His description of the moth is given below :—

Male.—Head, thorax, and abdomen red-brown. Fore-wing silky gray-brown, with a dark speck at end of cell, and a slightly incurved line from costa just before apex to near outer angle which is red-brown with a pale outer edge. Hind wing and underside dull brown. Antennæ with basal joint pale ; a conspicuous white spot at end of fore tibia.

Female.—With the sub-marginal line of fore wing erect; the basal joint of antennæ dark ; no white spot on tibia.

Larva green, with a yellow-bordered dorsal irregular band, linear and purplish anteriorly, dilated at middle and cleft behind, purple streaked, and with the angles at middle red ; anterior and posterior subdorsal spinous tubercles ; lateral and sub-lateral series of longer tubercles.

Hab.—Sikkim ; Ceylon. *Exp*. ♂ 38, ♀ 44 millim.

The remedial measures suggested were that children might be employed to remove and destroy the caterpillars. If this were carefully done, and if also the cocoons were searched for, in and on the ground near the affected trees, and were destroyed, it would (if not of any immediate benefit) at any rate be likely to prevent or to alleviate a reoccurrence of the pest in a future year.

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3. ***Thosea divergens***, Moore.

Plate XIV, *fig*. 3—a, *cocoon* ; b *and* c, *moths* ♂ & ♀.

Thosea divergens, Moore, *Lep. Atk*. p. 75, pl. 3, fig. 23 ; C. and S. No. 1325 ; Hamp. *Faun. B. Ind. Bur. Ceyl. Moths*. I, p. 380, No. 835.
Aphendala divaricata, Moore, *Trans. Ent. Soc*. 1884, p. 376 ; *C*. and *S*. No. 1296.

This insect is another addition to the Indian Tea pests, of the genus *Thosea*.

In March 1897, specimens of a living cocoon were sent to the Museum by Mr. J. W. Fleet, with a note, that they were taken from the Bishnauth Tea Gardens, Darrang, Assam, where they had been doing damage to tea bushes.

From the cocoons, several moths emerged in the latter end of the month. They appeared to be new to the Museum collection and were forwarded to Sir G. F. Hampson who determined them as belonging to the species *Thosea divergens*, Moore,=*Aphendala divaricata*, Moore.

As the Museum Library does not possess Mr. Moore's description of *T. divergens*, it is not printed here, the description of *A. divaricata*, however, is quoted below.

Aphendala divaricata, ♀. Upper-side pale purplish, brownish-ochreous. Forewing with a slender dark ochreous-brown band curving upward from posterior margin at one-third from the base to one-third before the apex, and from which a straight erect similar band extends from its costal end to the posterior angle. Body dark ochreous-brown. Expanse 1⅜ inch.

Hab.—Silcuri, Cachar.

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4. ***Belippa lohor***, Moore,

(Sub-ord. Heterocera, Fam. Limacodidæ.)

Plate XIV, *fig. 4*—a, *cocoon* ; b *and* c, *moths* ♂ & ♀.

Belippa lohor, Moore, *Lep. E. I. Co.*, p. 430, pl. xiiia, fig. 3 ; Hamp. *Faun. Brit. Ind. Bur. Ceyl. Moths.* I, p. 400, No. 897.

In March 1897, Mr. W. J. Fleet forwarded to the Museum several living specimens of a cocoon, with the statement that he had collected them from the Salonah Tea Estate, Assam. About the same time similar (live) cocoons were also sent to the Museum through Dr. G. Watt, Reporter on Economic Products to the Government of India, as infesting tea plants in the Doom Dooma Tea Gardens, Dibrugarh, Assam.

The samples of cocoons were separately confined in a breeding cage, from which, after a lapse of a week, moths began to emerge. These on examination proved to belong to the genus *Belippa ;* the species being new to the Museum collection.

On submitting specimens of the moth to Sir G. F. Hampson for identification, he pronounced it to be identical with *Belippa lohor*, Moore, the female being almost indistinguishable from that of *Belippa laleana*, Moore, and hitherto unknown to entomologists.

Mr. Moore describes the male, as deep ferruginous; fore-wing with patches on the disc, and a small patch at the apex, black hind-

wing with a triangular hyaline space from exterior margin; the anterior and abdominal margins fuliginous-brown; thorax with two black spots in front, and one on each side; base of abdomen black. Expanse $1\frac{1}{8}$ inch.

Hab.—Cachar, Java.

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5. ***Astycus lateralis***, Fabr.

(Order Coleoptera, Fam. Curculionidæ.)

Astycus lateralis, Fabr. Ent. Syst. I, 2, p, 454;—Gylh. Schh. Gen. Cur. II p. 92;—Bohem. Schh. Gen. Curc. VI, 1, p. 249.
„ *obtusus*, Sturm. Cat. 1826, p. 172.
„ *rutilans*, Oliv. Ent. V. 83, p. 333, t. 25, f. 367.

Through Dr. G. Watt, Reporter on Economic Products to the Government of India, were received in the Museum in July 1897, specimens of a weevil said to be attacking tea plants in Assam. The original sender wrote concerning them that "they came during one night in thousands and simply stripped the bushes they were on." Fortunately they are easy to catch.

The specimens proved to be the same as *Asticus lateralis*, Fabr. which has previously been recorded as attacking various plants in different parts of India.

In 1889, Mr. Beck submitted specimens of this insect for examination, and reported, that they attacked the leaves of the "Some" plant in the Raj Gardens, Darbhunga. In Vol. II, *Indian Museum Notes*, page 151, it is referred to as "a small greenish weevil reported in the beetle stage as defoliating mulberry (*Morus*) bushes in Rangoon. Also thought to be the species which has been reported by Mr. Thompson as tunnelling into the timber of Chir (*Pinus longifolia*) in the North-Western Provinces; in this case the injury is no doubt done by the larvæ of the insect."

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6. ***Diapromorpha melanopus***, Lacord.

(Order Coleoptera, Fam. Chrysomelidæ.)

Diapromorpha melanopus, Lacord. *Mon.* p. 238; *Deg. Cat.* 3, ed., p. 442.
„ *pallens*, Oliv. *Ent.* VI. 96, p. 863, t. 2, f. 27.

In July 1897, specimens of a beetle which proved to be *Diapromorpha melanopus*, Lacord, were sent to the Museum by

Messrs. Williamson, Magor & Co. who reported that it had been doing damage among the tea bushes on one of their Assam Estates in the Jorehaut district.

This insect (known as the "Orange" beetle) is commonly found in tea gardens in Assam, where it no doubt does a good amount of injury by eating up the tender stems of tea-shoots.

Specimens accompanied by complaints of damage done by it are annually sent to the Museum, but no action, it appears, has hitherto been taken to ascertain the life-history of the pest.

Some previous accounts of it may be found in *Indian Museum Notes,* Vol. I, page 106, and Vol. II, No. 4, p. 7.

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7. ***Cremastogaster rogenhoferi,*** Mayr.

(The red and black ant of the Tea bushes.)

Plate XV, *fig. 1, a.* ant; *b,* nest.

In his report on the "Pests and Blights of the Tea Plant of Assam, 1898," Dr. G. Watt, Reporter on Economic Products to the Government of India, makes mention, in page 257, of a red and black ant which he had observed infesting tea bushes in Assam.

His elaborate account of the habits, etc., of the insect is very interesting, but his identification of the species with *Cremastogaster contenta,* Mayr., is incorrect. Dr. Watt was good enough to present specimens to the Entomological Section of the Indian Museum, these are undoubtedly identical with authentically named specimens of *Cremastogaster rogenhoferi,* Mayr., in the Museum collection.

To make quite certain, a few examples of the insect were despatched to Dr. Forel, of Zurich, who confirmed the identification as "*Cremastogaster rogenhoferi,* Mayr., one of the commonest species of India."

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8. *Euproctis caterpillar*?—On the 19th March 1897, from Dr. G. Watt, Reporter on Economic Products to the Government of India, were received specimens of a caterpillar reported as doing

a deal of damage to the tea bushes in Darjeeling. The following is an extract which he forwarded regarding the pest:—

"A new sort of this blight has developed. A blackish-brown hairy species, they attack the old leaves and strip the trees. This pest does all its ravages at night and hides itself under clods and stones during the day. I have boys on catching some thousands daily. They appear on the dry ridges and are not found in any damp hollows. They have stripped some 50 or 60 acres on an adjoining garden and are now attacking the bark. On lower portions of Lebong and M. S. they have now appeared and are doing considerable harm. I am sending you a bottle-full in spirit. I fancy they will disappear with rain, but of this there is no sign."

The specimens appeared to be the larvæ of a Lymentriid moth probably of the genus *Euproctis*, and not unlike the tea caterpillars sent in by Messrs. Andrew Yule & Co. from the Darjeeling district. (See p. 180).

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9. *Psychid caterpillar.*—In July 1897, specimens of a bag-worm said to be doing great injury to tea plants in the Golaghat district, Assam, were forwarded to the Museum through the Secretary, Agricultural and Horticultural Society of India.

The specimens proved to be the larvæ of a Psychid moth probably belonging to a species hitherto undescribed. We have only a few examples of the larva-case of this insect in our collection, but unfortunately we possess no moths, and Sir G. F. Hampson does not mention this species in his catalogue of moths of British India, Ceylon and Burma.

The most curious thing noticeable in this interesting group of moths is their larva-cases or protective coverings, which are usually composed of a silk lining with twigs, grass, and bits of leaves or vegetable matter attached on the outside, and are so constructed as to resemble little bundles of dried sticks, leaves, etc. In this insect, however, the larva-case is smooth and is covered with a coating of very finely divided vegetable matter and exactly resembles a thorn.

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10. *Coleopterous larvæ.*—In July 1897, Mr. D. Hooper, Curator of Economic Museum, sent to the Indian Museum specimens of grubs reported as tea pests for identification. He wrote:—

"A correspondent in Nazira Division, Sibsagar, has sent me the accompanying bottle of white grub (*Lachnosterna impressa*) as a tea pest. Most of the smaller

forms seem stages of the larvæ of that beetle, but I cannot think the very large ones can be the same species. I shall be much obliged for your opinion and, if possible, determination. I have found the very large one all over Assam imbedded in hard mud-houses of which I send a sample. It is particularly common in hard clay soils and does much damage to rice. These I at first mistook for queen white-ant houses until I dug them out for myself and found them invariably occupied by identically similar larvæ to the large ones herewith supplied. They are no doubt a species of *Lachnosterna*, but are they *L. impressa* ?

"I shall be very glad of any suggestions, more especially whether the very large larvæ have been known to injure the tea in the event of their being pronounced distinct from the smaller form."

The specimens proved to belong to two different species of insects, namely :—The large grubs are the larvæ of a Melolonthine beetle probably belonging to the genus *Lepidiota*, and the smaller ones are apparently the immature forms of *Lachnosterna impressa*.

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11. *Coccids.*—Four bottles containing specimens of scale insects reported as infesting tea plants in the Darjeeling district, were received in the Museum through the Reporter on Economic Products to the Government of India. The following particulars regarding the insects are taken from his forwarding letter, dated 28th May 1897 :—

"No. 1 seems somewhat like *Aspidiotus flavescens* and is said to be the most dangerous of the series. It attacks the young twig of young tea, the scale-insects inserting themselves below the bark and thus raising and distorting it, in older twigs the life seems sucked out of the plant through this rupturing of the bark and the withdrawal of the sap. The young insects are alive and seen escaping."

"No. 2 is said to be a twig with long white blotches."

"No. 3, a twig with large wax insects."

"No. 4, similar insect of smaller size and with orange-coloured central portion."

The specimens proved to belong to four different kinds of Coccids, namely :—No. 1 consisted of badly preserved specimens of larvæ apparently of *Aspidiotus theæ*, Mask ; No. 2 consisted of examples of an unknown Coccid not represented in the Museum collection; No. 3 consisted of a few larva-scales probably belonging to the species *Ceroplastes ceriferus ;* and No. 4 contained specimens of a Coccid hitherto not reported as occurring in India.

Specimens Nos. 2 and 4 were forwarded to Mr. W. M. Maskell for identification, and his report on them is given below :—

"The two parcels of tea leaves with Coccids. One of these insects is evidently a *Pulvinaria*, but only the white cylindrical cot-

tony sacs remain : the insects themselves (as usual in the genus) have fallen off : therefore I cannot identify the species.

"The other (No. 4), of which you sent three specimens and a small coloured drawing, is a *Ceroplastes*. The specimens are not sufficient for clearness. They seem to me to be, nearly certainly, either *C. vinsonii*, Sign. (Mauritius), or *C. floridensis*, Comst., which Green reports on tea in Ceylon. Very probably both these are the same species : but your insects are not in the full-grown stage or at least I think not. Every character corresponds to *C. vinsonii*, but also *nearly* all to *floridensis*. If you could let me have undoubtedly adult specimens and larvæ, I should be more positive. However the thing seems to be one or other of the two species named."

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12. ***Ceronema* sp.** [Coccid]—In May 1897, the same officer forwarded to the Museum specimens of tea leaves attacked by scale-insects. No report accompanied the specimens and no locality was mentioned in the forwarding note.

The insects appeared to be new to the Museum collection and were forwarded to Mr. W. M. Maskell who very kindly identified them as belonging to the genus *Ceronema*. He wrote, "this is a peculiar and abnormal form which I have had a few months ago from Japan, on *Ilex crenata* and an unnamed plant. I am very much inclined to attach it to my genus *Ceronema* of 1894 : the main difference from the single species *Cero. banksiæ* being that the curling white processes in your insect spring from the median region and curl outwards, while in *C. banksiæ* they are marginal and curl inwards. But I have not yet made up my mind, at least on some minor points."

II.—INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

1, Wheat and paddy pests, etc.

1. *Tanymecus indicus*, Faust.

(Ord. Coleoptera, Fam. Curculionidæ)

Wheat pest.

In December 1897, specimens of a Curculionid beetle, which proved to be *Tanymecus indicus* Faust, were forwarded to the

Museum through the Director, Land Records and Agriculture, Panjab, from the Settlement Officer, Jhelum district, as doing great damage to wheat in a small area in the north of Tahsil Chakwal.

This insect has been previously referred to in the pages of these *Notes* as doing a great deal of injury to agricultural crops in several parts of India. It has been reported (*a*) as attacking the seedlings of the poppy plants in Gazipur; (*b*) attacking wheat and gram crops in the North-Western Provinces; and (*c*) attacking *rabi* crops in Behar.

The following report has been furnished by the Settlement Officer:—

"Herewith specimens of an insect which has done great damage to the sprouting wheat in a small area in the north of Tahsil Chakwal; I have seen some of the fields damaged which have been sown and re-sown twice or thrice with the same result: the insect feeds on the part of the young plants above the surface of the ground, in the day-time it burrows into the soil (here light and friable), and the zamindars say, attacks the roots of the plants also. The pest is quite new to every one in these parts, and I should be glad to know if you can obtain the information, what the insect is, and what can be done to destroy it, should it appear on large numbers."

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a. Chrysomelid beetle.—In August 1897, a single specimen of a beetle was received in the Indian Museum from the Sub-Divisional Officer, Barasut, with a report that it had damaged the *aus* paddy crop at Kizipore in the Barasut Division.

The insect is a Chrysomelid beetle, of the genus *Pachmephorus?* and is new to the Museum Collection. It is locally called "Majra." Further specimens are required to enable the insect to be precisely determined.

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b. Noctues moth.—In September 1897, some specimens of an immature larvæ of a Noctues moth were received in the Indian Museum, through the Director, Land Records and Agriculture, Bengal, from the Commissioner of the Orissa Division, Cuttack, as injuring the paddy crop in the Bhudrack sub-division, where the insect is called "Dhali-poka."

The specimens forwarded are insufficient for precise identification.

c. Micro-lepidopterous moth.—In September 1897, specimens of an insect destructive to paddy plant were received in the Indian Museum from the Sub-Divisional Officer, Magura, who wrote :—

"These insects appeared in June and July last and damaged the plants of *Aus* and *Aman* paddy in this sub-division, but disappeared as soon as heavy rains set in. They have re-appeared in certain tracts in this sub-division with the cessation of rains.

"The insects are called by the cultivators, 'Modhupoka' from a sort of gum or juice attached to their bodies, which tastes sweet.

"They made the leaves of the paddy plants first to be twisted and then to turn gray, and look as if sun-burnt. The plants lose their green colour in a day or two. They have damaged the plants where there is no water in the *khet* or even where there are two to three yards water. I have not been able to see the stages of their development."

The specimens appeared to be the caterpillars of a micro-lepidopterous moth, which cannot be identified without the examination of the imago into which they transform.

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d. Grasshoppers attacking paddy crop.—In October 1897, specimens of *Acrididæ* were forwarded to the Museum by the Superintendent, Government Museum, Madras, as the locusts which had appeared in the Head-quarters Deputy Collector's Division of the Ganjam district where they are reported to have attacked the paddy crop.

The specimens proved to belong to two distinct species of grasshoppers, namely, *Hieroglyphus furcifer*, Sauss., and *Euprepocnemis bramina*, Sauss. Both the insects have previously been referred to in the pages of these *Notes* as occasioning damage to crops in several parts of India.

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e. Noctues caterpillars destructive to rice crops.—In December 1897, some caterpillars known locally as "Ledapok," were forwarded to the Museum, through the Director, Land Records and Agriculture, Bengal, from the Collector of Chittagong, with the information that they had been doing much damage to the rice crops in the Satkania Thana.

The insects are apparently the larvæ of the Noctues moth, *Heliothis armigera*, Hubn., which has previously been reported as destructive to crops in all parts of India, and in many other parts of the world.

Accounts of it may be found in *Indian Museum Notes*, Vol. I, pp. 97 and 109, pl. VI, fig. 4; and Vol. II, pp. 24, 27 and 160.

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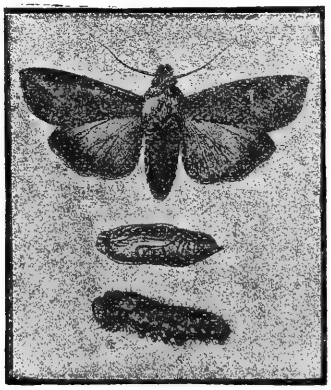
f. Leucania unipuncta, Haw.

(Sub-ord. Heterocera, Fam. Noctuidæ.)

JOWARI PEST.

Leucania unipuncta, Haw., *Lep. Brit.*, p. 174 (1803).
„ *extranea*, Guen. *Noct.* i, p. 77, No. 104; C. and S. No. 1674.

Specimens of a moth, reared from caterpillars which are said to have done an enormous amount of damage to jowari crops in the district of Poona, have been received in the Indian Museum from the Assistant Superintendent of the Poona Farm in September 1897.



The following is an extract from the report furnished by Mr. J. Mollison, Deputy Director of Agriculture :—

"The caterpillars when they are in large numbers and when hard pressed for food, take to almost any crop. They apparently prefer jowari and strip the leaves

of all green tissues, except the midribs. They are not *cut* worms. They feed at night, crawl up the stems and are found in colonies, 5 to 20 in a lot, lightly covered with soil in the driest parts of the soil surface during the day. The insects are found usually at first in one portion or along one side of a field, but they sweep across it in about two days stripping every plant.

"The chrysalides are red-brown in colour, the covering being tough. They are further protected by a cemented coating of earth which has no distinct outer surface, the inner surface being cemented as described in the form of the chrysalis. The chrysalides are found quite close to the surface of the field about ½ inch or so under the surface. I think that if this position is much disturbed, the moths will not be able to emerge. I have, therefore, taken the precaution of ploughing the affected fields expeditiously. In this way the chrysalides are turned down about 4 inches below the surface. The moth, I believe, emerges from the chrysalis in about 8 days, but we have been unable to rear the caterpillars in confinement. We have got moths from perfectly formed chrysalides collected in the field. The caterpillars are found chiefly in fields which have been manured with farm yard manure this season.

"I have been particularly struck this year with the unusually large numbers of moths and butterflies, and unquestionably cultivated plants are affected with insect-pests to a greater extent than usual."

The insect proved to be a Noctues moth belonging to the species *Leucania unipuncta*, Haw.=*extranea*, Guen. It is referred to in the pages of these *Notes* as attacking paddy crops in Bengal, oat (*Avena sativa*) plants in Sibpur, and pea (*Pisum sativum*) in Patna.

Sir G. F. Hampson describes the species as pale brick-red or very pale brown and irrorated with dark specks and blotches. Fore wing with slight traces of the orbicular and reniform stigmata; a minute white speck at lower angle of cell with a black speck inside it; fairly prominent postmedial and marginal series of black specks the former curved; and indistinct oblique dark apical streak. Hind wing pale suffused with fuscous, in the red specimens less suffused towards base. Underside of hind-wing sometimes with faint cell-spot and postmedial series of specks.

Hab.—Universally distributed. *Exp.* 44-50 millim.

As regards remedial measures, Mr. Mollison writes:—

"The only practical means of preventing damage is to reap at once the affected portion. Scarify the surface of the ground to expose the caterpillars a hand rake does well for the purpose; hand pick and drown the caterpillars in a tub half filled with water. If this method is adopted, crow and other birds in large numbers are soon attracted to the field, and are extremely industrious in disposing of the caterpillars. If the crops when cut from an affected field is left in swathe, the caterpillars will be found on the following day under the swathe, and not covered with soil, so that by moving a yard or two of swathe at a time, the caterpillars can very readily be collected."

2. Cotton pests.

a. Oxycarenus lugubris, Motsch.

The Egyptian Cotton bug.

Specimens of this insect have been received in the Indian Museum in May 1897, through the Director, Land Records and Agriculture, Panjab, from the Superintendent of the Experimental Farm, Nagpur, who wrote :—

"These insects are doing great damage to the green bolls. They bore small holes when the boll is green and consequently it never comes to perfection. The plants are in such a thriving condition that one will admire to look at them. As for Cairo cotton plant growing, I have been thoroughly successful, but these insects are doing such a damage that if they continue to live for a month more, I will not get a single perfect boll."

This insect has previously been reported from several parts of India in connection with cotton, *vide Indian Museum Notes*, Vol. II, pp. 32-35, and Vol. III, No. 5, p. 56. The description of it may be found in a paper on Indian Rhynchota by the late Mr. E. T. Atkinson in the pages of these *Notes* (*Indian Museum Notes*, Vol. I, p. 188).

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b. Noctues caterpillar destructive to cotton.—In August 1897, specimens of a caterpillar said to attack cotton crop in the Poona Farm were received in the Museum from the Assistant Superintendent, Poona Farm, Kirkee.

The specimens proved to be the larvæ of a Noctues moth, which cannot be precisely identified without the examination of the imago into which they develope.

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3. Poppy pests.

a. Noctues moths.—Specimens of insects reported to be attacking poppy plants in Azamgarh have been received in the Indian Museum through the Director of Land Records and Agriculture, North-West Provinces and Oudh, from the Sub-Deputy Opium Agent, Azamgarh.

The following is an extract from the report (dated 26th March 1897) :—

" I am forwarding to you two samples of the caterpillars which destroy poppy. In the bottle labled A, are specimens of those which only appear towards the middle or close of the season. The specimens obtained of this sort, I found on the under-part of the leaf, and these were evidently hatched on it from ova deposited thereon and the attack on the leaf commenced on the spot, on the under side where they first came into existence. I found by keeping them as boys keep silkworms at home that they grew rapidly and also changed colour as they grew. The specimens sent are not full grown. I believe they would have grown another quarter of an inch and have been stouter in proportion. The growth of these caterpillars is so rapid that in fifteen days they become full grown. Since I collected them they have matured and are passing into the chrysalis stage.

"I send you specimens of these in a match box together with a portion of the cells formed by them.

" The specimens in the bottle B, are the sort which live under ground and attack the young plant in its earlier stage, and frequently denude whole fields, the natives call them ' Kator ' or " Kumwah. "

The insects received are as follows :—

(1) Specimens marked A consist of some larvæ of a Noctues moth, the material being insufficient for precise identification.

(2) Specimens marked B prove to be caterpillars not unlike the larvæ of the Noctues moth *Agrotis suffusa*, Hubn., which has previously been recorded as attacking young opium plants and other agricultural crops in India. See *Indian Museum Notes*, Vol. I, pp. 33, 95, 103, 108, and 206.

(3) Specimens in a match box consisted of a few chrysalids belonging to two different species of Noctues moths.

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4. Indigo pests.

a. Agrotis segetis, Schiff., and *A. biconica*, Koll.

Some Lepidopterous larvæ (alive) were received in March 1897 from Messrs. Finlay, Muir & Co., as attacking indigo plants in one of their indigo estates. The caterpillars were reared in the Indian Museum, and by the end of March there emerged moths belonging to two distinct species of Noctuidæ. One of these is *Agrotis segetis*, Schiff. (three specimens), and the other species being *Agrotis biconica*, Koll. (one specimen).

The insect *A. segetis* is well known both in Europe and in India, as a very destructive pest to agriculture, and according to Curtis.

"Farm Insects of Europe," it feeds on a great variety of plants, especially those of turnip and corn. In India, however, it has hitherto only been reported to attack coffee plants.

Sir G. F. Hampson in his Fauna of British India moths ii, describes the species as whitish brown, pale brown or fuscous; palpi darker at sides; collar with dark line; abdomen whitish. Forewing with double waved sub-basal ante- and postmedial lines; an obscure waved sub-marginal 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-wings iridescent white with dark marginal line, and in some specimens with dark suffusion on the margin.

Hab.—Europe; and throughout India and Ceylon. *Exp.* 42-48 millim.

The second species *Agrotis biconica*, Koll., reared from the batch of Indigo caterpillars has not previously been reported to attack crops in India, but as it is a species very closely allied to *A. segetis*, there is every probability of its becoming at any time a troublesome pest. In its description it differs from *segetis* in having the sub-basal ante- and postmedial lines of the forewing almost or quite obsolete; the submarginal line strongly dentate, with dark streaks on it; the orbicular elongate, with a dark streak from it to the reniform; the claviform very elongate and filled in with black.

Hab.—S. Africa; N.-W. Himalayas; Panjab; Sikkim; throughout the Bombay and Madras Presidencies; Ceylon. Exp. 38 millim.

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b. Noctues caterpillar.—The following is a letter, dated 6th April 1897, from Mr. H. Thorp, of Luchmipur Indigo Factory advising the despatch of specimens of caterpillars destructive to indigo:—

"I am sending you by this post a small bottle containing specimens, preserved in spirit, of the caterpillars that are now doing great damage to Indigo. There seem to be at least three distinct varieties of them. The most destructive of all, is, I think, the smallest in size: the little dark coloured one. As a preliminary symptom there appears a little cobweb on the young indigo plant which binds the topmost shoots together, and on the leaves appear minute black specks, whether the excrement or eggs of the caterpillars I cannot say. On opening the egg web I have mentioned a tiny caterpillar is found. 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 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 on 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 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, attack 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 invariably. Though these do not kill the plant, they strip it of its leaves and render it practically unfit for manufacture. I have some live specimens of caterpillars, and as soon as I can send you their chrysalids I will do so, and also specimens of the resulting insect."

The specimens received appeared to be the larvæ of a Noctues moth, the material being insufficient for any identification.

Mr. Thorp subsequently forwarded a living chrysalis, which, however, arrived in the Museum in a dried state and dead that nothing could be made of it.

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5. Insects infesting vegetable plants.

a. Plutella maculata, Curt.

(Sub-ord. Heterocera, Fam. Tineidæ.)

Cauliflower Moth.

Plate XV, *fig.* 2—a, and b, *larva dorsal and side views*; c, *chrysalis*; d *moth*; e, *piece of cauliflower attacked by larvæ.*

Caterpillars of this Tineid moth have been received in the Indian Museum through the Entomological Artist Babu G. C. Chuckerburtty in the latter end of February, with a statement that they were found attacking a cauliflower which had been purchased locally in the market.

The caterpillars are of very small size like most of the family of Tineidæ to which they belong, measuring little above one-half inch in length, very slender and more or less cylindrical, but gradually tapering both towards the head and the tail. They are of an olive-green colour of a transparency that permits the pulsation of the "heart" and the internal organs to be seen through the skin.

The caterpillar spins a small oblong cocoon of very fine white silk in which pupation takes place, the moth emerging after four or five days. It is a tiny little insect of a grayish-brown colour measuring no more than $\frac{7}{12}$ of an inch in length across the two fore-wings.

Seven specimens were reared in the Museum, and Sir G. F. Hampson has been kind enough to determine the species as "*Plutella maculata*, Curt. = *cruciferarum*."

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b. Rhopalosephum dianthi, Schrank.

Infesting brinjal plant.

In the latter part of December 1896, Babu Probod Chunder De forwarded to the Museum specimens of brinjal leaves attacked by insects, and reported that he was frequently being troubled with these pests who were carrying depredations in his kitchen garden in the vicinity of Calcutta.

On examining the samples of brinjal leaves they were found to be badly infested with Aphids of the well-known species *Rhopalosephum dianthi*, Schrank.

This insect appears to be a common pest in Europe where it is no doubt an indigene. It has been reported by different authors as attacking numerous plants, and according to Mr. F. Walker's account it feeds on the following:—*Thalictrum minus*, *Ranunculus bulbosus*, *R. hirsutus*, *R. repens*, *R. acris*, *Aquitegia vulgaris*, *Papaver rhæas*, *Fumaria officinalis*, *Nasturtium officinale*, *Cochlearia armoracæa*, *Alliaria officinalis*, *Erysimum barbarea*, *Capsella Bursa-pastoris*, *Cakile maritima Brassica oleracea*, *B. rapa*, *B. campestris*, *B. napus*, *Sinapis arvensis*, *S. alba*, *S. nigra*, *Raphanus sativus*, *R. raphanistrum*, *Dianthus*, *Euphorbia peplus*, *Crepis tectorum*, *Potentilla anserina*, *Pyrethrum inodorum*, *Myosotis scorpioides*, *Inula dysenterica*, *Digitalis Sonchus*, *Leontodon taraxacum*, *plantago lanceolata*, *Mentha hirsuta*, *Heliotropium peruvianum*, *Beta vulgaris*, *B. maritima*, *Calceolaria pinnata*, *Callistemma*, *Tussilago*, *Geranium robertianum*, *Spergula arvensis*, *Bunias kakile*, *Galium mollugo*, *Crocus*, *Dianthus caryophyllus*, *D. prolifer*, *Tulipa*, *Fuchsia coccinea*, *F. globosa*, *F. micrantha*, *Narcissus*, *Mesembryanthemum*, *Hyacinthus*, *Verbina*, *Tropæolum tricolor*, *Solanum tuberosum*, *Polygonum persicaria*, *Pimelea sylvatica*, *Myrtus*, *Citrus*, *Ruscus androgynus*, and *Cactus*.

In India this insect was first noticed in 1894 as injurious to rape crop in the district of Berhampur, see *Indian Museum Notes*, Vol. IV, No. 1, p. 23.

Now that the occurrence of this destructive pest has twice been recorded in India within such a short space of time as two years,

and on two different kinds of plants, there is every reason to suppose that it will soon extend its ravages on other agricultural crops.

As regards remedial measures, spraying the affected plants with a solution of kerosine emulsion would be the simplest means to get rid of the pest.

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c. Potato Aphis.—In January 1897, Dr. G. Watt, Reporter on Economic Products to the Government of India, furnished specimens to the Indian Museum of an Aphis said to be infesting potato plants in the vicinity of Calcutta. He reported that the stem of the plant gets withered near the ground, the very part on which the Aphis occurs, and that all the affected parts of the crop consisted of plants reared from cut seed potatoes; where whole potatoes were employed the disease had not appeared.

Aphids are well known to be agricultural pests, but the few dried specimens that were sent for examination are insufficient for precise identification.

Some specimens of a red ant were also forwarded as occurring along with the Aphis. These have been kindly identified by Dr. Forel as belonging to the species *Dorylus orientalis*, Westw.= *curtisii*, Shuch.=*oberthuri* and *fuscus* of Emery.

With regard to the habits of this species he writes:—

"All *Dorylus* species feed on animal food (insect under the ground), never plants. This ant is certainly not obnoxious to potatoes, but was hunting after worms and other insects in the same way as *Dorylus fulvus* worker hunts in Algeria."

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d. Kankrol fruit pests.—In September 1897, the Scientific Secretary to the Indian Gardening Association, Calcutta, forwarded to the Indian Museum specimens of insects found boring into "Kankrol" fruits which he had bought in one of the Calcutta markets.

The specimens consisted of two different kinds of insects, namely, small larvæ of a Tineid moth, and some Dipterous grubs of an unknown species.

The following report has been furnished by the Scientific Secretary :—

"On Sunday, the 15th August last, I bought some specimens of the fruit 'Kankrol,' what attracted me in buying them were the warty growths on the epicarp of the fruits. I subsequently found holes on the epicarp. The fruits were placed within a stoppered phial and allowed to remain in this condition for a week. After the expiration of the week I had to remove one finding it very rotten, and while removing it I marked two larvæ come out of it. They were of brownish colour and possessed the power of leaping, which feat they accomplished by bringing the both ends of the body together. They leapt over spaces of $1\frac{1}{2}$ feet. These specimens, however, were unfortunately lost. I dissected the remaining fruits and succeeded in securing one good specimen which is exhibited in the phial XXX 20, with the portion of the fruit where it was found.

"Pushing the enquiry further and examining several specimens of the fruit from time to time, I have fortunately succeeded in securing some full-fed larvæ, some immature ones and three eggs, all of which will be found in the phial XXX 21. . . . . .

"Now a word about the disease itself. These fruits, as far as I can conclude from the existing data, were possibly diseased *after* the maturation of the ovary. In any case they were not diseased *during* the maturation of the ovary in which case the larvæ would have bored their way from inside outwards; while in the present instance, the structure of the holes show that the insects laid their eggs on the epicarp, and the larvæ after coming out of the eggs ruptured the hypodermal vessels and found their way to the endocarp; next, the placental regions were attacked. In this stage decomposition set in. The putrefaction is in part caused by some fungal element the conidia of which may be seen on the fruit.

"The fruit itself has some economic importance. It is largely used by the poorer classes who deem it a delicacy. The local markets supply them in large quantity from which it can be inferred that the fruits at least are in moderate demand."

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6. *Sugar-cane pest.*—In October 1897, samples of sugar-cane said to be affected by insects were forwarded to the Museum by the Chairman of the Chamber of Commerce, Cocanada, who reported :—

"Although season favourable sugar-canes are dying largely from previously unknown cause. Dissection shows caterpillar and earwig in heart of canes. Can you send expert to advise."

"This message speaks for itself, and contains, I regret to say, all the information I am able to give on the subject.

"About three weeks ago I first learned that the canes in the Godavary Delta were 'withering' in a manner never before seen by the cultivators, and for which they could furnish no explanation. These cultivators are entirely natives, and the crop had, up till then, been reported to be thriving well. Within the last

few days the reports of damage have become accentuated, and have been confirmed by European observation. I have had some of the canes dissected with the result mentioned in my telegram. The earwig is smaller and thinner than an English earwig. The caterpillar is about 1¼ inch in length, of a pale semi-transparent whitish grey colour, having thin longitudinal stripes of very pale brown, along which at intervals are largish spots of much darker brown.

"I fear that the crop in the delta has already suffered severely, and shall be glad if you can assist the ryots in staying the progress of the ravage. In the uplands, where the canes are irrigated from wells, the scourge does not seem to have made its appearance."

On examining the samples of cane, none of the caterpillars mentioned in the report were discovered in them, but only a few earwigs which are not thought to be the real cause of the disease.

It is well known that the sugar-cane in this country is subject to the attack of a borer moth *Diatræa sacharalis*, Fabr., the caterpillar of which tunnels into and destroys the cane. Accounts of the insect may be found in *Indian Museum Notes*, Vol. 1, pp. 22-27.

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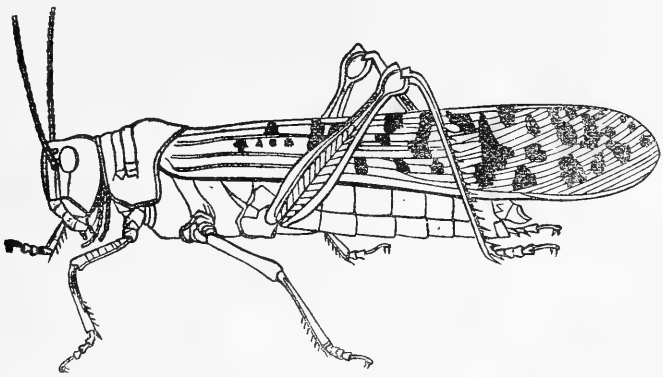
7. The Migratory locust of North-West India.

Acridium peregrinum, Oliv.

During the year 1897 the flights of the migratory locust (*Acridium peregrinum*, Olivr,) of North-Western India, appear to have been very prevalent and the injury done by them to crops, etc., very extensive both in India and the Baluchistan Agency, and also in the Persian Gulf. In Baluchistan alone the damage done to cultivation by this insect is estimated at ₹60,000 or ₹70,000 to State revenue. On the 12th June they were reported to



be in such swarms that the train from Quetta to Chaman was

delayed 2½ hours on their account ; while in Toba almost all the barley crops were destroyed, and the owners in despair of saving their crops let their cattle, goats and sheep loose into their fields as they preferred to see their crops eaten by them rather than by locusts.

Now that the judicious use of arsenic as a means of destroying locusts has been proved beyond doubt by actual experiments in the Victoria County, Natal (see *Indian Museum Notes*, Vol. IV, No. 3, pp. 137—139) to be a remedy of very great value, and assuredly superior to any other measures hitherto adopted as regard effectiveness and cheapness, it is to be hoped that this method may be tried in India.

The following are the reports that have been forwarded to the Museum regarding the flights :—

(*a*) From the Baluchistan Agency —

Extract from the Baluchistan Agency Diary for the week ending 31st May 1897 :—

" Dense swarms of young crawling locusts have come to Chaman from the Registan. About 400 men of the 29th Bombay Infantry, Railway gangs and other people are engaged with great vigour, in destroying them.

" Lieutenant Webb Ware also reports that Nushki is swarming with these young locusts, and similar reports have been received from parts of Pishin."

Extract from the Baluchistan Agency Diary for the week ending 8th June 1897 :—

" *Zhob.*—Locusts have made their appearance in large numbers in the Lower Zhob sub-division. Numbers of young locusts have been hatched and great apprehensions are felt for the *kharif* crops.

" *Chaman.*—Young crawling locusts have also appeared in dense swarms in Chaman and destroyed the garden crops and vegetables in spite of the efforts made by the men of the Infantry regiment, the railway gangs, Levies and Police, to keep them out."

Extract from the Diary of the Baluchistan Agency for the week ending 30th June 1897 :—

" Locusts are said to have greatly decreased in Chaman, but reports from Toba state that myriads of young locusts are all over the country and have done very great damage to the crops. They are reported to be in such swarms that the train from Quetta to Chaman was delayed 2½ hours on this account on the 12th."

Extract from the Baluchistan Agency Diary for the week ending 8th July 1897 :—

" *Zhob.*—Locusts still infest almost every part of the district, and, at places in the Hindubagh and Fort Sandeman tahsils, have done a considerable amount of damage to vegetables and trees. It will probably be necessary to suspend or remit some of the revenue demand in parts of Pishin and Toba owing to the damage done."

"*Chaman.*—Locusts have destroyed almost all the barley crops in Toba. The owners have, therefore, let their cattle, goats and sheep loose into their fields as they prefer to do this, rather than see the locusts eat up the crops."

Extract from the Baluchistan Agency Diary for the week ending 16th July 1897 :—

"Reports from Toba show that locusts have destroyed nearly all the barley crops and have done considerable damage to fruit trees and to the autumn harvest. They have, moreover, eaten up all the green and dry grass both in the valley and on the mountain tops. There is likely in consequence to be serious distress among the Achakzais. The Revenue Commissioner has been asked to report on the subject."

Extract from the Diary of the Baluchistan Agency for the week ending 24th July 1897 :—

"*Zhob, for week ending 16th.*—Enormous flights of locusts have been seen in Ghosa and near Murgha, but they have as yet done no damage except to trees and grass. It is feared that if they do not leave before the *kharif* crops are above ground, they will do much harm.

"At Mekhtar where the crops are more advanced, one sowing of China nung has been almost completely cleared off by them and the people have sown the lands again.

"Reports from the Upper Zhob sub-division show that locusts are still very numerous in many parts and that great damage has been done by them in the western circle of Bori and in the hill villages near Hindubagh."

Extract from the Diary of the Baluchistan Agency for the week ending 8th September 1897 :—

"*Thal Chotiali.*—Ziarat and the adjacent country has been again visited by an enormous flight of locusts.

"They are still there and considerable damage has been done."

Extract from the Baluchistan Agency Diary for the week ending 24th September 1897—

"*Zhob, for the week ending the 16th September.*—The Assistant Political Agent, Upper Zhob, reports that the crops of only 9 of the Mirzai and Shadozai Karezes near Killa Saifulla, have escaped severe damage from locusts, the rest have been considerably damaged and in some cases completely destroyed.

Extract from the Baluchistan Agency Diary for the week ending 24th October 1897 :—

"*Southern Baluchistan, for the week ending the 16th October 1897.*—During the week, daily reports have been received from Las Bela stating that great damage has been done to the crops by locusts, and it is feared that serious loss of revenue will be the result."

Extract from the Baluchistan Agency Diary for the week ending 31st October 1897 :—

"*Southern Baluchistan, for the week ending 24th October.*—The damage done to cultivation by locusts is estimated at ₹60,000 or ₹70,000 to State revenue.

"*Thal Chotiali, for the week ending 24th October 1897.*—The Tahsildar, Barkhan, reports that a flight of locusts appeared in the Barkhan tahsil and did much damage to the *kharif* crop."

The Extra Commissioner, Sibi, reports that a swarm of locusts also visited the Sibi tahsil and ate up a portion of the crop.

Extract from the Baluchistan Agency Diary for the week ending the 30th November 1897 :—

"*Southern Baluchistan, for the week ending 16th November.*—The Wazir's inspection of the cultivation shows that the major portion of the crops have been destroyed by locusts, a fact which is telling on the people as they are contemplating leaving their homes and seeking employment elsewhere. Damage by locusts is being daily reported from all parts of the State."

(*b*) From the Political Resident in the Persian Gulf, Bushire—

Extract from the Diary of the Political Resident in the Persian Gulf, Bushire, for the week ending 12th June 1897 :—

"*Shiraz, June 5th.*—Locusts have destroyed all the harvests at Kafrak and Marvdasht, and have now flown to the places round Shiraz, where they are destroying the summer crops."

Extract from the Diary of the Political Resident in the Persian Gulf for the week ending 26th June 1897 :—

"*Shiraz, 12th June.*—Large numbers of locusts have swarmed about Shiraz and after destroying the wheat and barley crops are now devouring the vegetables sown in the suburbs."

(*c*) Through the Survey Commissioner and Director, Land Record and Agriculture, Bombay—

(1) From the Collector of Karachi (7th June 1897)—

"To forward herewith a bottle containing specimens of locusts, preserved in country liquor. These locusts formed part of a large flight that arrived at Jarruck on the 5th instant. On the 4th and 5th also locusts came, but the main body appears to have come on the 5th instant. They came from the North-West and went off nearly due North.

"The Mukhtyarkar of Tatta has not as yet reported whether damage has been caused by them elsewhere, but at Jerruck rice seedlings have suffered."

(2) From the Deputy Commissioner, Upper Sind Frontier (29th July 1897)

"To inform you of the appearance on the 19th instant, of locusts in the Shahdadpur taluka of this district. A large swarm is reported to have come from Garhi Khyra in the Jacobabad taluka and Kelat Territory to the North-West. It is reported that they have slightly damaged the young crops in nine tapas of the taluka. These locusts were seen going to Kamhar taluka in the Shikarpur district on the next day. A certain number of them, however, appeared again on the 22nd instant and went back to the Kamhar taluka.

"The specimens sent by the Mukhtyarkar, enclosed in a bottle, are herewith forwarded."

(3) From the Political Agent, Mahikantha (9th August 1897)—

"I have forwarded to you by parcel post a specimen of locusts which were seen passing through the Godhawada thana limits on the 29th and 30th ultimo. The swarms came from North-West and passed towards Hadol and Idar in the South-East laying eggs in some places.

"The flight of the insects was further seen passing through the Idar and the Sobarkantha limits on the 1st instant. They did not settle but passed towards the East from the Sobarkantha.

"The damage done to the crops in Idar and Gadhawada was slight."

(4) From the Political Agent, Mahikantha (20th October 1897)—

"On the 18th instant at about 4 P.M. a flight of locusts was seen in the limits of Sadra coming from Oran under Prantij in the North, they halted for night covering over an area of about one mile. In the morning from 6 A.M. they commenced to eat the jowari crop that was standing in the fields till 11 A.M. when they swarmed away in the southern direction towards Jakhora, a village under Baroda.

"During their stay in the limits of Sadra the damage done by them to the jowari crop is estimated at about 25 maunds, *i.e.*, ₹50.

"As required in Government Resolution No. 14, dated the 3rd January 1890, Revenue Department, a specimen of the insect has been forwarded to the Director of Land Records and Agriculture, Bombay."

(5) From the Mamlatdar of Olphad (19th November 1897)—

"To report that this taluka is infected by a swarm of locusts. Some of the villages have been visited by them, but no considerable damage has been done. I am engaged at Ophad in plague work . . . . and have since deputed a Karkun and Havaldars to destroy them. Villagers try their utmost to clear off the villages of them. . . . The villages visited are as below :—

"Mandroi, Bolav, Anita, Masma, Sefetawad, Sultanpur, Karamla, Isanpu and Umrachi."

(6) From the Collector of Nasik (4th November 1897)—

". . . . to forward in a separate parcel a few specimens of locust preserved in country liquor received from the Mamlatdar of taluka Sinnar. The Mamlatdar has reported that great swarms of them visited Sinnar itself last evening (27th October) and have been there till this morning.

"They have eaten up some bajri crop (a few specimen ears are sent in the parcel referred to), but no great damage has yet been done as the locusts are reported to be paralyzed by the cold at Sinnar. They are reported to have come from the East. . . . . ."

(7) From the Collector of Broach (6th November 1897),—

". . . . on the 19th of October flights of locusts were seen coming from the direction of Rajpipla Hills to the east of Broach taluka. They passed over several villages of the taluka and settled for a short time on trees of the West of

Broach, but did no damage to crops. They then went straight on to the westward and entered the Wagra taluka on 20th and 21st October where they caused only some slight damage to crops in the following villages.

"*Rahiad.*—Til crops damaged to the extent of ₹25. No injury to cotton and jowari crops.

"*Suva.*—Slight damage to cotton leaves which, it is reported, will reappear. No damage was done to other crops. If, however, the cotton plants of which the leaves have been eaten up die, the damage would amount to about ₹75.

"*Jolwa.*—Til and cotton damaged to a slight extent.

"*Kaliad.*—No damage is reported.

"On 21st they appeared at Dehej and other villages around it, namely, Lakhigam, Luvera Ambheta, Jageshwar, and then went over several other villages. The crops that were damaged are:—Bawata, Kodra, Kharif Jowari, Tur, Til and Cotton crops. Bhavta has suffered the most. Bhavta, Kharif Jowar and Til crops which fortunately were sold in a small area are expected to yield no outturn, but the outturn of Tur and Cotton crops is affected to a small extent only. Damage to cotton crop is reported also in about 20 other villages but details have not yet been received. In the villages which the Mamledar, personally visited, namely, Jambusar, Magnad, Tugrelpur, Khajampur, Wavli, Dostpur and Khanpur Deh, he found that the damage done to the above mentioned crops was comparatively small, but that in Kajampur, Dostpur, and Khanpur Deh especially the cotton crops, which covered an area, of 20, 200, and 300 acres, respectively, have been seriously damaged. Cotton plants which had been sown early and so were well grown have not been damaged so as to render impossible the putting forth of new leaves, but the late crops which were not full grown have been damaged past all hopes. This strengthens the presumption that the locusts were not old enough to devour harder substance.

"News has just reached me that vast swarms of locusts were again seen yesterday in the neighbourhood of Palej, so that I regret to say that our outlook which was exceedingly favourable is now clouded over."

(*d*) Through the Under-Secretary to Government, Revenue Department, Bombay—

(1) From the Political Agent, Mahikantha (26th August 1897)—

". . . to state for the information of Government that from a report received from the Gadhwada Thandar it appears that swarms of locusts appeared in the villages of Khaski, Rampura and Fudeda under Valasna taluka on the 3rd, 4th, 5th, and 6th instant and flew away causing damage to the extent of about ₹1,000. They had laid eggs in some places but there is no possibility of their being hatched, as they are destroyed by heavy rains falling there subsequently.

(2) From the Political Superintendent, Palanpur (8th September 1897)—

". . . . . to report for the information of Government that a slight rise in the price of grain has lately taken place in these districts owing to the apprehension that locusts will damage the crops which are now standing. Great swarms of locusts visited these districts in the latter part of July flying from West to East

They deposited eggs from which the young locusts which are so much dreaded have been hatched.

"The Thanadar of Santalpur has lately reported locusts passing from Marwar towards the Ran of Cutch and leaving eggs in his district."

(3) From the Collector of Kaira (11th January 1898)—

". . . . . to submit the following report about the appearance of locusts in the district in October and November last.

"On the 28th October a flight of locusts passed from North-East to South-West of the Borsad taluka going in the direction of Cambay. Another flight also passed on the 1st November from North-East to South-West of that taluka. They caused slight damage to the crops of Tur and other pulses.

"On the 30th October a flight appeared from the Modasa side and passed through several villages of the Kapadvanj taluka, and rested for the night in the villages of Dhudadra, Nes and Bhadrasar, causing damage to the extent of ₹200, ₹400, and ₹1,000, respectively, to the crops of Math, Chola and late Bajri. In the afternoon of the following day (31st October) they left and were seen at about 5 P.M. at Nariad passing on their way through Umreth. They alighted on trees in Nariad, Piplata, Gutal and Keriam, but did little or no damage to crops. Next morning (1st November) they left in the direction of the Matar taluka, but do not seem to have appeared there.

"On the 2nd November a flight appeared at Saudesar in the Anand taluka, and after going to the South re-appeared on the 3rd, and alighting in Saudesar and Velasan, did damage to the extent of ₹1,000 and ₹200.

"On the 5th November, another flight passed through the Kapadvan taluka, but it did not alight.

"The total amount of damage caused to crops is estimated at ₹2,200."

(4) From the Collector of Ahmednagar (30th October 1897)—

". . . . . to inform you that the Mamlatdar of Kopergaon reports under date the 27th instant, that a flight of locusts arrived at Kopergaon that morning at 11 A.M. from the South-East and West. The trees on the Kopergaon Signapur roads were covered with them and they eventually alighted on the Bajr crops and did some damage. On being driven off, they next alighted in the fields of the villages of Dharangaon and Murshatpur. Here too they were similarly treated and the Mamlatdar understands they have gone into the Sinar taluk of the Nasik district."

(5) From the Deputy Commissioner of Mandla district (11th December 1897) through the Commissioner of Settlements and Agriculture, Central Provinces—

"A flight of locusts entered this district at Patwari Circle No. 10 on the 16th October 1897, coming from the direction of Birgi in the Jubbulpur district. It passed through Kirho, Piparia, Salaya, Maneri, Moldongri (in Circle No. 10), Cheolia, Dongaria, Maldha, Bhartipur, Sangwon, Pindrai and Sohajpuri (in

Circle No. 11), and then entered the Seoni district at the Kedarpur pargana It appeared again on the 20th October in Circle No. 24 and passed through the marginally noted villages causing varying damage in its flight. It then passed over the hills on the boundary between the two tahsils and bore southward, returning into the Mandla tahsil in Patwari Circle No. 71 and caused some damage in the villages of Kanhari, Guara, Kewa, etc., of Circle No. 50 in the Dindori tahsil. It then travelled over the jungles to the South of Bajag and was next met with in Khamor Khudru, Sohajno, Chakmi, Gopalpur and Majh gaon in the very South of the Dindori tahsil. On about the 26th October the flight passed away over the hills in the direction of Amarkantak.

Saledanda, Pondi, Thonda, Surajpur of Circle No. 24; Babeha, Jujhari, Bacheragondi, Bakori, Umaria, Kosumdongri of Circle No. 22; Tikrakhespaui, Kanadongri, Kheri of Circle No. 18; Sudgaon of 55; Saliwara, Mohgaon of 56; Kumharra, Silghuli Cheolatola of Circle No. 57; Khonda Khudra, Goriapondi and Chalin, Circle No. 60.

"The principal damage was caused to the Kodon Kutki, and Sarson crops but the Juar crop was also damaged to some extent as the heads were in flower at the time. The area damaged in any single village does not exceed 50 acres except in the five villages of Kirhopiparia, Karhopiparia ryotwari in Circle No. 10, Thonda and Pondi in Circle No. 24, and Khondra Khudra in Circle No. 60, all in the Mandla tahsil.

"With regard to these five villages the necessary enquiries under Revenue Book Circular 1-9 (Vol. II), are being made.

"A second flight appeared on 23rd November 1897 from the direction of Seoni. It passed through Circle Nos. 15 and 16 of the Mandla tahsil, and entered the Dindori tahsil near Peparin and Mewas and then passed northward into the Jubbulpur district. This flight caused very little damage, except in some places, to the wheat seedlings.

"A third flight is reported to have appeared at Dindori on the 28th of November and to have gone southward towards Bajag, but it does not appear to have caused serious damage at any place in its course."

(6) Through the Officiating Commissioner of Settlement and Agriculture, Central Provinces, Nagpur, from the Deputy Commissioner, Hoshangabad—

"The first flight of locusts crossed the North-East corner of the Sohagpur tahsil on the 9th October and did comparatively little damage, the village most affected was Ajera, where 60 acres of tilli, kutki, urad and mung were slightly injured.

"On the 23rd, 24th, 25th, 28th, 29th, 30th and 31st further flights entered this tahsil from Bhopal, some portion of them spending the night in different villages. All these flights appear to have come from a large flight in the Bhopal State across the Narbada, a flight which was still in evidence as late as the 15th December.

"In most cases very little damage was done during the day time, the locusts only staying a short time and moving on then to other fields.

"In the villages where the locusts rested at night the damage is more serious. Their numbers were so great that branches of trees were broken by their weight, and the only reason why the crops did not suffer more than they did was, that much of the jawari was too young to be seriously damaged. Any

head which was ripe and attacked by locusts presents the appearance of having passed through the threshing floor," and hardly a grain has been left"; luckily one of the largest swarms missed the cultivated fields and rested for the night in the jungle near Sukhakheri where the damage to the trees was of little moment.

"In the Hoshangabad tahsil the flights of locusts appeared later than in Sohagpur, and on examination of the dates and places shows, that the swarm was moving East to West. The principal swarms were on the 31st October and the 1st and 2nd November.

"The damage done in the day time here also was comparatively small, but two villages suffered severely from the locusts on the night of the 31st October, *viz.*, Jhalsar and Satwasa, ... Taradonda Sankhera, Itarsi, Goar and Sona Saoni also suffered considerably.

"The Seoni tahsil appears to have escaped almost entirely, the only village affected was Chapragrahan in which the damage was trifling and the people did not even complain about it when I visited it yesterday, though they made every imaginable excuse to show how difficult it was to pay rent this year.

"In the Harda tahsil also the damage done was comparatively small and no proposals for suspension of revenue are required.

"Omitting all villages where the crops have turned out more than Re-8-0 in all fields, I submit a statement showing the area affected in each village, the total anna value of the produce and the estimate of the crop in the field which has suffered most :—

Tahsil.	Name of village.	Area affected.	Anna value of produce.	Anna estimate of crop in worst field.
		Acres.	Acres.	*R. a. p.*
Sohagpur.	Malkajra . .	348·71	2,778·22	0 7 0
	Tantra . . .	225·38	1,519·68	0 4 0
	Purena . . .	367·23	2,712·76	0 7 0
	Semkhera . .	248·00	1,654 00	0-3-4-8-0
	Khera . . .	193·24	1,489·92	
	Gadroli . . .	316·27	2,381·16	0 7 0
	Budhni . . .	352·10	2,414·35	0 1 0
	Swula Khd. . .	157·88	919·01	0 1 0
	Kanthi . . .	345·51	2,452·85	0 1 0
	Mathni . . .	248·42	2,480·72	0 4 0
	Dhandya . .	221·04	1,735·60	0 4 0
	Mundyakhera .	372·73	3,372	0 8 0
	Ranigohan . .	339·60	3,531	0 4 0
	Mohwakhera . .	133·60	1,137	0 4 0
Hoshangabad.	Jolsar . . .	403·18	1,285	0 1 0
	Satwasa Mahal No. 1	322·07	2,360	0 6 0
	Tararonda . .	99·46	397	0 4 0
	Sankhera . .	58·16	232	0 4 0
	Itarsi . . .	59·98	423·54	0 1 0

III.—INSECTS INFESTING FRUIT TREES.

1. *Psychid caterpillars destructive to vines.*—Samples of grapes together with some leaves of the same were forwarded to the Indian Museum in January 1897 by Mr. N. R. Lester, Superintendent, Empress Botanical Gardens, Poona, as suffering from what appeared to him to be fungus growths on the fruits and leaves.

On examining the vines they were found to be attacked by minute caterpillars of an unknown Psychid moth the like of which had not hitherto been recorded as destructive to grapes in India. From the caterpillars that had arrived in the Museum alive some moths were reared, but owing to their very minute size and the difficulty in obtaining good specimens the identity of the species could not be decided.

To be quite certain that the vines were not also simultaneously attacked by fungus, the samples were submitted to Dr. D. Prain, of the Royal Botanic Garden, Sibpur, for examination, who wrote upon the subject: "I have carefully examined the specimens of vines sent with your note of 22nd instant, and, so far as I can make out, there is no fungoid disease present. The pathological effects seem to be the result of some insect blight. . . . . "

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2. *Mango caterpillar.*—The Superintendent, Empress Gardens, Poona, reported in August 1897 the appearance of a number of caterpillars with stinging bristles, which were destroying mango leaves in his gardens.

The specimens forwarded by him, though they arrived in the Museum alive, soon died apparently from the effects of the long journey. They proved to be the caterpillars of a moth belonging to the family *Limacodidæ*.

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3. *Cerambycid larvæ destructive to apple tree.*—Some Coleopterous larvæ said to be tunnelling into the stems of an apple tree in Muktesar, were forwarded in the Indian Museum by Mr. M. K. Bamber, Superintendent, Government Nursery, Muktesar, in January 1897.

The insects proved to be the immature forms of a Cerambycid beetle, which cannot be further identified without the examination

of the imago. Mr. Bamber reports that he is using kerosine oil to kill the pest, by pouring small quantities into the holes in the stems.

Pouring kerosine oil into the burrows would no doubt prove an effectual means of destroying the insects, provided it does not also injure the tree on which it is used.

IV.—FOREST PESTS.

1. *Eriococcus paradoxus,* Mask., var. *indica.*

(Sub-ord. Homoptera, Fam. Coccidæ.)

Plate XV, *fig.* 3.

From Mr. J. S. Gamble, Director of the Imperial Forest School, Dehra Dun, were received in January 1896 specimens of a Coccid found on stems of *Helicteres isora* at Mohand in the district of Saharanpur.

The specimens appeared to be new to the Museum collection. Mr. W. M. Maskell who kindly examined the insect, wrote: "This is *Eriococcus paradoxus*, Mask., a variety which I shall name *indica*, differing from the type in the very slightly larger size and in the more numerous and large figure of 8 spinnerets. The type is from South Australia and is described by me in the Trans. of Roy. Soc. S. Australia, 1887-88."

The following is Mr. Maskell's description of the type:—

Eriococcus paradoxus.—Sac of adult female dark reddish brown, circular, convex, aggregated in masses on the bark, and so thickly covering it sometimes as probably to smother the plant; diameter about $\frac{1}{8}$ inch.

The aggregated mass is so thick that on cutting a vertical section it appears like a honeycomb of cells each containing an insect. At the summit of the convex sac is a very minute orifice (not apparent in every instance). This orifice is probably intended to give access to the male insect, specimens of which may sometimes be found inside the cellular sacs with the females. The sac is so closely fitted that it has quite the appearance of being waxy instead of cottony, but a little pressure with the point of a pencil makes an impression in it as if it were leathery; and on boiling in potash it becomes dissolved, which is not the case with any waxy Coccid test, as far as I know. The spinnerets and threads described below are also evidences that the sac is really felted, though very closely.

The sac of the male is reddish-yellow, narrow, elongated, convex above and flat beneath; after its last metamorphosis the male escapes by an orifice at one end.

Adult female somewhat peg-top-shaped, the cephalic region large and smooth, the abdomen small, segmented and tapering to the two anal tubercles, which are prominent, and bear each a long seta. Colour dark reddish-brown; length, exclusive of the tubercles, about $\frac{1}{10}$ inch. On maceration and boiling in potash the anatomical details can be made out. On the cephalic region, there are four bands of very small, circular spinneret orifices; these bands correspond with the position of the four stigmata of the body. On the abdominal segments there are rows of double, or figure-of-eight, spinnerets; many of these also are scattered over the cephalic region. From these double spinnerets spring long white curling threads, which form the felted sac. The rostrum is conical, and the mentum is bi-articulate. The antennæ are atrophied and very short; the number of joints cannot be clearly made out, owing to compression, which confuses them; but the normal number in the genus is six, and probably this is the case here also. The tip bears a few strong short hairs. The feet are entirely absent.

The second stage of the insect has not been observed.

The larva, just after leaving the egg, is of the normal shape of the genus—elongated, flattish, tapering slightly posteriorly; exhibiting the anal tubercles. Colour reddish; length about one-fortieth of an inch. Antennæ of six sub-equal joints, all slightly dilated at the end except the last, which is irregular and pointed, and bears some hairs; all the joints appear to be numerously ringed. Feet normal. On the body there are four longitudinal rows of figure of eight spinnerets. The anal tubercles bear long setæ.

Adult male red; somewhat short and squat; the thorax broad, and the abdominal segments compressed. Length of the body, about one-fortieth of an inch. The last segment of the abdomen bears on each side three longish setæ. Antennæ of ten joints, the first very short, the rest sub-equal, elliptical, except the second, which is dilated at the tip; all the joints bear hairs. Feet slender; upper digitules long and slender, lower pair short; fine hairs. Abdominal spike conical pointed.

Hab.—On *Pittosporum undulatum*, South Australia.

Diaspis calyptroides, Costa, var. ***cacti,*** Comstk.

Coccid on Prickly Pear.

In March 1896, specimens of Prickly Pear infested by Coccids were forwarded to the Museum from Southern India through

Dr. G. Watt, C. I. E., Reporter on Economic Products to the Government of India.

The insect proved to be new to the Museum collection, but it was identified as belonging to the genus *Diaspis*. It was kindly examined by the late Mr. W. M. Maskell who considered it a *Diaspis calyptroides*, Costa, var. *cacti*, Comstock. He wrote :—

"The species is found on Cactaceæ in many countries. The type is described by Signoret, *Ann. de La Soc. Entom. de France*, March 1868, p. 434 : and the variety by Comstock, 2nd Report, Department of Entomology, Cornell University, 1883, p. 91.

"Comstock considered his insect as a distinct species : but the difference from the type is but slight, and I incline to look upon it as only a variety. Costa's original description (*Faun. Nap.*, 1827, p. 6) is most incomplete, and chiefly concerns the male scale : but Signoret gives full details.

"This insect is almost always, where it occurs, very numerous on the plant (as in those you sent) : and must therefore be usually injurious.

"There is another variety *opunticola*, Newstead, on *Opuntia* in Demerara (*Ent. Mo. Mag.*, 1893, p. 1888), which has more prominent terminal lobes than your insect. I fancy all the varieties arise from climate or from a slightly different species of Cactus."

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3. *Coccid on Prickly Pear.*—Mr. E. Thurston, Superintendent, Government Museum, Madras, forwarded specimens of a scale-insect infesting Prickly Pear in the Kurnool and Anantapur districts.

The specimens were found to be unrepresented in the Museum collection, so were submitted to Mr. W. M. Maskell for examination.

Mr. Maskell kindly furnished the following report regarding the insect : "The insect sent to me .... as infesting Prickly Pear in Kurnool and Anantapur is clearly a form which Mr. E. E. Green is proposing to name *Coccus cacti*, var. *ceylonicus*, a variety of the Cochineal insect. It is identical with specimens sent to me some time ago by Mr. Green."

I presume that a full description of this form will appear in Mr. Green's book on the Coccidæ of Ceylon now in the press. Pending its publication I cannot well give you a detailed note for *Indian Museum Notes*. It is possible that Mr. Green may see fit to change

the name ; and I am inclined rather to look on the insect as perhaps more than a mere variety. But you may be sure at least that you specimens are identical with those from Ceylon.

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4. *Aleurodes sp. on betel-nut palm.*—In May 1896, Dr. G. Watt, while on deputation to enquire into the cause of the disease affecting betel-nut palms in Backerganj, found a small black scale-insect with a white waxy border fairly abundant on diseased trees.

The leaves forwarded by him to the Indian Museum were found to be thickly beset with scale-insects which appeared to belong to the sub-family *Aleurodidæ;* the specimens being new to the Museum collection.

In order to obtain the precise identification of the pest, specimens were submitted to Mr. W. M. Maskell who kindly examined them and furnished a note upon the subject. Mr. Maskell found that the leaves were covered with a species of *Aleurodes*, larvæ, and pupæ, which appear to be intermediate between *A. barodensis* and *A. piperis* of his paper of 1895. They have the strong black hairs of *A. piperis* with a thick white waxy fringe rather more solid than that of *A. barodensis.* They seem to be nearest to *A. piperis*, but differ from it sufficiently for him to consider them distinct.

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5. *Cœlosterna sp.*— Specimens of a longicorn beetle were received in December 1897 from Mr. B. O. Coventry, Assistant Conservator of Forests, Lahore, with the information that they were causing much damage to the Mulberry trees in the Shahdera Plantation.

The insect appeared to be a *Cœlosterna* and not unlike the species *C. scabrata*, Fabr., which does a good deal of damage to sâl trees in Oudh.

Mr. Coventry has furnished the following note regarding the insect:—

"The presence of the larvæ of this beetle is easily recognised by the red rusty colour on the stems of the mulberry trees, due to the sap trickling down from the holes made by the larvæ in coming to the surface. The burrow usually commences high up the stem and often from a branch. From this point the larva burrows down the stem, in the heart-wood, making a tunnel which gradually increases in diameter,—at intervals it comes to the surface making a hole from which wood dust is thrown out and the sap trickles down staining the stem a rusty red colour.

"The perfect beetle appears at end of July and beginning of August, and can be found at the end of the burrows at this time of the year.

"The larval stage evidently extends over several years, for larvæ of all sizes are found at the same time of the year.

"The forest in which this beetle occurs very extensively is a mixture of Shisham (*Dalbergia sissoo*) and Mulberry (*Morus indica*). It is worked on the coppice with Standards system. The standards being all Shisham.

"The beetle does not attack Shisham. With exception of these standards the forest is worked for fuel with a rotation of 15 years.

"The damage is therefore not so very serious as far as this forest is concerned."

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6. ***Hyblæa puera***, Cram.

(Sub-ord. Heterocera, Fam. Noctuidæ.)

Teak pest.

From Mr. C. C. Hatt, Deputy Conservator of Forests, Puri district, have been received in August 1897 specimens of a moth said to be causing much damage to teak trees in the forest of Khurda.

The specimens were identified with *Hyblæa puera*, Cram., a common teak tree pest of India. It has previously been recorded in the pages of these *Notes* as attacking teak trees in Lower Burma, Dehra Dun, North-West Provinces and in the Kulsi plantation in Assam, etc.

The following is the description of the species as given by Sir G. F. Hampson in *Faun. Brit. Ind. Moths.*, II, p. 371.

Head and thorax greyish red-brown; abdomen black-brown with orange segmental bands. Fore wing greyish red-brown, irrorated with a few dark specks. Hind wing black-brown, with curved orange band with scarlet edges from upper angle of cell to near anal angle; a band on the margin from vein 2 to anal angle. Underside of fore wing black, with orange fascia in cell and far beyond it; the costa and apex pale brownish with dark specks; the inner margin yellow. Hind wing pale brownish with dark specks; orange towards anal angle with two large black spots.

Larva with a few short hairs; dark purple-grey above, olive-green below, with dorsal and lateral white lines; a subdorsal series of minute white dots and rings, a series of black dots on lateral line; head and 1st somite black.

Hab.—W. Indies; S. Africa; throughout India, Burma and Ceylon; Java; New Guinea; Cape York. *Exp.* 32-40 millim.

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7. *Psychid caterpillar injurious to Chir.*—Babu Sadanand Gairola, of the Forest Department, Chakrata, North-West Provinces, forwarded to the Indian Museum in June 1897 specimens of an insect said to attack Chir (*Pinus longifolia*) in the Jaunsar Forest division.

The specimens consisted of larva-cases of a Psychid moth probably belonging to the genus *Clania*. Babu Sadanand Gairola wrote:—

"I saw any number of them lying about or sticking to the stalks of grass. But by March the cases were observed to be generally empty, the insects having apparently transformed. . . . . .

"It will be observed that the cases externally are made of pieces of the bark of Chir. But they were not seen attached to those trees and the specimens sent were indeed found attached to the stalks of grass."

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8. *Poplar and Willow tree pest*—[*Chrysobothris sp.*]—From Lieutenant C. O. Tanner have been received, through the Director, Land Records and Agriculture, Bengal, in July 1898, specimens of an insect with the information that they have done great damage to forest trees in Chaman, Baluchistan. The insect is said to attack chiefly soft wood trees, namely, the white Poplars and Willows, and it rarely touches hard wood trees such as Mulberry, Almond and Apricot, etc., but those soft wood trees that get a plentiful supply of water seem to suffer less than others.

The specimens proved to be the larvæ of a Buprestid beetle probably belonging to the genus *Chrysobothris*.

The following is an extract from Lieutenant C. O. Tanner's letter dated 10th August 1897:—

"This pest attacks all soft-wood trees (such as Poplars and Willows) and eats away the wood fibre from the weather side principally. So far as I can ascertain, it works upwards from the roots, as several young trees, which have died this year, do not appear to be affected above that point. In some cases it eats through the tree at half its height when the first strong wind breaks off the upper half."

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9. *Grasshoppers destructive to Chil and Bamboo.*—In September 1897, specimens of grasshoppers belonging to the family *Acrididæ* were forwarded to the Museum, through the Director of Imperial Forest School, Dera Dhun, from the Deputy Conservator of Forests, Kangra Division, as the locusts which had

been inflicting considerable damage to the young sowings of chil and bamboos, in the Kangra Division.

The insects belong to two distinct species of *Acrididæ*, namely, *Tryxalis turrita*, Linn., and *Oxya velox*, Burm. They have been previously recorded in the pages of these Notes as the species amongst other *Acrididæ* in connection with the damage done to crop by so-called locusts in Ganjam both in the year 1890 and 1891.

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10. *Bamboo Coccid,—Planchonia sp.*—Some blighted bamboo leaves were received in June 1898 from Mr. D. Hooper, Curator of Economic Museum, who wrote :—

"While exploring in North Bengal I was shown a clump of bamboos that were dying. I examined these and could find no fungus on them, but a minute insect was seen on the leaves. As this may be the cause of death, I send a tube to you in order to see if the insect can be recognised and, if possible, said whether or not it could be the cause of the destruction."

The insects proved to be a Coccid, and new to the Museum collection. Mr. W. M. Maskell to whom specimens were submitted for examination, replied :—

"Your insect on bamboo in Northern Bengal is clearly a *Planchonia* : and is probably *P. solenophoroides*, Green, MS. But I must wait for Mr. Green's published description before I can definitely give you the species.

"I think you may be sure of the *genera* at least of the insect."

V.—DETERMINATION OF SOME INSECT PESTS REFERRING TO PREVIOUS YEARS, ETC.

1. Specimens of a red-ant sent to the Indian Museum by Mr. A. E. Lourie, of the Forest Department, as infesting a house in Coorg. These have been determined by Dr. Forel as belonging to the species *Dorylus fulvus*, Westw. var., *labiatus*, Shuck.

2. In the case of a mite found infesting flour in one of the Calcutta Bazars, Mr. A. Michael wrote :—

"This appears to be our common cheese mite, *Tyroglyphus siro*, which is quite as abundant in flour as in cheese, the specimens which you send are rather smaller than the English specimens, but I do not rely much on size, and moreover, contrary to what might be expected, where a species of *Acarus* is common to both temperate and

tropical countries, as is frequently the case, I have usually found the tropical specimens the smaller. I cannot find any structural difference."

3. Mite (Tetranychus) injurious to palm tree in Calcutta, identified by Mr. A. Michael as belonging to the genus *Brevipalpus ?*

4. Moths reared in the Indian Museum from caterpillars found tunnelling into the pods of *Cassia occidentalis*, Linn., in Hoogly, have been determined by Sir G. F. Hampson as belonging to the species *Lamoria infumatella*, Hamps., Fam. *Pyralidæ*, Sub-fam. *Gallerianæ*.

5. Chrysomelid beetle (Sub-fam. Galerucidæ) injurious to *Grewia asiatica* in the Dun Forest, identified by Mr. Martin Jacoby as belonging to *Mimastra cyanura*, Hope. The specimens were received in the Indian Museum from Mr. C. J. Rogers, Instructor, Dehra Dun Forest School, through the Director of the Imperial Forest School, Dehra Dun.

6. Scarabæid beetle (Sub-fam. Melolonthini) said to be destructive to the young and tender leaves of *Mallotus philippinensis* in the Dun Forest has been determined by Herr Ernst Brenske as a new species *Serica Alcocki*, Brensk. The specimens were received in the Museum, through the Director, Forest School, Dehra Dun, from Mr. C. J. Rogers, Instructor, Dehra Dun Forest School.

7. Pyralid moth injurious to juar, makai, etc., in Karachi, identified by Sir G. F. Hampson as the same as *Chilo simplex*, Butlr.

VI.—SOME BENEFICIAL INSECTS IN INDIA.

The following letter from the Superintendent of the Indian Museum, to the Honorary Secretary to the Trustees, covers a valuable report from Mr. E. Barlow, the Assistant in charge of Entomology, on this subject:—

With reference to your endorsement No. $\frac{187}{RR}$, dated 27th September 1897, forwarding a letter No. $\frac{1427}{39\text{-}2}$, dated 18th September 1897, from the Officiating Under-Secretary to the Government of India, together with copies of correspondence from the Government

of Madras, Nos. 634 and 635, dated 27th July 1897, relating to the very promising subject of utilizing Lady-birds and other natural enemies of the insect pests of the country, I have the honor to submit the following report by Mr. E. Barlow, the Assistant in charge of Entomology :—

"In India there is already known a good number of indigenous insectivorous insects belonging to the three orders of Coleoptera (beetles), Diptera (two-winged flies), and Hymenoptera (Ichneumon flies, etc.), which have proved to be more or less beneficial to agriculture by keeping down insect pests.

"I.—SOME BEETLES KNOWN TO BE DESTRUCTIVE TO PESTS.

"(*a*) Among the Lady-birds I may mention—

"(i) *Chilocorus circumdatus* Schonh., which is said to prey upon the brown bug (*Lecanium coffeæ*) of coffee plants in Ceylon.

"(ii) *Scymnus rotundatus*, Motsch., which is parasitic upon the white bug (*Pseudococcus adonidum*) of coffee bushes in Ceylon.

"(iii) *Platynaspis villosa*, Mulsant, attacks the scale-insect (*Icerya ægyptiacum*) in Calcutta.

"(iv) *Vedalia fumida*, var. *roseipennis*, Muls., said to prey upon the Coccid *Icerya ægyptiacum* in Calcutta.

The last named was submitted to Mr. L. O. Howard, United States Entomologist, for identification, who wrote regarding it (see *Indian Museum Notes*, Vol. IV, No. 1, p. 28). 'It is interesting to find that this Coccinellid is not distantly related to the well-known *Vedalia cardinalis*, Mulsant, which Mr. Albert Kœbele of this department, brought from Australia some years ago, and which destroyed *Icerya purchasi* on our Western coast. It is Mulsant's *Rodolia roseipennis*, which according to Crotch's revision of the Coleopterous family Coccinellidæ, is a colour variety of *R. fumida*, Muls. Accepting the nomenclature given by Crotch, the name of the insect is therefore *Vedalia fumida*, var. *roseipennis*, Muls.' It may be mentioned that the *Vedalia cardinalis* here referred to is an Australian species of Lady-bird which on introduction into America is said to have at once cleared thousands of orange trees of destructive scale-insects of the species *Icerya purchasi*.

"(*b*) Among beetles other than Lady-birds are—

"(v) A Tiger beetle of the species *Cicindela sexpunctata*, Fabr., which devours the rice-sapper (*Leptocorisa acuta*) in Chumparun.

"(vi) A Carabid beetle *Calosoma orientale*, Hope, which destroys the young locusts of the species *Acridium peregrinum*, Oliver.

"II.—SOME DIPTERA (TWO-WINGED FLIES) KNOWN TO BE DESTRUCTIVE TO INSECT-PESTS.

"(vii-viii) *Syrphus nietneri*, Schinr., and *S. splendens*, Dolesch., the larvæ of these two flies are said to prey on the coffee Aphis (*Aphis coffeæ*) in Ceylon.

" (ix) *Anthomyia peshawarensis,* Bigot, parasitic upon the eggs of the locusts (*Acridium peregrinum*) in India.

"(x) *Masicera subnigra,* Wulp., parasitic upon the larvæ of the moth *Olene mendosa,* Hubn., which attack tea plants in Darjeeling.

" (xi) *Masicera castanea,* Wulp., said to prey upon caterpillars of the moth *Leucania extranea,* Guen., which attack the young paddy plants in Bengal.

" (xii) *Masicera dasychiræ,* Wulp., parasitic upon caterpillars of the moth *Dasychira thwaitesii* which does much damage to tea plant and sâl tree in Assam.

" (xiii-xiv) *Demoticus strigipennis,* Wulp., and *Calodexia lasiocampæ,* Wulp. The larvæ of these two flies are parasitic upon a hairy Lasiocampid caterpillar destructive to rice in the Central Provinces.

" (xv) *Miltogramma 12-punctata,* Wulp., which preys upon the locust (*Acridium peregrinum*) in India.

III.—SOME HYMENOPTERA (FAMILY CHALCIDIDÆ) KNOWN TO BE DESTRUCTIVE TO INSECT-PESTS.

" (xvi) *Chalcis* (*Brachymeria*) *euplæa,* Westw., preys upon the Dooars tea and sâl caterpillar (*Dasychira thwaitesii*).

" (xvii) *Cotesia flavipes,* Cameron, parasitic upon the Sorghum-borer (*Diatræa saccharalis*).

" (xviii) *Aphelinus theæ,* Cameron, a minute fly-like insect that attacks the tea scale bug (*Chionaspis theæ,* Mask).

" (xix-xxvi) *Cirrhospilus coccivorus,* Motsch., *Encyrtus nietneri,* Motsch. *E. paradisicus,* Motsch., *Scutellista cyanea,* Motsch., *Marietta leopardina,* Nietner, *Cephaleta purpureiventris,* Motsch., *C. bunneiventris,* Motsch., and *C. fusciventris,* Motsch., are said to be parasitic upon the Brown bug (*Lecanium coffeæ*) of coffee plant in Ceylon.

" (xxvii) *Chartocerus musciformis,* Motsch., said to attack the white bug (*Pseudococcus adonidum*) of coffee plant in Ceylon.

" (xxviii) *Pteromalus oryzæ,* Cameron, a minute coppery green-coloured Ichneumon-fly believed to be parasitic upon the wheat and rice weevil (*Calandra oryzæ*) in India."

The above are some of the indigenous species of insect-parasites of insect-pests that have come to light without any special inquiry, and no doubt systematic research (which certainly ought at some day to be undertaken), would reveal many more. In the face of Mr. Barlow's report it can hardly be hoped that the introduction of a single foreign species of Lady-bird—even if that species be able to hold its own against the native species—will have any very marked effect.

VII.—REPORTS OF RESULTS OF REMEDIES, ETC., TRIED DURING THE YEAR 1897.

1. UTILIZING FIREARMS AS A MEANS OF DRIVING AWAY LOCUSTS.

The following is a report (dated 16th November 1897), received from Mr. R. P. Lambert, District Superintendent of Police, Panch Mahals, through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, giving an instance of a very simple and successful method, adopted by the Police in Panch Mahals, in order to frighten away locusts from the fields. The apparently complete success of a means so handy ought to be more widely known :—

"About 10-15 A.M. on Friday, the 5th instant, after my return to Bungalow from duty with the Inspector General of Police in the town, information was given to me that enormous flights of locusts were devastating the country round about Godhra. I immediately rode to the fields where the locusts were settling.

"2. A Bora came up to me in a half frantic state and begged that the Armed Police with their guns and blank ammunition might be employed to get rid of these pests. The idea appeared to me both novel and sensible, and I at once galloped to the Bungalow (where the Inspector General of Police was staying during his visit in Godhra) and asked Mr. Kennedy to allow me to use the Government blank ammunition for the purpose, suggested by the Bora. Mr. Kennedy most kindly and readily gave the required permission and a sowar was at once sent to the head-quarters ordering every available man to be present at the scene of action.

"3. It speaks greatly to the credit of the head-quarter Chief Constable that from 60 to 70 Armed Policemen each supplied with 10 rounds of blank ammunition, joined me within 15 minutes after the alarm bugle had gone. I also collected all my servants and orderlies, who together with 40 or 50 ryots made up a total of 150 persons in all. I then had a long line formed extending sometimes to 3 or 4 hundred yards, and where locusts were seen to be most thick, there our mimic skirmishing line was taken. I also sent into the town for aid, but was not disappointed when it did not arrive, as it is perhaps too much to expect that either the Ghauchis or Boras would assist Government officers in protecting other people's property.

"4. Mr. Wallington arrived a few minutes after the commencement of our organized attack on the locusts, and shortly after his arrival sowars also appeared on the scene who greatly assisted me in keeping the long and unwieldy skirmishing line in hand.

"5. In some fields locusts could be seen covering every inch of ground waiting until their more lucky brethren had had their fill. Our skirmishing line must, however, have disturbed many thousands of expectant and hungry locusts who, as they rose in the air, received volleys and blank ammunition to hasten their ascension. Far away to the East could be seen heavy clouds of smoke rising skywards through which enormous flights of locusts happily and unconcernedly winged their way. To the West masses of disappointed locusts

could be seen swiftly winding their way to a less noisy and sulphurous districts. The combined police and ryot attack on the intruders lasted until 1-30 P.M., and certainly in my opinion saved the surrounding country from much damage for which the Bora who suggested the idea, should receive every credit.

"6. My object in submitting this report is to show, that gun-powder appears to be more efficacious than any other suggestion or scheme that I have ever heard mooted for the prevention of locusts settling on crops, as after the commencement of the firing, the creatures flew up to a very great height and hovered for some time over head apparently dismayed by the extraordinary reception they had received."

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2. EASY METHOD OF COMPOUNDING ARSENICAL SOLUTION FOR THE DESTRUCTION OF LOCUSTS.

The following is an extract taken from a note by Mr. D. Hooper Curator, Economic Section, Indian Museum, on the preparation of an arsenical solution for the destruction of locusts :—

"Arsenic is very insoluble in water, and an alkali, such as soda or potash, is always required to dissolve it freely.

"Lime is unsuitable as a solvent, as it is not very soluble in water itself and it forms unstable compounds with arsenic.

"The ashes of wood and of plants are commonly met with in or near all native dwellings and a liquor made from the ashes would form a convenient solvent for the poison.

"From experiments made with ashes taken from a fire-place where wood was used as fuel, I find that one part of white arsenic is rendered soluble by boiling it with the liquid obtained from ten parts of the ash. One pound of the ashes is mixed with water and strained and washed with more water until the solution amounts to four gallons. The liquid is then heated in a vessel and the arsenic added and the heating continued until no residue is left. The solution when cold is preserved for use."

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3. REPRINTS.

1. THE HORSE BOT-FLIES.[1]

Gastrophilus equi, Fabr.

Bots in horses have been a familiar form of parasite to farmers, stockmen, and veterinarians for we know not how long. Whether they were familiar to the ancients has been a matter of discussion among learned men, but the mention in ancient writings of the Œstrus and its habits is now generally considered as referable to some of the flies capable of piercing, such as the gad-flies or horse flies and not the bots. The occurrence of two or three similar species affecting the horse has led to some confusion in their names. Thus the *Œstrus equi* of Linnæus appears to correspond with the *Œstrus vituli* of Fabricius, while the latter author includes in *Œstrus equi* the *Œstrus nasalis*, *Œstrus hæmorrhoidalis*, and *Œstrus veterinus* of Linnæus. Without going into a discussion of this synonymy here, it will be seen that all of these forms were apparently familiar to scientific writers more than a century ago, as well as the more striking features of their life-history. Thus the statement made by Linnæus (Turton's translation, p. 582) reads as follows: "Deposits eggs on the hairs of horses, and always on those parts which are most liable to be licked by the tongue; these, either in the egg or larval state, are conveyed by the tongue into the stomach, and passing through the intestines with the food are discharged with the dung." These larvæ are commonly known by the name of bots. In 1815 Mr. Bracy Clark published his essay on bots of horses and other animals presenting the results of thorough investigation upon these interesting parasites, and subsequent investigation has but confirmed in large part the conclusions reached by him.

Nature and extent of injury.—Different writers have placed very different estimates upon the injury due to bots, and as great diversity, or perhaps greater, exists in the opinions of practical men and veterinarians, some holding that the presence of the bot in the horse's stomach does not interfere with its normal activities, while others look upon them as extremely dangerous and sometimes refer almost any serious disturbance of the digestive organs, or death from unknown cause, to bots.

[1] Extracts from a report by Herbert Osborn, published in Bulletin No. 5, United States, Department of Agriculture, Division of Entomology, 1896.

The injury to the horse from the larvæ may take four forms. (1) The attachment to the walls of the stomach causes an irritation which may interfere with the normal action of the glands or reduce the extent of glandular surface ; (2) the bots abstract some nutriment from the walls of the stomach, or by absorption, from the contents of the stomach itself ; (3) by collecting, particularly in the region of the pylorus, they serve as an obstruction to the free passage of food from the stomach to intestines ; (4) in passage through intestines they may attach themselves at times to walls or in rectum and cause great irritation. Some consider this as the source of most of the serious symptoms from presence of bots. In any of these methods the extent of injury depends in large degree upon the number of bots present, a few probably causing no appreciable damage, while large numbers (sufficient as we have seen them, to completely cover large patches of the stomach walls) must cause serious disturbance and loss of nutrition and would seem a sufficient cause to produce fatal results. From the nature of the case no definite statistics can be given for the losses incurred. It is probably safe to say that nine-tenths of all colts and horses that are pastured during summer, and a smaller proportion of driving an work horses, become infested with bots each year. Aside from the injuries inflicted by the larvæ, we must consider the excitement produced by the flies when depositing the eggs as a source of loss and this in many cases is by no means insignificant.

Life-history and habits.—Adults of this species are about three-fourths of an inch in length, the wings are transparent with dark spots, those near the centre forming an irregular, transverse band. The body is very hairy, the head brown with whitish front, thorax brown, abdomen brown, with three rows of blackish spots, which are subject to considerable variations. In the females the segments are often almost entirely brown with simply a marginal series of yellowish spots, while in males the abdomen may be almost entirely yellow or very light brown, with brown or dark spots very distinct. The males are rarely seen, for while it is one of the most common occurrences to witness the female around the horses depositing their eggs, the males evidently hold aloof. They are readily distinguished by the form of the abdomen, which lacks the two tubular segments at the end, and is provided on the under-side of the last segment with a pair of dark brown or black hooks, or clasping organs. Otherwise except the colour of the abdomen, already mentioned, they resemble very closely the females. The eggs are light yellow in colour and will be found attached to the hairs of the shoulders, forelegs, under-side of body, and sometimes even the mane and other parts of the body,

most commonly, however, on the forelegs and shoulders. The method of deposition has been frequently observed. The female hovers near the horse in a position which appears to be nearly vertical, since the body is bent downward, and the extended abdomen is thrust forward under the body to its full extent. The fly then darts toward the horse, the egg is glued to the hair in an instant and the fly retreats a yard or two to hover till another egg is ready to be deposited. The operation is repeated at very short intervals, so that hundreds of eggs may be deposited upon a horse in a comparatively short time. The eggs are held by a sticky fluid, which quickly dries and thus glues them firmly to the hairs. They are about one-sixteenth of an inch in length, and taper a little toward each end, though the attached end is the smaller. The outer end is provided with a little cap (operculum), which is set quite obliquely to the axis of the egg, though some authors represent it as cutting the egg square off at the end. This cap or operculun breaks or is pushed off when the grub hatches. Bracy Clark wrote that the eggs do not hatch until twenty-five to thirty days old, while Joly found them to hatch in four or five days. Verrill says :—

"The eggs contain more or less perfectly developed larvæ when laid; and when they are mature or have been a few days attached to the hair they burst open and allow the young to escape almost instantaneously, when moistened. Thus when the horse licks itself or its companions, the moisture hatches the eggs and the young larvæ are transferred to the mouth by the tongue or lips, and thence to the stomach, where they fasten themselves to the lining membrane by their two hooks."

Evidently some such condition is essential to the hatching of the eggs, as we have removed hairs containing eggs from the horse and keeping them, where not subject to moisture they failed entirely to hatch, and even after a year's time do not appear greatly shrivelled. Doubtless they must hatch in a comparative short time or lose their vitality, for moisture does not effect a hatching in those long kept away from the horse. The empty egg shells may cling to the horse for some time after the hatching of the larvæ and give it the appearance of being coated with eggs. Examination, however, will readily disclose the absence of the operculum in the hatched eggs.

In order to determine more certainly as to the exact condition of hatching and the time involved, I undertook in 1893 some observations which were reported in Bulletin No. 32 of the Division of Entomology (pp. 46-49). Eggs collected from a horse while flies were depositing, and therefore probably not long laid, were opened

at different times by rubbing them with a moistened finger, simulating as nearly as possible the action of the tongue in licking the body. While the larvæ appeared to be fully formed during the first three or four days after deposition, the eggs hatched with difficulty and the larvæ seem quite inactive, and all larvæ that were freed in this manner up to the tenth day were hatched with difficulty, though the larvæ at the end of this time were becoming fairly active.

Four weeks after hatching the eggs opened with the slightest touch of a wet finger, and the larvæ adhering to the finger were very active, though in some cases they were inactive and apparently dead. About five weeks after collecting the eggs nearly all gave only inactive or dead larvæ, though opened with ease on being touched with the finger, and in forty days after collecting no living larvæ could be found in the remaining eggs, except one which had succeeded in pushing off the cap of the egg and partially emerging.

In view of these results, I conclude :—

(1) That the eggs of the horse bot-fly do not hatch, except by the assistance of the horse's tongue.

(2) That hatching does not ordinarily occur within ten or twelve days and possibly longer, or if during this period, only on very continuous and active licking by the horse.

(3) That the hatching of the larvæ takes place most readily during the third to fifth week after deposition.

(4) That the majority of the larvæ lose their vitality after thirty-five to forty days.

(5) That larvæ may retain their vitality and show great activity upon hatching as late as thirty-nine days after the eggs were deposited.

(6) That it is possible, though not normal, for eggs to hatch without moisture or friction.

(7) That in view of these results, the scraping off of the eggs, or their removal of destruction by means of washes will be effective even if not used oftener than once in two weeks during the period of egg deposition, and, probably, that a single removal of the eggs after the period of egg deposition has passed, will prevent the great majority of bots from gaining access to the stomach, or at least so large a proportion that little injury is likely to occur.

Wishing to know still more definitely the period of most ready hatching, and the effect of different washes for treatment, I suggested to a veterinary student, Mr. Harry Shanks, a careful series of observations, which were carried through during the summer of 1894.

From this study, which was made under my direction, and so that I had frequent opportunity to note progress, a number of points were gained, which are worth adding to the above record. Three hundred eggs were collected from a horse which had been previously

freed from eggs, so that the exact date of deposition was assured. The eggs were tested every day.

On the day of collection (first day) the eggs appeared immature. One day later eight eggs opened by picking the operculum off showed three larvæ with slight movement, and five immovable. On the third day a half hour of friction failed to hatch eggs, but the larvæ when freed by picking off the operculum showed two, slight movement; one, no movement, and one sufficient movement to get out of the opened shell.

On the fourth day the larvæ in eleven eggs were all active, but had to be freed by picking off the operculum; the same was true up to the seventh day, the only difference being noted in greater maturity and size of larvæ.

On the ninth day, or when the larvæ were eight days from deposition, one larva was freed by seventeen minutes of rubbing with wet finger, another in twenty-two minutes; on the tenth day two others, one in fourteen and the other in eight minutes; and on the eleventh day several were hatched, the time varying from two to five minutes of subjection to the saliva and friction. On the twelfth day it required but one or two minutes, and on the thirteenth eggs would hatch in fifteen to thirty seconds. On the fourteenth day a number of eggs were tried, about one-third of which hatched almost immediately upon being touched with the moist finger, the others in from five to eight seconds. On the fifteenth day all eggs seemed fully mature, and probably nine-tenths would have hatched at once upon being touched by a horse's tongue in the ordinary motion of licking. From the sixteenth day to the twenty-second the eggs would open with a touch of the finger, but the larvæ would not adhere except with moisture. On the twenty-third day the first dead larva was noted, and a day later four out of eleven eggs opened had dead larvæ. On the twenty-fourth day all of the eggs not previously opened were examined with a lens, and only one showed the cap removed, the larva being partly out, but dead. The hatching of but one egg out of three hundred seems to me to establish pretty fully my former opinion, that the eggs require moisture or friction for the release of the young.

On the twenty-fifth day, out of ten eggs three contained dead larvæ, five could move slightly, and two were quite active. On the twenty-sixth day caps were removed from thirty-five eggs, twenty-seven larvæ being dead, seven were capable of slight movement, and one was active enough to escape from the shell.

On the twenty-seventh day out of forty-three eggs opened only one larva was alive, and on the twenty-eighth day only one out of sixty-five, and on the twenty-ninth day all the remaining eggs, one hundred and three, showed only dead larvæ.

The results of this study, it will be seen, confirm in the main the conclusion of the former observations, the principal difference lying in the fact that all the larvæ were dead at a somewhat earlier period. Of course it could not be said that of the eggs opened in the earlier days none would have survived longer than four weeks, but considering the number used and that one-third of them were kept the full four weeks, and two-thirds nearly that long before being opened, the presumption is strong that that is the full normal period of survival.

It is safe, I think, to sum up the matter by saying that the eggs normally require friction and moisture to permit of their hatching and transfer to the horse's mouth, that hatching occurs with difficulty before the tenth day, and most readily after the fourteenth day, and that they lose vitality at a period varying between the twenty-eighth and fortieth days, the bulk not surviving more than four weeks. This gives a solid foundation upon which to base recommendations as to the time when eggs must be destroyed.

The newly hatched larva is a slender, worm-like creature, so transparent that the internal organs are plainly visible. It grows rapidly at first, its food consisting probably of the mucous secretions of the mouth and œsophagus. . . . . As soon as it reaches the stomach it fixes itself to the walls by the hooks next the mouth and soon undergoes considerable change in its form and appearance. The body becomes more conical, but instead of the head end being widest this becomes more slender, while the tail end broadens. The spiracles at first exposed in two flap-like projections from the last segment are drawn more within the body and are protected by the development of a horny plate. The spines on the segments following the head become more pronounced. When full grown the larva is three-fourths of an inch to one inch in length . . . . . At this time they occur in large clusters upon the walls of the stomach, generally more especially numerous at the pyloric portion, where they serve to retain the contents of the stomach. From the fact that the food of the horse does not become completely reduced to fluid, this obstruction may be considerably greater than if only fluid matter had to pass the pylorus. This growth has occupied from late in the fall, through the winter, till late in the spring, and when fully developed the bots loosen their

hold and are carried through the intestines and, escaping with the excrement, burrow into the ground to pass the pupa stage. This lasts for several weeks, thirty to fourty days, according to some authors, when the fly, which has been already described, issues and is ready to proceed with the business of providing for another generation of bots.

The larva of this species has been found in the stomach of the dog, though it cannot be considered a normal habitat for it, and it is very doubtful whether the young larvæ could survive in the stomach of a carnivorous animal. Railliet (Comptes Bendus des séances de la Société de Biologie, 1894) cites records by Colin and others of such occurrences, and details experiments which show the possibility of the survival of nearly mature larvæ that are swallowed with fragments of the stomach walls attaching to the stomach of the dog and remaining alive and healthy fifteen days after the ingestion.

Prevention.—In dealing with bots in horses, by far the most important point is to prevent the introduction of the larvæ, and while we have no opportunity, as in the case of the ox bot-fly, to completely exterminate the pest, it is certain that proper attention to preventive measures would in a few years greatly reduce the numbers of the insects and procure comparative freedom. The better care usually accorded horses makes it possible to deal with it in some respects more easily than the species infesting cattle. The most vulnerable point of attack lies in the conspicuous position of the eggs. No horseman probably can overlook these objects when occurring on the horse he is caring for, and colts in pasture sometimes become so covered with them as to give a decided change in colour to the parts most affected. It is evident that removing or destroying these eggs previous to hatching is all that is necessary to prevent "bots" in the horse. With horses kept in stables or used daily there is little trouble ; the flies have less opportunity to deposit eggs upon them, and the ordinary grooming of the animal serves to remove some of the eggs, or being constantly under observation the eggs attract the attention of the person in charge and he removes them, if not to prevent bots at least to avoid the unsightly or ill-kept appearance they give the animal. With colts or horses in pasture, however, the case is very different. Not knowing the curry-comb or card through the whole summer, and perhaps hardly seen from one week's end to the other, the eggs deposited on them by hundreds have every possible chance to transmit larvæ to the alimentary canal where they commence their growth. During

July, August, and September, or as late as eggs appear on the horses, those kept in pastures should be examined once every two or three weeks and the eggs destroyed or removed. This can be accomplished in several ways. By using washes of dilute carbolic acid, about one part carbolic acid to thirty parts water or, rubbing the affected parts over lightly with kerosene, by clipping the hair or by shaving the eggs off with a sharp knife or razor. Our own experience leads us to prefer the last. With a very sharp knife or razor (a dull one will glide over the eggs) the affected parts can be very quickly run over without removing much, if any, of the hair. This method leaves no doubt as to whether or not the eggs have been touched, as in washes, and subsequent examinations are not complicated by a lot of dead eggs or shells. Perform once every two weeks, and there can be very few of the larvæ which gain entrance to the stomach. Will it pay may naturally be asked by the man who has, say, from twenty-five to a hundred colts in the pasture. Possibly not, if but a single season is considered, but the loss of a single horse, or the poor condition of a number, resulting from bots, or the fretting of the whole number in pasture, would more than equal all the cost of removing the eggs from the entire lot. But when the presence on the farm of the pest year after year is considered with all its attendant evils, we believe most emphatically that it will pay.

Quite frequently the flies will be observed at work depositing eggs on the legs or body of a horse at work or in carriage. If not noticed at once, the nervous stamping, biting, or often greater excitement of the horse will apprise the driver of their presence. Although the flies are pretty wary and dart away when approached, a few seconds' watching will enable one, by striking them down to the ground with hand or hat, to capture and kill the fly and thus stop the deposition of eggs and annoyance to the horse. Whether the larvæ of this species can mature except upon gaining access to earth seems not to have been determined, and for all the time the horses are in the field or on the road they have ready access to earth. But as some other forms can pupate successfully in the dung heap, it would seem worth while to subject the droppings of horses known to contain bots to some process that would destroy them and thus prevent maturity of the fly.

Remedies for bots.—The prescription of drugs for the removal of bots from the stomach when their presence is known or suspected belongs rather to the veterinarian than to the entomologist, but it may not be out of place here to call attention to a few of them. It is of course not

an easy matter to determine during the life of the horse whether any particular disturbance of the digestive organs or lack of nutrition is due to the presence of bots or to some other agency producing similar symptoms, and even a competent veterinarian may be puzzled, in diagnosis. If occasional bots are noticed in the excrements of the animal together with poor condition, their presence in numbers may be inferred. It must be remembered that the bots are capable of withstanding almost any substance that the walls of the stomach can endure, and the safest plan, if intending to dose for them is to employ a veterinarian. Turpentine is perhaps most generally given, but must be used with care.

THE HÆMORRHOIDAL BOT-FLY.

Gastrophilus hæmorrhoidalis, Linn.

While it is common to speak of the horse bot-fly, it should not be inferred that there is but one kind parasitic upon the horse. Take the world over, there are at least six well-defined species occurring on the horse, ass, or mule, and any of these are liable to be introduced into this country with imported animals. The above-named species is probably next to *equi,* the most generally distributed in this country. With the other allied species it was well known in Europe during the last century and received mention or more elaborate description from Linnæus, DeGeer, Fabricius, and other leading writers on entomology.

Extent of injury.—The losses to be referred to this species are similar to those of the other species, but from the accounts of various authors and what we have heard from persons who were plainly describing the actions of this particular form, it is evident that the excitement and consequent loss due to the attacks of the adult fly are much worse with this species than the common one. This is described by Clark as follows:—

At the sight of this fly the horse appears much agitated, and moves his head backward and forward in the air to balk its touch and prevent its darting on the lips; but the fly, waiting for a favourable opportunity, continues to repeat the operation from time to time; till at length, finding this mode of defence insufficient, the enraged animal endeavours to avoid it by galloping away to a distant part of the field, if it still continues to follow and tease him, his last resource is in the water where the Œstrus is never observed to follow him. At other times this Œstrus gets between the forelegs of the horse whilst he is grazing, and thus makes its attack on the lower lip. The titillation occasions the horse to stamp violently with his forefoot against the ground, and often strikes with his foot, as

if aiming a blow at the fly. They also sometimes hide themselves in the grass, and as the horse stoops to graze, they dart on the mouth or lips and are always observed to poise themselves during a few seconds in the air, while the egg is preparing on the point of the abdomen.

Life-history and habits.—Having discussed pretty fully the habits of the common species, it will be unnecessary to go into details that are similar in other species, but simply call attention to distinguishing characters and such differences in habit as may be of economic importance.

Professor A. E. Verrill (Report on External and Internal Parasites of Man and Domestic Animals, p. 29) gives the following condensed statement of its life-history and habits :—

The *Gastrophilus hæmorrhoidalis* or red-tailed bot-fly, is a small species easily distinguished by the bright orange-red tip of the abdomen. The thorax above is olive gray and hairy with a black band behind and suture. The base of the abdomen is whitish and the middle blackish, in strange contrast with the orange-red of the end. The larvæ have the same habits and are found in the same situations with those of the common bot-fly, which they much resemble, except that they are whiter and smaller, their length not exceeding one-half or five-eighths of an inch. They change to pupæ within two days after leaving the horse, and the pupæ are deep red. They remain in the pupa state about two months, and the flies appear from the last of June till the cool weather of autumn. In depositing the eggs the female differs in habit from the common bot-fly, for she selects the lips and nose of the horse as the most suitable place for this purpose. The eggs are darker coloured (some authors say black) than those of the common bot-fly, and contain a nearly developed embryo, so that they very soon hatch, and the young larvæ are transferred to the mouth by the tongue, and thence get into the stomach.

Remedies.—On account of the shorter time between deposition of eggs and hatching of larvæ, it is evident that the removal of eggs as for that species would be less successful. For horses in use, immediate attention when they give signs of the presence of the fly, the capture of the insect and the removal of eggs already attached would be but the natural method suggested by a knowledge of the insect. For horses in pasture, if exhibiting signs of molestation by this insect, the same attention would be advisable whenever the nature of the case will permit. It would be worth while to try the application of some oil or tar to the hairs of the lips as a prevention to the fastening of the eggs to them.

3. ***Gastrophilus pecorum,*** Fabr.

We are not aware that this species has been encountered in the United States, and, if so, it is evidently rather rare. The follow-

ing paragraph from Professor Verrill's report would seem to indicate an acquaintance with specimens collected in this country :—

The *Gastrophilus pecorum* is densely covered with yellow hairs, with a band of black hairs on the thorax behind the suture in the male. The female is yellowish brown, the abdomen black, with yellowish hairs at its base, as well as on the thorax. The wings are grayish or light brownish, clouded with yellowish brown. The larvæ are similar to those of the more common G. equi, and have similar habits. The flies appear at the same time.

Ostan Sacken's List of American Diptera records it only from Jamaica on the authority of Walker.

4. HORSE BOT-FLY OR "CHIN FLY."

(Gastrophilus nasalis, Linn.)

As already stated, this species has been more or less confused with *equi* in scientific writings, and doubtless still more so in general observation.

It was described as *Œstrus nasalis* by Linnæus (Fauna Suec) and it was also given the name of *veterinus* by Clark. It was included by Fabricius with *hæmorrhoidalis* under *Œstrus equi*. The description in Systema Naturæ (Turton's translation) is as follows :—

Wings immaculate, body ferruginous, sides of the thorax and base of the abdomen with white hairs. Deposits its eggs on horses and cattle, the larvæ probably pass through the stomach like the former one.

Less than *Œstrus equi* Insertion of the wings and base of the abdomen covered with whitish hairs; second segment of the abdomen with two hairy tubercles. Beneath and legs rusty brown. Female with sometimes a blackish abdomen.

Of this species Verrill writes (Ext. and Int. Parasites, p. 28) : —

The *Gastrophilus nasalis* is a smaller species, densely hairy, with the thorax yellowish red or rust-coloured. The abdomen is either whitish at base with the middle black and the apex yellowish brown and hairy; or the base is whitish and all the rest brown ; or the middle is black, with the base and apex whitish, with grayish hairs. The wings are unspotted. The larvæ are much like those of the preceding (hæmorrhoidalis), except that they are smaller, and also live in the stomach of horses. They change to pupæ beneath the manure and the flies appear from June to September. It also infests the ass and mule and some authors say that it lives even in cattle.

Zuru[1] ascribes this parasite to horses, asses, mules and goats, and says the eggs, 1 mm. long, are laid on the lips and margin of nostrils. He describes the full-grown larva as 13 to 14 mm. long, deep yellow

[1] Die tierischen Parasiten, p. 100.

or yellow brown, thicker behind than before, and the segments 2 to 9 above and 2 to 10 below with a single row of yellowish, brown-tipped spines.

The pupa he described as dark-brown or black, the segments with only a single series of horny spines, its length of life in this stage from thirty to forty-two days.

Professor Garman[1] in a recent paper on the subject gives a record of the occurrence of this species in Kentucky.

From this record it would appear that the species is somewhat common and troublesome in that region, and as the species has been recorded from many places in this country, it may be looked upon as having quite a general distribution.

The most essential point in habit of this species is the fact that the eggs are laid on the lips or nostrils, within easy reach of the tongue, and as it is quite probable that they hatch more promptly than those of *equi*, it is more difficult to adopt measures of prevention. Measures must consist in preventing as far as possible the deposition of eggs, for which purpose the application of a little tar and fish oil to the hairs of the under-lip may be of service, and where eggs are suspected, the use of a wash of carbolic acid to the lips and margin of nostrils.

According to Garman, the eggs are white, and are attached to the hairs of the lip and throat by the greater part of one side. The species occurs in Europe and has been observed in New England, New York, Ohio, Kentucky, Kansas, Utah, and probably elsewhere in this country.

Professor Garman gives the following key by which the different species of bot-flies may be distinguished :—

1. (6) Discoidal cell closed by cross vein.
2. (3) Wings marked with brown . . . . G. equi.
3. (2) Wings not marked with brown.
4. (5) Anterior basal cell nearly or quite equal to the discoidal cell in length . . . . G. nasalis.
5. (4) Anterior basal cell markedly shorter than the discoidal cell . . . . . G. hæmorrhoidalis.
6. (1) Discoidal cell open . . . . . G. pecorum.

[1] The Bot-flies of the Horse, Seventh An. Rep. Ky. Ag. Exp. Sta., p. xxvii.

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CONTENTS.

EXPLANATION OF ILLUSTRATIONS.

PLATE XVI—

FIG. 1. LACHNUS PYRI, Buck. n. sp. *a*, half-grown larva; *b*, winged female, March brood; *c*, antenna; *d*, winged female, June brood; *e*. Apterous adult, June brood (all enlarged).

PLATE XVII—

FIG. 1. CHAITOPHORUS MACULATUS, Buck. n. sp. *a*, Apterous female; *b*, head; *c*, wings; *d*, nectary; *e*, hind femur (all enlarged).

„ 2. RHIZOBIUS JUJUBÆ, Buck. n. sp. *a*, Apterous adult; *b*, young insect; *c*, part of the head and antenna; *d*, Tarsus with single claw.

PLATE XVIII—

FIG. 1. EXORISTA HETERUSIÆ, Coquillett n. sp. *a*, fly; *b* and *c*, front and side views of the face; *d*, puparium.

„ 2. HETERUSIA CINGALA, Moore. *a* and *b*, moths ♂ and ♀; *c*, larva; *d*, cocoon.

Vol. IV.] [No. 5.

LIST OF THE MELOLONTHINI CONTAINED IN THE COLLECTION OF THE INDIAN MUSEUM.

By EDWARD BARLOW,

Assistant in charge of Entomology.

The following list comprises all the named Melolonthini in the collection of the Indian Museum. The collection is not a complete one, and many known species of the Indian Region are wanting: still it is worthy of attention as it contains numerous type specimens, of which a good number are unique.

The total number of species included in the list amounts to 213 of which 140 are Indian, while 73 are exotic.

The synonymy and references have been worked out as far as is practicable from the literature contained in the Indian Museum Library, but the compiler's thanks are particularly due to Herr Ernst Brenske for his unremitting kindness and assistance in identifying almost all the species referred to.

Genus: ANISONYX, Latreille.

1. Anisonyx longipes, Linn.

Anisonyx longipes, Linn., *Syst. Nat.* I., 2, *p.* 555.—Gem. Har. *Cat. Coleop.* IV, *p.* 1100.

„ *crinitus*, Fabr., *Mant. Ins.* I., *p.* 24.—Blanch. *Cuv. Règn. Anim. Atl. t.* 44, *f.* 12.—Burm. *Handb.* IV, 1, *p.* 42.

Reg. No. $\frac{3442}{13}$, Cape of Good Hope, Herr E. Brensk 26th March 1892.

2. Anisonyx ursus, Fabr.

Anisonyx ursus, Fabr., *Syst. Ent. App.*, *p.* 184.—Burm. *Handb.* IV, 1, *p.* 41.—Gem. Har. *Cat. Coleop.* IV, *p.* 1100.

Reg. No. $\frac{3441}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

Genus: PERITRICHIA, Burm.

3. Peritrichia capicola, Fabr.

Peritrichia capicola, Fabr., *Syst. El.* II, *p.* 179.—Burm. *Handb.* IV, 1, *p.* 48.—Gem. Har. *Cat. Coleop.* IV, *p.* 1100.

Reg. No. $\frac{3443}{13}$, Cape of Good Hope, Herr E. Brenske.

4. Peritrichia nigrita, Blanch.

Peritrichia nigrita, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 60—Gem. Har. *Cat. Coleop.* IV, *p.* 1101.

„ *ursus*, Oliv., *Ent.* I, 5, *p.* 58, *t.* 8, *f.* 88.

Reg. No. $\frac{3444}{13}$, Cape of Good Hope, Herr E. Brenske.

Genus: LEPITRIX, Serville.

5. Lepitrix bilateralis, Thunb.

Lepitrix bilateralis, Thunb., *Mém. Ac. Petr.* 1818, VI, *p.* 446.—Burm. *Handb.* IV, 1, *p.* 39.—Gem. Har. *Cat. Coleop.* IV, *p.* 1101.

„ *abbreviata*, Guer., *Ic. Règn. Anim. Ins. t.* 25, *bis. f.* 7.

Reg. No. $\frac{3447}{13}$, Cape of Good Hope, Herr E. Brenske.

6. Lepitrix lineata, Fabr.

Lepitrix lineata, Fabr., *Syst. Ent. App.*, *p.* 820.—Oliv. *Ent.* I, 6, *p.* 66, *t.* 7, *f.* 63.—Burm. *Handb.* IV, 1, *p.* 38.—Gem. Har. *Cat. Coleop.* IV, *p.* 1101.

„ *quadrata*, DeGeer. *Mém. Ins.* VII, *p.* 645, *t.* 48, *f.* 10.

„ *thoracica*, Thunb., *Mém. Ac. Petr.*, 1818, VI, *p.* 444.

Reg. No. $\frac{3445}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

7. Lepitrix stigma, DeGeer.

Lepitrix stigma, DeGeer., *Mém. Ins.* VII, *p.* 645, *t.* 84, *f.* 9.—Bohem, *Ins. Caffr.* II, *p.* 142.—Gem. Har. *Cat. Coleop.* IV, *p.* 1101.

„ *fuscipes*, Thunb., *Mém. Ac. Petr.*, 1818, VI, *p.* 445.

„ *nigripes*, Fabr., *Spec. Ins.* I, *p.* 49.—Oliv. *Ent.* I, 6, *p.* 67, *t.* 9, *f.* 85.—Burm. *Handb.* IV, 1, *p.* 38.

Reg. No. $\frac{3446}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

Genus: ERIESTHIS, Burm.

8. Eriesthis vestita, Burm.

Eriesthis vestita, Burm., *Handb.* IV, 1, *p.* 51.—Gem. Har. *Cat. Coleop.* IV, *p.* 1102.

Reg. No. $\frac{3448}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

Genus: PACHYCNEMA, Serville.

9. Pachycnema alternans, Burm.

Pachycnema alternans, Burm., *Handb.* IV, 1, *p.* 61.—Gem. Har. *Cat. Coleop.* IV, *p.* 1102.

„ *flaviventris*, Sturm., *Cat.*, 1843, *p.* 128.

Reg. No. $\frac{3450}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

10. Pachycnema crassipes, Fabr.

Pachycnema crassipes, Fabr., *Syst. Ent. App.*, *p.* 818.—Burm. *Handb.* IV, 1, *p.* 60.—Lacord. *Atl.* 3, *t.* 29, *f.* 1.—Gem. Har. *Cat. Coleop.* IV, *p.* 1102.

„ *albispila*, Sturm., *Cat.*, 1843, *p.* 128.

Reg. No. $\frac{3449}{13}$, Cape of Good Hope, Herr E. Brenske.

Genus: **DICHELUS,** Serville.

11. Dichelus gonager, Fabr.

Dichelus gonager, Fabr., *Spec. Ins.* I, *p.* 45 —Olivr. *Ent.* I, 5, *p.* 74, *t.* 6, *f.* 68.—Burm. *Handb.* IV, 1, *p.* 97.—Gem. Har. *Cat. Coleop.* IV, *p.* 1105.

Reg. No. $\frac{3453}{13}$, Cape of Good Hope, Herr E. Brenske.

12. Dichelus podagricus, Fabr.

Dichelus podagricus, Fabr., *Spec. Ins.* I, *p.* 44.—Oliv. *Ent.* I, 5, *p.* 73, *t.* 5. *f.* 51.—Burm. *Handb.* IV, 1, *p.* 91.—Gem. Har. *Cat. Coleop.* IV, *p.* 1105.

Reg. No. $\frac{3451}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

13. Dichelus villosus, Burm.

Dichelus villosus, Burm., *Handb.* IV, 1, *p.* 109.—Gem. Har. *Cat. Coleop.* IV, *p.* 1106.

Reg. No. $\frac{3452}{13}$, Cape of Good Hope, Herr E. Brenske, 26th March 1892.

Genus: **MONOCHELUS,** Serville.

14. Monochelus squamulatus, Casteln.

Monochelus squamulatus, Casteln., *Hist. nat.* II, *p.* 145.—Dej. *Cat.*, 3 *ed. p.* 184.—Gem. Har. *Cat. Coleop.* IV, *p.* 1108.

Reg. No. $\frac{3454}{13}$, Cape of Good Hope, Herr E. Brenske.

Genus: **GONIASPIDIUS,** Burm.

15. Goniaspidius variabilis, Burm.

Goniaspidius variabilis, Burm., *Handb.* IV, 1, *p.* 128.—Gem. Har. *Cat. Coleop.* IV, *p.* 1109.

" *bidens,* Ecklon,, *Cat. nr.* 377.

" *bidentatus,* Ecklon,, *Cat. nr.* 378.

" *relhaniæ,* Ecklon., *Cat. nr.* 376.

" *tridentatus,* Dej. *Cat.*, 3 *ed., p.* 184, *a.*

Reg. No. $\frac{3455}{13}$, Cape of Good Hope, Herr E. Brenske 26th March 1892.

Genus: **LEPISIA**, Serville.

16. Lepisia rupicola, Fabr.

Lepisia rupicola, Fabr., *Syst. Ent. App.*, *p.* 818—Guér *Jc. règn. anim. Ins.*, *t.* 25, *f.* 5.—Burm. *Handb.* IV, 1. *p.* 167.—Gem. Har, *Cat. Coleop.* IV. *p.* 1111.

Reg. No. $\frac{3456}{13}$, Cape of Good Hope, Herr E. Brenske 26th March 1892.

Genus: **ECTINOHOPLIA**, Redten.

17. Ectinohoplia nigra, Brsk.

Ectinohoplia nigra, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7455}{13}$, N. Khasi Hills, Colonel G. Austin.

18. Ectinohoplia rufipes, Brsk.

Ectinohoplia rufipes, Brensk. n. sp. *Ms.*

Reg. No. $\frac{3457}{13}$, India, Herr E. Brenske.

19. Ectinohoplia variolosa, Waterh.

Ectinohoplia variolosa, Waterh, *Trans. Ent. Soc., London*, 1875, *p.* 99. Nonf., *Berl., Ent. Zeits.*, XXXVII, 1892, *p.* 254.

Reg. No. $\frac{7471}{13}$, locality unknown, probably from India.

Genus: **HOPLIA**, Illiger.

20. Hoplia advena, Brsk.

Hoplia advena, Brensk., *Mèm. Soc. Ent. Belg.*, II, 1894, *p.* 35.

Reg. No. $\frac{745}{13}$, Shillong, Colonel G. Austin.
One unregistered spec., India.

21. Hoplia bilineata, Fabr.

Hoplia bilineata, Fabr., *Syst. El.* II, *p.* 178.—Gem. Har. *Cat. Coleop.* IV, *p.* 1112.

Reg. No. $\frac{2244}{4}$, Algeria, Mons. T. Bouvier, 30th December 1884.
„ Nos. $\frac{2246\text{-}48}{4}$, ditto ditto.

22. Hoplia coerulea, Drury.

Hoplia coerulea, Drury, *Ill. Exot. Ins.* 1773, II, *p.* 59, *t.* 32, *f.* 4.—Muls. *Col. Lamell*, *p.* 514.—Gem. Har. *Cat. Coleop.* IV. *p.* 1112.

„ *argentea*, Fourcroy, *Ent Par.* I, *p.* 8.

„ *farinosa*, Fabr., *Syst. Ent.*, *p.* 38.—Guèr. *Ic. Règn. anim. t.* 25.

„ *formosa*, Latreille, *Gen. Crust.* II, *p.* 116.

„ *squamosa*, Oliv., *Ent.* I, 5, *p.* 66, *t.* 2, *f.* 14, *a.-c.*

Reg. Nos. $\frac{3461\text{-}62}{13}$, Europe, Herr E. Brenske, 26th March 1892.

23. Hoplia concolor, Shp.

Hoplia concolor, Sharp, *Journ., Asia. Soc., Beng.*, XLVII, 1878, *p.* 171.—*Scient. Resw.*, 2nd, *Yark Mis. Coleop.* 1879, *p.* 47.—Nonfr., *Berl. Ent. Zeits.*, XXXVII, 1892, *p.* 254.

Reg. No. $\frac{2148}{10}$, Kogyar, Dr. F. Stoliczka (Yarkand Expd.)

24. Hoplia farinosa, Linn.

Hoplia farinosa, Linn., *Syst. Nat.* I, 2, *p.* 555.—Oliv. *Ent.* I., 5, *p.* 65. *t.* 2, *f.* 14.—Erichs. *Nat. Ins.* III, *p.* 710.—Gem. Har. *Cat. Coleop.* IV, *p.* 1112.

„ *argentea*, Poda., *Mus. Græc.*, *p.* 20.—Herbst. *Käp.* III, *p.* 122, *t.* 25, *f.* 6.—Muls. *Col. Lamell*, *p.* 511.

„ *squamosa*, Fabr., *Syst. El.* II, *p.* 177.—Burm. *Handb.* IV, 1, *p.* 187.

Reg. Nos. $\frac{3463\text{-}64}{13}$, Europe, Herr E. Brenske, 26th March 1892.

„ $\frac{7642}{13}$, ditto ditto.

25. Hoplia graminicola, Fabr.

Hoplia graminicola, Fabr., *Syst. El.* II, *p.* 179.—Ratzeb. *Forstins.* I, *p.* 83; *t.* 3, *f.* 16.—Erichs. *Nat. Ins.* III, *p.* 713.—Gem. Har. *Cat. Coleop.* IV, *p.* 1113.

„ *argentea*, Marsh., *Ent Brit.* I, *p.* 45.

„ *ochracea*, Sturn., *Cat.*, 1843, *p.* 127.

„ *pulverulenta*, Herbst., *Käf.* III, *p.* 124, *t.* 25, *f.* 7,—Fabr., *Syst. El.* II, *p.* 181.

Reg. No. $\frac{3460}{13}$, Europe, Herr E. Brenske, 26th March 1892.

26. Hoplia philanthus, Sulz.

Hoplia philanthus, Sulz., *Abgek. Gesch. Ins.*, *p.* 18.—Herbst. *Füssl. Arch.* IV, *p.* 17.—Erichs. *Nat. Ins.* III, *p.* 707.—Gem. Har. *Cat. Coleop.* IV, *p.* 1114.

„ *argentea*, Oliv. *Ent.* I, 5, *p.* 67, *t.* 3, *f.* 22, *a.-d.*—Fabr. *Ent. Syst.* II, *p.* 174.—Burm. *Handb.* IV, 1, *p.* 184.

„ *pulverulenta*, Illig., *Mag.* II, *p.* 229.—Muls. *Col. Lamell*, *p.* 506.

Reg. Nos. $\frac{3458\text{-}59}{13}$, Europe, Herr E. Brenske, 26th March 1892.

„ $\frac{7636}{13}$, ditto ditto.

27. Hoplia pollinosa, Krynick.

Hoplia pollinosa, Krynick., *Bull. Mosc.* V, 1832, *p.* 127.—Gem. Har. *Cat. Coleop.* IV, *p.* 1114.

„ *pilicollis*, Erichs., *Nat. Ins.* III, *p.* 711.—Burm. *Handb.* IV, 2, *p.* 485.

Four specimens, Reg. Nos. $\frac{8939\text{-}42}{2}$, Caucasus, Prof. K. L. Bramson, 20th March 1884.

28. Hoplia retusa, Klug.

Hoplia retusa, Klug., *Abhandl. Berl. Ac.*, 1832, *p.* 170, *t.* 3, *f.* 9.—Burm. *Handb.* IV, 1, *p.* 199.—Gem. Har. *Cat. Coleop.* IV, *p.* 1114.

„ *orientalis*, Dej., *Cat.* 3, ed., *p.* 185.

Reg. No. $\frac{3465}{13}$, Madagascar, Herr E. Brenske, 26th March 1892.

29. Hoplia viridissima, Brsk.

Hoplia viridissima, Brensk. *Mèm. Soc. Ent., Belg.*, II, *p.* 34.—*Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 151.

Reg. No. $\frac{7639}{13}$, Kurseong, Herr E. Brenske.

30. Hoplia viridula, Brsk.

Hoplia viridula, Brensk. *Ind. Mus. Notes*, IV, No. IV, *p.* 177.

Reg. Nos. $\frac{7453}{13}$, and $\frac{7454}{13}$ Types, from Khasi Hills, specimens lent to Herr E. Brenske.

Genus: **OTOCLINIUS,** Brenske.

31. Otoclinius gracilipes, Brsk.

Otoclinius gracilipes, Brensk. *Berl. Ent. Zeits.* XLI, 1896, *p.* 320.,
Reg. No. $\frac{7374}{13}$, Type ♂, Baluchistan, Dr. F. P. Maynard, 1896.

Genus: **PHYLLOTOCUS,** Fischer.

32. Phyllotocus erythropterus, Blanch.

Phyllotocus erythropterus, Blanch., *Cat. Coll. Ent.,* 1850, *p.* 97.—Gem. Har. *Cat. Coleop.* IV, *p.* 1116.
Four unregistered specs., Adelaide, C. Wilson, Esq.

33. Phyllotocus macleayi, Fischer.

Phyllotocus macleayi, Fischer, *Mém. Mosc.* VI, 1823, *p.* 255, *t.* 22, *f.* 2 *a-e.*—Burm. *Handb.* IV, 2, *p.* 183. —Gem. Har. *Cat. Coleop.* IV, *p.* 1116.
„ *præustus,* Boisd., *Voy. Astrol. Col., p.* 210.—MacLeay, *Dej. Cat.,* 3 *ed., p.* 181.
Reg. No. $\frac{7637}{13}$, Europe, Herr E. Brenske.
Two unregistered specs., Adelaide, C. Wilson, Esq.

34. Phyllotocus rufipennis, Boisd.

Phyllotocus rufipennis, Boisd., *Voy. Astrol. Col., p.* 210.—Burm. *Handb.* IV, 2, *p.* 184.—Dej. *Cat.,* 3 *ed., p.* 182.
Reg. No. $\frac{7640}{13}$, Australia, Herr E. Brenske.

Genus: **LASIOSERICA,** Brensk.

35. Lasioserica bræti, Brsk.

Lasioserica bræti, Brensk. *Ann. Soc. Ent., Belg.,* XL, 1896, *p.* 155.
Reg. No. $\frac{7383}{13}$, Sikkim, E. Barlow, Esq., September 1896.

36. Lasioserica calva, Brsk.

Lasioserica calva, Brensk. *Ann. Soc. Ent., Belg.,* XL, 1896, *p.* 155.
Reg. No. $\frac{7381}{13}$, Sikkim, A. V. Knyvett, Esq., 1891.

37. Lasioserica pilosella, Brsk.

Lasioserica pilosella, Brensk. *Ann. Soc. Ent. Belg.*, XL, 1896, *p.* 155.
Reg. No. $\frac{7382}{13}$, Sikkim, E. Barlow, Esq., 1896.

Genus: OPHTHALMOSERICA, Brenske n. gen.

38. Ophthalmoserica unbrinella, Brsk.

Ophthalmoserica unbrinella, Brensk. n. sp. *Ms.*
Nine specs., Reg. Nos. $\frac{7385\text{-}88}{13}$ and $\frac{7429\text{-}33}{13}$ from Sikkim, A. V. Knyvett, Esq., 1891.

Genus: SERICA, MacLeay.

39. Serica adnexa, Brsk.

Serica adnexa, Brensk. n. sp. *Ms.*
Reg. Nos. $\frac{7446-49}{13}$, Khasi Hills, Major G. Austin.
„ No. $\frac{7450}{13}$, Naga Hills, ditto.

40. Serica alcocki, Brsk.

Serica alcocki, Brensk. n. sp. *Ms. Ind. Mus. Notes,* Vol. IV, 4. p. 217.
Reg. Nos. $\frac{6874-76}{13}$, Co-types, Dehra Dun, Director, Forest School, Dehra Dun.
Defoliates the leaves of *Mallotus philippinensis* in the Dehra Dun Forests.

41. Serica andamana, Brsk.

Serica andamana, Brensk. n. sp. *Ms.*
Reg. No. $\frac{7403}{13}$, Type, Andaman Is., unknown.
„ Nos. $\frac{7467-70}{13}$, ditto ditto.

42. Serica assamensis, Brsk.

Serica assamensis, Brensk. *Ind. Mus. Notes,* Vol. IV, 4, *p.* 176, *pl.* XIII, *f.* 4.
Reg. No. $\frac{7650}{13}$, Type, Duars, Assam, Dr. G. Watt.
„ Nos. $\frac{7651-60}{13}$, Co-types, ditto ditto.
Destructive to tea plants in Assam.

43. Serica calcuttæ, Brsk.

Serica calcuttæ, Brensk., *Ind. Mus. Notes.* IV, 4, *p.* 176, *pl.* XIII, *f.* 3.

Reg. No. $\frac{6294}{13}$, Type, Calcutta, Surgn.-Col. G. S. Ranking.
„ „ $\frac{6292}{13}$, Co-type, ditto ditto.
„ „ $\frac{756}{12}$, Calcutta, Museum Collector.

44. Serica clypeata, Brsk.

Serica clypeata, Brensk. n. sp. *Ms.*

Reg. No. $\frac{5639}{5}$, Darjeeling, C. H. Dreyer, Esq., 18th July 1885.
„ „ $\frac{4426}{6}$, Sikkim, E. T. Atkinson, Esq., 26th May 1886.

45. Serica ferruginea, Redtenb.

Serica ferruginea, Redtenb., *Hügel Kaschm.*, 1848, IV, 2, *p.* 525.—Gem. Har. *Cat. Coleop.* IV, *p.* 1118.

Reg. No. $\frac{3690}{5}$, Maldah, W. H. Irvine, Esq., 26th June 1885.
„ No. $\frac{3823}{6}$, Gilgit, Dr. G. M. Giles.
One unregistered spec., Khasi Hills, Colonel G. Austin.
Ditto Ceylon, unknown.

46. Serica festina, Brsk.

Serica festina, Brensk. n. sp. *Ms.*

Reg. No. $\frac{3689}{5}$, Co-type, Maldah, W. H. Irvine, Esq.

47. Serica fumosa, Brsk.

Serica fumosa, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{7400}{13}$ and $\frac{7401}{13}$, Types, Dehra Dun, Director, Forest School, Dehra Dun.

48. Serica gigantea, Brsk.

Serica gigantea, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7458}{13}$, Khasi Hills, Colonel G. Austin.

49. Serica himalyica, Brsk.

Serica himalayica, Brensk. *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 152.

Reg. Nos. $\frac{7379\text{-}80}{13}$, Sikkim, E. Barlow, Esq., 1896.

50. Serica immutabilis, Schönh.

Serica immutabilis, Schönh., *Syn. Ins.* I, 3, *p.* 181.—Burm. *Handb.* IV, 2 *p.* 165.—Gem. Har. *Cat. Coleop.* IV, *p.* 1119.

„ *mutabilis*, Oliv., *Ent.* I, 5, *p.* 51, *t.* 3, *f.* 24.

Reg. No. $\frac{7456}{13}$, Dunsiri, unknown.

Two unregistered specs., locality unknown.

51. Serica indica, Blanch.

Serica indica, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 77.—Gem. Har. *Cat. Coleop.* IV, *p.* 1119.

Reg. No. $\frac{2875}{5}$, Srinagar, unknown.

Two unregistered specs. locality unknown.

52. Serica inornata, Brsk.

Serica inornata, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7193}{3}$, Java, Captain Downes, 22nd September 1884.

53. Serica insularis, Brsk.

Serica insularis, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7502}{13}$, Type, Andaman Is., unknown.

One unregistered spec., ditto, ditto.

54. Serica læticula, Shp.

Serica læticula, Sharp, *Jour. Asia. Soc. Beng.*, XLVII, 1878, *p.* 172.—*Scient. Res., Second York., Mis. Colep*, 1879, *p.* 47.—Nonfr. *Berl. Ent. Zeits.*, XXXVII, 1892, *p.* 257.

Reg. No. $\frac{2147}{10}$, Type, Murree, Dr. F. Stoliczka, 1874.

55. Serica lugubris, Brsk.

Serica lugubris, Brensk. *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 152.

Reg. Nos. $\frac{7392}{13}$ and $\frac{7398}{13}$, Ranchi, W. H. Irvine, Esq., 1890.

„ No. $\frac{7399}{13}$, Calcutta, Museum Collector, 1896.

„ „ $\frac{3989}{8}$, Murshidabad, E. T. Atkinson, Esq., 1888.

56. Serica maculosa, Brsk.

Serica maculosa, Brensk. n. sp. ***Ms.***

Reg. Nos. $\frac{7462}{13}$ ♂, $\frac{7463}{13}$ ♂, $\frac{7465}{13}$ ♂ and $\frac{7465}{13}$ ♀, Naga Hills, Colonel G. Austin.

„ No. $\frac{9526}{13}$, N.-E. Frontier, Colonel G. Austin.

One unregistered spec. locality unknown.

57. Serica marginella, Hope.

Serica marginella, Hope, *Gray. Zool. Misc.*, 1831, *p.* 24.—Blanch. *Cat. Coll. Ent.*, 1850, *p.* 78.—Gem. Har. *Cat. Coleop.* IV, *p.* 1119.

Reg. No. $\frac{7466}{13}$, Andaman Island, unknown.

One unregistered spec., S.-E. Frontier, Colonel G. Austin.

58. Serica marmorata, Blanch.

Serica marmorata, Blanch., *Cat. Coll. Ent.*, 18 0, *p.* 77.—Gem. Har. *Cat. Coleop.* IV, *p.* 1119.

Reg. No. $\frac{7452}{13}$, Sibsagar, S. E. Peal, Esq.

59. Serica mutabilis, Fabr.

Serica mutabilis, Fabr., *Syst. Ent.*, *p.* 39.—Burm. *Handb.* IV, 2, *p.* 169.—Gem. Har. *Cat. Coleop.* IV, *p.* 1119.

Reg. No. $\frac{9430}{3}$, N.-E. Frontier, Colonel G. Austin.

One un-registered spec., ditto. ditto.

60. Serica penangica, Brsk.

Serica penangica, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7195}{3}$, Co-type, Penang, Captain Downes.

61. Serica pruinosa, Burm.

Serica pruinosa, Burm., *Handb.*, IV, 2, *p.* 165.—Gem. Har. *Cat. Coleop.* IV, *p.* 1120.—Cotes, *Ind. Mus. Notes*, III, 3, *p.* 117; III, 6, *p.* 3.

Reg. No. $\frac{3765\text{-}68}{13}$, Devikulam (6,000 feet), A. W. Turner, Esq., 29th June 1892.

„ Nos. $\frac{3736\text{-}39}{13}$, Trevandrum, Lieutenant H. S. Ferguson 2nd June 1892.

Two unregistered specs., Harmutti, unknown.

This species is said to attack coffee plants in the Madras Presidency.

62. Serica rufocuprea, Blanch.

Serica rufocuprea, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 77.—Gem. Har. *Cat. Coleop.* IV, *p.* 1120.

Reg. No. $\frac{7459}{13}$, Shillong, Colonel G. Austin.

63. Serica sempiterna, Brsk.

Serica sempiterna, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{7389}{13}$ and $\frac{7390}{13}$, Khasi Hills, Colonel G. Austin.

64. Serica severini, Brsk.

Serica severini, Brensk. *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 153.
Reg. Nos. $\frac{6072}{12}$, $\frac{6077}{12}$, $\frac{6080}{12}$, and $\frac{7428}{13}$, Bangalore, J. Cameron, Esq., 1890.

65. Serica sikkimensis, Brsk.

Serica sikkimensis, Brensk. n. sp. *Ms.*

Reg. No. $\frac{2643}{9}$, Sikkim, E. T. Atkinson, Esq., 28th December 1888.

" " $\frac{5640}{5}$, Darjeeling, C. H. Dreyer, Esq.

66. Serica sphærica, Burm.

Serica sphærica, Burm. *Handb.* IV, 2, *p.* 172.—Gem. Har. *Cat. Coleop.* IV, *p.* 1120.

Reg. No. $\frac{5891}{4}$, Tavoy, Museum Collector.

67. Serica tridens, Brsk.

Serica tridens, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{7391}{13}$, $\frac{7460}{13}$ and Naga Hills, Colonel G. Austin.

68. Serica truncata, Brsk.

Serica truncata, Brensk. n. sp. *Ms.*

Reg. No. $\frac{8569}{7}$, Sikkim, E. T. Atkinson, Esq.

" Nos. $\frac{959\text{-}61}{8}$, Calcutta, Museum Collector.

" " $\frac{5685}{12}$, $\frac{5693}{12}$ and $\frac{5694}{12}$, Mungphu, E. T. Atkinson, Esq.

69. Serica umbrina, Blanch.

Serica umbrina, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 77.—Gem. Har. *Cat. Coleop.* IV, *p.* 1121.

Reg. No. $\frac{7457}{13}$, Khasi Hills, Colonel G. Austin.

Genus: HOMALOPLIA, Stephens.

70. Homaloplia limbata, Krynick.

Homaloplia limbata, Krynick., *Bull., Mosc.*, V, 1832, *p.* 126.—Megerie. *Sturm. Cat.*, 1843, *p.* 126.—Gem. Har. *Cat. Coleop.* IV, *p.* 1123.

Reg. No. $\frac{805}{6}$, S. Russia, K. L. Bramson, Esq., 24th December 1885.

„ „ $\frac{806}{6}$, ditto ditto.

71. Homaloplia ruricola, Fabr.

Homaloplia ruricola, Fabr., *Syst. Ent.*, *p.* 38.—Ratzeb., *Forstins*, 1, *p.* 80. *t.* 3, *f.* 13.—Burm. *Handb.* IV, 2, *p.* 154.—Gem. Har. *Cat. Coleop.* IV, *p.* 1123.

„ *floricola*, Laichart, *Verz, Ins. Tyrol.* 1, *p.* 41.

„ *marginata*, Fuessl., *Verz. p.* 3.—Fourer., *Ent. Par.* 1, *p.* 9.

„ *nigromarginata*, Herbst., *Arch., p.* 155, *t.* 43, *f.* 7.

Reg. No. $\frac{7634}{13}$, Europe, Herr E. Brenske.

72. Homaloplia spirææ, Gebler.

Homaloplia spirææ, Gebler, *Bull. Mosc*, 1847, IV, *p.* 465.—Gem. Har. *Cat. Coleop.* IV, *p.* 1123.

Reg. No. $\frac{8935}{2}$, Sahibgunge, C. A. Wilson, Esq.

Genus: TRIODONTA, Mulsant.

73. Triodonta aquila, Casteln.

Triodonta aquila, Casteln, *Hist. nat.*, 1840, 11, *p.* 148.—Muls, *Col. Fr. Lamell, p.* 468.—Jacq., *Duv. Gen. Col.* III, *t.* 13, *f.* 63.—Dej, *Cat.*, 3 ed., *p.* 183.—Gem. Har. *Cat. Coleop.* IV, *p.* 1123.

Reg. No. $\frac{7613}{13}$, Europe., Herr E. Brenske.

Genus : **DIPHUCEPHALA**, Serville.

74. Diphucephala edwardsi, Waterh.

Diphucephala edwardsi, Waterh., *Mon.*, *p.* 220.—Burm. *Handb.* IV, 2, *p.* 121.—Gem. Har. *Cat. Coleop.* IV, *p.* 1128.

One unreg. specimen, Adelaide, S. Australia, C. Wilson, Esq.

Genus : **STETHASPIS**, Hope.

75. Stethaspis suturalis, Fabr.

Stethaspis suturalis, Fabr., *Syst. Ent.*, *p.* 34.—White, *Voy. Ereb. Terr. Zool. Ins.*, *p.* 11, *t.* 2, *f.* 7.—Burm. *Handb.* IV, 2, *p.* 222.

Reg. No. $\frac{5627}{3}$, N. Zealand, Captain T. Brown, 1st August 1884.

Genus : **PYRONOTA**, Boisduval.

76. Pyronota festiva, Fabr.

Pyronota festiva, Fabr., *Syst. Ent.*, *p.* 36.—Oliv., *Ent.* I, 5, *p.* 47, *t.* 5, *f.* 48 *a-b*.—Burm. *Handb.* IV, 2, *p.* 219.—Gem. Har. *Cat. Coleop.* IV, *p.* 1130.

Three specs., Reg. Nos. $\frac{5630\text{-}32}{3}$, N. Zealand, Captain T. Brown, 1st August 1884.

Genus : **LIPARETRUS**, Guèrin.

77. Liparetrus discipennis, Guèr.

Liparetrus discipennis, Guèr., *Voy. Coquille*, 1830, *Col.*, *p.* 90, *t.* 3, *f.* 10.—Burm. *Handb.* IV, 2, *p.* 195.—Durville *Dej. Cat.*, 3 ed., p. 181.—Gem. Har. *Cat. Coleop.* IV, *p.* 1131.

One unregistered spec., Adelaide, C. Wilson, Esq.

78. Liparetrus hirsutus, Burm.

Liparetrus hirsutus, Burm., *Handb.* IV, 2, *p.* 197.—Gem. Har. *Cat. Coleop.* IV, *p.* 1131.

One unregistered spec., Adelaide, C. Wilson, Esq.

79. Liparetrus xanthotrichus, Blanch.

Liparetrus xanthotrichus, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 103.—Gem. Har. *Cat. Coleop.* IV, *p.* 1132.

Two unregistered specs., Adelaide, C. Wilson, Esq.

Genus: HAPLONYCHA, Blanch.

80. Haplonycha crinita, Burm.

Haplonycha crinita, Burm., *Handb.* IV, 2, *p.* 229.—Gem. Har. *Cat. Coleop*, IV, *p.* 1133.

One unregistered spec., Adelaide, S. Australia, C. Wilson, Esq.

Genus: HETERONYX, Guèrin.

81. Heteronyx obesus, Burm.

Heteronyx obesus, Burm. *Handb.* IV, 2, *p.* 236.—Gem. Har. *Cat. Coleop.* IV, *p.* 1134.

One unregistered spec. from Adelaide, S. Australia, C. Wilson, Esq.

82. Heteronyx oblongus, Blanch.

Heteronyx oblongus, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 110.—Gem. Har. *Cat. Coleop.* IV, *p.* 1134.

Reg. No. $\frac{7404}{13}$, Australia, unknown.

Genus: ODONTRIA, White.

83. Odontria striata, White.

Odontria striata, White, *Voy. Ereb. Terr. Ins.*, *p.* 10, *t.* 2, *f.* 5.—Blanch, *Voy. Pole. Sud. Zool.*, IV, *p.* 125, *t.* 8, *f.* 5.—Gem. Har. *Cat. Coleop.* IV, *p.* 1136.

Reg. No. $\frac{5628}{3}$, New Zealand, Captain T. Brown.

84. Odontria zelandica, Whit.

Odontria zelandica, White, *Voy. Ereb. Terr. Ins.*, *p.* 10.—Lacord., *Gen. Atl.*, *t.* 30, *f.* 3.—Gem. Har. *Cat. Coleop.* IV, *p.* 1136.

Reg. No. $\frac{5629}{3}$, N. Zealand, Captain T. Brown.

Genus : **RHINASPIS**, Perty.

85. Rhinaspis schranki, Perty.

Rhinaspis schranki, Perty., *Del. anim.*, *p.* 47, *t.* 10, *f.* 1.—Gem. Har. *Cat. Coleop*, IV, *p.* 1150.

Reg. No. $\frac{3480}{13}$, Brasilia, Herr E. Brenske, 26th March 1892.

Genus : **DEJEANIA**, Blanch.

86. Dejeania alsiosia, Blanch.

Dejeania alsiosia, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 96.—Lacord., *Gen. Atl.*, *t.* 30, *f.* 5.—Gem. Har. *Cat. Coleop.* IV, p. 1154.

Reg. No. $\frac{8226}{4}$, Tavoy., Museum Collector, 27th February 1885.

Genus : **ANCISTROSOMA**, Curtis.

87. Ancistrosoma farinosum, Sallé.

Ancistrosoma farinosum, Sallé, *Ann. Fr.*, 1849, *p.* 300, *t.* 8. *f.* 3, *a.-d.*—Blanch., *Cat. Coll. Ent.*, 1850, *p.* 124.—Burm. *Handb.* IV, 2, *p.* 104.—Gem. Har. *Cat. Coleop.* IV, *p.* 1155.

Reg. No. $\frac{3489}{13}$, Columbia, Herr E. Brenske, 20th March 1892.

Genus : **APOGONIA**, Kirby.

88. Apogonia andamana, Brsk.

Apogonia andamana, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{7412}{13}$ and $\frac{7413}{13}$, Andaman Island.
One unregistered spec., ditto.

89. Apogonia angustata, Brsk.

Apogonia angustata, Brensk. n. sp. *Ms.*

Reg. No. $\frac{6438}{12}$, Berhampur, E. T. Atkinson, Esq., 1890.

90. Apogonia brunnea, Hope.

Apogonia brunnea, Hope, *Gray. Zool. Misc.*, 1831, *p.* 23.—Blanch. *Cat. Coll. Ent.*, 1850, *p.* 228.—Gem. Her. *Cat. Coleop.* IV. *p.* 1156.—Waterh. *Cist. Ent.* II, 1877, *p.* 227.—Ritz. *Tijds. voor. Ent.*, XXXIV, *p.* xcii.

Reg. No. $\frac{870}{12}$, Calcutta, Museum Collector, 1889.

91. Apogonia carinata, Brsk.

Apogonia carinata, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{6454}{12}$ and $\frac{6480}{12}$, Berhampur, E. T. Atkinson, Esq.

„ „ $\frac{3985}{8}$ and $\frac{3986}{8}$, Murshidabad, ditto.

92. Apogonia cribricollis, Burm.

Apogonia cribricollis, Burm., *Handb.* IV, 2, *p.* 256.—Gem. Har. *Cat. Coleop.* IV, *p.* 1156.

Reg. Nos. $\frac{6111}{1}$ and $\frac{9421}{3}$, Sibsagar, S. E. Peal, Esq.

93. Apogonia destructor, Bos.

Apogonia destructor, Bos., *Tijdskr. v. Ent.*, XXXIII, 1890, *p.* 336, *t.* 14, *f.* 16.—Nonfr., *Berl. Ent. Zeits.*, XXXVII, 1892, *p.* 271.—Rits., *Tijd. v. Ent.*, XXXIV, p. xciv.

Reg. Nos. $\frac{1341}{13}$ and $\frac{1342}{13}$, East Java, Mons. C. Ritsema. 3rd July 1890.

This species has been reported as attacking sugar-cane in Java.

94. Apogonia ferruginea, Fabr.

Apogonia ferruginea, Fabr., *Spec. Ins.*, I, *p.* 41.—Oliv., *Ent.*, I, 5, *p.* 44, *t.* 7, *f.* 82.—Burm. *Handb.* IV, 2, *p.* 258.—Gem. Har. *Cat. Coleop.* IV, *p.* 1156.

Reg. No. $\frac{3672}{5}$, Maldah, W. H. Irvine, Esq., 1885.

„ „ $\frac{7640}{13}$, Ranchi, ditto.

Two unregistered specs., Calcutta, E. T. Atkinson, Esq.

95. Apogonia kombirana, Brsk.

Apogonia kombirana, Brensk. *Ann. Soc. Ento., Belg.*, XL, 1896, *p.* 155.

Reg. No. $\frac{63}{3}$ Konkir, Bengal, Herr E. Brenske.

96. Apogonia lævicollis, Lansb.

Apogonia lævicollis, Lansb., *C. R. Soc. Ent., Belg.*, 1879, *p.* cxlix.—*Berl. Ent. Zeits*, XXXVII, 1892, *p.* 271.

Reg. Nos. $\frac{1343}{13}$ and $\frac{1344}{13}$, Java, Mons. C. Ritsema, 3rd July 1890.

97. Apogonia metasternalis, Rits.

Apogonia metasternalis, Rits., *Notes Leyden Mus.*, XVII, *p.* 207.

Reg. No. $\frac{7739}{10}$, Pegu, E. T. Atkinson, Esq., 8th May 1889.

98. Apogonia mœsta, Burm.

Apogonia mœsta, Burm., *Handb.* IV, **2**, *p.* 257.—Gem. Har. *Cat. Coleop.* IV, *p.* 1156.

Reg. Nos. $\frac{6440}{12}$ and $\frac{6469}{12}$, Berhampur, E. T. Atkinson, Esq.

99. Apogonia proxima, Waterh.

Apogonia proxima, Waterh., *Cistul. Ent.*, II, *p.* 223.—Nonfr., *Berl. Ent. Zeits.*, XXXVII, 1892, *p.* 272.

Reg. Nos. $\frac{8133}{7}$, $\frac{8136}{7}$, $\frac{8139}{7}$, $\frac{8137}{7}$, $\frac{4995}{5}$, $\frac{4996}{5}$ and $\frac{4997}{5}$, Andaman Island, unknown.

„ „ $\frac{3691}{6}$ and $\frac{3692}{6}$, Andaman Island, Revd. Warnefords.

100. Apogonia splendida, Bohem.

Apogonia splendida, Bohem., *Res. Eugen.*, 1858, *p.* 55.—Gem. Har. *Cat. Coleop.* IV, *p.* 1156.

Reg. Nos. $\frac{2153}{8}$ and $\frac{2160}{8}$, Sikkim, E. T. Atkinson, Esq., 28th August 1888.

101. Apogonia uniformis, Blanch.

Apogonia uniformis, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 229.—Lacord., *Gen.* III, *p.* 277, not. 1.—Gem. Har. *Cat. Coleop.* IV. p. 1156.

Reg. Nos. $\frac{7408}{13}$, $\frac{7409}{13}$ and $\frac{7410}{13}$, Ranchi, W. H. Irvine, Esq. 10th September 1889.

„ „ $\frac{7405\text{-}7407}{13}$, Bangalore, J. Cameron, Esq., 18th December 1889.

„ No. $\frac{2058}{\infty}$, Sikkim, E. T. Atkinson, Esq., 28th August 1888.

102. Apogonia vicina, Burm.

Apogonia vicina, Burm., *Handb.* IV, 2, *p.* 256.—Dej. *Cat.*, 3 ed., *p.* 179.—Gem. Har. *Cat. Coleop.*, IV, *p.* 1156.

Reg. No. $\frac{8194}{5}$, Maldah, W. H. Irvine, Esq.

„ „ $\frac{3174}{8}$, Sikkim, E. T. Atkinson, Esq., 30th July 1888.

103. Apogonia villosella, Blanch.

Apogonia villosella, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 229.—Lacord. *Gen.* III, *p.* 277, not. 1.—Gem. Har. *Cat. Coleop.* IV, *p.* 1156.

Reg. No. $\frac{7411}{13}$, Calcutta, E. T. Atkinson, Esq.

Genus: HEPTOPHYLLA, Motsch.

104. Heptophylla picea, Motsch.

Heptophylla picea, Motsch., *Etud. Ent.*, 1857, *p.* 33.—Gem. Har. *Cat. Coleop.* IV, *p.* 1158.

Reg. No. $\frac{8503}{1}$, Formosa, Surgn.-General R. Hungerford, 17th March 1882.

„ „ $\frac{8597}{1}$, ditto ditto.

Genus: SCHIZONYCHA, Blanch.

105. Schizonycha crenata, Gyllen.

Schizonycha crenata, Gyllenh., *Schonh. Syn. Ins.* I, 3, App., *p.* 78.—Burm. *Handb.* IV, 2, *p.* 268.—Gem. Har. *Cat. Coleop.* IV, *p.* 1159.

Reg. No. $\frac{7926}{1}$, Siberia, Dr. Dohrn, 9th January 1882.

106. Schizonycha fuscescens, Blanch.

Schizonycha fuscescens, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 150.—Gem. Har. *Cat. Coleop.* IV., *p.* 1159.

One unregistered spec., Trevandrum.
Ditto ditto, India.

107. Schizonycha rhizotrogoides, Brsk.

Schizonycha rhizotrogoides, Brensk. n. sp., *Ind. Mus. Notes*, IV, 4, p. 177.

One unregistered spec., Senife (7,000 feet) Abysenia, lent to Herr E. Brenske.

Genus: **EUCIRRUS,** Melly.

108. Eucirrus mellyi, Melly.

Eucirrus mellyi, Melly, *Mag. Zool.,* 1832. *Cl.* IX, *t.* 47.—Burm. *Handb.* IV. 2, *p.* 293.—Gem. Har. *Cat. Coleop.* IV, *p.* 1163.

One unregistered spec. from Ceylon.

Genus: **LEPIDIOTA,** Hope.

109. Lepidiota bimaculata, Saund.

Lepidiota bimaculata, Saund, *Trans. Ent. Soc.* II, 1839, *p.* 176, *t.* 16, *f.* 2.—Burm. *Handb.* IV, 2, *p.* 294.—Gem. Har. *Cat. Coleop,* IV, *p.* 1163.

" *griffithi,* Hope, *Trans. Ent. Soc.* III, 1841, *p.* 62.

Reg. No. $\frac{8566}{3}$, Ladak, E. I. Co's Museum, 27th September 1894.

" " $\frac{8567}{3}$ Sikkim, ditto ditto.

" " $\frac{2018}{4}$, Assam, A. J. Mein, Esq., 1884.

" " $\frac{4004}{13}$, Shillong, Shillong Museum, 1892.

" " $\frac{1765}{4}$, Cherra, Abyssinian Collection, 27th October 1884.

One unregistered spec., Naga Hills, Captain Butler.
Ditto ditto, Khyokphow, Mr. Davidson.
Two ditto specs. Sikkim, unknown.

110. Lepidiota crenulata, Burm.

Lepidiota crenulata, Burm., *Handb.* IV, 2, *p.* 297.—Gem. Har. *Cat, Col.* IV, *p.* 1163.

Reg. No. $\frac{2909}{5}$, South India, unknown.

111. Lepidiota luctuosa, Blanch.

Lepidiota luctuosa, Blanch., *Cat. Coll. Ent.,* 1850, *p.* 157.—Gem. Har. *Cat. Coleop.* IV, *p.* 1163.

One unregistered spec. from Kallig.

112. Lepidiota punctatipennis, Blanch.

Lepidiota punctatipennis, Blanch., *Cat. Coll. Ent.,* 1850, *p.* 157.—Gem. Har. *Cat. Coleop.* IV, *p.* 1163.

One unregistered spec. from Sikkim.

113. Lepidiota rugosa, Shp.

Lepidiota rugosa, Sharp, *Coleop. Hefte.* XV, *p.* 72.—Nonfr, *Berl. Ent. Zeits*, XXXVII, 1892, *p.* 275.

One unregistered spec. Jahore, J. Meldrum, Esq.

114. Lepidiota rugosipennis, Blanch.

Lepidiota rugosipennis, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 157.—Gem. Har. *Cat. Coleop.* IV, *p.* 1163.

Two unregistered specs. from Kallig.

115. Lepidiota stigma, Fabr.

Lepidiota stigma, Fabr., *Syst. El.* II, p. 160. 1.–Burm. *Handb.* IV, 2. *p.* 295.—Gem. Har. *Cat. Coleop.* IV, *p.* 1163.

„ *alba*, Fabr., *Syst. El.* II, *p.* 160. 2.

Reg. No, $\frac{1735}{3}$, Perak, unknown.

Two unregistered specs. ♂ and ♀ locality unknown.

Genus: ASACTOPHOLIS, Brenske.

116. Asactopholis bicolor, Shp.

Asactopholis bicolor, Sharp, *Coleop. Hefte.* XV, *p.* 78.

Reg. Nos. $\frac{7588}{4}$, $\frac{7872}{4}$, and $\frac{7579}{4}$, Tavoy, Museum Collector, 1884.

„ No. $\frac{7358}{8}$, Pegu, E. T. Atkinson, Esq., 12th December 1888.

Genus: CYPHOCHILUS, Waterhouse.

117. Cyphochilus candidus, Olivr.

Cyphochilus candidus, Olivr., *Ent.* I. 5, *p.* 15, *t.* 8, *f.* 98.—Burm. *Handb.* IV, 2, *p.* 301.—Gem. Har. *Cat. Coleop.* IV. *p.* 1164.

Reg. No. $\frac{992}{2}$, Sibsagar, Assam, S. E. Peal, Esq., 21st June 1882.

„ Nos. $\frac{7423-26}{8}$ and $\frac{7428}{8}$, Sikkim, E. T. Atkinson, Esq., 12th December 1888.

„ „ $\frac{4008}{13}$ and $\frac{4009}{13}$ Shillong, Shillong Museum, 1892.

One unregistered spec., Mungphu, E. T. Atkinson, Esq.

Ditto ditto Naga Hills, Captain Butler.

118. Cyphochilus proximus, shp.

Cyphochilus proximus, Sharp, *Coleop*, *Keft*, XV, *p*, 81,—Nonfr, *Berl. Ent, Zeit.* XXXVII, 1892, *p*, 275.

Reg. No. $\frac{7877}{4}$, Tavoy, Museum Collector.

119. Cyphochilus pygidialis, Nonfr.

Cyphochilus pygidialis, Nonfr., *Berl. Ent. Zeits*, XXXVIII, 1893, *p*. 332.

Reg, Nos, $\frac{8001}{12}$ and $\frac{8002}{12}$, Shillong, Museum Collector, November 1889.

,, ,, $\frac{7423-24}{13}$ and $\frac{7375}{13}$ Shillong, Shillong Museum.

One *unregistered spec.*, Shillong, ditto.

120. Cyphochilus sikkimensis, Brsk.

Cyphochilus sikkimensis, Brensk. n. sp. *Ms.*

Reg. Nos. $\frac{7376-78}{13}$, Sikkim, E. Barlow, Esq., September 1896.

121. Cyphochilus waterhousi, Brsk.

Cyphochilus waterhousi, Brensk. n. sp. *Ms.*

Reg. No. $\frac{8766}{4}$, Trichinopoly, Father Honoré, 2nd March 1885.

Genus : LEUCOPHOLIS, Blanchard.

122. Leucopholis crassa, Brsk.

Leucopholis crassa, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p*. 58.

Reg. No. $\frac{3047}{11}$, Shillong, E. T. Atkinson, Esq., 9th August 1889.

One unregistered spec., Assam, Asia. Soc. Bengal, 1864.

Ditto ditto, Darjeeling, unknown.

Ditto ditto, locality unknown.

123. Leucopholis irrorata, Chevr.

Leucopholis irrorata, Chevrol., *Rev. Zool.*, 1841, *p*. 222.—Gem. Har. *Cat, Coleop.* IV, *p*. 1164.

,, *pollinosa*, Burm., *Handb.* IV, 2, *p*. 304.—Dej. *Cat.*, 3 ed., *p*. 177,

Reg. No. $\frac{3481}{13}$, Philippine Is., Herr E. Brenske,

,, ,, $\frac{8563}{3}$, ditto, Est. Ind. Co.'s Museum.

124. Leucopholis plagiata, Blanch.

Leucopholis plagiata, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 158.—Gem. Har. *Cat. Coleop.* IV, *p.* 1164.

Reg. No. $\frac{8563}{3}$, Penang, Dr. Cantor.

Three specs., Reg. Nos. $\frac{1734}{3}$, $\frac{1737}{3}$ and $\frac{1739}{3}$, Perak, unknown.

125. Leucopholis tetaranus, Brsk.

Leucopholis tetaranus, Brensk., var. *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 157.

Reg. No. $\frac{8576}{3}$, Deccan, Colonel Sykes.

Genus: TRICHOLEPIS, Blanchard.

126. Tricholepis grandis, Castel.

Tricholepis grandis, Castel., *Hist. nat.* II, 1840, *p.* 133.—Gem. Har. *Cat. Coleop.* IV, *p.* 1165.

„ *pubera*, Burm., *Handb.* IV, 2, *p.* 307.—Dej. *Cat.*, 3 ed., *p.* 177.

„ *puberina*, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 138.

Reg. No. $\frac{1736}{3}$, Perak, unknown, 9th June 1884.

127. Tricholepis niveopilosa, Blanch.

Tricholepis niveopilosa, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 156.—Burm. *Handb.* IV, 2, *p.* 307.—Gem. Har. *Cat. Coleop.* IV, *p.* 1165.

Reg. No. $\frac{3479}{13}$, Madagascar, Herr E. Brenske, 26th March 1892.

Genus: LACHNOSTERNA, Hope.

(*Ancylonycha*, Blanch.—*Holotrichia*, Hope.)

128. Lachnosterna andamana, Brsk.

Lachnosterna andamana, Brensk, *Ind. Mus. Notes*, IV No. 4, *p.* 178.

Reg. No. $\frac{4906}{5}$, Type, And. Is., lent to Herr Brenske.

129. Lachnosterna atkinsoni, Brsk.

Lachnosterna atkinsoni, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 191.

Reg. No. $\frac{7709}{5}$ ♂, Type (unique), S. India, Father Honoré, 11th July 1885.

130. Lachnosterna aurosericea, Brsk.

Lachnosterna aurosericea, Brensk, *Berl. Ent. Zeits.* XXXVII, *p.* 172.—*Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 160.

Reg. No. $\frac{7472}{13}$ ♀, Type, Tenasserim, Museum Collector.

131. Lachnosterna bidentata, Burm.

Lachnosterna bidentata, Burm., *Handb.* IV, 2, *p.* 316.—Gem. Har. *Cat. Coleop.* IV, *p.* 1166.

One unregistered spec., Jahore, J. Meldrum, Esq.

132. Lachnosterna biehli, Brsk.

Lachnosterna biehli, Brensk., *Berl. Ent. Zeits.*, 1892, XXXVII, *p.* 170.—*Ann. Soc. Ent., Belg.*, 1896, XL, *p.* 151.

Reg. No. $\frac{8539}{3}$, Type, Darjeeling, Captain Pemberton.
„ „ $\frac{8538}{3}$, ditto ditto.
„ „ $\frac{7371}{13}$, Sikkim, E. Barlow, Esq., 1896.

133. Lachnosterna brevicollis, Burm.

Lachnosterna brevicollis, Burm. *Handb.* IV, 2, *p.* 314.—Gem. Har. *Cat. Coleop.* IV, *p.* 1170.

Reg. No. $\frac{8542}{3}$, N.-W. Himalayas, Captain Pemberton.

134. Lachnosterna cavifrons, Brsk.

Lachnosterna cavifrons, Brensk., var. *Berl. Ent. Zeits.*, XXXVII, *p.* 167.

One unregistered spec. from India.

135. Lachnosterna clypealis, Brsk.

Lachnosterna clypealis, Brensk, *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 159.

Reg. No. $\frac{7368}{13}$, Sikkim, E. Barlow, Esq.

One unregistered spec., Sikkim.

136. Lachnosterna consanguinea, Blanch.

Lachnosterna consanguinea. Blanch., *Cat. Coll. Ent.*, 1850, *p.* 139.—Gem. Har. *Cat. Coleop.* IV, *p.* 1166.

Reg. No. $\frac{5460}{1}$, Amoy (China), Dr. Hungerford, 19th April 1881.
„ „ $\frac{5461}{1}$, ditto ditto.

137. Lachnosterna cotesi, Brsk.

Lachnosterna cotesi, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p*, 185, and XLI, 1896, *p.* 348.

Reg. No. $\frac{7402}{8}$, Type, Sikkim, E. T. Atkinson, Esq., 12th December 1888.

" " $\frac{7365}{13}$, , Kurseiong, E. Barlow, Esq., 1896.

138. Lachnosterna flavosericea, Brsk.

Lachnosterna flavosericea, Brensk., *Berl. Ent. Zeits.* XLI, 1896, *p.* 348.

Reg. No. $\frac{7367}{13}$, Type, Sikkim, E. Barlow, Esq., 1896.

139. Lachnosterna fusca, Fröh.

Lachnosterna fusca, Fröhlich., *Naturf.*, 26, *p.* 99.—*Lec. Journ. Ac., Phil.*, 1856, *p.* 244.—Candeze. *Mém., Liege.*, XVI, 1861, *p.* 347, *t.* 2, *f.* 3.—Gem. Har. *Cat. Coleop.* IV, *p.* 1167.

" *fervens*, Gyllenh., *Schönh., Syn. Ins.*, I, 3, App., *p.* 74.

" *fervida*, Oliv., *Ent.*, I, 5, *p.* 24, *t.* 9, *f.* 109.

" *quercina*, Knoch., *Beitr.*, I, *p.* 74, *t.* 1, *f.* 27.—Burm. *Handb.*, IV, 2, *p.* 319.

Reg. No. $\frac{3476}{13}$, America, Herr E. Brenske, 26th March, 1892.

140. Lachnosterna lata, Brsk.

Lachnosterna lata, Brensk. *Berl. Ent. Zeits.* XXXVII, *p.* 163.

Reg. No. $\frac{101}{5}$, Tavoy, Museum Collector, 1885.

" " $\frac{102}{5}$, ditto ditto.

141. Lachnosterna longicarinata, Brsk.

Lachnosterna longicarinata, Brensk. *Berl. Ent. Zeits.* XXXVII, *p.* 181.

One unregistered spec. from Kallig.

142. Lachnosterna nigropunctata, Brsk.

Lachnosterna nigropunctata, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7434}{13}$, Type (unique), from Assam

143. Lachnosterna obscura, Brsk.

Lachnosterna obscura, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 162.
One unregistered spec. from Assam.

144. Lachnosterna pagana, Burm.

Lachnosterna pagana, Burm. *Handb.* IV, 2, *p.* 312.—Gem. Har. *Cat. Coleop.* IV, *p.* 1169.
Two specs., Reg. Nos. $\frac{7439}{13}$, and $\frac{7440}{13}$, India.

145. Lachnosterna pilosa, Brsk.

Lachnosterna pilosa, Brensk, *Berl. Ent. Zeits.* XLI, 1896, *p.* 350.
Reg. No. $\frac{7364}{13}$, Type, Upper Tenasserim, J. Wood-Mason, Esq.
One unregistered spec., ♂ ditto ditto.

146. Lachnosterna plagiata, Brsk.

Lachnosterna plagiata, Brensk, *Berl. Ent. Zeits.* XXXVII *p.* 185.
Reg. No. $\frac{7435}{13}$, Type from India.

147. Lachnosterna problematica, Brsk.

Lachnosterna problematica, Brensk, *Ind. Mus. Notes*, IV,4, *p.* 178.
One Type spec. from Srinagar lent to Herr E. Brenske.

148. Lachnosterna glabriclypeata, Brsk.

Lachnosterna glabriclypeata, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 161.
One unregistered spec. from India.

149. Lachnosterna glabrifrons, Brsk.

Lachnosterna glabrifrons, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 190.
Reg. No. $\frac{7473}{13}$, Type, Khasi Hills, unknown.

150. Lachnosterna imitatrix, Brsk.

Lachnosterna imitatrix, Brensk. n. sp., *Ind. Mus. Notes*, Vol. IV, No. 4, *p.* 178.
Reg. No. $\frac{3510}{6}$, Co-type, Sikkim, C. Dreyer, Esq.

151. Lachnosterna impressa, Burm.

Lachnosterna impressa, Burm., *Handb.* IV, *2*, *p.* 314.—Gem. Har. *Cat. Coleop.* IV, *p.* 1168.—Cotes' *Ind. Mus. Notes*, I, p. 59; *Tea insects*, *p.* 5.

Reg. No. $\frac{3289}{13}$, Sikkim, Messrs. Devenport & Co., 3rd October 1891.

" " $\frac{7834}{7}$, Sikkim, D. King, Esq., 14th February 1883.

" " $\frac{7835}{7}$, ditto ditto.

This species attacks tea plants in Sikkim.

152. Lachnosterna intermedia, Brsk.

Lachnosterna intermedia, Brensk, *Mem. Soc. Ent., Belg.*, II, 1894, *p.* 64.

Two unregistered specs. from India.

153. Lachnosterna iridipennis, Brsk.

Lachnosterna iridipennis, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 177.

Reg. No. $\frac{7436}{13}$, Type, Sibsagar, Assam, S. E. Peal, Esq.

$\frac{7370}{13}$, Calcutta, Museum Collector.

One unregistered spec. Khasi Hills, Colonel G. Austin.

154. Lachnosterna rustica, Burm.

Lachnosterna rustica, Burm., *Handb.* IV, *2*, *p.* 313.—Gem. Har. *Cat. Coleop.* IV, *p.* 1169.

One unregistered spec. from Bangalore.

155. Lachnosterna scabrifrons, Brsk.

Lachnosterna scabrifrons, Brensk. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 164.

Reg. No. $\frac{7474}{13}$, Type, Ceylon, unknown.

156. Lachnosterna scrobiculata, Brsk.

Lachnosterna scrobiculata, Brensk, *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 174.

Reg. No. $\frac{7438}{13}$, Type ♀, Sikkim, unknown.

157. Lachnosterna scutellata, Brsk.

Lachnosterna scutellata, Brensk. n. sp. *Ms.*

One unregistered spec. from India.

158. Lachnosterna sericata, Brsk.

Lachnosterna sericata, Brensk. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 168.

Reg. No. $\frac{7175}{13}$, Type ♀, Khasi Hills, Colonel G. Austin.

159. Lachnosterna serrata, Fabr.

Lachnosterna serrata, Fabr., *Spec. Ins.* I, *p.* 35.—Oliv. *Ent.* I, 5, *p.* 11, *t.* 1, *f.* 5.—Burm. *Handb.* IV, 2, *p.* 310.—Gem. Har. *Cat. Coleop.* IV, *p.* 1170.

Reg. No. $\frac{7377}{8}$, Berhampur, E. T. Atkinson, Esq., 12th December 1888.

" " $\frac{7399}{8}$, Sikkim, ditto ditto.

" " $\frac{3583}{5}$, Maldah, W H. Irvine, Esq., 31st July 1885.

160. Lachnosterna sikkimensis, Brsk.

Lachnosterna sikkimensis, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 169.

Reg. No. $\frac{8535}{7}$, Type ♀, Sikkim, E. T. Atkinson, Esq., 25th July 1887.

161. Lachnosterna sinensis, Hope.

Lachnosterna sinensis, Hope, *Trans. Ent. Soc.* IV, 1845, *p.* 8.—Burm. *Handb.* IV, 2, *p.* 316.—Gem. Har. *Cat. Coleop.* IV, *p.* 1170.

" *sinæ*, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 139.

Reg. No. $\frac{3482}{13}$, China, Herr E. Brenske, 26th March 1892.

" " $\frac{3483}{13}$, ditto ditto.

162. Lachnosterna standfussi, Brsk.

Lachnosterna standfussi, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 182.

Reg. No. $\frac{8646}{5}$, Tavoy, Museum Collector, 25th June 1885.

163. Lachnosterna staudingeri, Brsk.

Lachnosterna standingeri, Brensk., var. *Berl. Ent. Zeits.* XXXVII, 1892 *p.* 166.

Reg. No. $\frac{7366}{13}$, Calcutta, Museum Collector, 1896.

" " $\frac{7643}{13}$, Shillong, Mr. Giles.

164. Lachnosterna stoliczkæ Shp.

Lachnosterna stoliczkæ, Sharp, *Journ. As. Soc. Beng.* XLVII, 1878, *p.* 172.—*Scient. Res. Sec. Yark. Miss. Coleop.*, 1879, *p.* 49. Nonfr. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 278.

Reg. No. $\frac{2167}{10}$, Type, Murree, Dr. F. Stoliczka, 1874.
„ „ $\frac{2168}{10}$ Type, ditto ditto.

165. Lachnosterna stridulans, Shp.

Lachnosterna stridulans, Sharp, *Journ. As. Soc. Beng.* XLVII, 1878, *p.* 172 —*Scient. Res. Sec. Yark. Mis. Coleop.*, 1879, *p.* 48.—Nonfr. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 278.

Reg. No. $\frac{2103}{10}$, Type, Murree, Dr. F. Stoliczka, 1874.

166. Lachnosterna tenasserima, Brsk.

Lachnosterna tenasserima, Brensk., *Berl. Ent. Zeits.* XLI, 1896, *p.* 349.

Reg. No. $\frac{6006}{10}$, Type ♂, Upper Tenasserim, J. Wood-Mason, 2nd March 1889.

Genus: HOLOMELIA, Brenske.

167. Holomelia mirabilis, Brsk.

Holomelia mirabilis, Brensk., *Ent. Nachr.* XVII, 1891, *p.* 314.

Reg. No. $\frac{7437}{13}$, Type, Jahore, Jas. Meldrum, Esq.

Genus: BRAHMINA, Blanch.

168. Brahmina calva, Blanch.

Brahmina calva, Blanch., *Cat. Coll. Ent.*, 1850. *p.* 140.—Burm. *Handb.* IV, 2, *p.* 365, *nota.*—Gem. Har. *Cat. Coleop.* IV, *p.* 1173.

Reg. No, $\frac{2157}{10}$, Murree, Dr. F. Stoliczka (Yarkand Expdn.)
„ „ $\frac{8545}{3}$, N.-W. Himalayas, East. Ind. Co.'s Museum.
„ „ $\frac{8547}{3}$, ditto ditto.
„ „ $\frac{8549}{3}$, ditto ditto.
„ „ $\frac{8550}{3}$ ditto ditto.

169. Brahmina cardoni, Brsk.

Brahmina cardoni, Brensk., *Berl. Ent. Zeits.* XXXVII, *p.* 108.
Reg. No. $\frac{7644}{13}$, Kurseong, Herr E. Brenske.
„ „ $\frac{7645}{13}$, ditto E. Barlow, Esq.

170. Brahmina comata, Blanch.

Brahmina comata, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 140.—Burm. *Handb.* IV, 2, *p.* 364.—Gem. Har. *Cat. Coleop.* IV, *p.* 1173.
One unregistered spec., Calcutta, Museum Collector.

171. Brahmina cotesi, Brsk.

Brahmina cotesi, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 100.
Reg. No. $\frac{7400}{8}$, Type ♀, Sikkim, E. T. Atkinson, 12th December 1888.
„ „ $\frac{7403}{8}$, Type ♀, ditto ditto.
„ Nos. $\frac{2870}{8}$, $\frac{2873}{8}$, ditto ditto.
„ „ $\frac{2871}{8}$, $\frac{2100}{8}$ and $\frac{2101}{8}$, ditto ditto.
„ No. $\frac{7369}{13\text{b}}$, ♀, Kurseong, E. Barlow, Esq.

172. Brahmina flabellata, Brsk.

Brahmina flabellata, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 104.
Reg. No. $\frac{7441}{13}$, Type ♂, Sikkim, unknown.

173. Brahmina obscura, Brsk.

Brahmina obscura, Brensk., *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 105.
Reg. No. $\frac{7414}{13}$, Type ♂, Khasi Hills, unknown.

174. Brahmina siamensis, Brsk.

Brahmina siamensis, Brensk., *Berl. Ent. Zeits.* XXXVII, *p.* 103.
Reg. No. $\frac{7476}{13}$, Assam, Asiatic Soc. Bengal, 1864.

175. Brahmina sikkimensis, Brsk.

Brahmina sikkimensis, Brensk., *Berl. Ent. Zeits.* XXXVII, *p.* 113.
Reg. No. $\frac{7445}{13}$, Type ♂, Sikkim, unknown.

176. **Brahmina tavoyensis,** Brsk.

Brahmina tavoyensis, Brensk., *Berl. Ent. Zeits.* XXXVII, *p.* 104.

Reg. No. $\frac{7563}{5}$, Type ♀ (unique), Amiah, East of Tavoy. Museum Collector.

177. **Brahmina thoracica,** Brsk.

Brahmina thoracica, Brensk., *Berl. Ent Zeits.* XXXVII, *p.* 109.

Reg. No. $\frac{7442}{13}$, Type ♂, Khasi Hills, Colonel G. Austin.
„ „ $\frac{7443}{13}$, Type ♀, ditto ditto.
One unregd. spec. ditto ditto.

Genus: **BRACHYLLUS,** Brenske.

178. **Brachyllus ulcerosus,** Brsk.

Brachyllus ulcerosus, Brensk. *Ann. Soc. Ent., Belg.,* XL, 1896, *p.* 162.

Reg. No. $\frac{7388}{8}$, Sikkim, E. T. Atkinson, Esq., 12th December 1888.

Genus: **EMPELATIRA,** Brenske. n. gen.

179. **Empelatira fairmairei,** Brsk.

Empelatira fairmairei, Brensk. n. sp. *Ms.*

Reg. No. $\frac{7661}{13}$, Type (unique), Jahore, Museum Collector.

Genus: **CLYTIA,** Brenske n. gen.

180. **Clytia pilosa,** Brsk.

Clytia pilosa, Brensk. n. sp. *Ms.*

Reg. No. $\frac{3765}{4}$, South India, Father Honoré, 1885.
„ „ $\frac{6719}{7}$ ditto ditto.

Genus: **RHIZOTROGUS,** Latreille.

(*Amphimallus,* Muls.—*Pseudotrematodes,* Jacq. Duv.)

181. **Rhizotrogus æstivus,** Oliv.

Rhizotrogus æstivus, Oliv., *Ent.* I, 5, *p.* 17, *t.* 2, *f.* 11.—Burm. *Handb.* IV, 2, *p.* 379.—Gem. Hav. *Cat. Coleop.* IV, *p.* 1173.

Rhizotrogus bimaculatus, Herbst., *Käf.* III, *p.* 80, *t.* 23, *f.* 10.
„ *gracilis*, Fröhl., *Natur. f.* 26, *p.* 96.
„ *inanis*, Brahm. *Ins. Kol.*, I, *p.* 85.
„ *maculicollis*, Zubkoff, *Bull. Mosc.* VI, 1833, *p.* 322.—Falderm. *Dej. Cat.*, 3 ed., *p.* 178.

Reg. No. $\frac{3884}{13}$, Germany, Herr E. Brenske, 26th March 1892.

182. Rhizotrogus assimilis, Herbst.

Rhizotrogus assimilis, Herbst., *Käf.* III, *p.* 83, *t.* 23, *f.* 12.—Burm. *Handb.* IV, 2, *p.* 393.—Gem. Har. *Cat. Coleop.* IV, *p.* 1174.
„ *aprilinus*, Duft., *Faun. Austr.* I, *p.* 190.—Heeger, *Sit. Zungsb. Vien. Ac.* XIV, 1854, *p.* 35.

Reg. No. $\frac{3491}{13}$, Germany, Herr E. Brenske.
„ „ $\frac{7631}{13}$, ditto ditto.

183. Rhizotrogus ater, Gebl.

Rhizotrogus ater, Gebl., *Bull. Mosc.*, 1847, IV, *p.* 463.—Gem. Har. *Cat. Coleop.*, IV, *p.* 1174.

Four specs., Reg. Nos. $\frac{3487}{13}$, $\frac{3488}{13}$, $\frac{7629}{13}$ and $\frac{7630}{13}$, Germany, Herr E. Brenske.

184. Rhizotrogus beludschistanus, Brsk.

Rhizotrogus beludschistanus, Brensk., *Berl. Ent. Zeits.* XLI, 1896, *p.* 318.

Reg. No. $\frac{7372}{13}$, Type, Baluchistan, Dr. F. P. Maynard.
„ „ $\frac{7373}{13}$, ditto ditto ditto.
„ Nos. $\frac{7426\text{-}27}{13}$, Co-types, ditto ditto.

185. Rhizotrogus bilobus, Shp.

Rhizotrogus bilobus, Sharp, *Journ. Asia. Soc. Beng.* XLVII, 1878, *p.* 173.—*Scien. Res., 2nd Yark. Mis. Coleop.*, 1879, *p.* 49.—Nonfr. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 281.

Reg. No. $\frac{2152}{10}$, Type, Yangihissar, Dr, F Stoliczka,
Seven specs., Reg. Nos. $\frac{2153\text{-}54}{10}$, $\frac{2156}{10}$, $\frac{2159}{10}$, $\frac{2161}{10}$, $\frac{2165}{10}$, and $\frac{2166}{10}$, } Co-types, ditto ditto.

186. Rhizotrogus frivaldszkyi, Ménétr.

Rhizotrogus frivaldszkyi, Ménétr., *Bull. Ac. Petr.* I., 1836, *p.* 150 ; *Mém. Ac. Petr.* V, 1838, *p.* 24.—Jacq. Duv. *Gem. Col.*, III, 16, *f.* 79.—Gem. Har. *Cat. Coleop.* IV, *p.* 1175.

„ *carbonarius*, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 148.—Burm. *Handb.* IV, 2, *p.* 366.—Dej. *Cat.*, 3 ed., *p.* 178.

„ *tenebrioides*, Frivaldszk, *A'magyar tudòs. Tàrs.*, 1835, *p.* 259. *t.* 5, *f.* 11.

Reg. No. $\frac{3402}{13}$, Asia Minor, Herr E. Brenske, 26th March 1892.

187. Rhizotrogus rufescens, Latr.

Rhizotrogus rufescens, Latr., *Hist. Crust. et Ins.*, 1802, X, *p.* 180.—Burm. *Handb.* IV, 2, *p.* 394.—Gem. Har. *Cat. Coleop.* IV, *p.* 1178.

„ *semirufus*, Gyllenh, *Schönh. Syn. Ins.* I, 3, App., *p.* 91.

Reg. No. $\frac{3490}{13}$, Germany, Herr E. Brenske, 26th March 1892.

188. Rhizotrogus ruficornis, Fabr.

Rhizotrogus ruficornis, Fabr., *Syst. Ent.*, *p.* 33.—Ratzeb. *Forst. Ins.* I, *p.* 79, *t.* 3, *f.* 6.—Burm. *Handb.* IV, 2, *p.* 391.—Germ. *Dej. Cat.*, 3 ed., *p.* 178.—Gem. Har. *Cat. Coleop.* IV, *p.* 1178.

„ *marginatus*, Herbst., *Füssl. Arch.*, IV, *p.* 14, *t.* 19, *f.* 22.—Muls. *Col. Lamell.*, *p.* 454.

„ *paganus*, Oliv., *Ent.* I, 5, *p.* 82, *t.* 10, *f.* 116.

Reg. No. $\frac{7632}{13}$, Gallia, Herr E. Brenske.

189. Rhizotrogus solstitialis, Linn.

Rhizotrogus solstitialis, Linn., *Faun. Suec.*, *p.* 137.—Ratzeb. *Forst. Ins.*, *p.* 78, *t.* 3, *f.* 5.—Burm. *Handb.* IV, 2, *p.* 385.—Gem. Har. *Cat. Coleop.* IV, *p.* 1178.

„ *autumnalis*, Fourer., *Ent. Par.* I, *p.* 6.—Frisch. *Beschr. Ins.* IX, *p.* 30, *t.* 15, *f.* 1-5.

Reg. Nos. $\frac{3485\text{-}86}{13}$, Germany, Herr E. Brenske, 26th March 1892.

190. Rhizotrogus tauricus, Blanch.

Rhizotrogus tauricus, Blanch., *Cat. Coll. Ent.*, 1850, *p.* 146.—Burm, *Handb.* IV, 2, *p.* 379.—Steven. *Dej. Cat.*, 3 ed., *p.* 178.—Gem. Har. *Cat. Coleop.* IV, *p.* 1178.

Three specs., Reg. Nos. $\frac{7304\text{-}96}{2}$, Crimea, unknown.

Genus: **ANOXIA**, Casteln.

(*Cyphonotus*, Fischr.)

191. Anoxia orientalis, Kryn.

Anoxia orientalis, Krynick, *Bull. Mosc.* IV, 1832, *p.* 123.—Casteln. *Hist. nat.* II, *p.* 132.—Burm. *Handb.* IV, 2, *p.* 398.—Ziegler *Dej. Cat.*, 3 ed., *p.* 176.—Gem. Har. *Cat. Coleop.* IV, *p.* 1180.

Reg. No. $\frac{3475}{13}$, Syria, Herr E. Brenske, 26th March 1892.

192. Anoxia pilosa, Fabr.

Anoxia pilosa, Fabr., *Syst. El.* II, *p.* 162.—Burm. *Handb.* IV, 2, *p.* 401.—Gem. Har. *Cat. Coleop.* IV, *p.* 1180.

„ *deserti*, Lepech., *Tageb.* I, *p.* 313, *t.* 19, *f.* 17 (forte).

Reg. Nos. $\frac{3474}{13}$, $\frac{7627}{13}$ and $\frac{7628}{13}$, Europe, Herr E. Brenske, 26th March 1892.

193. Anoxia testacea, Pallas.

Anoxia testacea, Pallas, *Jc. Ins. Ross.* I, *p.* 19, *t.* B, *f.* A. 22.—Burm. *Handb.* IV, 2, *p.* 402.—Jacq. Duv. *Gen. Col.* III, *t.* 15, *f.* 72.—Gem. Har. *Cat. Coleop.* IV, *p.* 1180.

„ *anketeri*, Herbst., *Käf.* III, *p.* 43, *t.* 22, *f.* 4.—Fisch. *Ent. Russ.* II, *p.* 212, t. 28, f. 4.

Reg. No. $\frac{7362}{13}$, Baluchistan, Dr. F. Maynard, 1896.

194. Anoxia villosa, Fabr.

Anoxia villosa, Fabr., *Spec. Ins.* App., *p.* 496.—Oliv. *Ent.* I, 5, *p.* 13, *t.* 1, *f.* 4, a-c.—Burm. *Handb.* IV, 2, *p.* 400.—Gem. Har. *Cat. Coleop.* IV, *p.* 1180.

„ *cerealis*, Scopol., *Del. Ins. insubr.* I, *p.* 49, *t.* 21, *f.* B.

„ *glauca*, Linn., *Syst. Nat. Ed. Gmel.* I, 4, *p.* 1583.

„ *pilosa*, Muls., *Col. Lamell.*, *p.* 25.

Reg. Nos. $\frac{3471}{13}$, $\frac{3472}{13}$, $\frac{7624}{13}$ and $\frac{7625}{13}$, Europe, Herr E. Brenske.

195. Anoxia zemindar, Shp.

Anoxia zemindar, Sharp, *Coleop. Heft.* XV, *p.* 85.—Nonfr. *Berl. Ent., Zeits.* XXXVII, 1892, *p.* 283.

Reg. No. $\frac{2771}{5}$, Bangalore, unknown.

„ „ $\frac{6}{13}$, Bushire, W. D. Cumming, Esq., 29th October 1897.

Genus: **POLYPHYLLA,** Harris.

196. Polyphylla fullo, Linn.

Polyphylla fullo, Linn., *Faun. Suec., p.* 137.—Herbst. *Kaf.* III, *p.* 36, *t.* 22, *f.* 1-2.,—Erichs *Nat. Ins.*, III, *p.* 660.—De Haan. *Mém. Mèt. Col., p,* 18, *t.* 2, *f.* 5; *t.* 5, *f.* 4; *t.* 6, *f.* 4.—Gem. Har. *Cat. Coleop.* IV, *p.* 1181.

Reg. Nos. $\frac{397}{6}$ and $\frac{398}{6}$, Germany, Herr B. Winde, 5th December 1885.

„ No. $\frac{4543}{6}$, Europe, ditto ditto.

„ Nos. $\frac{3477\text{-}78}{13}$, Germany, Herr F. Brenske.

197. Polyphylla pulverea, Ballion.

Polyphylla pulverea, Ballion, *Bull. Soc. Ent. Mosc.*, 1870, *p.* 342.—Nonfr. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 285.

Reg. No. $\frac{7361}{13}$, Baluchistan, Dr. F. P. Maynard.

Genus: **Hoplosternus,** Guérin.

198. Hoplosternus bifurcatus, Brsk.

Hoplosternus bifurcatus, Brensk., *Soc. Ent., Belg.*, 1896, *p.* 164.

Reg. No. $\frac{2639}{5}$, N.-E. Frontier, unknown.

199. Hoplosternus chinensis, Guér.

Hoplosternus chinensis, Guér., *Voy. Favor., p.* 63, *t.* 232, *f.* 3.—Burm. *Handb.* IV, 2, *p.* 40.—Hope, *Trans. Ent. Soc.* IV, 1895, *p.* 13.—Gen. Har. *Cat. Coleop.* IV, *p.* 1182.

Reg. No. $\frac{7137}{3}$, China, Dr. Cantor, East-Ind. Co.'s Museum, 22nd September 1884.

Two unregistered specs. from unknown locality.

200. Hoplosternus flabellata, Shp.

Hoplosternus flabellata, Sharp, *Hefte. Coleop.* XV, *p.* 86.—Nonfr. *Ber. Ent. Zeits.* XXXVII, 1892, *p.* 285.—Brensk. *Ann. Soc. Ent., Belg.*, XL, 1896, *p.* 164.

Reg. No. $\frac{8727}{4}$, ♀ Darjeeling, C. H. Dreyer, Esq., 2nd March 1885.

201. Hoplosternus furcicandus, Ancey.

Hoplosternus furcicandus, Ancey, *Le Natural,* 1881, *p.* 412.—Nonfr. *Ber. Ent. Zeits.* XXXVII, 1892, *p.* 286.—Brensk. *Ann. Soc. Ent., Belg.,* XL, 1896, *p.* 163.

Reg. No. $\frac{7140}{3}$, Darjeeling, unknown.

„ „ $\frac{7647}{13}$, ♀ N. India, ditto.

„ „ $\frac{3825}{6}$, Bunu, Gilgit (5,000 feet), Dr. G. M. Giles, Gilgit Expedition.

One unregistered spec. ♀ Sikkim, K. Skalsky, Esq.

202. Hoplosternus japonica, Harold.

Hoplosternus japonica, Harold, *Abh. Miss. ver. Bremen.* IV, *p.* 291.—Nonfr. *Berl. Ent. Zeits.* XXXVII, 1892, *p.* 285.

Reg. No. $\frac{8456}{1}$, Formosa, Surgn.-General R. Hungerford, 16th March 1882.

One unregistered spec. from Japan.

203. Hoplosternus lævipennis, Blanch.

Hoplosternus lævipennis, Blanch., *Cat. Coll. Ent.,* 1850, *p.* 158. Gem. Har. *Cat. Coleop.* IV, *p.* 1182.

One unregistered spec., China?

204. Hoplosternus shillongensis, Brsk.

Hoplosternus shillongensis, Brensk. n. sp. *Mss.*

Reg. No. $\frac{7649}{13}$, Shillong, Shillong Museum.

Genus: MELOLONTHA, Fabr.

205. Melolontha argus, Burm.

Melolontha argus, Burm., *Handb.* IV, 2, *p.* 419. Gem. Har. *Cat. Coleop.* IV, *p.* 1182.

Reg. No. $\frac{1719}{8}$, India, unknown.

One unregistered spec., Jahore, J. Meldrum, Esq.

206. Melolontha guttigera, Shp.

Melolontha guttigera, Sharp, *Coleop. Heft.* XV (Munchen), *p.* 87.

Reg. No. $\frac{1194}{6}$, Jalpaiguri, G. Shillingford, Esq., 1885.

„ „ $\frac{3224}{12}$, Kurseong, E. Barlow, Esq., 20th October 1889.

207. Melolontha hippocastani, Fabr.

Melolontha hippocastani, Fabr., *Syst. El.* II, *p.* 162.—Ratzeb. *Forstins.* I, *p.* 76. *t.* 3, *f.* 3.—Erichs, *Nat. Ins.*, III, *p.* 673.—Gem. Har. *Cat. Coleop.*, IV, *p.* 1182.

" *pectoralis*, Megerle, *Bemerk. zw. Illig.*, 1812, *p.* 21.

Reg. Nos. $\frac{3169\text{-}70}{13}$, Europe, Herr E. Brenske, 26th March 1892.

208. Melolontha pennata, Shp.

Melolontha pennata, Sharp, *Coleop. Heft.* (Munchen), *p.* 88.

One unregistered spec., Sikkim.

209. Melolontha rangunensis, Brsk.

Melolontha rangunensis, Brensk. n. sp., *Ind. Mus. Notes*, IV, 4, *p.* 179.

Reg. No. $\frac{7037}{7}$, Type (unique), Rangoon, spec. lent to Herr E. Brenske.

210. Melolontha serrulata, Gyll.

Melolontha serrulata, Gyllenh., *Schonh. Syn. Ins.* I, 3, App., *p.* 73.—Burm. *Handb.* IV, 2, *p.* 418.—Gem. Har. *Cat. Coleop.* IV, *p.* 1183.

" *difficilis*, Dej., *Cat.* 3 ed., *p.* 177.

" *manillarum*, Blanch., *Cat., Coll. Ent.*, 1850, *p.* 160.

Reg. No. $\frac{5463}{1}$, Amoy, China, Dr. Hungerford, 19th April 1881.

211. Melolontha sulcipennis, Casteln.

Melolontha sulcipennis, Casteln., *Hist. Nat.* II, *p.* 131.—Burm. *Handb.* IV, 2, *p.* 418.—Eschsch. *Dej. Cat.*, 3 ed., *p.* 176.

Reg. Nos. $\frac{8312}{3}$ and $\frac{8613}{3}$, Philippine Is., East-Ind. Co., Museum.

212. Melolontha vulgaris, Fabr.

Melolontha vulgaris, Fabr., *Syst. Ent.*, *p.* 32.—Ratzeb. *Forstins.* I, *p.* 63, *t*, 3, *f.* 1-2.—Erichs. *Nat. Ins.* III, *p.* 671; larva, l. c., *p.* 669.—Gem. Har. *Cat. Coleop.* IV, *p.* 1183.

" *majalis*, Moll., *nat. Brief.* I, *p.* 179.

" *melolontha*, Linne., *Faun. Suec.*, *p.* 136.—DeGeer, *Mem.* IV, *p.* 273, *t.* 10, *f.* 14.

Reg. Nos. $\frac{2430}{4}$ and $\frac{2434}{4}$, France, Mons. F. Bouvier, 30th December 1884.

" " $\frac{3468}{13}$ and $\frac{3473}{13}$, Europe, Herr E. Brenske, 26th March 1892.

Genus: **TRINOXIA**, Brenske.

213. **Trinoxia cyphonotoides**, Brsk.

Trinoxia cyphonotoides, Brensk., *Mem. Soc. Ent., Belg.*, II, 1894, *p.* 81.

Reg. No. $\frac{2640}{5}$, ♀, N.-E. Frontier, unknown.

LIST OF GENERA.

Amphimallus, Muls.
Ancistrosoma, Curtis.
Ancylonycha, Blanch.
Anisonyx, Latreille.
Anoxia, Casteln.
Apogonia, Kirby.
Asactopholis, Brensk.

Brachyllus, Brensk.
Brahmina, Blanch.

Clytia, Brensk.
Cyphochilus, Waterh.
Cyphonotus, Fischr.

Dejeania, Blanch.
Dichelus, Serville.
Diphucephala, Serville.

Ectinohoplia, Redten.
Empelatira, Brensk. n. g.
Eriesthis, Burm.
Eucirrus, Melly.

Goniaspidius, Burm.

Haplonycha, Blanch.
Heptophylla, Motsch.
Heteronyx, Guerin.
Holomelia, Brensk.
Holotrichia, Hope.
Homaloplia, Stephens.
Hoplia, Illiger.
Hoplosternus, Guerin.

Lachnosterna, Hope.
Lasioserica, Brensk.
Lepidiota, Hope.
Lepisia, Serville.
Lepitrix, Serville.
Leucopholis, Blanch.
Liparetrus, Guerin.

Melolontha, Fabr.
Monochelus, Serville.

Odontria, White.
Ophthalmoserica, Brensk. n. g.
Otoclinius, Brensk.

Pachycnema, Serville.
Peritrichia, Burm.
Phyllotocus, Fischer.
Polyphylla, Harris.
Pseudotrematodes, Jacq. Duv.
Pyronota, Boisduval.

Rhinaspis, Perty.
Rhizotrogus, Latreille.

Schizonycha, Blanch.
Serica, Mac Leay.
Stethaspis, Hope.

Tricholepis, Blanch.
Trinoxia, Brensk.
Triodonta, Mulsant.

THE PEAR-TREE APHIS,

Lachnus pyri, Buckton.

By G. B. BUCKTON, F.R.S., etc.; with introductory note by

E. E. GREEN, F.E.S., *Honorary Consulting Entomologist to the Government of Ceylon.*

Plate No. XVI.

In March of the present year (1898) I was requested to examine and report upon specimens of a blight that was said to be attacking cultivated Pear-trees in the Muvara Eliya district of Ceylon. I was subsequently able to observe the insect *in situ*. It proved to be a large species of Aphis occurring in large groups upon the stems and branches of the trees,—always, apparently, upon the ripe wood. Where possible, the insects were massed upon the lower or sheltered side; but they were present in such large numbers that they frequently covered the whole surface of the stem. They secreted an abundant supply of 'honey-dew'; so much, that it collected into large drops which ran down the stems and covered the adjacent leaves, attracting numerous flies and other insects. I did not, however, notice any ants in attendance upon this species. Nor were there any larvæ of *Syrphus* flies preying upon them at the time. In places where the pest had taken complete possession, they seemed to have cut off the supply of sap, with the result that the ends of such branches presented a very sickly appearance, and in some cases died back.

Female insects in all stages were present, though the winged adults were comparatively scarce. No males could be found. No eggs were observed though the young larvæ were very abundant. It is therefore probable that the insect is viviparous.

If left unchecked this pest is likely to considerably weaken the trees. But, being confined to the stems and branches, it can be very easily destroyed by the use of any insecticide, such as one of the soapy emulsions, applied with a large brush. Plain soap and water, applied very hot, is almost equally effective, and would not injure the tree unless applied to the more tender shoots. The pest may also be kept in check by crushing them with the hand—or a piece of coarse sacking—on the first appearance of the colonies.

In general appearance this insect approaches *Lachnus platanicola*, Riley, a species that affects plane trees in North America. But as the pattern of spots on the body differs to some extent, I sent specimens to Mr. G. B. Buckton, for determination. It proves to be a new species of *Lachnus*. From the material submitted, Mr. Buckton has kindly prepared the appended description.

Lachnus pyri n. sp.

Some interest attaches to this hitherto unobserved insect, inasmuch as it forms another exception to the usual observation, that the Lachninæ mostly infest the conifer of a country. Its habit is to encrust the smaller branches of the cultivated pear-trees at Muvara Eliya, Ceylon, much in the same manner as the species *Lachnus viminalis* encrusts the bark of the willows of Europe.

In Ceylon it appears to leave the foliage unattacked, but nevertheless causes them to wither from exhaustion or probably by their occurrence in thousands altering the character of the sap.

Apterous Larva (fig. *a*).

Somewhat oval, constricted below the thorax, abdomen globose: vertex, rather pointed, eyes large, antenna with two small vasal joints, followed by two longer and obscurely jointed articulations. The terminal joints are as in the genus *Lachnus*.

The whole body is rugose and furrowed, brown, with dark spots, showing also distinct stomata. There is a slight swelling or protuberance on the dorsum. Nectaries large and tuberculose, from which a secretion is poured, much appreciated by ants and flies. Tail rounded, hirsute, as also are the legs. These are stout, particularly the hind part. Rostrum long and reaching nearly to the caseda.

General colour umber brown, more or less covered by a slaty-coloured mealy coat. Femora ferruginous red. Tarsi black. Size = 3·5 × 2·5 millemetres.

Winged female (fig. *b*).

Much larger than the above, with much the same colour, however, on the upper-side. The under-side rather downy, and of a rusty red. Head small, thorax and stirnum black. Antennæ fine and short.

Wings smoky with cubital vein twice forked. Stigma lengthened. Abdomen obscurely dotted with black.

This insect gives a fine crimson stain to Canada balsum and other resins. Size of body 4·0 millemetres. Expanse 12·5 millemetres.

Note.—The above descriptions and measurements were made from examples that had become partly shrivelled in alcohol. I find that dimensions of the living insect are slightly greater. The body, in both the apterous and winged female adult, measures from 4·50 to 5·0 mm. The expanded wings in a well developed example, cover nearly 16·0 mm.

Examples of the winged females collected in June (fig. *d*) seem to be more brightly coloured than those of the March brood.

The bases of both wings are thickly clouded with black: there is a small yellow patch at the base of the costa on the fore-wing; and the elongate stigma is almost jet black.

Mr. Buckton does not appear to have described the apterous adult. It differs from the larva chiefly in size, the length of the body being about 4·50 mm. The abdomen is swollen and smoothly rounded, showing no segmental divisions; though the position and number of the segments is plainly indicated by the series of large round black spots (fig. *e*). The cornicles are abruptly truncate, with a not very prominent median papilla. Antennæ with six joints; the first and second shortest; the third very long; the fourth to sixth sub-equal, together scarcely exceeding the third.

fig. *a*. Half-grown larva } drawings from shrivelled specimens
„ *b*. Winged female, March brood } by Mr. G. B. Buckton.
„ *c*. antenna,
„ *d*. Winged female, June brood } drawn from living specimens by
„ *e*. Apterous adult, „ „ } Mr. E. Ernest Green.

(*fig. e* is drawn to a larger scale than *fig. d*).

NOTES ON TWO NEW SPECIES OF APHIDS.

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

1. *Chaitophorus maculatus*[1] n. sp.

Plate No. XVII (fig. 1).

Head and pronotum honey-yellow; front broad between the eyes and bristly, eyes large and red. Body pink or yellowish, tuberculose, and furnished with capitate hairs. Nectaries short and hardly visible, tail blunt. The upper-side garnished with numerous brown spots disposed in vertical rows down the dorsum. Antennæ about the length of the body. Legs honey-yellow, hind and front femora rather dilated. The sides of the thorax in some specimens are swollen.

The wings are short, rounded at the tips, and veined as in *Chaitophorus*. The stigma is large and punctured, nervures slightly clouded at their terminations.

Size of apterous female 2·0 millemetres.

Infests *Medicago sativa* in Jodhpur, India.

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2. A NEW ROOT-FEEDING APHIS.

Rhizobius jujubæ n. sp.

Plate No. XVII (fig. 2).

Burmeister formed the genus Rhizobius to include certain aphides having subterranean habits, and amongst other characteristics seemed to be apterous in all their metamorphoses. Since his day Lechtenstein and others have conclusively shown that many insects of this family have both ærial and under-ground habits as illustrated by *Aphis subterranea* and the destructive *Phylloxera vastatrix* of Europe and America.

[1] Specimens were forwarded to the Indian Museum in March 1897 by the Superintendent of Forests, Marwar, as destructive to lucerne grass (*Medicago sativa*) in Jodhpur, E. B.

But the life-history of these Rhizobiinæ is still obscure, and for a time it will be well to retain the genus, as Kaltenbach has done. I now describe an Aphis feeding in plenty on the roots of *Zigyphus jujubæ* in the neighbourhood of Kaladhughi, India. They were collected some two or three years ago by Mr. Octavius Greig.

Rhizobius jujubæ n. sp.—Long, oval, hirsute, and of a rich brown colour; the smaller individuals being paler. Antennæ very short, with five joints, the terminal joint being somewhat clavate and ending with two setæ.

Eyes close to the insertion of the antennæ, very small and not faceted. Nectaries absent. Legs stout and short, tarsi with one claw only. Rostrum reaching to the second coxæ.

The young are much smaller and are much more aphis-like in general form.

The companies were attended by ants, but for what purpose it is not clear, since the Aphides do not possess nectaries to pour out "honey dew."

Size 16 × 7 millemetres.

DESCRIPTION OF A NEW PARASITIC TACHINID FLY FROM CEYLON.

BY D. W. COQUILLETT.

COMMUNICATED BY E. E. GREEN, F.E.S.

Plate No. XVIII (fig. 1).

Exorista heterusiæ,[1] Coquillett, new species.

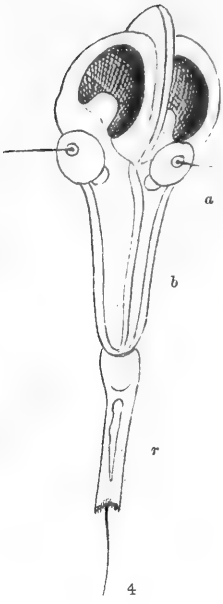
♂ ♀ black, the apical two-thirds of the palpi and a spot on sides of the second and third abdominal segments, yellowish. Front in the male two-fifths, in the female three-fifths, as wide as either eye, the sides gray pollinose, orbital bristles present in the female, wanting in the male, frontal bristles descending to base of third antennal joint, face whitish pollinose, vibrissæ on a level with the front edge of the oral margin, four or five bristles above each, cheeks one-seventh as broad as the eye-height; antennæ nearly as long as the face, the third joint two and one-half times as long as the second, arista thickened on the basal third, its penultimate joint scarcely longer than broad, palpi greatly thickened apically. Thorax gray pollinose, marked with four black vittæ; four postsutural and three sternopleural macrochætæ, but the lowest of the latter sometimes very small; scutellum bearing four marginal pairs, of which the hindmost pair is cruciate and directed obliquely backward. Abdomen subshining, broadly whitish pollinose on the bases of the last three segments, except a black dorsal vitta, macrochætæ of the first three segments only marginal. Hind tibiæ outwardly ciliate, middle tibiæ each bearing a single macrochæta on the front side near the middle, front pulvilli of male as long as the last tarsal joint. Wings hyaline, slightly gray at the base, third vein bearing two or three bristles at its base, bend of fourth vein destitute of an appendage; calypteres whitish. Length 6 to 9 mm. One male and three females. Pussellawa, Ceylon. Bred from *Heterusia cingala*,[2] Moore, by Mr. E. E. Green, F.E.S., Honorary Government Entomologist, Ceylon.

[1] This Tachinid fly is said to have done good service in checking the ravages of the tea pest *Heterusia cingala*, Moore, in Ceylon. Specimens received from the Pussellawa district, were found to be so thoroughly infested by it that from over one hundred of the caterpillars not more than half a dozen moths were reared by Mr. Green. In some cases as many as ten pupæ of the fly were found in the dead cocoons.

[2] The caterpillar of this moth periodically occurs in very large numbers, and sometimes completely defoliates the tea bushes over a large acreage in Ceylon (for an illustration of the pest, See *Plate* XVIII, *fig.* 2.)

G. I. C. P. O.—No. 291 R. & A.—13-10-99.—D. R.—1,000

1



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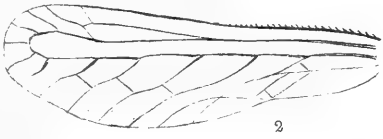

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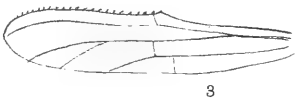

3

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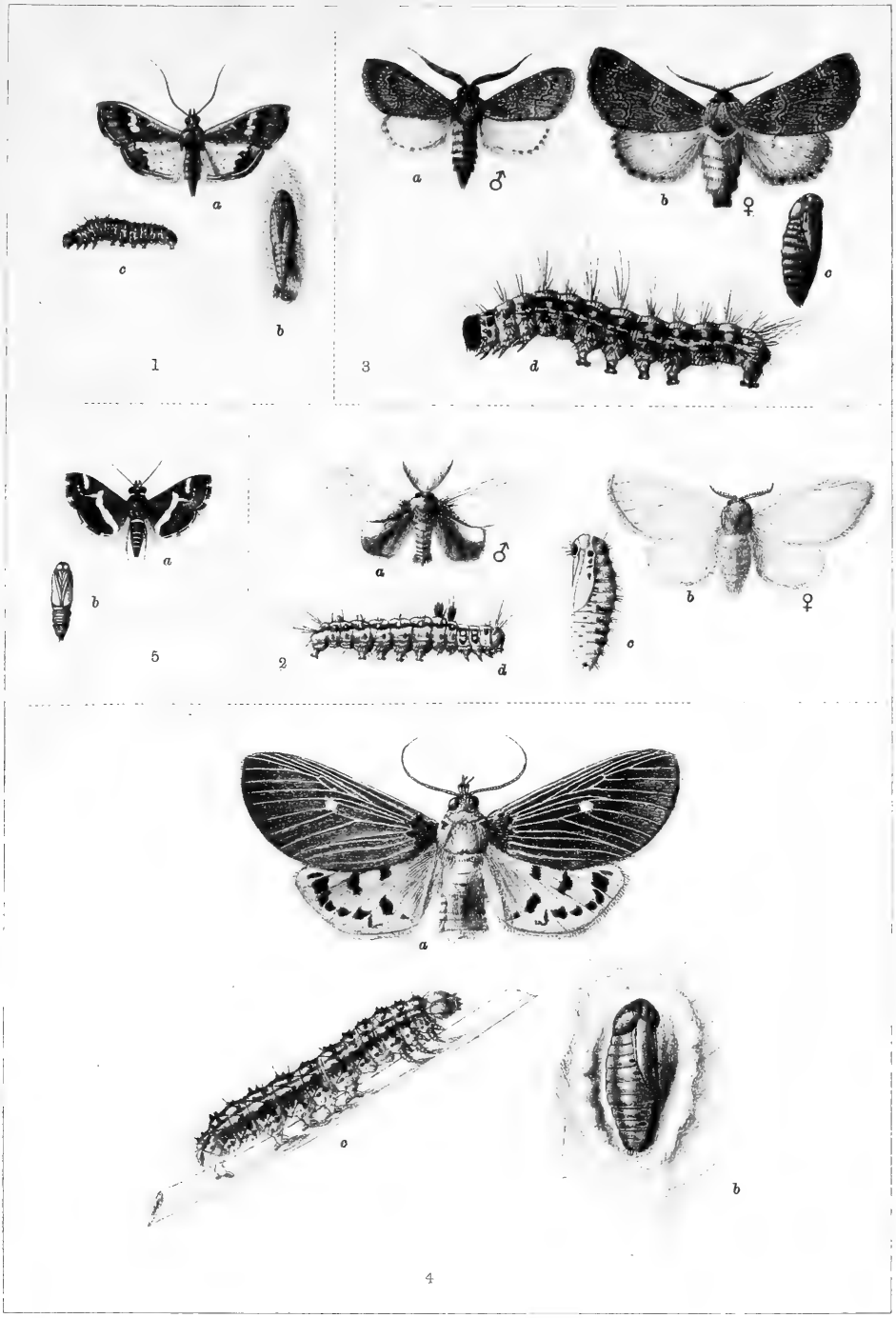
ASSAMIA DENTATA, N. Sp.

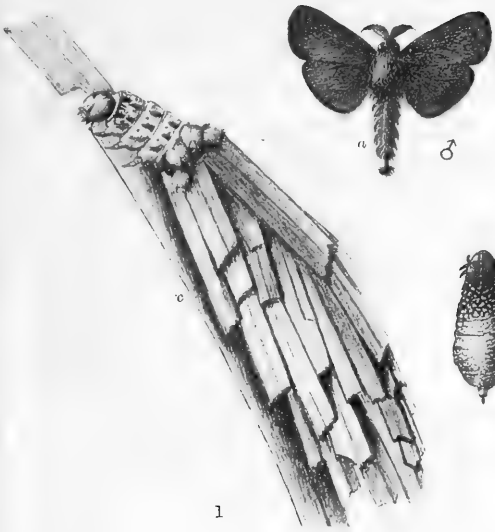
Photo-etching from the original drawings—Survey of India Offices, Calcutta, July 1895.

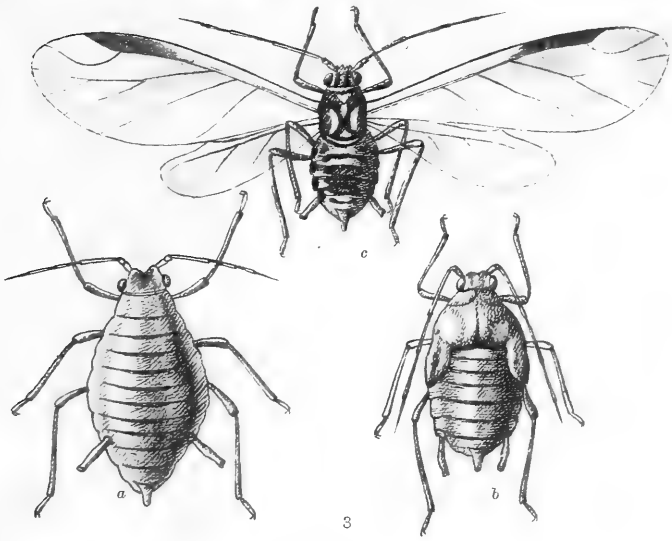


G. C. Chuckrabutty, del.

1. MARUCA TESTULALIS, GEYER.
2. PERINA NUDA, FABR.
3. THIACIDAS POSTICA, WALK.
4. HYPSA ALCIPHRON, CRAM.
5. HYMENIA RECURVALIS, FABR.

Photo etching from the original drawings—Survey of India Offices, Calcutta, July 1895.





C. C. Chuckraburtty, del.

1. MAHASENA GRAMINIVORA, N. Sp.
2. EUMETA CRAMERI, WESTW.
3. RHOPALOSIPHUM DIANTHI, SCHR.
4. MILLEPEDE.

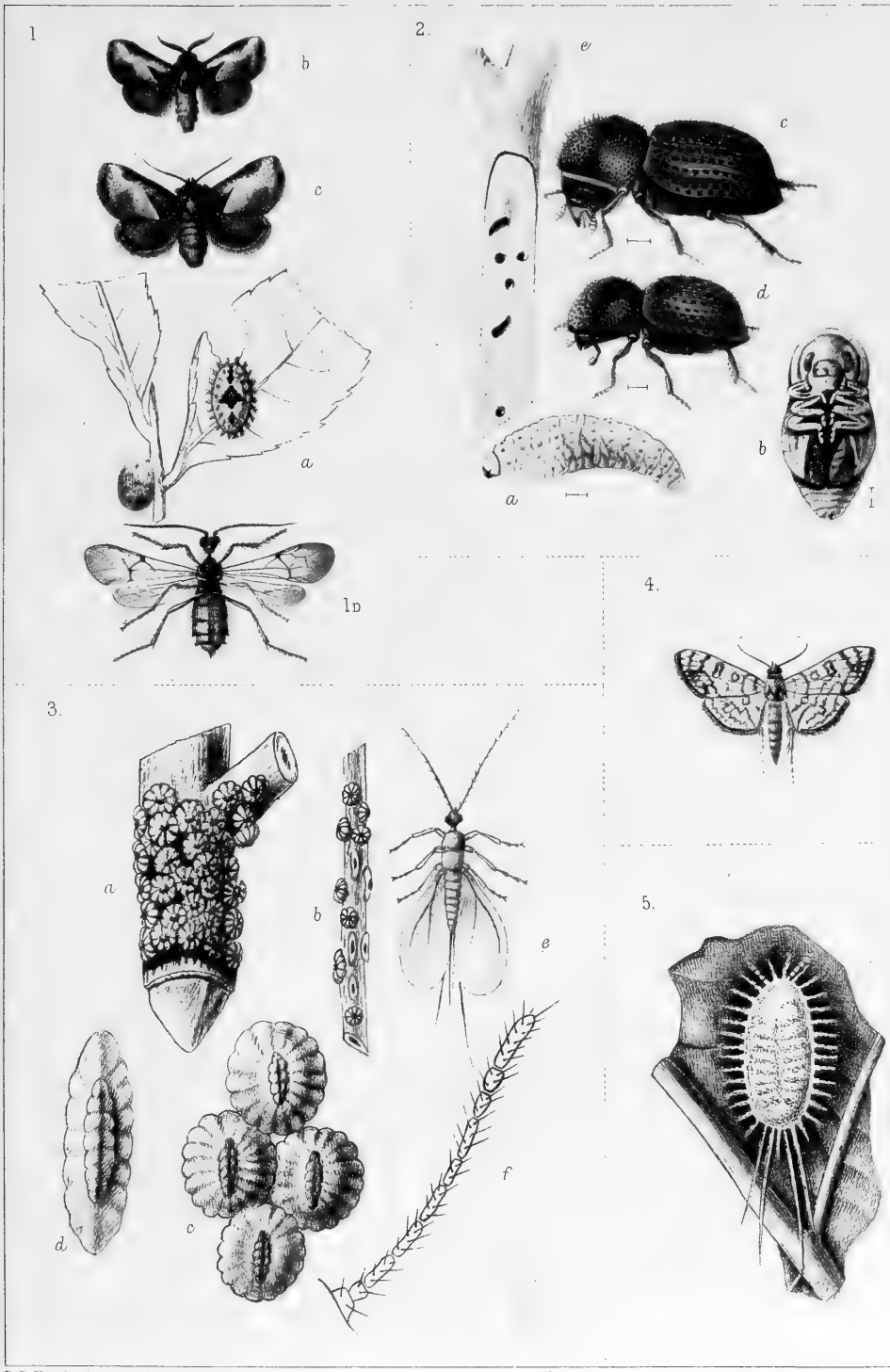
Photo-etching from the original drawings—Survey of India Offices, Calcutta, July 1895.

G.C.Chuckrabarty, del.

Photo-etchings - Survey of India Offices, Calcutta. November 1896.

1. PEMPHIGUS NAPÆUS *N. Sp.*

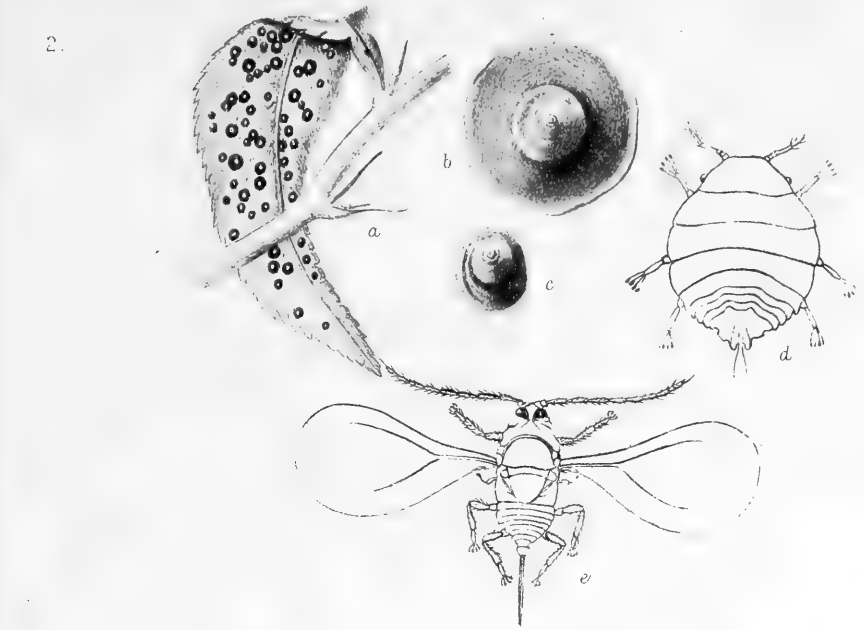
2. PEMPHIGUS IMMUNIS *N. Sp.*

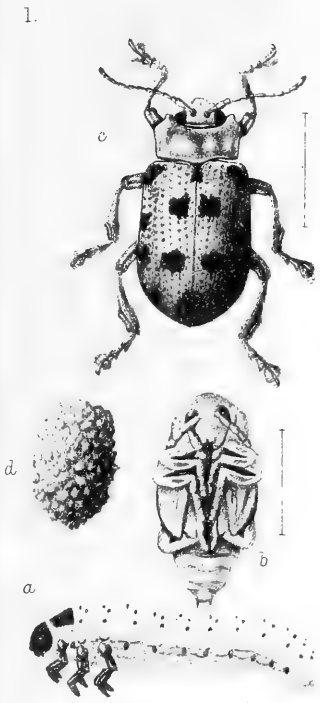


G. C. Chuckrabarty, del.

Photo-etching Survey of India Offices, Calcutta, November 1896

1. THOSEA RECTA, HAMPS
1D. ICHNEUMONID PARASITE OF THOSEA RECTA.
2. XYLOBORUS FORNICATUS, EICHHOF
3. CARTERIA DECORELLA, MASK.
4. SYNCLERA MULTILINEALIS, GUEN.
5. DACTYLOPIUS LONGIFILIS, COMSTOCK.





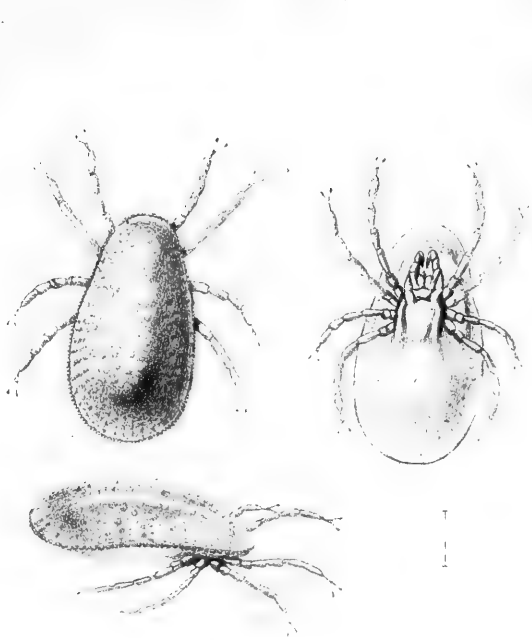


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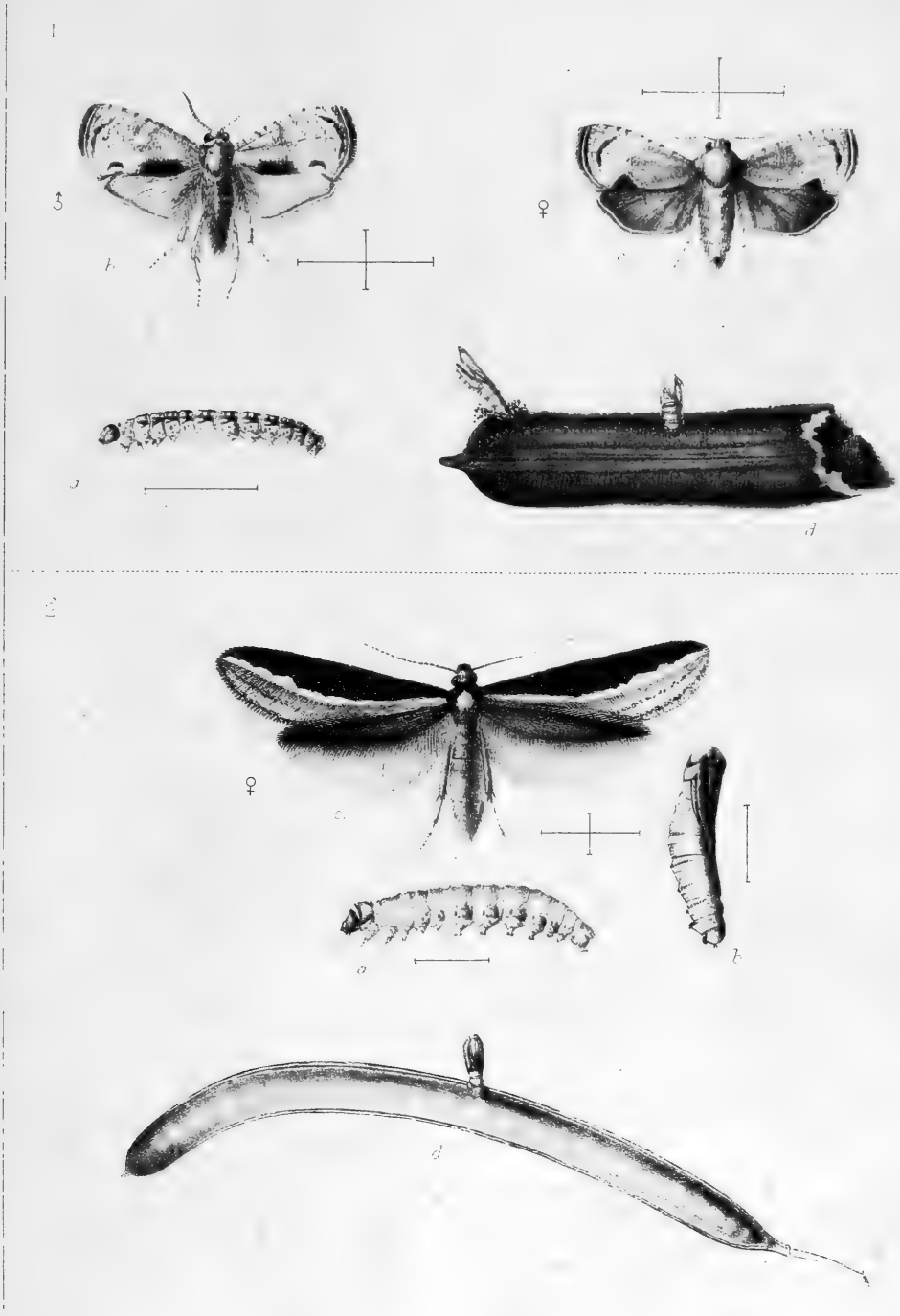
Photo-etching Survey of India Offices, Calcutta, November 1896.

1. PODONTIA 14-PUNCTATA, LINN. 2. ASPIDIOTUS FICUS, (RILEY) COMSTOCK.
3. ARGAS REFLEXUS, FABR.

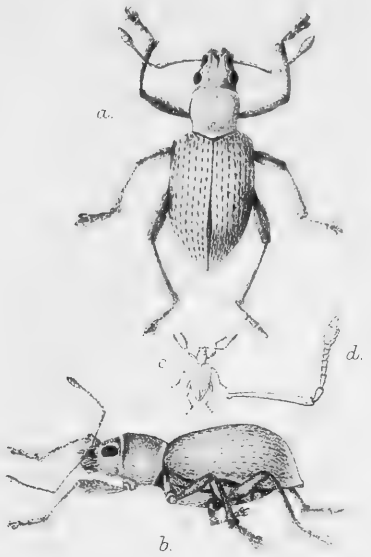


G. C. Chuckraburtty. del.

Photo-etching, Survey of India. Offices, Calcutta. May. 1898.

1. CRYPTOPHLEBIA CARPOPHAGA, WLSM, *N. Sp.*
2. EREUNETIS ? SEMINIVORA, WLSM, *N. Sp.*

1



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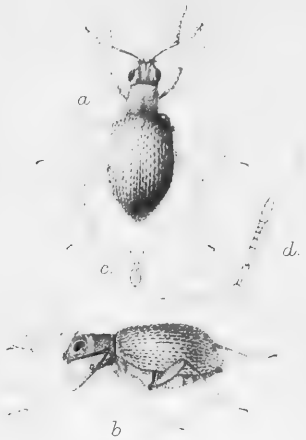

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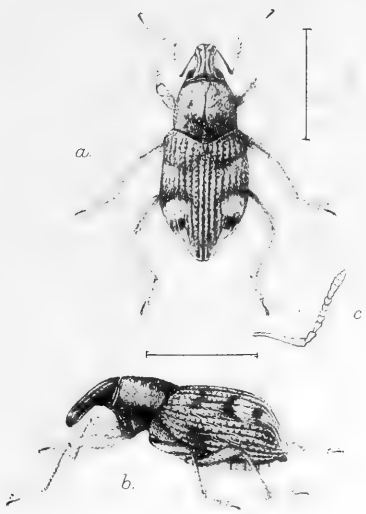
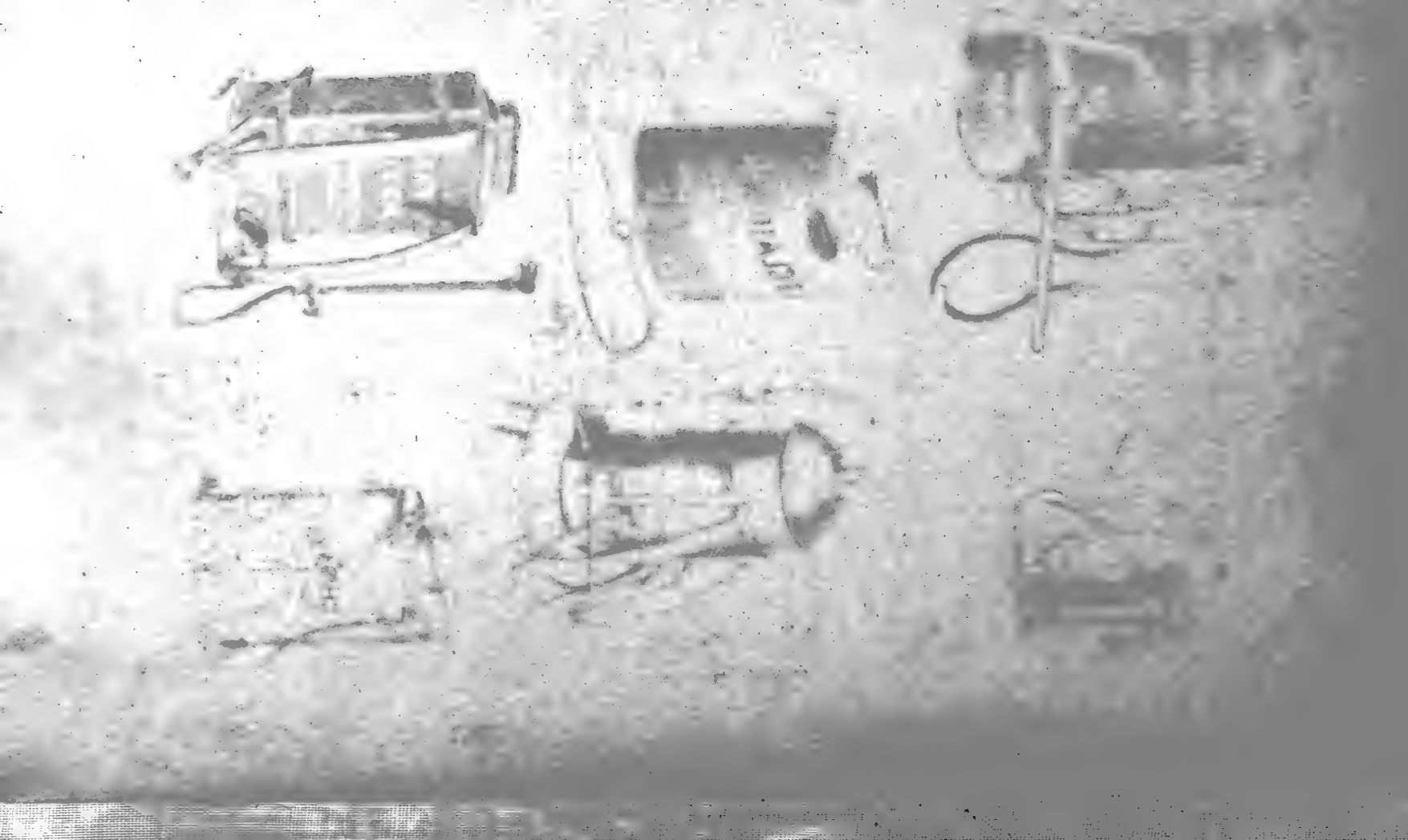
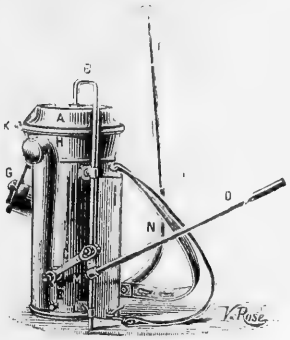


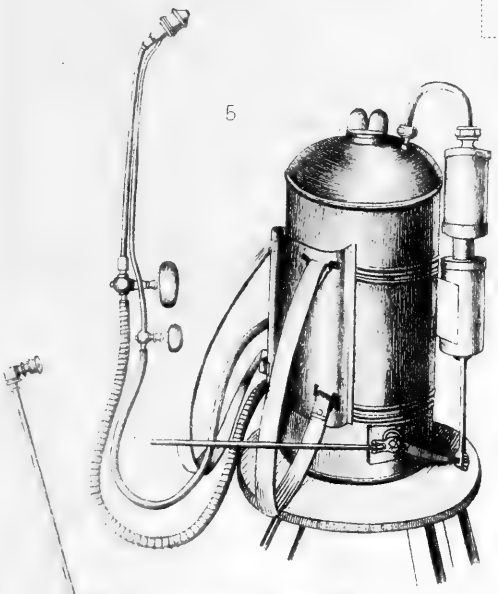
G. C. Chuckraburtty, del.

Photo-etching, Survey of India Offices, Calcutta, May, 1898.

1. MYLLOCERUS MACULOSUS, *De. d. Log. N. Sp*
2. MYLLOCERUS SETULIFER, *De. d. Log N. Sp.*
3. LEUCOMIGUS ANTENNALIS. FAUST.







G. C. Chuckrabarty. del.

Photo-etching, Survey of India Offices, Calcutta, May 1898.

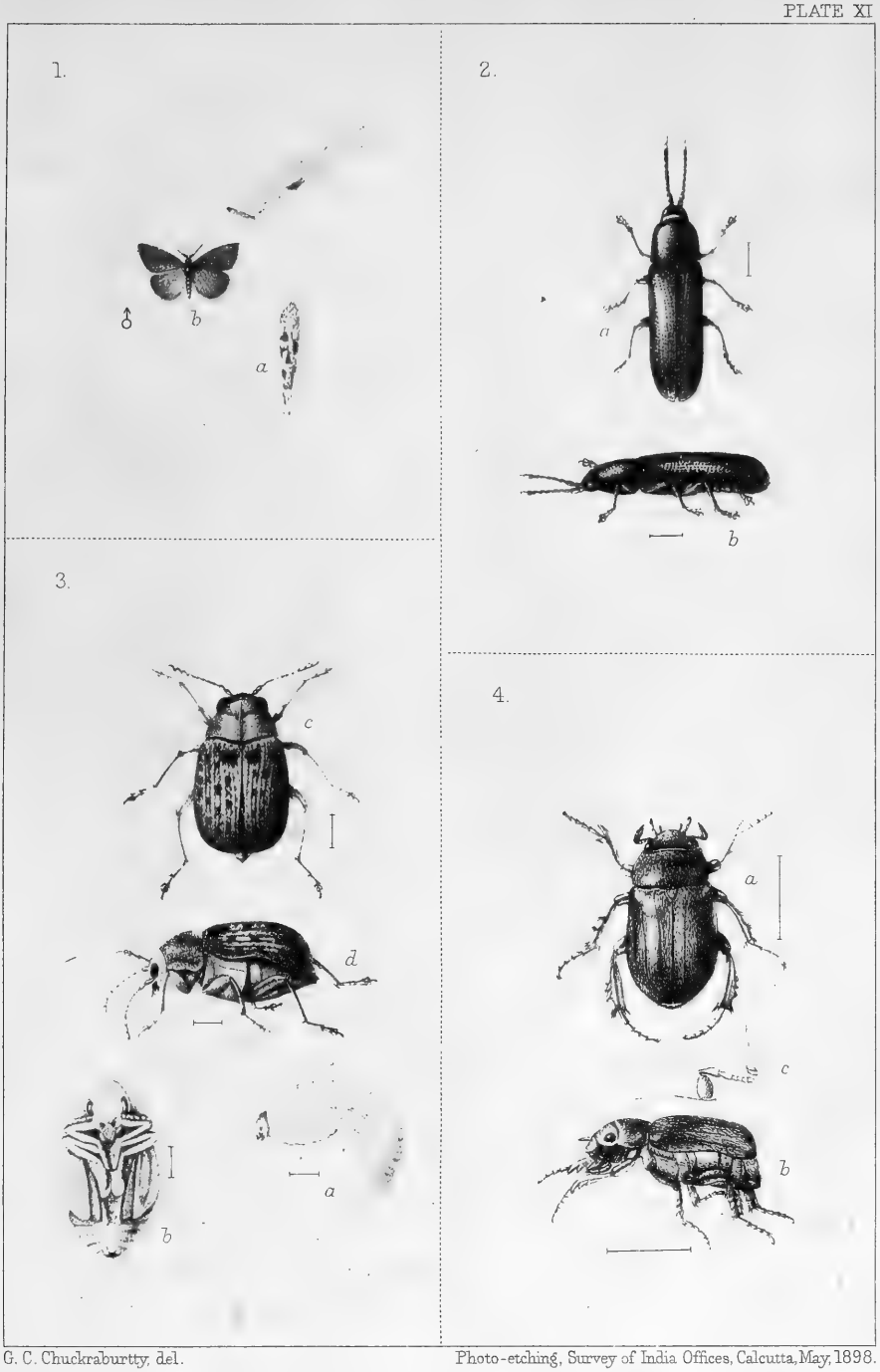
1. STRAWSON'S "CORONETTE"
2. VERMOREL'S "TORPILLE"
3. ,, D° ,, "ECLAIR"
4. STRAWSON'S "NOTUS"
5. ,, D° ,, "ANTIPEST"
6. CHISWICK CO'S SPRAYER.

PLATE X

C. C. Chuckraburtty. del.

Photo-etching. Survey of India. Offices, Calcutta, May. 1898.

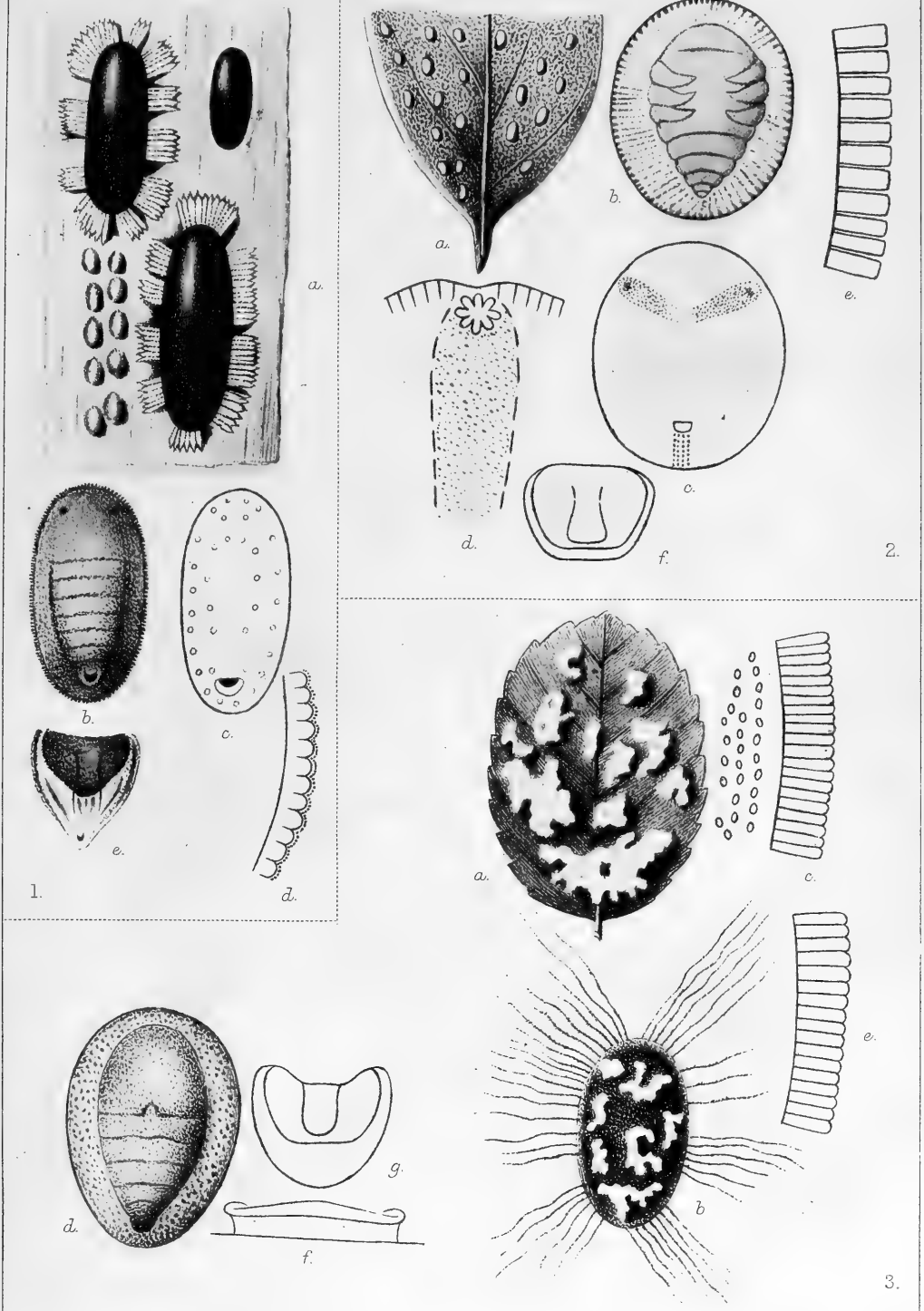
COOLIE USING VERMOREL'S "ECLAIR."



G. C. Chuckraburtty, del.

Photo-etching, Survey of India Offices, Calcutta, May, 1898.

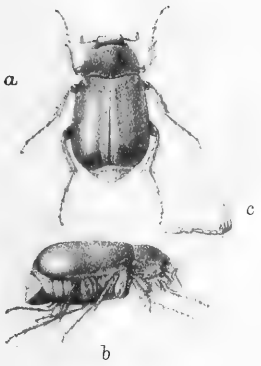
1. ACANTHOPSYCHE (BRACHYCYTTARUS) SUBTERALBATA, HMPS.
2. LEPTISPA PYGMAEA, BALY.
3. ARAEOCERUS FASCICULATUS, DEGEER.
4. ADORETUS CARDONI, BRENSKE



G. C. Chuckraburtty, del. Photo-etching, Survey of India Offices, Calcutta, May, 1898.

1. ALEURODES BARODENSIS MASKELL,
2. ..... D° ..... EUGENIAE MASKELL, VAR. AURANTII,
3. ..... D° ..... COTESII, MASKELL.

1.



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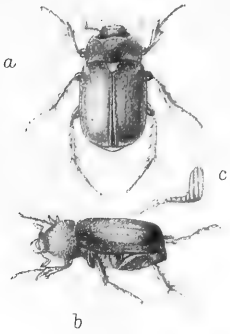

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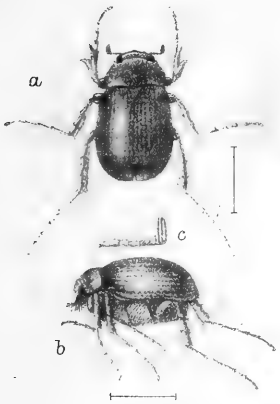

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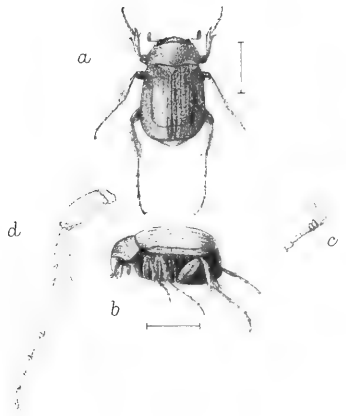
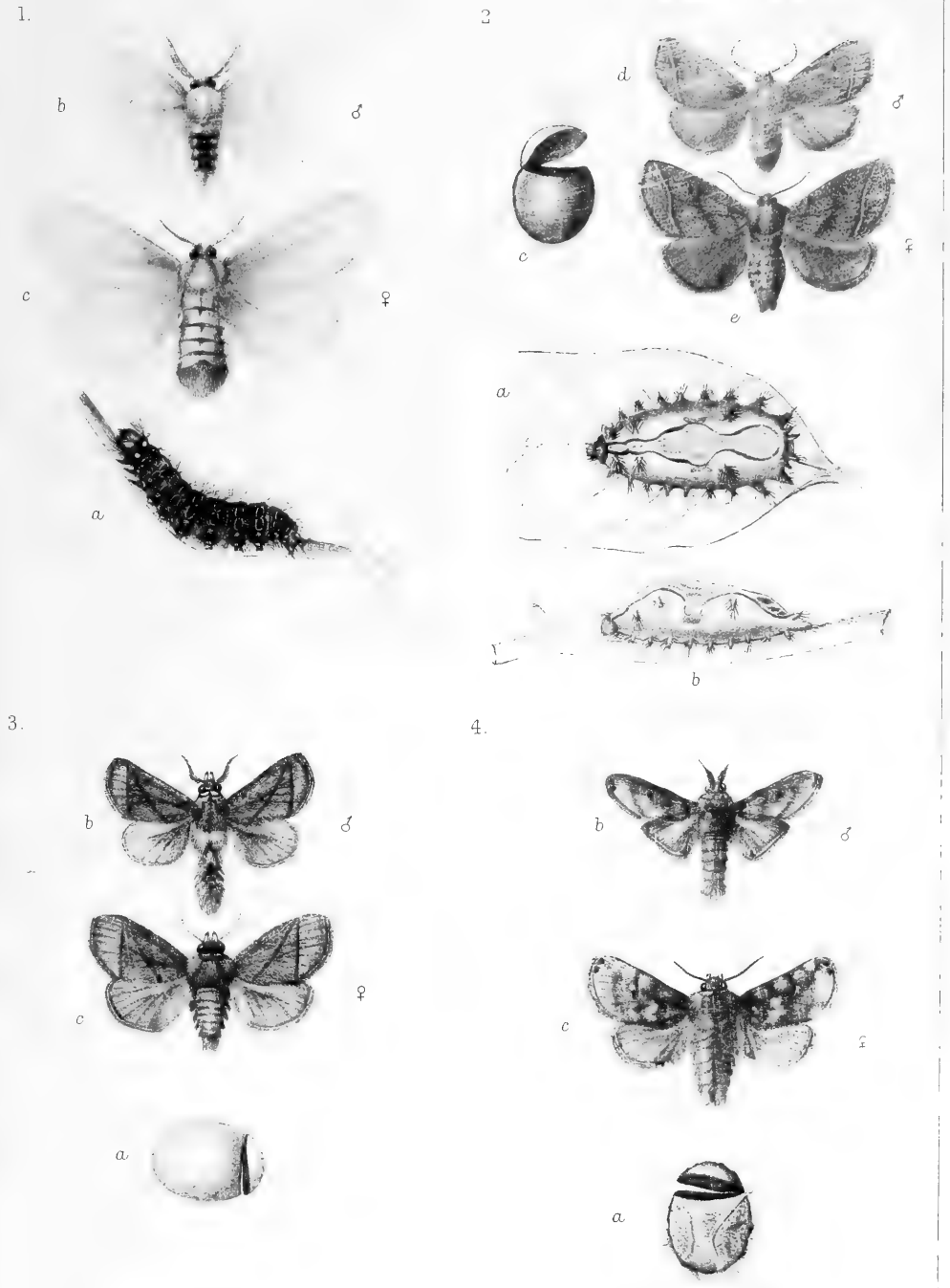


G.C.Chuckraburtty, del.

Photo-etching Survey of India Offices, Calcutta, March 1899.

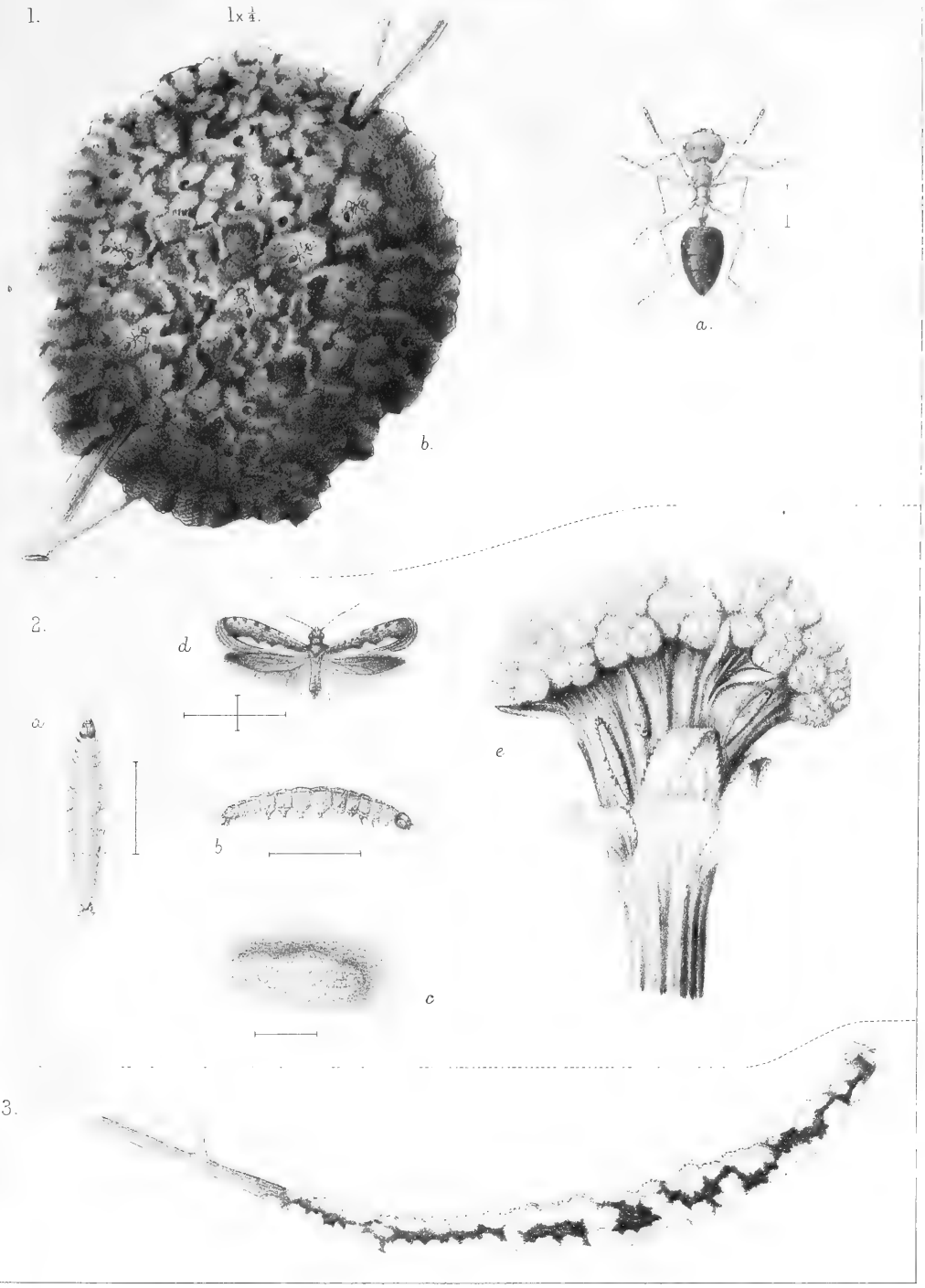
1. HOLOTRICHIA IMITATRIX, BRSK. *N. Sp.*
2. HOLOTRICHIA ANDAMANA, BRSK. *N. Sp.*
3. SERICA CALCUTTAE, BRSK. *N. Sp.*
4. SERICA ASSAMENSIS, BRSK. *N. Sp.*



G.C.Chuckrabarty.del.

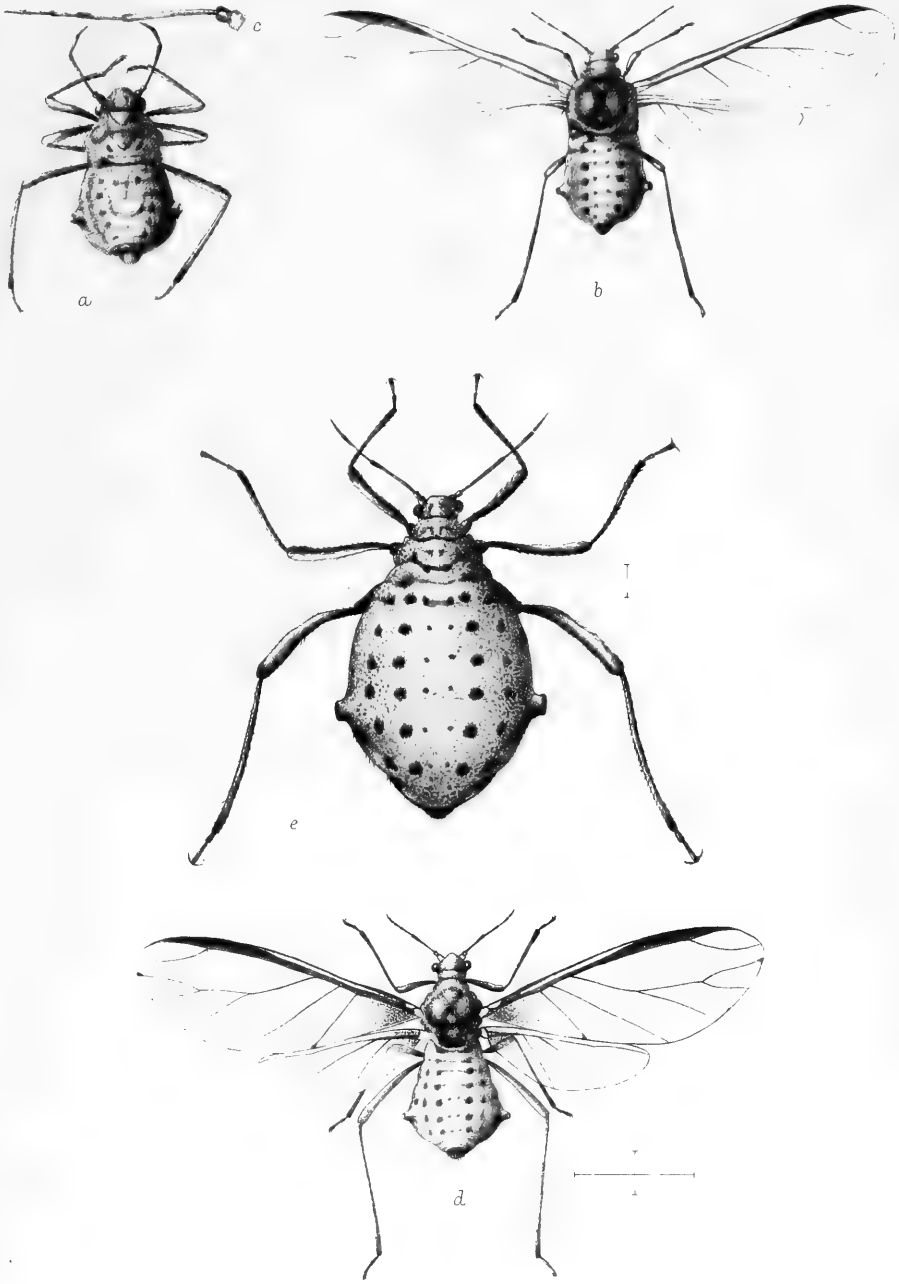
Photo-etching-Survey of India Offices, Calcutta, March 1900

1. EUPROCTIS LATIFASCIA, WALK.
2. THOSEA CERVINA, MOORE.
3. THOSEA DIVERGENS, MOORE.
4. BELIPPA LOHOR, MOORE.



G.C.Chuckrabarty, del. Photo-etching Survey of India Offices, Calcutta, January 1899

1. CREMASTOGASTER ROGENHOFERI, MAYR.
2. PLUTELLA MACULATA, CURT.
3. ERIOCOCCUS PARADOXUS, VAR. INDICA, MASK.

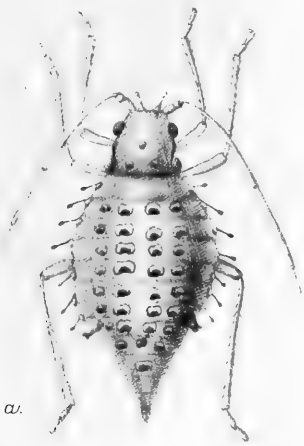


G.C.Chuckrabarty,del.

Photo-etching Survey of India Offices, Calcutta, February 1893

LACHNUS PYRI BUCKTON, *N. Sp.*

1.



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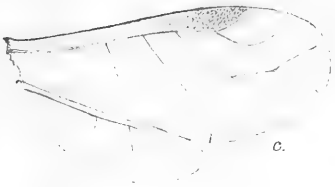

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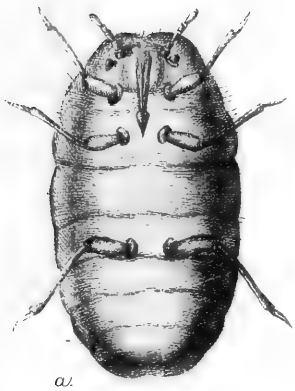

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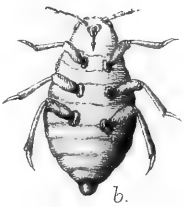
d.



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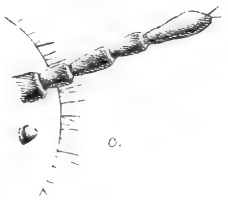


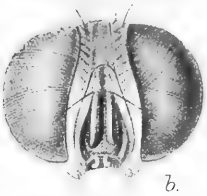
c.

G.C.Chuckraburtty, del. Photo-etching Survey of India Offices, Calcutta, February 1899.

1. CHAITOPHORUS MACULATUS BUCKTON. *N. Sp.*
2. RHIZOBIUS JUJUBAE. BUCKTON. *N. Sp.*

1.

a.



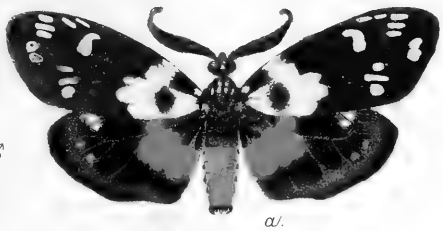
b.

c.

d.

2.

♂



a.

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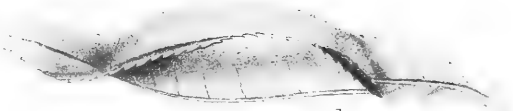
b.

c.



d.

G.C. Chuckraburtty. del.

Photo-etching.- Survey of India Offices, Calcutta, February 1893.

1. EXORISTA HETERUSIAE COQUILLETT *N. Sp.*
2. HETERUSIA CINGALA MOORE.

INDIAN MUSEUM NOTES.

ISSUED BY THE TRUSTEES.

EDITED BY THE SUPERINTENDENT.

VOLUME IV.—NO. 6.

CONTAINING THE TITLE PAGE, TABLE OF CONTENTS, AND INDEX TO THE VOLUME.

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Department of Revenue and Agriculture.

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1900.

Price Four Annas.

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		₹	a.
II	Indian Museum Notes, Vol. I, 1889 to 1891	4	4
	„ „ „ „ II, 1891 and 1893	7	12
	„ „ „ „ III, 1893 to 1896	3	0
	„ „ „ „ IV, 1896 to 1900	5	4

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