



31761 07550809 3

BRITISH MUSEUM (NATURAL HISTORY).

FIRST REPORT
ON
ECONOMIC ZOOLOGY

BY

FRED. V. THEOBALD, M.A.,

FOREIGN MEMBER OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, WASHINGTON, U.S.A.;
ZOOLOGIST TO THE SOUTH-EASTERN AGRICULTURAL COLLEGE; ETC.

*Author of "A Monograph of the Culicidae (Mosquitoes) of the World (Brit. Mus.)";
"A Text-Book of Agricultural Zoology"; "The Parasitic Diseases of Poultry";
"An Account of British Flies," etc.*

61416
23 | 1 | 04

LONDON:
PRINTED BY ORDER OF THE TRUSTEES.

SOLD BY

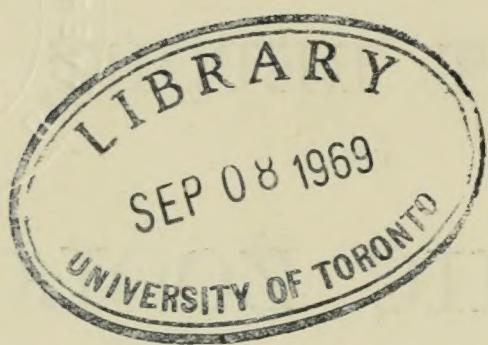
LONGMANS & Co., 39, PATERNOSTER ROW, E.C.; B. QUARITCH, 15, PICCADILLY, W.;
DULAU & Co., 37, SOHO SQUARE, W.; KEGAN PAUL, TRENCH,
TRÜBNER & Co., CHARING CROSS ROAD, W.C.;

AND AT THE

BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W.

1903.

(All rights reserved.)



LONDON:

PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
DUKE STREET, STAMFORD STREET, S.E., AND GREAT WINDMILL STREET, W.

SB
805
B75

P R E F A C E.

THE present volume consists primarily of a series of Reports to the Board of Agriculture, of Reports and letters to a variety of unofficial correspondents, and of Reports to the Foreign Office and to the Colonial Office, drawn up by Mr. F. V. Theobald during the years 1901-1902. Mr. Theobald has recently been employed by the Trustees of the British Museum to assist the Director in such work, especially with a view to furnishing the Board of Agriculture with scientific information on Economic Zoology, in accordance with a request made by that Department of his Majesty's Government. Mr. Theobald is well known as an authority on Economic Zoology, and has the advantage, in carrying out his work at the Natural History Museum, of consulting with the various specialists on the scientific staff, as well as of making use of the collections and library of the Museum.

I have added to Mr. Theobald's Reports an introductory scheme or outline of the study known as Economic Zoology, in the form of a classified survey of the various sub-divisions which it is found convenient to recognise in the treatment of this subject. For this classification I am responsible, whilst Mr. Theobald has been good enough to fill in the list of selected examples. I have also added some correspondence on Tsetse-fly disease, and on the proposed investigation of the Pearl Fisheries of Ceylon, and on the Marine Resources of the West Indies, which arose from my being consulted in my official capacity by his Majesty's Secretaries of State for Foreign Affairs and for the Colonies.

The Trustees have ordered the publication of the present Report, in order that the valuable information which it contains may be made easily accessible; and further, in order to make clear the nature and amount of scientific information on matters of economic importance which the staff of the Zoological Department is almost daily called upon and is prepared to furnish to the public service or to individuals. It must be remembered that the Reports and letters printed in this volume form only a portion of the work of economic importance which is carried out by this Museum, in addition to the

far more extensive work in the pure science of Natural History, which is the primary occupation of its official staff. The Trustees published in 1901 a descriptive treatise on Mosquitoes in three volumes, with forty-two plates, which was prepared by Mr. Theobald in connection with the specimens of Culicidæ already in the Museum, and others specially collected for the work, with a view to assisting in the study of the relationship of Culicidæ to Malaria and other diseases. A supplementary volume of this work, by Mr. Theobald, has been completed and published in the present year. Also in the present year the Trustees have published an illustrated monograph on the Tsetse-flies, by Mr. Austen, Assistant in the Zoological Department. Our rapidly increasing knowledge of the activity of the minute parasites known as Trypanosoma, as the specific causes of disease both in man and in horses and cattle, renders an accurate knowledge of the species of Tsetse-flies necessary, since one of these flies, the *Glossina moritans* of Westwood, is the carrier of the Trypanosoma causing the deadly disease of horses and cattle known in South Africa as Nagana, and it is possible that other species of *Glossina* are concerned, in a similar way, in the distribution of disease.

It is not, however, only in correspondence and publications, and in the researches of the naturalists of the staff that this Museum renders direct assistance to the development of the knowledge and application of Economic Zoology. The large study collections of the Museum have, for a long time past, comprised important series from all parts of the world of carefully named and recorded specimens of animals having economic importance, either as pests or as sources of commercial products. In addition to these, several cases are now exhibited in the North Hall of the Museum, in which the life-history and activities of animals important to man in one or other of the relations recognised in the classification adopted in this volume, are illustrated with a view to the edification of the public, and the promotion of the public interest in the thorough scientific treatment of the subject.

I have to thank the Board of Agriculture for permission to reproduce some of the Reports furnished to the Board.

E. RAY LANKESTER.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, S.W.

May 15th, 1903.

C O N T E N T S.

	PAGE
PREFACE	iii
INTRODUCTION.—THE CLASSIFICATION OF ANIMALS FROM THE POINT OF VIEW OF ECONOMIC ZOOLOGY	xi

P A R T I.

R E P O R T S O N A G R I C U L T U R A L Z O O L O G Y T O T H E B O A R D O F A G R I C U L T U R E.

G R O U P E.

S U B - G R O U P B . — S E C T I O N I . A N I M A L S I N J U R I O U S T O A G R I C U L T U R E .

CEREAL PESTS: Eel-worm disease in oats; The Frit Fly (*Oscinis frit*) on oats; Smut in Barley and Insects. ROOT CROP PESTS: *Silpha rugosa* on Turnips, and other Silphidae; Notes on Surface Larvæ; The Pigmy Mangold Beetle (*Atomaria linearis*); Black Fly on Mangolds (*Aphis atriplicis*, Linn.); Flies (*Bibionidae*) on Mangolds; Muscid Larvæ attacking roots; Chafer Larvæ (*Melolonthidae*); Leather Jackets (*Tipulidae*); The Green Rose Chafer on Beans and Currant Bushes. POTATO PESTS: Myriapoda in Potatoes; Wire-worm (*Agriotes murinus*) in Potatoes; A new Potato Feeder, the Cinnabar Moth (*Euchelia jacobaeæ*). MUSTARD PESTS: Destruction of the Mustard Beetle. FRUIT PESTS: An enquiry re Gall Mites in Black-currant bushes; The Apple-Blossom Weevil; Strawberry Beetles; Slug-worms on Fruit trees and Hedgerows; Maggots in Apples; Maggots in Imported Apples; Infestation of Fruit trees by Winter Moth caterpillars; The Pear Midge (*Diplosis pyrivora*); Scale disease and "false scale" amongst fruit trees and bushes; Scale Insects on Plum Trees; The Apple Bark-louse or Mussel Scale (*Mytilaspis pomorum*); Eggs on Apple trees, and a further remedy for Mussel Scale; Aphides (*A. malii*) on Apple trees; The Peach Aphid; A general wash for Fruit trees; Further Information re Winter Washing of Fruit trees; Canker fungus (*Nectria ditissima*) on Apple twigs mistaken for insect work; Enquiry as to poison for Moles

3-30

S U B - G R O U P B . — S E C T I O N I I . A N I M A L S I N J U R I O U S T O H O R T I C U L T U R E .

Land Bugs on Chrysanthemums (*Lygus pratensis*); The destruction of Ants; The destruction of subterranean insects and other ground garden pests; Directions for the employment of the Gas Treatment under glass; White Grubs or Maggots (*Phorbia brassicæ*) causing great damage amongst cabbage, carrots and broccoli, and exterminating Cabbage-fly

30-36

SUB-GROUP B.—SECTION III. ANIMALS INJURIOUS TO FORESTRY.	
Willow-beetle at Norwich (<i>Sarperda carcharias</i> , Linn.); Sirex Flies in Fir trees (<i>S. juvencus</i> and <i>S. gigas</i>); The Poplar Saw-fly (<i>Cladius viminalis</i>); Saw-fly Larvæ on Willows; Insect Galls on Osier plants; The Felted Beech-coccus (<i>Cryptococcus fagi</i>); <i>Chermes corticalis</i> on Pine trees	36-40

G R O U P F.

The Furniture Beetles and Clothes Moths; Insects and Mites in Furniture; the Larder Beetle (<i>Dermestes lardarius</i>); Weevils amongst stored corn (<i>Calandra granaria</i>)	41-47
Fungoid disease in Black-currant leaves (<i>Septoria ribis</i>); Gooseberry fungus (<i>Puccinia pringsheimiana</i>)	47-49

APPENDIX.

Tapeworm in Sheep at Okehampton; Black Wire-worm in Mangolds; List of leaflets prepared and revised for the Board	49-50
---	-------

PART II.

REPORTS ON ECONOMIC ZOOLOGY SENT IN REPLY TO VARIOUS CORRESPONDENTS.

A. British.

G R O U P B.

Origin and Varieties of Domesticated Geese	53-54
--	-------

G R O U P D.

Dipterous larvæ in human excreta; Correspondence on the Mosquito annoyance at Blackheath	55-59
--	-------

G R O U P E.

SUB-GROUP A.

Horse-worms and the use of Thymol; Depluming scabies in Fowls.	60-61
--	-------

SUB-GROUP B.

SECTION I. ANIMALS INJURIOUS TO AGRICULTURE.

FRUIT PESTS: The Bud Moth (<i>Hedya ocellana</i>); The Pith Moth (<i>Laverne atra</i>); The Pear and Cherry Sawfly; Notes on Fruit Pests in an Orchard at Wisbech; <i>Phyllobius</i> or Leaf Weevils; Insects on Vines in Jersey;

Contents.

vii

PAGES

The Pear Leaf Blister Mite; Big Bud in Currants; <i>Oribatidae</i> or Beetle Mites; Hover Flies or <i>Syrphidae</i> ; The Mussel Scale (<i>Mytilaspis pomorum</i>). Hop Pests: Woodlice in Hops. CEREAL PESTS: Beetles in Barley affected with Smut. POTATO PESTS: The Rosy Rustic Moth (<i>Hydraciella micacea</i>); Surface larvae attacking Potatoes and Celery; The Pigmy Potato Beetle (<i>Bathysecia wollastoni</i>); Millipedes attacking Potatoes; Notes on the Colorado Beetle in England. ROOT-CROP PESTS: Cabbage Aphis on Turnips; <i>Tipulidae</i> or Daddy-long-legs	62-104
--	--------

SECTION II. ANIMALS INJURIOUS TO HORTICULTURE.

<i>Julidae</i> destroying plants in the gardens of Downton Castle, Ludlow; Woodlice in Gardens; A new Phytoptid Disease in Violas; The Narcissus Fly (<i>Merodon equestris</i>); The Marguerite Fly and its Destruction; The Carrot-fly and Aphides on Carrots; Correspondence and Report on Insects in Orchid Houses; Fumigation for Mealy Bug	105-113
---	---------

SECTION III. ANIMALS INJURIOUS TO FORESTRY.

Goat-Moth larvae attacking Willows; Insects on Osiers and Willows; Insects on Elm and Willow; <i>Pissodes notatus</i> ravaging Austrian Pines; The Sycamore Gall Aphid (<i>Chermes abietis</i>)	113-119
---	---------

G R O U P F.

SUB-GROUP A.

Acarine household pests (<i>Glyciphagus domesticus</i> and <i>G. spinipes</i>); <i>Anobium tessellatum</i> in St. Alban's Cathedral; Earwigs causing annoyance indoors	119-124
--	---------

SUB-GROUP C.

The Cigar Beetle (<i>Lasioderma testaceum</i> , Duff); The Indian Meal Moth (<i>Plodia interpunctella</i>) attacking Almonds; The Larder Beetle	125-127
--	---------

G E N E R A L S U B J E C T S.

Green Matter in Lewes Public Baths; Short Reports	127-129
---	---------

B. Extra-British.

G R O U P D.

A poisonous Land Bug in Singapore; The Screw Worm in St. Lucia	130-131
--	---------

G R O U P E.

SUB-GROUP A.

	PAGES
The Screw Worm in Cattle at St. Lucia ; Pony Flies	132-133

SUB-GROUP B.

Scale Insects in Monte Video (<i>Mytilaspis citricola</i>) ; Scale on Pineapples in Jamaica (<i>Diaspis bromeliæ</i>) ; Pine Beetle (<i>Hylesinus piniperda</i>) ; Damaged Coffee-berries from Uganda and Costa Rica ; Weevils (<i>Hypomeces squamosus</i>) defoliating rubber ; Insect Pests of West Indies ; other Reports	133-142
--	---------

G R O U P F.

SUB-GROUP A.

Teredo and Canadian Timber	143-144
Other Short Reports	144-145

PART III.

REPORTS TO THE FOREIGN (A) AND COLONIAL OFFICES (B).

A. REPORTS TO THE FOREIGN OFFICE.

Tsetse-fly and its Connection with the Buffalo (<i>Bos caffa</i>) (Correspondence) ;	147-155
White Ants or Termites in the Sudan (Correspondence and Report) ;	155-163
Locust Plagues in the Sudan (Correspondence and Report)	163-169

B. REPORTS TO THE COLONIAL OFFICE.

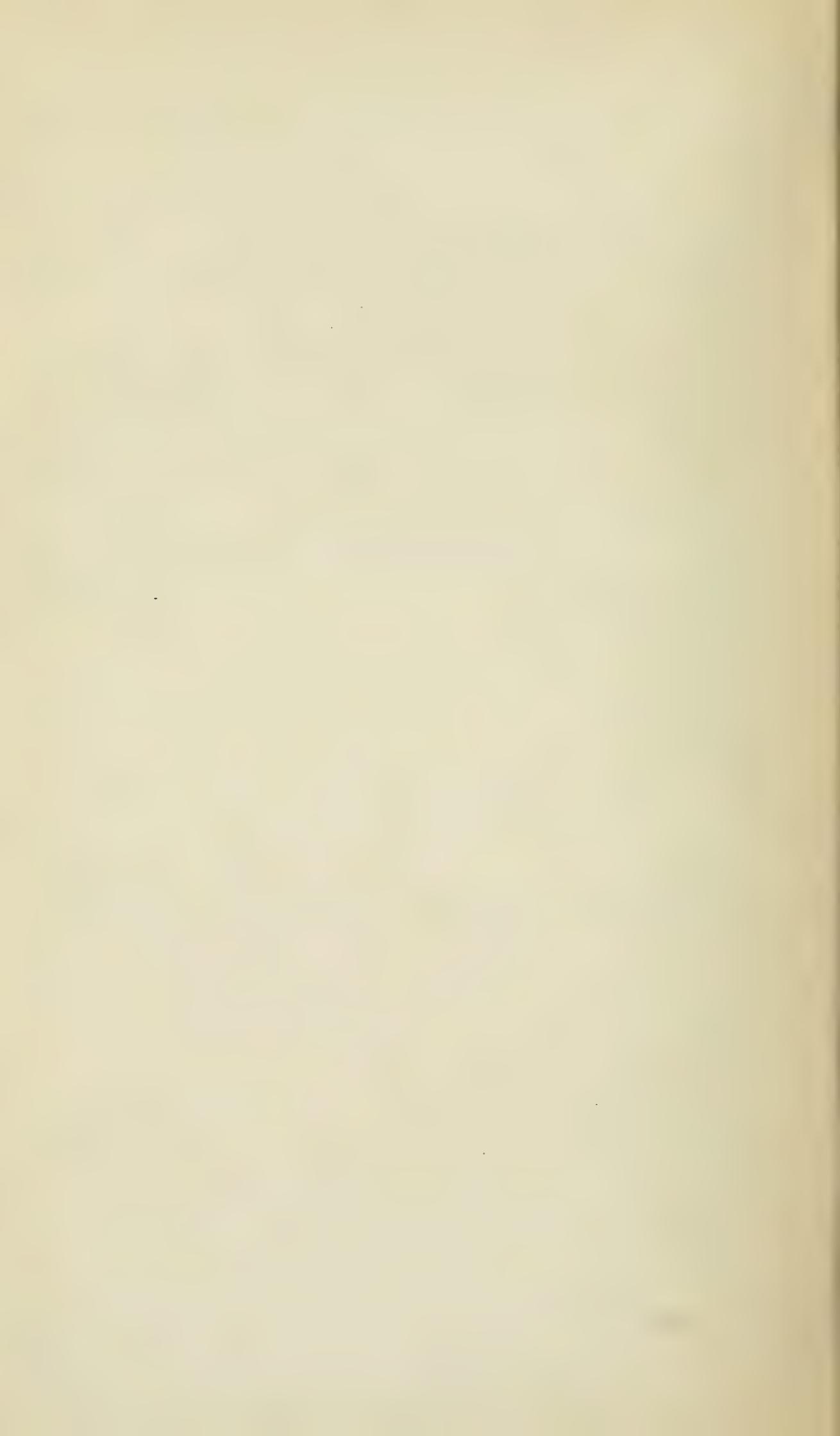
The Marine Resources of the West Indies ; Ceylon Pearl Fisheries	169-178
--	---------

APPENDIX.

List of North African Locusts	179-184
List of African Termites	184-185
Index	186-192

LIST OF FIGURES.

	PAGES
Fig. 1. The Pigmy Mangold Beetle (<i>Atomaria linearis</i>)	9
Fig. 2. The Green Rose Chafer (<i>Cetonia aurata</i>)	14
Fig. 3. Gall-male, true male and Canker-Larva on Fruit Tree	24
Fig. 4. Protection of Cabbage Plants from Root Maggots.	35
Fig. 5. The Bud Moth (<i>Hedya ocellana</i>)	65
Fig. 6. Twig with larval cases of Bud Moth and Buds	66
Fig. 7. The Pith Moth (<i>Laverna atra</i>).	70
Fig. 8. Mussel Scale (<i>Mytilaspis pomorum</i>)	75
Fig. 9. The Potato Stem-borer (<i>Hydracia micacea</i>)	82
Fig. 10. The Pigmy Potato Beetle (<i>Bathyscia wollastonii</i>).	85
Fig. 11. Injurious <i>Tipulidae</i> , or Daddy-long-legs	97
Fig. 12. Larva and Pupa of <i>Pissodes notatus</i>	116
Fig. 13. The Banded Pine Weevil (<i>Pissodes notatus</i>)	116
Fig. 14. Pine cone damaged by <i>P. notatus</i>	117
Fig. 15. House-Mi Mites (<i>Glyciphagus domesticus</i> and <i>G. spinipes</i>)	121
Fig. 16. Coffee Berries damaged by <i>Araecerus fasciculatus</i> and <i>Scolytus</i> sp. (?)	137
Fig. 17. Termite protection	161
Fig. 18. A Hopper-Dozer	166



INTRODUCTION.

A Classification of Animals from the point of view of Economic Zoology.

GROUP A.—Animals *captured* or *slaughtered* by man for food, or for the use by him in other ways, of their skin, bone, fat, or other products.

Examples.—Animals of the chase; food-fishes; whales; pearl-mussels.

GROUP B.—Animals *bred* or *cultivated* by man for food or for the use of their products in industry or for their services as living things.

Examples.—Flocks and herds; horses; dogs, poultry; gold-fish; bees; silkworms and leeches.

GROUP C.—Animals which directly promote man's operations as a civilised being without being killed, captured or trained by him.

Examples.—Scavengers such as vultures; carrion-feeding insects; earthworms and flower-fertilizing insects.

GROUP D.—Animals which concern man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character.

Examples.—Lions; wolves; snakes; stinging and parasitic insects; disease germ-carriers, as flies and mosquitoes; parasitic worms; parasitic protozoa.

GROUP E.—Animals which concern man as causing bodily injury or disease (both possibly of a deadly character) to (A), his stock of domesticated animals; or (B), to his vegetable plantations; or (C), to wild animals in the preservation of which he is interested; or (D), wild plants in the preservation of which he is interested.

Examples.—Similar to those of Group D, but also insects and worms which destroy crops, fruit and forest trees, and pests such as frugivorous birds, rabbits and voles.

GROUP F.—Animals which concern man as being destructive to his worked up products of art and industry, such as (*A*) his various works, buildings, larger constructions and habitations ; (*B*) furniture, books, drapery and clothing ; (*C*) his food and his stores.

Examples.—White ants ; wood-eating larvæ ; clothes moths, weevils, acari and marine borers.

GROUP G.—Animals which are known as “beneficials” on account of their being destructive to or checking the increase of the injurious animals classed under Groups D, E and F.

Examples.—Certain carnivorous and insectivorous birds, reptiles and amphibia ; parasitic and predaceous insects, acari, myriapoda, etc.

The above is a complete classification of animals in their economic relation to man, and proceeds from the simpler relations of primitive man and the animals around him to the more complex relations of civilised man with his endless arts and industries and circumscribed conditions.

It is, however, convenient in the treatment of the subject, whether in a Museum Collection or in a Handbook, to deal with the last group (Group G), the beneficial animals, in immediate connection with the injurious animals by the destruction of which they render service. The diseases of injurious animals caused by parasitic plants such as fungi and bacteria are naturally connected also with this subject of “beneficials.” But in the artificial scheme which we have decided for practical reasons to accept, they are omitted, and the student is referred to the botanist and pathologist for the treatment of these vegetable organisms.

A similar treatment of Group E, namely, those animals which injure other animals in the conservation of which man is interested, would be convenient in some ways. But it is not followed here for two reasons, firstly, because it is convenient rather to associate this group with the animals causing disease or death to man, the animals of the two groups being in many cases identical or closely related, and secondly, because the zoologist has to take cognizance of a further large and important series of injurious animals, namely, those which destroy or injure the cultivated or wild *plants* in the life of which man is interested.

It is obvious that the subject-matter of Economic Botany could be set forth in a series of groups exactly parallel to those which we have employed for reviewing the subject-matter of Economic Zoology ; we should merely have to substitute the word “plant” for “animal” in the groups given above, and to use the appropriate words in the place of “captured” and “slaughtered.”

A review of the contents of each of the main Groups A to G is given below. It is to be noted that the animals of Group G will, as explained above, be placed in our Museum series (and in any further treatment of the subject based on this prodromus) alongside of the particular forms of injurious animals to which they are hostile.

It is also found convenient in a subject which has such definite local interest and importance as has that of Economic Zoology to sub-divide every group into a series of sections corresponding to large geographical areas. For the purposes of the Natural History Museum, and with the

space at our disposal for the exhibition of specimens relating to the subject of Economic Zoology, we find it sufficient to distinguish in each group or smaller division the "British" and the "Extra-British" animals. An animal once established as an inhabitant of Britain we shall consider as British, whether it is of foreign importation or long established as an inhabitant of these islands.

G R O U P A.

Animals Captured or Slaughtered by Man for Food, or for the use by him, in other ways, of their Skin, Bone, Fat, or other Products.

This group includes those animals having the most primitive and direct relation to man, those which he hunts and captures or kills.

Perhaps the relation of some (but not all) of those animals which infest or attack the body of uncivilised man may be regarded as equally primitive, that is to say, the relations are free from the complicating circumstances of the civilisation of great communities of mankind.

It is not desirable in a general Museum of Natural History to bring together a special series of these animals of the chase or fishery. They are best seen and are fully represented in the general galleries of the Museum. Here they may be roughly enumerated. According to locality and circumstance, almost any animal may become the source of food or of economic products to this or that race of man. In the list given below these animals only are cited which are regularly and habitually pursued by man, either for the purposes of procuring them for food or as the source of economic products.

We divide the group into two sub-groups.

- (a) Animals pursued for food.
- (b) Animals pursued for their economic products.

SURVEY OF SUB-GROUP (a) OF GROUP A.

ANIMALS PURSUED FOR FOOD.

Protozoa.....	None.
Porifera	None.
Cœlentera	Sea anemones (<i>cul de mulet</i>) are to be seen in most French fish markets and are also eaten in Sicily, Trieste, and Istra (<i>Actinia viridis</i> and others).
Echinodermata	<i>Echinus</i> (sea urchins), the ovaries of various species in all parts of the world, especially in the West Indies and Adriatic Coast. <i>Holothurians</i> , known as "bêche-de-mer" or "trepang," are dried and cooked by the Chinese, Neapolitans and others.
Platyhelminia	<i>Cestodes</i> (tapeworms) are eaten by the Chinese.
Nemertina.....	None.
Nematoda	None.
Chætopoda	<i>Palolo worms</i> (<i>Eunice</i>) are eaten in the Samoan Islands in large quantities.

xiv *First Report on Economic Zoology.*

Crustacea	All groups are eaten. Even cirrhipedes (<i>Pollicipes</i>) are sold in the market at Madrid and <i>Balanus psittacus</i> in South America.
Arachnida	Only by uncivilised man.
Hexapoda	Locusts in countries where they abound (Greece and N. S. Wales); larvae of aquatic insects and midges are compressed into cakes in Africa (Kunga cakes); bees (honey); the grubs of palm weevils (<i>Rhynchophorus palmarum</i>) are eaten by natives of India and Burma. Manna produced by scale-insects (<i>Gossyparia mannipara</i> in Arabia); ants eaten in India; Bugong moths eaten in Australia; the Chinese eat the chrysalids of the silk moths. Karens eat cicadas; Kaffirs and East Indians cook termites, and also eat them raw.
Chilopoda	By South American Indians.
Diplopoda	None.
Mollusca	Examples of all groups are eaten either raw or cooked by both civilised and uncivilised people (oysters, <i>Ostrea edulis</i> , <i>O. parasitica</i> ; clams, <i>Mya arenaria</i> , species of <i>Mactra</i> and <i>Venus</i> and Razor shells, <i>Ensis Americana</i> ; Ark shells, <i>Arca</i> and <i>Codakia</i> in America and West Indies). Piddocks (<i>Pholas</i>) are eaten in Normandy; snails (<i>Helix aspersa</i>) in France; <i>Bulinus ovatus</i> is sold as food in Rio Janeiro; whelks (<i>Buccinum</i>) and limpets (<i>Patella</i>) in Europe; even sea slugs (<i>Aplysia</i>) are eaten in the South Sea Islands.
Tunicates	One species, <i>Cynthia microcosmus</i> , is eaten raw and cooked by the Adriatic fishermen.
Fishes.....	All kinds are eaten, even in civilised countries. Fish fins and fish maws eaten by Chinese, and isinglass obtained from swim-bladders of sturgeons and other fish.
Amphibians	Frogs only are eaten both in Europe (<i>Rana esculenta</i>) and India (croaking and spangled frogs).
Reptiles	Many lizards (<i>Iguana tuberculata</i> in West Indies, <i>I. delicatissima</i> in S. America, water lizards, <i>Varanus dracænia</i> , in India, and others) are eaten by civilised man; also chelonians, as the green turtle, <i>Chelone midas</i> , and the hawksbill, <i>C. imbricata</i> . Alligators are eaten by Indians, and crocodiles by Siamese. Snakes are eaten by Australian aborigines.
Birds	All kinds eaten except birds of prey and fish-eating birds. Eggs of some wild species, as plovers and gulls. Nests formed by swiftlets (<i>Collocalia fuciphaga</i> and <i>C. francica</i>) used for soups by Chinese.
Mammals	All except the carnivora are eaten; but civilised man is more selective than uncivilised man, and refuses as a rule to eat mammals not belonging to the Ruminantia, excepting the pigs, hares, rabbits, sometimes horse, and occasionally his dog. The manatee is eaten in West Indies; the fox bat (<i>Pteropus edulis</i>) in Malay; white whale (<i>Delphinapterus leucas</i>) in Greenland and Siberia. Various marsupials—the koala (<i>Phascolarctus cinereus</i>); wallabies and kangaroos (<i>Macropus</i>); rabbit-bandicoot (<i>Peragale lagotis</i>), etc.

SURVEY OF SUB-GROUP (b) OF GROUP A.

ANIMALS PURSUED FOR THEIR ECONOMIC PRODUCTS.

Protozoa.....	None.
Porifera	Sponges (grass sponge, <i>Hippoponcia equina</i> ; wool sponges, <i>H. equina</i> , variety <i>gossypina</i> ; Zimocca sponge, <i>S. zimocca</i> ; yellow sponge, variety <i>corlosia</i> , and others) are collected in many parts, as West Indies, Florida, Mediterranean.

Introduction.

XV

Cnidaria	Red coral (<i>Corallium rubrum</i>) and Iris and Myrra.
Echinodermata	Starfish (<i>Asterias vulgaris</i>) are collected and used as manure (five-finger manure) in some parts of Great Britain.
Platyhelminia to Chaetopoda	None.
Crustacea	None.
Arachnida	None.
Hexapoda	Various insects are sought for by man for their products—lac insects (<i>Coccidae</i>); "cantharides" (= dried beetles, <i>Cantharis vesicatoria</i> and others); oil extracted from locusts in Algeria; galls (<i>Cynips</i>) for dyes, tanning and ink; beetles for their metallic glints, used as ornaments in embroidery (<i>Chrysomela marginata</i> , <i>Drypta nitidula</i>); "ground pearl" of Bahamas produced by a scale insect, <i>Margarodes formicarium</i> .
Chilopoda	None.
Diplopoda	None.
Mollusca	Many shells are collected for ornamental purposes—cameos (<i>Cassis madagascarensis</i> and others); <i>Sepia</i> for cuttle bone and sepia; pearl oysters (<i>Ariaculidae</i>); cowrie (<i>Cypraea</i> , <i>Cyprina</i>) are used as money by some uncivilised races; the byssus of <i>Pinna</i> for silk; pearls and mother-of-pearl from pearl oysters (<i>Ariacula margaritifera</i>), and purple pearls from <i>Arca</i> ; others for dyes, as <i>Aplysia camelus</i> in Portugal.
Tunicata (Ascidians)	None.
Fish	Various sharks for their skin (shagreen); fish skins are used to clarify beer, also isinglass. Glue is also made from fish skins in India. Cod liver oil from the cod (<i>Gadus morrhua</i>). Fish bile used chemically in India. Fish scales, of the bleak (<i>Leuciscus alburnus</i>) and dace (<i>L. vulgaris</i>), to make artificial pearls. Fish scales of the mahasir (<i>Barbus tor</i>) also used in manufacture of playing cards in India.
Amphibia	Frogs for their skin for ornamental book-binding.
Reptiles	Many lizards and crocodiles are captured for their skins for ornamental purposes; also turtles (hawksbill and green turtle) for tortoise shell.
Birds	The plumage of many wild birds for ornamental purposes—grebes (<i>Colymbus cristatus</i>), skins used for muffs, trimmings, etc.; gulls (<i>Lissa tridactyla</i> and others), for hats and decoration; Argus pheasant (<i>Argus giganteus</i>); peacock feathers in China; eagle feathers in N. America; jays, cockatoos, and parakeets for making artificial flies; Eider ducks (<i>Somateria mollissima</i>) for eider down in Greenland, Iceland, and Norway; wild swans for swan down; bile (fel) of the peacock used medicinally in India.
Mammals	Most groups are sought for for their (i) furs; (ii) skin and hide; (iii) bone and horn; (iv) fats; and (v) scents. (i) For furs—seal, bear, ermine, marten, pine marten, sable, chinchilla, skunk, mink, neutria, caracal, wolverine, marmot, musquash, genet, squirrel, Arctic fox, moles, etc. Various marsupials—wallabies and kangaroos (<i>Macropus</i>), phalangers (<i>Trichosurus</i>), and others. (ii) For skin and hide—the wild pig, white whale (= porpoise hide) and true porpoises (<i>Piscesena communis</i>); buffalo and chamois; seal for black enamel leather. (iii) For bone and horn—elephant and narwhal for ivory; oxen, deer, and buffalo for horn; whales (<i>Balaena mysticetus</i>) for whalebone.

- Mammals—continued (iv) For fat, soaps and oil—whales and porpoises, wild pigs and bears; spermaceti from sperm whale.
 (v) For scents—musk from a gland in the skin of abdomen of male musk deer (*Moschus moschiferus*) in India and used as a stimulant medicinally, and scent from civets (*Viverra*); ambergris from sperm whale (*Physeter macrocephalus*).
-

G R O U P B.

Animals Bred or Domesticated by Man for Food, or for the use of their Products in Industry, or for their Services as living things.

This group is related to the organisation of human society in communities possessing fixed dwellings, fields, stock-yards, etc. The animals here comprised are captured, bred and reared by man. The purposes of this domestication by man are diverse, and the group may be broken up into sub-groups or sections accordingly, but they are of very unequal size. The chief purposes of man's domestication of animals are : (a) the provision of food for himself ; (b) the provision of beasts of burden ; (c) the provision of assistance or companions in the chase (hounds, ferrets, cheetah, etc.) ; (d) the provision of guardians for flocks, house and other property ; (e) the provision of animals which shall amuse and delight their owner either by brilliant plumage and colour, song (birds), or by courage and skill in fighting (gamecocks, fighting fish) ; (f) the provision of hides, wool, fat, bone and other products, such as wax, honey, silk and cochineal ; (g) the utilisation of the animal as a surgical agent (the leech).

SURVEY OF SUB-GROUP (a) OF GROUP B.

ANIMALS BRED OR DOMESTICATED FOR THE PROVISION OF FOOD.

Protozoa	None.
Porifera	None.
Cœlentera	None.
Echinoderma	None.
Platyhelminia	None.
Nemertina	None.
Nematoda	None.
Chætopoda	None.
Crustacea	Lobsters in Newfoundland; crayfish in France.
Arachnida	None.
Hexapoda	Bees (Honey).
Chilopoda	None.
Dilopoda	None.
Mollusca	Several kinds of molluses are cultivated, such as oysters (<i>Ostrea edulis</i>), cockles (<i>Cardium edule</i>), mussels (<i>Mytilus edulis</i>), snails in parts of Europe (<i>Helix pomatia</i>).
Tunicata	None.
Fish	Several fish are cultivated and bred for food (and sport)—salmon (<i>Salmo salar</i>), trout (<i>Salmo fario</i> , <i>S. levensis</i>), rainbow trout (<i>Salmo irideus</i>), land-locked salmon (<i>S. sebago</i>), whitefish (<i>Coregonus albus</i> and <i>C. clupeiformis</i>), the shad (<i>Clupea sapidissima</i>), carp (<i>Cyprinus carpio</i>).

Amphibia	Frogs are bred and cultivated for food in parts of America and Europe.
Reptiles	None.
Birds	Pheasants, turkeys, quails, fowls, ducks, and geese, are cultivated and bred in most parts of the world.
Mammals	Ruminantia, as oxen (<i>Bovidae</i>), sheep (<i>Ovidae</i>), and goats, are bred by man in most parts of the world, even amongst uncivilised tribes, for food; Pachyderms, as the pigs; and Rodents, as rabbits, also for food. The llama in parts of S. America, also the alpaca.

SURVEY OF SUB-GROUP (*b*) OF GROUP B.

ANIMALS BRED OR DOMESTICATED FOR THE PROVISION OF BEASTS OF BURDEN.

Mammalia.....	The mammalia alone form "beasts of burden," such as elephants in India; camels in Africa, etc.; oxen in India and parts of Europe; the horse and ass in metropolitan; the reindeer in Lapland; dogs in Arctic regions and parts of temperate Europe; at one time llamas in Peru.
---------------	--

SURVEY OF SUB-GROUP (*c*) OF GROUP B.

ANIMALS BRED OR DOMESTICATED FOR THE PROVISION OF ASSISTANCE OR AS COMPANIONS IN THE CHASE.

Birds and Mammals alone come in this section.

Birds	Hawks and falcons are used in various parts of the world for sporting purposes.
Mammalia.....	Various dogs, such as foxhounds, deerhounds, spaniels, setters, terriers; horses; elephants; the cheetah and ferrets.

SURVEY OF SUB-GROUP (*d*) OF GROUP B.

ANIMALS BRED AND DOMESTICATED FOR THE PROVISION OF GUARDIANS FOR FLOCKS, HOUSE, AND OTHER PROPERTY.

Reptilia	The Corn snake (<i>Coluber guttatus</i>) is domesticated in N. America, and keeps off rats and mice. Rat snake in India (<i>Zamenis mucosus</i>).
Birds	The secretary bird (<i>Gypogeranus serpentarius</i>) is domesticated by Cape farmers for killing snakes, etc., that attack their animals.
Mammalia.....	The animals represented in this sub-group are mainly dogs. The common cat. Genets are domesticated in the south of Europe for killing rats and mice. Mungooses (<i>Herpestes</i>) are tamed in India, America, and elsewhere, and keep snakes, rats, and mice away from buildings and ships. The hedgehog in Europe for destroying cockroaches.

SURVEY OF SUB-GROUP (*e*) OF GROUP B.

ANIMALS BRED AND DOMESTICATED FOR THE AMUSEMENT AND DELIGHT OF THEIR OWNER, EITHER BY BRILLIANT PLUMAGE AND COLOUR, SONG, OR BY COURAGE AND SKILL IN FIGHTING.

Hexapoda	<i>Mantis</i> flies and some beetles are kept by the Italians and Chinese for fighting; also a grasshopper (<i>Oeticus</i>); and crickets also by Chinese.
Reptilia	Horned or Californian toads (<i>Phrynosoma</i>) are kept as pets in North and Central America. The coral snake (<i>Tortrix scytale</i>) is used by native women in tropical America as an adornment round their necks.
Fish	Fighting races of fish (<i>Macropodus pugnax</i> , var.) are bred by the Siamese. Goldfish and others for ornamental purposes.
Birds	Fowls (Aseels and Malays) are bred by the Malayans and other races for fighting, and various game-fowls (Pile game, black-breasted reds, duckwings) in Europe for the same purpose. Great varieties of birds are bred for their brilliant plumage and colour and song—canaries, bullfinches, silver pheasants (<i>Gennæus nycthemerus</i>), golden pheasants (<i>Chrysolophus picta</i>), and others—and various ornamental ducks, geese and swans, peafowls.
Mammalia	Race-horses, greyhounds, and whippets, bull dogs, pugs and fancy dogs. Dutch, lop-eared, and other fancy rabbits. Cavies or guinea pigs. A special race of bulls is cultivated for fighting purposes in Spain.

SURVEY OF SUB-GROUP (*f*) OF GROUP B.

ANIMALS BRED AND DOMESTICATED FOR THE PROVISION OF HIDES, WOOL, FAT, BONE, FEATHERS, AND OTHER PRODUCTS SUCH AS WAX, HONEY, SILK, AND MEDICAMENTS.

Protozoa	None.
Porifera	None.
Cœlentera	None.
Echinoderma	None.
Platyhelminia	None.
Nemertina	None.
Nematoda	None.
Chætopoda	None.
Crustacea	None.
Arachnida	Spiders have been kept in some countries with a view to using their webbing as silk.
Hexapoda	Silk moths— <i>Antheraea mylitta</i> (Tusseh silk), <i>Antheraea pernyi</i> , <i>A. yama-mai</i> , <i>Attacus cynthis</i> (Ailanthus silk), and <i>Bombyx mori</i> are bred and reared in India, China, Japan and Europe for the silk formed by the larvæ, also for the “cat-gut” made from the inside of the silkworms. Bees are kept by all civilised nations for the production of honey and wax. Cochineal insects (<i>Coccus cacti</i>) are cultivated for dyes and colours in Mexico, Peru, Spain, Algiers.
Chilopoda	None.
Diplopoda	None.
Mollusca	None.
Tunicata	None.
Fish	None.

Amphibia	None.
Reptilia	None.
Birds	Ostriches are farmed for their feathers in South Africa and at Nice. Swans also to provide feathers (swan-down). Albumen prepared from fowls' eggs.
Mammalia	The same as Sub-group (a), i.e. cattle, sheep, goats, pigs, and others for (i) hide; (ii) wool; (iii) fat; (iv) bone and horn; (v) milk; and (vi) other products. (i) For hide—oxen (<i>Bovidae</i>), ox-hide, cow-hide, calf-skin; sheep-skin for chamois and Morocco leather; lamb-skin for gloves. Goat-skin used for Morocco leather and bottle making in the East. (ii) For wool—sheep, such as Merinos, Lincolns, Leicesters, Persian Lamb; goats, as Angora, Kashmir or Thibet and Sudan goats; camels for hair which is woven into cloth in Persia; alpaca and the llama in Peru and Bolivia. (iii) For fat—pigs, sheep, oxen; prepared suet from internal fat of sheep; wool fat (<i>Adeps lanæ</i>); prepared hog's lard. (iv) For bone—oxen, sheep, horses, and all domesticated animals. Horn—cattle and sheep. (v) For milk—cows, goats, mares. (vi) For other products—sugar of milk from whey of cows' milk; 'fel' or purified ox-bile; pepsina from mucus membrane of the stomach of sheep, pigs, calves. Modern medicine makes use of nearly all the glands of domesticated mammalia in order to manufacture "extracts" of a curative nature.

SURVEY OF SUB-GROUP (g) OF GROUP B.

THE UTILISATION OF THE ANIMAL AS A SURGICAL AGENT.

The chief animals coming in this sub-group are the Medicinal Leeches *Sanguisuga medicinalis* and *S. officinalis*. In Mexico another leech, a species of *Hæmentaria*, is made use of.

G R O U P C.

Animals which directly promote Man's operations as a civilised being, without being killed, captured or trained by him.

This is a remarkable group—remarkable because it is so small. The fact is that in more primitive conditions of civilisation man would recognise more clearly than he now does his indebtedness to other animals, as, for instance, the fisherman looks to the sea-gulls for guidance. Highly civilised man has almost completely separated himself from the ancient association with the animal world, excepting where he has seized and domesticated or more or less trained the useful animal. The scavenger animals and birds and the earthworms still act freely for man's benefit without submitting to his yoke.

SURVEY OF GROUP C.

Protozoa	None.
Porifera	None.
Cœlentera	None.
Echinoderm	None.
Platyhelminia	None.
Nemertina	None.
Nematoda	Various eel-worms (<i>Anguillulidæ</i>) hasten decay in plants.
Chætopoda	The earthworms form surface soil and bury stones on the surface, and prepare seed beds, etc., for plants.
Crustacea	None.
Arachnida	None.
Chilopoda	None.
Diplopoda	None.
Hexapoda	Many insects act as scavengers in all parts of the world; the larvæ of flies (<i>Calliphora</i>) feed upon and hasten decay of carrion; some carrion beetles (<i>Silphidæ</i>); dung beetles (<i>Copridæ</i> and <i>Dynastidæ</i>); burying beetles (<i>Necrophorus</i>) also act as scavengers; humble bees (<i>Bombi</i>) fertilise clover, and many other insects act as fertilisers (<i>Trigona</i> and <i>Vanilla</i> , <i>Blastophaga</i> and figs).
Mollusca	None.
Tunicata	None.
Fish	Fish, especially carp, keep water free from insects and decaying matter, and are used for such purposes in reservoirs.
Amphibia	None.
Reptilia	None.
Birds	Vultures, by destroying the flesh of dead animals and man.
Mammals	Rats feed upon carrion, as well as sound food; and also jackals and semi-wild dogs.

G R O U P D.

Animals which concern Man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character.

This large group contains representatives in most of the divisions of the animal kingdom. It may conveniently be divided into two sub-groups, viz., (a) animals which cause injury, by direct attack, to man, and (b) animals which cause disease by acting as germ carriers.

In the former section parasitism plays an important rôle.

SURVEY OF SUB-GROUP (a) OF GROUP D.

ANIMALS WHICH CAUSE INJURY, BY DIRECT ATTACK, TO MAN.

Protozoa	Malarial hæmamœbidæ, coccidia, <i>Amœba coli</i> , and <i>Trypanosoma</i> in the blood.
Porifera	None.
Cœlentera	Jelly-fish, by stinging man when in sea water.
Echinoderm	Spines of <i>Echinus</i> may penetrate the skin.
Platyhelminia	Numerous tapeworms (<i>Cestoda</i>) are parasitic in the intestines of man (<i>Tænia solium</i> , <i>Tænia saginata</i>), and in their cystic or hydatid stage in the various organs and connective tissue (<i>Echinococcus hominis</i>). Flukes (<i>Trematoda</i>) also occur as parasites in man (<i>Bilharzia hæmatobium</i> , <i>Distomum hepaticum</i>).

Nemertina.....	None.
Nematoda.....	Many species occur as parasites in the alimentary canal (<i>Acanthocephala</i>), in the blood system and connective tissues (<i>Filaria</i>), and skin disease (<i>Strongylo-</i> <i>tasis</i>) ; the Guinea worm (<i>Filaria medinensis</i>) ; <i>Trichina spiralis</i> .
Chaetopoda.....	Land leeches (<i>Hamulipha ceylonica</i>) attack man in Ceylon and India and elsewhere.
Crustacea	Crabs and lobsters bite, also land-crabs (<i>Gecarcinidae</i>).
Annelida	A few genera (<i>Myriididae</i>) have præputial glands (<i>Mare-</i> <i>coptidae</i>) produce itch, etc., and the sting of scorpions is poisonous.
Chilopoda	Centipedes (<i>Scolependra gigantea</i> , <i>S. morsitans</i>) in tropical climates are poisonous, and produce painful wounds.
Diplopoda	None.
Hexapoda	Insects of the orders Diptera (flies) and Hemiptera-Heteroptera (bugs) bite in all parts of the world. Biting Diptera include :—mosquitoes (<i>Culicidae</i>), sandflies (<i>Simulidae</i>), gadflies (<i>Tabanidae</i>), stinging-flies (<i>Chrysops</i> , <i>Stomoxys</i>), tsetse-flies (<i>Glossina</i>). Diptera also live as parasites in their adult stage (jiggers, fleas) and in the larval state in man (<i>Dermatobia</i> , Screw-worm). Bugs of the genera <i>Cimex</i> and <i>Conorhinus</i> .
Mollusca	The bites of some are poisonous (<i>Conus aulicus</i> in Moluccas, <i>C. textile</i> in South Sea Islands, and most other <i>Toxiglossa</i>).
Tunicata	None.
Fish	Sharks and various poisonous fish, the latter (i) poisonous as food, <i>Clupea thirissa</i> , <i>C. venenosa</i> ; species of <i>Scarus</i> , <i>Tetronarcus</i> , <i>Diodon</i> , <i>Holocentrus</i> , <i>Ostracion</i> ; the rays of barbel, pike and burbot, and (ii) on account of the poisonous wounds they may produce—wharries (<i>Trychodon</i>), stinging rays (<i>Trygonidae</i>), species of <i>Synanceia</i> and <i>Thalassophryne</i> .
Amphibia	None.
Reptilia	Many snakes are poisonous (rattlesnake, cobra, fer de lance, blue adder, puff adder, purple and short death adders) and a single lizard (the <i>Heloderma</i>). Crocodiles and alligators may devour man (the gavial, <i>Gavialis gangeticus</i> , <i>Crocodylus vulgaris</i>).
Birds	None.
Mammals	Most of the large carnivora (lions, tigers, bears, wolves) may cause bodily injury to man and often devour him. Any large mammals such as rhinoceros, elephant, deer, may attack and injure him.

SURVEY OF SUB-GROUP (b) OF GROUP D.

ANIMALS WHICH CAUSE DISEASE BY ACTING AS GERM CARRIERS.

Protozoa to Crustacea.....	None.
Arachnida	Probably ticks (<i>Ixodidae</i>) may distribute disease from animals to man.
Chilopoda and Diplopoda	None.
Hexapoda	All piercing-mouthed insects may either carry disease direct from man to man or animals to man gadflies (<i>Tabanidae</i>), <i>Stomoxys</i> and tsetse-fly (<i>Muscidae</i>), sandflies (<i>Simulidae</i>); bugs (<i>Cimex</i> and <i>Conorhinus</i>); or they may act as intermediate hosts of parasites (mosquitoes and malaria and filariasis). Germs may also be carried to food and drink by dung-feeding flies (<i>Musca</i> , <i>Calliphora</i> , <i>Scatophaga</i>) from latrines and foul matter (typhoid).

xxii First Report on Economic Zoology.

Mollusca	Some mollusca may carry germs, as oysters and cockles carry typhoid.
Tunicata	None.
Fish	None.
Mammalia.....	The imperfectly cooked flesh of various mammals may carry disease to man, as the flesh of pigs (cysts of <i>Tænia solium</i> , and <i>Trichina spiralis</i> , thus producing tapeworm and trichinosis in man); the flesh of oxen (cysts of tapeworms, <i>Tænia saginata</i>); milk of cow and other animals carries tuberculosis.

G R O U P E.

Animals which concern Man as causing bodily injury or disease (both possibly of a deadly character) to (A) his stock of Domesticated Animals; or (B) to his Vegetable Plantations; or (C) to Wild Animals; or (D) Wild Plants in the preservation of which he is interested.

The examples coming in this group are somewhat similar to those in Group D, but in addition must be included also worms and insects, which destroy crops and fruit, garden produce and forest trees, and such pests as the frugivorous birds, rabbits and voles. This forms the largest group, and is directly connected with the cultivation and improvement of land by tillage and forestry, and the animals used by man in carrying on his work, and kept for the improvement of the soil and food.

The sub-groups may conveniently be divided into smaller groups or sections.

SURVEY OF SUB-GROUP A OF GROUP E.

ANIMALS WHICH CONCERN MAN AS CAUSING BODILY INJURY OR DISEASE (BOTH POSSIBLY OF A DEADLY NATURE) TO HIS STOCK OF DOMESTICATED ANIMALS.

This sub-group may be divided into smaller groups or sections as follows:—Animals which concern man as causing bodily injury and disease to his stock of domesticated animals, i.e. (α) cattle; (β) sheep and goats; (γ) horses, asses and mules; (δ) the pig; (ϵ) elephant and camel; (ζ) guinea pig; (η) dogs and cats; (θ) rabbits, and (ι) poultry.

SURVEY OF SECTION (α) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE TO CATTLE.

I. By direct injury.

Protozoa	None.
Platyhelminia	Tapeworms (<i>Moniezia planissima</i>) and cysts (<i>Cysticercus bovis</i> , <i>C. tenuicollis</i>) produce disease; also flukes (<i>Distomum hepaticum</i> , <i>D. magna</i>).
Nematoda.....	Numerous thread and round worms (<i>Ascaris</i> , <i>Trichocelphalus</i> , etc.).
Chætopoda	None.

Arachnida	Ixodidae or ticks (<i>Ixodes</i>) and mange mites (<i>Sarcoptidae</i>).
Hexapoda	Biting flies (<i>Tabanus</i> , <i>Hæmatopota</i> , <i>Simulium</i>), warble flies (<i>Hypoderma lineata</i> and <i>H. bovis</i>).
Amphibia	None.
Reptilia	Poisonous snakes attack cattle—puff adder; crocodiles (<i>Crocodilus vulgaris</i>) in African rivers.
Birds	None.
Mammals	The larger carnivora attack cattle, especially leopards.

II. As germ carriers.

Arachnida	Ticks (<i>Ixodidae</i>) distribute various bovine diseases, as Texas fever.
Hexapoda	Probably biting flies, such as Tabanidae, Stomoxys, carry disease germs (Anthrax); tsetse-fly and Nagana.
Mollusca	Certain species of water snails (<i>Limnaeidæ</i>) carry the germs of flukes.

SURVEY OF SECTION (8) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE TO SHEEP AND GOATS.

I. By direct injury.

Protozoa	Protozoa are said to cause a disease in the feet of sheep in Australia.
Platyhelminia	Gastric cestodes (<i>Monogenea</i> , <i>Leucostoma</i> , <i>Plagiorchis</i> , <i>Alba</i>) in intestines and cysts in the body (<i>Cysticercus tenuicollis</i>), and in the brain (<i>Cænurus cerebralis</i>), causing "sturdy." The liver fluke (<i>Distomum hepaticum</i>) producing "rot."
Nemertina.....	None.
Nematoda	Numerous filaria in all sheep (lung worms, <i>Eustrongylus filaria</i> and husk). <i>Strongylus contortus</i> in intestines.
Arachnida	<i>Sarcoptidae</i> , producing scab (<i>Psoroptes communis v. ovis</i>); <i>Ixodidae</i> or ticks.
Chilopoda and Diplopoda	None.
Hexapoda	Keds (<i>Melophagus ovinus</i>), nasal fly (<i>Estrus ovis</i>), and sheep maggots (<i>Lepidoptera</i>). Fleas (<i>Mallophaga</i>) in sheep and goats.
Reptilia	Many poisonous snakes (puff adder, cobra).
Amphibia	None.
Birds	Some birds of prey (eagles); the halo parrot (<i>Nestor meridionalis</i>) attacks sheep in New Zealand.
Mammals	Large carnivora abroad and dogs generally.

II. As germ carriers.

Arachnida	Ixodidae and louping ill (<i>Ixodes scutulatus</i>), and heartwater (<i>Amblyomma</i>).
Hexapoda	Biting flies (<i>Tabanus</i> , <i>Chrysops</i>) may carry anthrax.
Mollusca	Some water snails (<i>Limnaeidæ</i>) carry the germs of the fluke.

SURVEY OF SECTION (7) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE TO HORSES, ASSES, AND MULES.

I. By direct injury.

Protozoa to Echinodermata	None.
Platyhelminia	A few occur in horses (<i>Tenia plicata</i> , and <i>perfoliata</i>).
Nemertina.....	None.
Nematoda	Many (in all parts of the body; armed strongyls (<i>Enterobius tetraecanthus</i> and <i>equinus</i>), thread worms <i>Filaria</i>); maw worms (<i>Oxyuris curvula</i> and <i>mastigoides</i>).

xxiv First Report on Economic Zoology.

Arachnida	<i>Acari</i> produce mange and sores (<i>Sarcoptes</i> , <i>Psoroptes</i> , <i>Symbiotes</i>).
Hexapoda	Biting flies (<i>Tabanus</i> , <i>Hæmatopota</i>) ; warble flies (<i>Gastrophilus</i>) ("bots") ; forest flies (<i>Hippoboscidae</i>).
Mollusca	None.
Fish	Electric eel (<i>Electrophorus electricus</i>) attacks horses at water in Brazil.
Amphibia	None.
Reptilia	Many poisonous snakes, especially the puff adder, fer de lance and others, and crocodiles.
Birds	None.
Mammalia	A few large carnivora, as leopards ; vampire-bats (<i>Vampyrus spectrum</i>).

II. As germ carriers.

Hexapoda	Tsetse flies (<i>Glossina</i>) and Nagana ; possibly other biting flies carry disease.
----------------	--

SURVEY OF SECTION (δ) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE IN PIGS.

I. By direct injury.

Protozoa	<i>Balantidium coli</i> causes ill-health.
Porifera to Echinodermata	None.
Platyhelminia	<i>Cysticercus cellulosæ</i> , cyst of human tapeworm (measles in pigs); no sexual tapeworm. <i>Echinococcus</i> frequent in the liver.
Nemertina	None.
Nematoda	<i>Ascaris suilla</i> in intestines and others; <i>Echinorhynchus gigas</i> ; <i>Trichina spiralis</i> ; <i>Strongylidæ</i> (<i>S. paradoxus</i>) in bronchi; <i>Stephenurus dentatus</i> .
Chætopoda	None.
Arachnida	Itch mites (<i>Sarcoptes scabiei</i>) transmittable to man, and <i>Demodex</i> .
Diplopoda and Chilopoda	None.
Hexapoda	<i>Stomoxys</i> (biting or stinging fly); <i>Mallophaga</i> and <i>Hæmatopinus</i> (lice).
Amphibia	None.
Reptilia	Poisonous snakes rarely attack the pig.
Birds	None.
Mammals	Larger carnivora.

II. As germ carriers.

Protozoa to Birds	None known.
Mammalia	Rats carry trichinosis (<i>Trichina spiralis</i>).

SURVEY OF SECTION (ε) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE IN ELEPHANTS AND CAMELS.

I. By direct injury.

Protozoa	None.
Porifera and Echinodermata	None.
Platyhelminia	<i>Amphistomes</i> cause sickness in Indian elephants ; Trematodes in lungs of camel ; also <i>Cysticercus tenuicollis</i> in camels; <i>Echinococcus</i> in liver.
Nemertina	None.
Nematoda	<i>Strongylus filaria</i> in the bronchi of camels.
Arachnida	Pentastomes (<i>Linguatula</i>) in camel ; <i>Ixodes camelinus</i> and <i>Galeodes aranoides</i> , a great camel pest, and <i>Sarcoptidæ</i> .
Chilopoda and Diplopoda	None.

Hexapoda	<i>Catoptria vomitorius</i> , common in cattle, and biting flies (<i>Tabanus, Chrysops</i>).
R. ptilia	None (?).
Amphibia	None (?).
Birds	None.
Mammals	None.

II. As germ carriers.

None known.

SURVEY OF SECTION (ζ) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE IN GUINEA PIGS.

Protozoa	Coccidia and Infusoria (<i>Monocercomonas caviae</i>) live in the intestines.
Porifera to Echinodermata	None.
Platyhelminia	Trematodes or flukes (<i>Distomum caviae</i>).
Nemertina.....	None.
Nematoda	None (?).
Araeohelminths	<i>Pentastomes</i> (<i>Ligula intestinalis</i>) occur in the intestine.
Hexapoda	None known except fleas (<i>Pulicidae</i>).
Reptilia	Various poisonous snakes.
Amphibia	None.
Birds	Most rapacious birds.
Mammals	Most large carnivora.

SURVEY OF SECTION (η) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE TO DOGS AND CATS.

I. By direct injury.

Protozoa	Protozoal forms in the blood cause malignant jaundice in dogs in Africa. <i>Coccidium perforans</i> in intestines of dog.
Porifera to Echinodermata	None.
Platyhelminia	Numerous Cestodes infest dogs (<i>Taenia cænurus, T. marginata, T. echinococcus</i>). <i>T. crassicollis</i> in cats.
Nemertina.....	None.
Nematoda	Various species in both cat and dog (<i>Ascaris mystax</i> in cats; <i>Filaria immitis</i> in dogs).
Araeohelminths	Ticks (<i>Ixodes</i>); Mange Insects (<i>Psoroptes, Sarcoptes</i> , etc.), and <i>Pentastomes</i> .
Chilopoda and Diplopoda	None.
Hexapoda	Fleas (<i>Pulicidae</i>) and lice (<i>Mallophaga</i>) on both dog and cat.
Reptilia	Poisonous snakes, and especially the alligator (<i>Alligator mississippiensis</i>).
Amphibia	None.
Birds	None.
Mammals	Other large carnivora.

II. As germ carriers.

Protozoa to Crustacea.....	None.
Arachnidia	A Tick (<i>Ixodes</i> , sp.) carries germs of malignant jaundice.
Hexapoda	Culicidae carry the embryos of <i>Filaria immitis</i> . Lice (<i>Trichodectes</i>), the cysts of <i>Taenia canina</i> .
Chilopoda to Birds	None.
Mammals	Sheep, rabbits, hares and mice contain hydatids of <i>Taenia canina</i> and cat tapeworms (<i>Cænurus cerebralis</i> in sheep, <i>Cysticercus pisiformis</i> in hares and rabbits).

xxvi First Report on Economic Zoology.

SURVEY OF SECTION (θ) OF SUB-GROUP A.

ANIMALS CAUSING BODILY INJURY AND DISEASE TO RABBITS.

I. By direct injury.

Protozoa	<i>Coccidia</i> produce disease in the liver (liver-rot).
Porifera to Echinoderma.	None.
Platyhelminia	Numerous tapeworms in the intestines and cysts in the organs and tissues (<i>Tænia pectinata</i> , <i>Cysticercus pisciformis</i>).
Nemertina.....	None.
Nematoda	<i>Strongylidæ</i> often cause great mortality (<i>Strongylus strigosus</i> , <i>Oxyuris ambigua</i>).
Chætopoda and Crustacea	None.
Arachnida	<i>Psoroptes</i> produce scab and itch.
Hexapoda	Fleas (<i>Pulex gonicephalus</i>).
Reptilia	Various snakes.
Birds	Rapacious birds (hawks, falcons and crows).
Mammals	The fox, dogs, cats, weasels, stoats, etc.

II. As germ carriers.

None known.

SURVEY OF SECTION (ι) OF SUB-GROUP A.

ANIMALS CAUSING BODILY HARM AND DISEASE TO POULTRY.

I. By direct injury.

Protozoa	Cause false coccidiosis of liver (<i>Amœba meleagris</i>), diphtheritic roup, epithelioma contagiosum.
Platyhelminia	Tape worms often occur in all poultry (<i>Davainea proglottina</i> , <i>Drepanidotænia infundibuliformis</i> and others).
Nemertina.....	None.
Nematoda	Thread worms (<i>Heterakis</i>) live in the intestines of fowls ; the gape worm (<i>Syngamus trachealis</i> , gapes).
Chætopoda	None.
Arachnida	<i>Sarcoptidæ</i> (depluming scabies, <i>Sarcoptes laevis</i>), scaly leg (<i>Sarcoptes mutans</i>) ; ticks (<i>Argas</i>) ; mites (<i>Dermanyssus avium</i>) on skin and feathers.
Chilopoda and Diplopoda	None.
Hexapoda	Lice (<i>Mallophaga</i>), fleas (<i>Pulicidæ</i>) and certain flies (<i>Ornithomyia</i>) and sand flies (<i>Simulium</i>) cause annoyance.
Mollusca	None.
Reptilia	Poisonous snakes attack poultry (chicken snake, <i>Coluber quadrivittatus</i> in N. America and others).
Birds	Hawks (sparrow-hawk) and crows take the chicks ; eagles, kites ; peregrine falcon.
Mammals	Many mammals prey on poultry and eggs (fox, polecat, weasel, rat, Indian civet, leopard cat).

II. As germ carriers.

Chætopoda..... Earthworms carry the ova and embryos of the gape worm and are eaten by fowls.

SURVEY OF SUB-GROUP B OF GROUP E.

ANIMALS WHICH CONCERN MAN AS CAUSING INJURY AND DISEASE TO HIS VEGETABLE PLANTATIONS.

This group deals with animals which cause loss to farmers, gardeners and foresters. It may then be divided into three main sections ; (i.) animals injurious to agriculture ; (ii.) to horticulture ; and (iii.) to forestry.

Each of these sections may be again conveniently divided up into smaller groups.

SURVEY OF SECTION I. OF SUB-GROUP B.

ANIMALS INJURIOUS TO AGRICULTURE.

This section may be divided up into several headings under the names of the particular crops grown by man. It is not possible here to enter at length into this sub-group, owing to its extensive nature. The following divisions of this section may be employed :—(a) animals injurious to cereal crops ; (β) to pulse ; (γ) to root crops ; (δ) to forage crops and grass ; (ε) to fruit and fruit trees ; (ζ) to hops ; (η) to tea ; (θ) to coffee ; (ι) to sugar.

Survey of Sub-section (a) of Section I.

ANIMALS INJURIOUS TO CEREAL CROPS.

The animal pests of corn crops are very numerous.

Protozoa	None.
Platyhelminia	None.
Nemertina	None.
Nematoda	Eelworms (<i>Anguillulidae</i>) cause disease, as tulip root in oats.
Chætopoda	Some <i>Enchytraeus</i> apparently cause disease to plants.
Crustacea	Land Isopods (woodlice) sometimes do harm (<i>Armadillidium, Oniscus</i>).
Arachnida	None (?).
Hexapoda	Numerous insects eat leaf (larvae of <i>Noctua</i>), stalks (Hessian fly, <i>Cecidomyia destructor</i> , maize aphis, <i>A. mali</i> , <i>Cephalosphaera pomonae</i> , <i>Lemnophila</i> , etc.), root (cater-worm, <i>Elateridae</i>), and seed and blossom (wheat midge— <i>Diplosis tritici</i>).
Chilopoda	None.
Diplopoda	Millepedes (<i>Julidae</i>) attack the roots of corn.
Mollusca	Many snails (<i>Helicidae</i>) and slugs (<i>Limacidae</i>) devour the leaves.
Reptilia and Amphibia ...	None.
	These burrow and pull up young plants (reels, snakes—wood-pigeons, cranes (<i>Gruidæ</i>), wild geese (<i>Anser anser</i> in Europe, <i>Plectropterus gambensis</i> in Transvaal)).
Mammals	Ruminantia, especially deer, often do harm to standing corn ; rodents, as voles and mice.

Survey of Sub-section (β) of Section I.

ANIMALS INJURIOUS TO PULSE.

Protozoa to Nemertina ...	None.
Nematoda	Eel-worms (<i>Tylenchus</i>).
Crustacea	Land Isopods (woodlice) attack young plants (<i>Porcellio, Oniscus</i>).

xxviii First Report on Economic Zoology.

Arachnida	None (?).
Hexapoda	Many insects attack leafage (pea weevils, <i>Sitones</i>), stem (<i>Aphides</i>), roots (wire-worm or <i>Elater</i> larvae), seed (pea moth, <i>Grapholitha pisana</i>).
Chilopoda and Diplopoda	None.
Mollusca	Snails (<i>Helix</i>) and slugs (<i>Limax</i>).
Reptilia and Amphibia	None.
Birds	Many of the passerine birds take the seed in the ground; also pigeons, rooks and jackdaws.
Mammals	Mice take seed in the ground.

Survey of Sub-section (γ) of Section I.

ANIMALS INJURIOUS TO ROOT CROPS.

Protozoa to Nemertina	None.
Nematoda	None (?).
Crustacea	Woodlice (<i>Oniscus</i> , <i>Armadillidium</i>).
Arachnida	None (?).
Chilopoda	None.
Diplopoda	Many <i>Julidæ</i> damage roots.
Hexapoda	Large numbers of insects attack root crops (flea beetles (<i>Halticidæ</i>); surface larvae (<i>Noctuæ</i>); diamond-back moth (<i>Plutella maculipennis</i>); root weevils (<i>Ceutorhynchus</i>) and <i>Aphides</i>).
Mollusca	Slugs and snails (<i>Limacidæ</i> and <i>Helicidæ</i>).
Reptilia and Amphibia	None.
Birds	Many birds eat the seedlings (linnets, sparrows, green-finches, larks).
Mammalia.....	Rabbits, hares and deer.

Survey of Sub-section (δ) of Section I.

ANIMALS INJURIOUS TO FORAGE CROPS AND GRASS.

Protozoa to Nemertina	None.
Nematoda	<i>Tylenchus devastatrix</i> causes clover sickness.
Arachnida.....	None.
Hexapoda	Large numbers attack roots (chafer larvae, <i>Melolontha</i> , <i>Cetonia</i> , leather jackets or larvae of <i>Tipulidæ</i>), leaves (weevils— <i>Apions</i>), and seeds (thrips, midges— <i>Diplosis</i>).
Chilopoda and Diplopoda	None.
Mollusca	Slugs and snails attack young forage crops.
Reptilia.....	None.
Amphibia	None.
Birds	The seed of grass, clover, etc., is eaten by sparrows and finches.
Mammalia.....	Moles cause annoyance in pastures by throwing up hills; gophers in America; voles and rabbits.

Survey of Sub-section (ϵ) of Section I.

ANIMALS INJURIOUS TO FRUIT AND FRUIT TREES.

Protozoa to Chætopoda	None.
Crustacea	Woodlice damage soft fruits (<i>Oniscus</i> , <i>Asellus</i>).
Arachnida	Various mites (red spider, <i>Tetranychus</i> and <i>Bryobia</i>) damage the leafage.
Hexapoda	Hosts of insects attack fruit—codling moth, woolly aphid, San José scale, pear midge, mussel scale, bark beetles, plum curculio, fruit flies (<i>Ceratitis</i>), phylloxera. Leafage, fruit, stem and roots are all subject to insect ravages in all parts of the world.
Chilopoda	None.
Diplopoda	Some millipedes (<i>Julidæ</i>) damage soft fruits.
Mollusca	Slugs and snails damage soft fruits on the ground.

Amphibians and Reptilia	None.
Birds	Many frugivorous birds, hornbills (<i>Bucerotidae</i>), trogons (<i>Trogonidae</i>), cockatoos and parrots (<i>Psittacidae</i>) <i>moluccensis</i>), depredate whole fields of fruit, in Moluccas; ring parrot (<i>Palauornis torquatus</i>), in Africa and India, grey parrot (<i>Psittacus erithacus</i>) in Africa, do much harm in fruit plantations; others do so now and then; starlings (<i>Sturnus</i>), thrushes (<i>Turdidae</i>), toucans (<i>Rhamphastidae</i>); other birds damage twigs, etc. (plant cutters, <i>Phytotomidae</i>).
Mammalia.....	Rabbits and hares damage young trees by biting the bark: squirrels take nuts and soft fruit, and some fruit bats (<i>Pteropus poliocephalus</i> , <i>P. Kerandrenii</i>), and others do much harm abroad.

Survey of Sub-section (ζ) of Section I.

ANIMALS INJURIOUS TO HOPS.

Protozoa to Nemertina ..	None.
Nematoda	Eel-worms (<i>Heterodera</i>), produce disease.
Crustacea	Woodlice (<i>Armadillidium</i> and <i>Ascellus</i>).
Arachnida	Red spiders (<i>Tetranychus telarius</i>).
Chilopoda	None.
Diplopoda	Millepedes (<i>Julidae</i>) damage the roots.
Hexapoda	Many insects attack root, leaves and stem— <i>Aphis</i> , flea beetle (<i>Haltica concinna</i>), wire-worm (<i>Agriotes lineatus</i>), hop-dogs (<i>D. pudibunda</i>), shy-bugs (<i>Calocoris fulvomaculatus</i>).
Mollusca	Occasionally snails (<i>Helix</i>).
Reptilia and Amphibia ..	None.
Birds	Some birds, as linnets, damage the cones.
Mammals	Rabbits and hares attack the bine.

Survey of Sub-section (η) of Section I.

ANIMALS INJURIOUS TO TEA.

Protozoa to Chaetopoda ..	None.
Crustacea	Land crabs in India.
Arachnida	Red tea mite (<i>Tetranychus biaculatus</i>); fire-legged tea mite (<i>Typhlodromus carinatus</i>); yellow tea mite (<i>Icarus translucens</i>); pink mite (<i>Phytoptus theae</i>).
Hexapoda	Red borer (<i>Zenzeria coffee</i>); black grub (<i>Agrotis suffusa</i>); faggot worm (<i>Eumeta carmeri</i>); tea scale (<i>Ispidiotus theae</i>); tea aphis (<i>Ceylonia theacola</i>); white ants (<i>Termites taprobanes</i>); tea mosquito or tea bug (<i>Heliopeplus theivora</i>), and others.
Chilopoda and Diplopoda	None.
Mollusca	Snails and slugs do much harm (<i>Helicinus bilineatus</i> and others).
Reptilia and Amphibia ..	None.
Birds	None.
Mammals	Wild elephants do much harm in tea plantations; also stray cattle, hares and land rats.

Survey of Sub-section (θ) of Section I.

ANIMALS INJURIOUS TO COFFEE.

Protozoa to Crustacea ..	None.
Arachnida	None recorded, but probably several occur on coffee leaves.

XXX First Report on Economic Zoology.

Hexapoda	Coffee scales (<i>Lecanium caffæ</i> , <i>Aspidiotus articulatus</i>); mealy bug (<i>Dactylobius destructor</i>); coffee moth (<i>Heliothis armigera</i>); coffee miner (<i>Gracillaria coffeifoliella</i>); also <i>Oryzia Ceylonica</i> , <i>Zeuzera coffæ</i> , and others.
Chilopoda and Diplopoda	None.
Mollusca.....	Probably snails and slugs.
Reptilia and Amphibia ...	None.
Birds	None.
Mammals	The same as section (η).

Survey of Sub-section (i) of Section I.

ANIMALS INJURIOUS TO SUGAR-CANES.

Protozoa to Nemertina ...	None.
Nematoda	Several damage sugar cane (<i>Heterodera sacchari</i> , <i>Tylenchus sacchari</i> , and others).
Arachnida	Numerous mites damage leafage and stems (<i>Histiostoma rostroserratus</i> , <i>Tarsonymus Bancroftii</i>).
Hexapoda	Sugar-cane borers (<i>Diatraea saccharalis</i>); tropical sugar-cane borer (<i>Chilo saccharalis</i>); pin borers (<i>Xyleborus piceus</i> and <i>X. perforans</i> ; Sandwich Island borers (<i>Sphenophorus obscurus</i>); white grub of Queensland (<i>Lepidiota squamulata</i>); sugar scale (<i>Aspidiotus sacchari</i>).
Chilopoda and Diplopoda	None.
Mollusca.....	None.
Reptilia and Amphibia ...	None.
Mammalia.....	Rats and stray domestic stock.

SURVEY OF SECTION II., SUB-GROUP B.

ANIMALS INJURIOUS TO HORTICULTURE.

The number and variety of plants cultivated in the garden is so great and so varied that it is not possible to sub-divide them in detail. For our purpose we may, however, divide them into two sub-sections in connection with their animal enemies :—

- (a) The animals injurious to culinary plants.
- (β) The animals injurious to ornamental plants.

Sub-section (a) of Section II.

ANIMALS INJURIOUS TO CULINARY PLANTS.

Protozoa to Nemertina ...	None.
Nematoda	Various eel-worms (<i>Tylenchus</i> , <i>Heterodera</i>). (Tomato root disease).
Chætopoda	<i>Enchytraeus</i> and a few others damage roots.
Crustacea	Land isopods (<i>Oniscus</i> , etc.) attack roots and seedlings.
Arachnida	Red spiders and various acari damage leaves.
Hexapoda	Most groups of insects attack vegetables—onion fly (<i>Phobia cepetorum</i>), cut-worms (<i>Noctuæ</i>), thrips, aphids, leather jackets (<i>Tipulidæ</i>).
Chilopoda	None.
Diplopoda	Millepedes attack various roots (<i>Julus</i> , <i>Polydesmus</i> , etc.).
Mollusca	Snails and slugs attack delicate leaves.
Amphibians	None.
Reptiles	None.
Birds	Several finches, the sparrow, and other small birds, as long-tailed tits, take seeds, buds, and fruit.
Mammals	Mice, rats, voles, skunks, and others do damage in gardens.

Sub-section (β) of Section II.

ANIMALS INJURIOUS TO ORNAMENTAL PLANTS.

Protozoa to Nematoda ... None.	
Chelopoda Earthworms often do harm to potted plants.	
Copepoda Land isopods are destructive, especially under glass.	
Arachnida Many acari cause harm (<i>Tetranychus</i> , <i>Bryobia</i>). ¹	
Hexapoda Most orders of insects are injurious (carnation maggot, narcissus fly (<i>Merodon equestris</i>), scales (<i>Chionaspis rosae</i> , <i>Lecanium oleae</i>), thrips (<i>Thripidae</i>), mealy bug (<i>Dactylopius</i>), rose sawflies (<i>Hylotoma rosae</i> , <i>Blennocampa pusilla</i>)).	
Chilopoda None.	
Diplopoda Millipedes (<i>Julidae</i>) often attack ornamental plants, especially bulbs.	
Mollusca Snails and slugs (<i>Helicidae</i> and <i>Limacidae</i>).	
Amphibia and Reptilia ... None.	
Birds Small birds take plant seeds (finches, sparrows), also damage the blossoms.	
Mammals Moles, rabbits, mice, voles, and rats all do harm amongst ornamental plants.	

SURVEY OF SECTION III., SUB-GROUP B.

ANIMALS INJURIOUS TO FORESTRY.

The animal pests of forestry may be best treated in detail under smaller sections dealing with allied groups of trees; i.e., animals injurious to (A) Pines; (B) Oak; (C) Willows, etc., but for our purpose here no division need be made.

There are no enemies amongst the lower groups of invertebrates until we come to the—

Arachnida	A few attack the leaves of trees (<i>Tetranychus</i>).
Hexapoda	Most orders occur on forest trees—wood borers, as wood wasps (<i>Sirex</i>), goat moth (<i>Cossus</i>); leaf eaters, gypsy moth (<i>Lymantria</i>), tree caterpillars (<i>Cladonotata</i>); bark beetles (<i>Tomicus</i> , <i>Pissodes</i>).
Chilopoda and Dilopoda... None.	
Mollusca	None.
Reptilia and Amphibia ... None.	
Birds	Woodpeckers and others damage the trunks, and others (crossbills, <i>Loxia</i>) take cones and seeds. Capercaillie and other grouse damage buds and young growths.
Mammals	Many mammals do harm by barking trees (deer, rabbits, mice, voles, hares).

SUB-GROUPS C AND D OF GROUP E.

It is difficult to enumerate the members of these two sub-groups. Numerous parasitic worms attack wild rabbits, big game, and game birds. Mange mites and ticks attack the fox and other animals. Birds destroy the useful earth-worms. The schedules adopted by the International Conference for the Preservation of Wild Animals in Africa may be referred to as giving some indications on the subject. In Sub-group D we find numerous insects damaging such wild plants as rushes, croci, the cranberry, pepper plants, and familiar forest trees already considered.

G R O U P F.

Animals which concern Man as being destructive to his worked-up Products of Art and Industry, such as (A) his various Works, Buildings and larger Constructions and Habitations; (B) his Furniture and Books, Drapery and Clothing; (C) Food and Clothes.

The numerous animal pests coming in this group do not all confine their attacks to one sub-group only, but they will be dealt with under the heading of that sub-group in which they occasion most damage. A large number of these pests are cosmopolitan, having been distributed chiefly by artificial agencies (*i.e.*, Corn Weevils, Cockroaches, Rats). Others have a wide distribution from natural agencies, such as ocean currents (Teredo worms).

SURVEY OF SUB-GROUP A OF GROUP F.

ANIMALS DESTRUCTIVE TO MAN'S BUILDINGS AND LARGER CONSTRUCTIONS AND HABITATIONS.

Protozoa to Chætopoda	None.
Crustacea	<i>Limnoria terebrans</i> and <i>lignorum</i> , and others do damage to marine works and shipping.
Arachnida	None.
Hexapoda	Numerous insects destroy the woodwork of bridges, telegraph poles, etc., such as <i>Termites</i> or white ants; carpenter bees (<i>Xylocopa</i>); death watch beetles (<i>Anobium</i>); ants (<i>Formicidæ</i>).
Chilopoda and Diplopoda	None.
Mollusca	Teredo worms damage marine works by boring into the wood; <i>Dreissena</i> by entering water pipes; <i>Saxicava</i> burrow into stone piers.
Tunicata	None.
Fishes.....	None.
Birds	Birds do damage and cause annoyance by building in chimney stacks (sparrows, storks) and by destroying mortar in buildings (pigeons). Woodpeckers damage telegraph poles in Germany.
Mammals	Burrowing animals may undermine man's buildings and habitations (rabbits, rats, mice), and dam-forming animals (beavers), by causing floods, may damage bridges; otters, voles, by burrowing, damage canal and river banks.

SURVEY OF SUB-GROUP B.

ANIMALS INJURIOUS TO FURNITURE, BOOKS, DRAPERY AND CLOTHING.

Protozoa to Crustacea.....	None.
Arachnida	Acari (<i>Glyciphagus</i>) spoil furniture and are obnoxious.
Hexapoda	<i>Termites</i> or white ants; wood-boring beetles (<i>Xylobium</i> and <i>Anobium</i>); leaf-cutting bees (<i>Megachile</i>); clothes moths (<i>Tinea</i>); <i>Dermestes</i> beetles attack soft goods; cockroaches (<i>Blattidae</i>) attack boots, also <i>Anobium</i> ;

Hexopoda—continued.....	Books and papers damaged by book-worms (<i>Ampelus divinatoria</i>) and by Chelifers or tailless scorpions in India, also by <i>Lepisma</i> . Clothing also damaged in India by <i>Anthrenus vorax</i> .
Chilopoda and Diplopoda	None.
Tunicata to Birds	None.
Mammalia.....	Mice and rats (occasionally).

SURVEY OF SUB-GROUP C.

ANIMALS INJURIOUS TO MAN'S FOOD AND OTHER STORES.

Protozoa to Crustacea.....	None.
Acarina	A few acari attack food—household mites (<i>Glyciphagus</i>); cheese mites (<i>Tyroglyphus</i>); sugar mites (<i>Glyciphagus</i>).
Hexapoda	Numerous insects attack man's food and other stores, both dry goods and fresh—corn weevils (<i>Calandra</i>); bacon beetles (<i>Dermestes</i>); cheese fly (<i>Piophila</i>); blow flies (<i>Calliphora</i>); cockroaches (<i>Blattidae</i>); cigar beetles (<i>Lasioderma</i>); drug beetle (<i>Anobium panicum</i>); death-watch (<i>Atropos divinatoria</i>); silver fish (<i>Lepisma</i>).
Chilopoda and Diplopoda	None.
Mollusca	Slugs attack corks.
Tunicata to Birds.....	None.
Mammals	Rats and Mice.

GROUP G.

Animals which are known as "Beneficials" on account of their being destructive of or checking the increase of the injurious Animals classed under Groups D, E, and F.

The animals falling in this group, spoken of as a rule as "natural enemies," are best treated in connection with the pests enumerated in the groups D, E and F. They may be beneficial, either by (i) being predaceous, or (ii) being parasitic upon the pests of crops, animals, and man.

SURVEY OF GROUP G.

Protozoa	None.
Porifera to Echinodermata	None.
Platyhelminia	Parasitic cestodes help to keep down certain noxious birds and mammals (rabbits, sparrows, and others).
Nemertina.....	None.
Nematoda	Act the same as Platyhelminia.
Crustacea	None?
Arachnida	Spiders by destroying noxious insects; mites (<i>Dermanyssus</i>) by being parasitic on destructive birds.
Hexapoda	Many insects prey upon other insect pests. Hover flies (<i>Syrphidae</i>) and lace-wing flies (<i>Hemerobiidae</i>) feed upon Aphides, dragon flies (<i>Odonata</i>) upon mosquitoes, butterflies, etc.; carnivorous ground beetles (<i>Carabidae</i> , etc.), lady birds (<i>Coccinellidae</i>) upon Aphides and scale insects.

xxxiv *First Report on Economic Zoology.*

Chilopoda	Most centipedes kill noxious ground insects and molluscs.
Diplopoda.....	None.
Tunicata	None.
Fishes.....	Many fish prey upon mosquito larvæ—carp, etc.
Amphibia	Frogs and toads especially, by devouring insects and slugs.
Reptilia	Snakes destroy insects, rats, mice, and other noxious animals (fer de lance, grass snake, rat or corn snake).
Birds	All insectivorous birds and some birds of prey (warblers, swallows, starlings, rooks, kestrel hawk, owls. Starlings (<i>Sturnus</i>) devour ticks on sheep; <i>Buphaga</i> or ox-peckers the ticks on oxen in S. Africa*).
Mammals	Many mammals are beneficial (moles, skunk, hedgehogs, fox, shrews, various insect-eating bats (<i>Vespertilionidæ</i>) and others).

* The Oxpeckers do some harm as well, for when no ticks are present on the ox or sheep they will wound the back of the animal, pecking deeply into the flesh.

E. RAY LANKESTER.

PART I.

REPORTS ON ECONOMIC ZOOLOGY

TO THE

BOARD OF AGRICULTURE.

FIRST REPORT ON ECONOMIC ZOOLOGY.

GROUP E.

Animals which concern Man by causing bodily injury or disease, both possibly of a deadly character, to (A) his stock of Domesticated Animals, (B) his Vegetable Plantations, or (C) to Wild Animals in the preservation of which he is interested, or (D) Wild Plants in the preservation of which he is interested.

SUB-GROUP E. ANIMALS WHICH CAUSE INJURY AND DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION I.

ANIMALS INJURIOUS TO AGRICULTURE.

CEREAL PESTS.

Eel-worm Disease in Oats.

SOME oat plants, sent by a correspondent of the Board from South Tawton, Devon, from a field that was seriously damaged, were found to be attacked by eel-worms (*Tylenchus derastatric*, Kuhn). The popular names for the disease these eel-worms cause are "tulip-root" and "segging." This disease takes its name from the swollen appearance of the base of the stem. This swollen basal part is surrounded in most cases with contorted shoots of a pale unhealthy hue. The minute eel-worms are found in abundance amongst the deformed shoots and in the stem (at its base). This species of eel-worm attacks chiefly oats, rye, clover, onions, turnips, but also occurs in wheat, buckwheat, and various wild grasses, as sweet-

scented vernal and annual meadow-grass; it is also found in daisies, buttercups, and plantains. Teasels and hyacinths also harbour it, according to Ritzema Bos. It appears that barley and carrots are free from its attack.

Part of their life is spent in the soil, and they can then be successfully treated as mentioned below.

PREVENTION AND TREATMENT.

1. Deep ploughing in autumn; the depth should be eighteen inches. By this treatment the layer of earth that contains the eel-worms is buried, and so they are put out of the way of the next crop. Ploughing at a less depth does good if a skim coulter is attached, but the deeper the land is ploughed the better.

2. On eel-worm land avoid crops in rotation that are attacked, and use those that are not—*i.e.* barley. Clover after “tulip-root” must carefully be avoided.

3. Sulphate of potash on a diseased field does good at about the rate of 1 cwt. to the acre.

There is not the least doubt that by late autumnal deep ploughing, by judicious rotation, and by the use of certain artificial manures, the pest can be easily fought with success. It is also said that stable manure should be avoided.

There was also a single puparium of the Frit Fly (*Oscinis frit*) found in one plant from this district.

The Frit Fly on Oats.

(*Oscinis frit*, L.)

Oat plants sent to the Board of Agriculture from the sewage farm of the Croydon Corporation were being destroyed by a small dipteron, which has done a great deal of damage to the oat and barley crops in the south of England. This small fly is the so-called Frit Fly, the *Oscinis frit* of Linnaeus, the *Oscinis vastator* of Curtis.

The larvæ of the *Oscinis* feed just inside the crown of the plant, and in the majority of cases destroy it; but when they feed between the outer leaves, as they often seem to do, the crop may survive.

Crops that look irreparably damaged often tiller out and produce a moderate yield. This year (1902) the pest has been very harmful. The flies were nearly all hatched out by June, but some sent in the sample of oat plants from Croydon were only just entering the pupal stage. The second brood probably lays its eggs on the

developing grain. In Sweden this second attack is often harmful, producing light shrivelled samples of corn (frits).

Little or nothing can be done when a crop is badly attacked, as the one reported from Croydon. Moreover, the damage is now (June) done, and the second brood cannot be materially lessened, even by ploughing up the crop, as they are hatching out rapidly.

One feature has been noticed in districts where *Oscinis* frit is abundant, namely, that early sown crops suffer the least. Oats sown 29th of March were not attacked; those sown on 29th of April had over 70 per cent. of the stems attacked.

Where a field is irreparably damaged it is as well to deeply plough it up at once, so as to bury the puparia of the fly and thus prevent the second and summer brood, that cannot be so easily destroyed, from appearing.

When early signs of the crop being attacked are noticed, the loss may be materially lessened by the timely application of some stimulating dressing such as nitrate of soda.

Smut in Barley and Insects.

The barley sent by a correspondent of the Board from Brackley, Northamptonshire, was found to be suffering from the fungoid disease called Loose Smut (*Ustilago nuda*, Jensenii).

Two methods of treatment are known for Smuts: (1) the "blue-stone" treatment and (2) the "hot water" treatment. The former does well for covered smut (*Ustilago jensenii*, Rostr.), but has little effect on Loose Smut.

The "hot water" treatment consists of soaking the grain for five minutes in hot water heated to 126° F.

The grain should be warmed just before by putting it in a sack and steeping it for a few minutes in water of 120° F. After the grain has been five minutes in the hot water, 126° F., it should be taken out and plunged right away into cold water and then spread out to dry.

Some Clavicorn Beetles of the genus *Phalaenus* of Paykull were found in the diseased ears. They apparently feed upon the spores of the Smut fungus, but at the same time they no doubt help to distribute this fungoid disease, for they are often seen covered with the spores, amongst which they crawl during feeding time. The remedy of this combined attack lies in treatment of the seed; no steps need be taken in regard to the insects.

ROOT CROP PESTS.

Silpha rugosa, L., on Turnips, and other Silphidæ.

One of the Carrion Beetles, *Silpha rugosa*, L., closely related to the Beet Carrion Beetles (*Silpha opaca* and *S. atrata*), sent to the Board, was appearing in great numbers on a turnip crop. Both of the latter species are injurious to mangolds, the larvae devour the leaves and stem and often destroy a crop entirely. *Silpha rugosa* occurs with them nearly always and is probably the commonest member of the genus, being found almost everywhere, but there have been no observations made on this species showing that it does any harm to crops, such as occurs with the two closely related Carrion Beetles.

The larvae of the Silphidæ and also the adults are normally carrion feeders. Numbers of these three species may usually be found in June in and under any dead carcase laying about in the fields, but as previously stated the two species *S. opaca* and *S. atrata* frequently give up their carnivorous habits and attack mangolds and beetroots. Canon Fowler also records finding the larvae of a member of this genus on the roots of plants in the Isle of Wight. It is, therefore, possible that *S. rugosa* may sometimes become vegetarian in habit, but no mention has been made of this, nor does the Board correspondent make any such statement.

The larvae of *S. rugosa* are moderately broad with the edges of the thoracic (i.e. first three) segments rounded, those of the remaining segments projecting. The body ends in two processes called cerci, which in this species are long, at least three times as long as the anal process between them; the head is large and projecting.

When full grown, which is usually by the middle, but sometimes not until the end, of July, they bury themselves in the soil to a depth of from three to four inches and turn to pupæ.

After from three to four weeks beetles appear from these pupæ, and these beetles apparently live through the winter.

Miss Ormerod records the Beet Carrion Beetle (*S. opaca*) on potato and also as devouring the Spurrey (*Spergula arvensis*), and it is thus possible that we may get *S. rugosa* working in a similar manner on various plants and not on any one in particular.

As there is a possibility of these carrion beetles becoming destructive, steps should be taken to have the turnip and other fields cleared of them and any of their larvae. To do this is a comparatively easy matter if we employ natural traps in the form of dead

birds or small mammals, scattered over the ground every here and there. The dead bodies attract the beetles and the larva, which can be shaken out into pails of hot lime and so destroyed.

Caterpillars (*Surface larva*) on Turnips, etc.

The Turnip or Dart Moth (*Agrotis segetis*) and the Heart and Dart Moth (*A. exclamationis*).

Some larvae attacking turnips and potatoes, sent by a correspondent of the Board of Agriculture, were the caterpillars of the Heart and Dart Moth (*Agrotis exclamationis*), popularly called Surface Larvae—Cutworms in Canada and the United States. Two species occur in abundance, viz., *A. exclamationis* and *A. segetis*; the latter is called the Turnip Moth.

Another correspondent, writing from Dadlington, Nuneaton, states "that turnips are eaten off and potatoes burrowed into. In this district acres are spoilt by eating the turnips under the ground."

These caterpillars were also sent by a correspondent from Loughborough, where they were attacking mangold.

There has been a serious outbreak of these pests during the present year in all parts of England and Wales.

A leaflet (No. 33) has been issued by the Board on these pests under the title of "Surface Caterpillars." To this leaflet the following information should be added:—

(a) No dressings can be applied in sufficient strength to kill these caterpillars as recommended, but the dressings do good in helping on growth of the plant.

(b) Land after mangolds had best be lightly broken up, not deeply ploughed; this would bury, not expose, the larvae, and birds are the greatest help in keeping them in check.

(c) In land invaded by Cutworms, a crop of mustard ploughed in has done good.

(d) The long and exhaustive series of experiments, conducted at the Agricultural Experimental Station of Cornell University, have shown that by far the most successful way of combating these pests is the employment of "poison-baits." These "poison-baits" have been employed in the field by soaking clover, lucern, etc., in a solution of Paris green and throwing little heaps of it about in the field amongst the roots, etc., or, in the case of garden cultivation, bran soaked in Paris green may be used.

When clover, etc., is employed the solution of Paris green in

which it is dipped should be one pound of Paris green to fifty gallons of water.

For bran bait use 1 lb. of Paris green to 25 lbs. of wheat bran, and mix with just enough water to make a mash.

Of course it should not be placed where poultry go or sheep or other stock feed.

In mangold fields the clover bait might be tried where the attack is very bad.

The fresher the clover the better the results would be. The baits should be placed on the ground late in the afternoon.

The green-stuff might be sprayed with the Paris green before being cut—so as to save the trouble of dipping it.

The Pigmy Mangold Beetle.

(*Atomaria linearis*, Stephens.)

Some beetles sent by a correspondent of the Board from Barnstaple that were destroying his mangolds proved to be the Pigmy Mangold Beetle (*Atomaria linearis*). A similar attack was reported to Wye College by Mr. Thos. Powell. In this case the beetles had destroyed a field of mangolds on the Waldershare estate. Miss Ormerod has recorded damage to mangolds by an *Atomaria* which she identified as *linearis*, Stephens.

As far as is known, these little beetles (Fig. 1, d) destroy the sprout of the mangold seed just as it germinates, and later they attack both root and the leaves.

The leaves are gnawed away and gradually die (Fig. 1, c); they also gnaw away the lower parts of the leaf stalks below the ground level and so kill the plants. The tap root is attacked, the damaged part turning black (Fig. 1, b). It thus seems that all parts of the plants suffer in the young stages and during germination. The beetles may be found in great numbers on the ground under clods of earth, on the leaves and in the earth around the roots. They appear in May and June and seem to decrease in July and August, those occurring in the last two months apparently being a second brood. Nothing is known of its life-history, but apparently the larvæ feed below ground, probably on the roots of the plants.

This attack was first observed in 1839 by M. Bazin at Mesnil St. Firmin, and later Macquart noticed this pest devouring the fields of red beet in the environs of Lille to such an extent that whole crops were ploughed up. It occurs in Great Britain in many districts in great numbers and does much harm; it is not noticed on accoun

of its small size. It seriously injured the mangold crop at Cirencester in 1891; it is also recorded as damaging mangolds at Lyminster, Ashburton (Devon), Weston-super-Mare, Shifnal (Shropshire), Denham (Bucks); and it has been abundant this year in the neighbourhood of Wye, Kent. The beetles may be noticed on the wing, pairing on warm evenings. They probably hibernate in the adult stage.

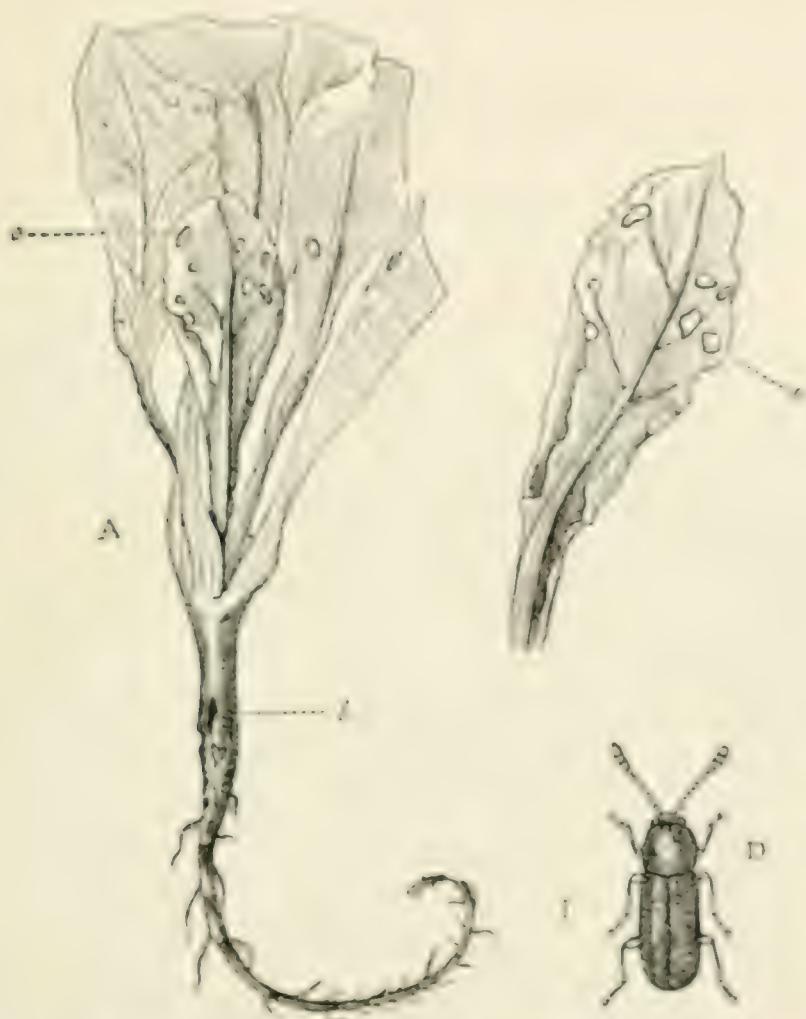


FIG. 1.—THE PIGMY BEETLE (*Atemaria linearis*).

A, damaged plant; B, damaged tap root; C, holes eaten in leaves; D, adult.

The best way of destroying this pest would be to run a Strawsoniser over the field with ordinary Paris green wash in July, when the beetles seem to feed mainly on the young seed leaves.

If the crop is destroyed as is the case with this outbreak at Barnstaple, deep ploughing would be advisable.

In districts on the Continent where this beetle is a serious pest to sugar-beet, thick sowing of seed is practised and would be worth

doing in the case of mangolds in this country in districts where the beetle occurs in large numbers.

If the land is in good heart maize may be put in in the place of the mangolds that have been destroyed. The beetles would probably leave this plant alone, if they are not all destroyed by deep ploughing.

This is not an uncommon pest, but is not reported very often on account of the damage being attributed to other causes, such as ants, etc., the beetles, owing to their small size, being either not observed or if observed mistaken for ants.

Black Fly on Mangold.

(*Aphis atriplicis*, Linn.)

Some insects attacking the seed heads of the mangold were sent to the Board of Agriculture from Childerley Hall, Cambridge; they were one of the Aphides known as *Aphis atriplicis*, Linn. This species feeds normally on the Chenopodiums in the summer and on the common Orache (*Atriplex patula*) in the autumn.

The apterous females are of various colours, green, olive green, black. Buckton describes four distinct varieties: (1) wholly black, (2) black with orange tibiæ and white patches on the body, (3) body green with white bands, legs ochreous or whitish, (4) head and thorax black, abdomen green with white spots. The pupal stage is black with white patches, thorax and wing cases olive. The winged female that produces living young is dark olive, the abdomen barred with black and with lateral spots; the honey tubes are green at the base and black at the apex; the legs are yellowish except the hind femora and tips of the other femora. The male is wingless and of a greenish-yellow colour, head black, thorax with black markings; the abdomen has three longitudinal rows of black spots forming almost bands on the apical part. Legs, and cornicles dull grey.

The oviparous female is also apterous and green, the head having two dark spots.

THE LIFE-HISTORY.

Little is known concerning its life-history. The females of the last generation lay their eggs on the dead rolled up leaves of the plants upon which they have been feeding, amongst their débris formed of cast skins, frass, etc. The ova are elongated oval, yellow at first, and gradually become black. These eggs are laid in the autumn after the apterous males have appeared and fertilised the

females. How the winter is passed is not known. In the early and late summer they feed upon wild *Chenopodiums* and mangolds and in the autumn on *Atriplex latifolia*.

Not only does this aphid cause the leaves to roll up longitudinally, but they also feed upon the seed heads of the mangold.

Spraying with paraffin emulsion or quassia wash would check their increase and clear most of them off. This, of course, should not be done when the sun is out.

Flies (Bibionidae) on Mangolds.

Some flies were sent by a correspondent from Billericay of the dipterous family—Bibionidae, species *Bibio hortulanus*—from a field of mangolds cleared off in one night.

These flies can have had nothing to do with the two acres of mangold reported to have been destroyed.

Although their larvae are more or less injurious to roots, the adult flies do no harm, not having a biting or piercing mouth.

The damage reported seems to point to the small beetle recently sent to the Board from North Devon—the Pigmy Mangold Beetle (*Atomaria lincoris*), which is evidently abundant in some parts.

The correspondent was advised to look for these small beetles, which may be most easily caught by pulling up the young mangolds and the earth round them, when the beetles fall out of the soil. On fine days they occur above ground as well (*vide* page 8).

In any case the flies sent cannot have damaged the mangolds in the way reported.

Muscid Larvæ attacking Roots.

A correspondent of the Board of Agriculture sent from Burley Beacon, Ringwood, Hants, two different kinds of larvæ attacking roots of plants.

(1) A dipterous maggot changed during transit into the so-called chrysalis or puparium stage of one of the flies belonging to the group *Anthomyidae*. There are several of these diptera which are root-feeders in their maggot stage. Probably the one sent was *Anthomyia radicum*, L.

(2) Three small larvæ which were the caterpillars of one of the Tineæ.

The damage was probably all caused by the *Anthomyia* larvæ, which are often serious root pests.

TREATMENT.

Soot and lime have been found of some benefit. The chief thing to do, however, is to treat the land with gas-lime during the autumn and winter to kill the hibernating insects, then in the puparium stage in the soil, and so prevent their doing damage another year.

On the Continent some good is said to have been done by applying superphosphate of lime as a preventative.

Treatment with gas-lime is the only certain way of lessening these pests on a large scale.

The three small caterpillars were probably non-injurious.

Chafer Larvæ.

(*Melolonthidæ.*)

Several enquiries have been made at the Board of Agriculture during the past summer concerning Chafer larvæ, the so-called White Grubs. From Ferryside, South Wales, the grubs of the Garden Chafer or Cock-y-bondu (*Phyllopertha horticola*, L.) were sent on June 20th. They were reported as Antler Moth caterpillars (*Charæas graminis*, L.). The Cock-y-bondu is apparently the common Welsh chafer, for nearly all the larvæ examined have proved to be this species; the attack seems to have been fairly general in Wales this year. The Summer Chafer (*Rhizotrogus solstitialis*, L.) has also done much damage in many parts of Great Britain. From Launceston they were especially reported as damaging pasture land, also from Wye.

By far the most abundant species, however, has been the Cock-chafer (*Melolontha vulgaris*, Fabr.), which has occurred this summer in large numbers in the following localities: Wetherby, York, Chester, Lytham, Southwell, Pewsey, Roydon, Limpsfield, Croydon, Tooting, Highgate, St. Leonards, Catford and Wye.

The brood appeared from the first to the third week in June. The Summer Chafer (*R. solstitialis*) has occurred as adults at Wye, the brood occurring from the third week in July to the end of August. In districts where these broods are recorded we shall now know when to expect the next brood of beetles and so be prepared to take steps to collect them wholesale as soon as they appear. In this way only can any real good be done in districts where these Chafer larvæ are harmful. Full information regarding these pests is given in the revised leaflet No. 25 of the Board.

Leather-Jackets or Larvæ of *Tipulidae*.

The insects sent to the Board of Agriculture by a correspondent from Eaton, Norwich, that had been damaging the roots of grass proved to be the pupæ of one of the Daddy Long Legs (*Tipulidae*). The larvæ of these *Tipulidae* are known as "leather-jackets," and are very destructive to all kinds of roots, especially grass. Pasture land is often ruined by them.

They were those of the Yellow Spotted Crane Fly (*Pachyrhina maculosa*), whose larvæ work in a very similar way to those of the Common Crane Fly (*Tipula oleracea*). The pupæ of the latter are larger than those of the former.

(A full report on these pests is given on pages 94 to 104).

PULSE PESTS.

The Green Rose Chafer (*Cetonia aurata*, Linn.) on Beans and Currant Bushes.

The Green Rose Chafer (*Cetonia aurata*) was sent to the Board from Gloucester, with a note that they were appearing in great quantities and were stripping the beans and currant bushes of their leaves.

This beetle is generally distributed in the South of England and occurs in plenty in the Midlands, but becomes rarer in the North. It is usually very common at Gloucester, so that it is not surprising that it now and then occurs in such numbers as to become a serious pest. The beetle attacks all kinds of flowers and also the leaves; it is especially injurious to the rose, apple and strawberry. It is also recorded as damaging turnips for seed. When attacking blossoms the beetles seem to mainly devour the anthers and thus destroy the crop. They are very frequently found in Peonies and on the Elder; they also destroy Iris blossom at times. These brilliant beetles fly readily in bright sunshine, but become very sluggish during dull, damp, and cold weather.

LIFE-HISTORY.

The beetles appear from the middle of May on through June. They lay their eggs in the ground, seeking out some crack or crevice into which they crawl. Heaps of rich earth such as cucumber beds and vine borders are favourite places for them to lay their eggs. These soon give rise to white grubs very like those of the Cockchafer,

but which can easily be told by having a deep reddish-brown spot on each side of the first thoracic segment; the legs are also longer than in the Cockchafer grub, and the whole surface is clothed with transverse rows of reddish-brown hairs. The larvae may also be found amongst rotten and rotting wood, but mainly in rich soil; their food consists chiefly of the roots of various plants and probably of decaying vegetable matter as well. When full grown they attain the length of an inch and a half, taking from two to three years to reach maturity. The pupal stage takes place in an earthen cell over an inch in length formed deep in the ground; the outer part of the cell is rough, the inner surface smooth. The pupa is of an ochre colour.

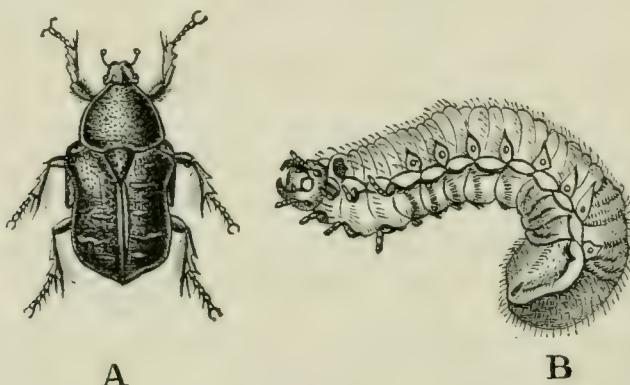


FIG. 2.
THE GREEN ROSE CHAFER (*Cetonia aurata*).
A, Imago; B, Larva.

The grubs apparently pupate in the summer, and the beetles appear from these in the following May and June. Canon Fowler notes that the little larvae and perfect insects are often found in ants' nests.

REMEDIES.

By far the most successful way to cope with these large sluggish beetles is by "hand-picking." This should be done during dull weather when they are very quiet, as on warm days they become more active and fly about.

Heaps of leaf mould, cucumber beds, and heaps of decaying wood should be examined when turned over or moved and the grubs hand-picked. Old tree stumps frequently harbour them and should thus be grubbed up in the winter and burnt. In garden and field cultivation poultry do much good if turned on to the land when it is being broken up, for they greedily devour these larvae as well as those of the Cockchafer.

"Turf-traps," i.e. heaps of rotting turf, may be left here and

there about in the garden to attract any stray beetles to deposit their eggs; these heaps can be examined in the winter and all the grubs burnt.

POTATO PESTS.

Myriapoda in Potatoes.

Numbers of centipedes and some millepedes were sent to the Board from Honiton with a note to the effect that they (the centipedes) were destroying the potato crop in that neighbourhood.

The *Scolopendridæ* were mostly alive in a small tin box, but several had been killed by the stronger ones in the box.

These Scolopendridæ are certainly carnivorous and do not seem to be destructive to roots, although Curtis mentions such a habit, quoting the following from a correspondent: "Mr. Hope attributed the potato disease to the attacks of wire-worms, and also to a small *Scolopendra* which was found in myriads infesting diseased potatoes at Southend."

In all cases where these myriapods are sent as the culprits other pests will be found on careful examination. In the box sent from Honiton were also the remains of some small *Julidæ* which have undoubtedly been the cause of the trouble. The large centipedes sent had probably been feeding off these *Julidæ* and other animals in the soil.

With regard to destroying the *Julidæ*, nothing further can be added to the information given on pages 86 and 105.

Wire-worm (*Lacon murinus*, L.) in Potatoes.

An insect sent to the Board in a potato from Barley, near Burnley, proved to be the larva of one of the Elateridæ or Click Beetles, i.e., a wire-worm—*Lacon murinus*.

There is unfortunately no remedy when wire-worm get into the potato crop. The field should be deeply trenched later on and a crop of mustard grown afterwards. Sometimes wire-worm will leave potatoes for wurzel and carrot, so that slices of either, if procurable, might be put here and there along the rows just under the ground and examined every few days, or rape cake may be spread between the rows, as this class of larvae are very fond of this as food, and would probably be drawn away from the plants.

(Mr. Deadman, of Wye, finds that beet-root forms a much more attractive bait than any other root for catching these pests.)

A New Potato Feeder: The Cinnabar Moth (*Euchelia jacobæa*).

During the past year quite a number of new potato pests have appeared. Amongst them may be mentioned the caterpillars of the Cinnabar Moth (*Euchelia jacobæa*), sent by a correspondent of the Board from Alton, Hampshire. This moth is fairly common. The front wings when expanded measure from an inch and a half to an inch and three-quarters across; they are dull black with a narrow red stripe near the upper margin and two spots on the outer margin of the same colour; the hind wings are scarlet red with a narrow dull black margin. The moth appears in May and June and flies slowly during the day-time. The caterpillars feed usually on the Ragwort (*Senecio jacobæa*), and sometimes, as stated by the Board's correspondent, on the Groundsel. As far as can be found out the potato is quite a new food-plant. As the larvæ are found in companies, they could easily be cleared out of the potato crop, which should certainly be done, as they are very ravenous feeders. Ragwort may frequently be seen quite stripped of its leaves by these black and orange ringed larvæ.

MUSTARD PESTS.

The Mustard Beetle (*Phædon betulæ*, Linn.).

The Mustard Beetle (*Phædon betulæ*, Linn.) was reported this year (1902) to the Board as very destructive at Holbeach, Lincolnshire, and information was asked for as to the best plans of coping with the attack. It can be materially lessened by various methods.

The beetles pass the winter in a torpid condition in any shelter where they have been working in the summer and autumn.

The larvæ hatch from eggs laid in the spring upon various plants. The beetles which deposit these spring eggs have previously passed the winter in hollow stems of reeds along the dykes and ditches of the district and also commonly in the hollow mustard stocks left about in and around the fields and also in the mustard stubble. They also winter in mustard stacks, cracks and crevices of gates, posts, fences, rough grass and all manner of places. The larvæ when mature pass into the ground to pupate, in which stage they remain from two to three weeks; the beetles coming from these pupæ at once attack the mustard crop. We find the beetle practically all the summer: it is therefore probable that there is more than one brood

every year. The eggs laid in the spring are placed on all kinds of Cruciferæ; the larvae feed upon the leaves; they are dull, smoky yellow creatures, slightly hairy and spotted with black, the head and the six legs are also black; there is also a distinct caudal foot and a row of tubercles along each side from which can be protruded curious yellow glands; when mature they reach about three-fourths of an inch in length. These larvae can be easily seen on the leaves, and are vulnerable at this stage.

PREVENTIVE AND REMEDIAL MEASURES.

All precautions should be taken to destroy as much winter shelter as possible. After a bad attack it would be advisable to burn the mustard straw, not at once, but after it has been allowed to stand some time in heaps in the fields; the beetles would seek winter shelter there, and on firing the heaps they would be destroyed.

All hedge trimmings and reedy growths along dykes should be cut and burnt during the winter.

No experiments on a large scale seem to have been made in destroying the larvae upon the young plants when it is possible to get on the land. There is no doubt that the proper time to attack this pest is in its larval stage when feeding upon the young leaves.

The fields should then be sprayed by means of a horse Strawsonizer with Paris-green wash; the time to carry out this operation would depend upon the time the grubs are noticed on the leaves.

The beetles also attack the young leaves, and would also be destroyed by the same wash. The beetles may also be collected when present in numbers on the young plant, by dragging a long strip of tarred sacking attached to a light rod over the fields, and also by special machines. The beetles which attack the crop later on in the year may be kept in hand by preventing their movements from place to place. Towards the latter part of the year when so much damage is reported, the beetles do not seem inclined to use their wings, but migrate in a body along the ground from field to field. They can thus be "held up" like locusts by cutting a trench across their line of march, or by burning damp straw so that the smoke blows on to them. The employment of a shallow trench about a foot deep is the best plan to check them, especially if it can be filled or smothered repeatedly with tar.

It is also important to keep horse-hoeing as long as possible between the rows; by this means the pupæ are turned out of the earth and are exposed to the attack of various birds.

Mustard should always therefore be drilled far apart when grown for seed; more than a foot should be allowed between each row. Not only can the crop then be easily horse-hoed, but special machines can be taken across the fields between the rows to catch the beetles. Wooden scoops, with tar or soft soap smeared over the insides, may be arranged so as to be pulled through the field, either by hand or horse-power, and so collect the beetles.

The early spraying with some arsenical wash so as to kill the larvæ and beetles is, however, most to be recommended.

FRUIT PESTS.

An Enquiry re Bud Mites (*Eriophyes ribis*, Nalepa) in Black Currant Bushes.

A correspondent of the Board of Agriculture living at Suckley sent an enquiry regarding the stacking of diseased black currant bushes and the subsequent escape of the Bud Mites (*Eriophyes ribis*). Information was sent that it is best to burn the cuttings from the black currant bushes infested with the "Big Bud" mite. There are several points not yet settled in the life-history of this pest, notably how long the egg stage lasts; under the circumstances, it is best to destroy all infested parts, as ova will be found at most times of the year in the buds.

The probability is, however, that if the black currant faggots were stacked in the centre of the rick of other wood, that the acari would die out and the eggs become destroyed; but, owing to the great increase and ravages of this pest, it is best to be on the safe side and to recommend the burning of the infested cuttings, which cannot be of much value as wood.

The most complete life-history of this serious pest has recently appeared in the *Journal of the S. E. Agricultural College*, by Mr. E. J. Lewis (No. 11, pp. 55 to 80 (1902)).

The Apple Blossom Weevil.

(Anthonomus pomorum, Linn.)

Some apple blossoms sent by a correspondent of the Board from Cottenham on July 20th were attacked by the Apple Blossom Weevil (*Anthonomus pomorum*). The blossoms all contained the mature beetles, ready to emerge. These beetles feed upon the leaves

to some extent for the rest of the year, and hibernate during the winter under the bark of trees, and amongst rubbish, etc., at the foot of hedgerows.

It appears from observations made on the specimens sent from Cottenham that the beetles do not leave the dead blossoms for some days.

Much good may be done by collecting, as far as possible, all the dead blossoms beneath the trees (first seeing that all "capped" blossoms have fallen; if not, shake the remainder off the trees) and burning them. At the same time spray the ground beneath the trees with strong soft soap and paraffin wash, adding double the amount of paraffin usually employed.

At present all we can do in this attack is to destroy the beetles and so prevent their increase. This can be done in three ways: (i) by that mentioned above; (ii) by destruction of winter shelter by use of caustic alkali wash; and (iii) by jarring the trees when the blossom appears in spring so as to shake off the weevils on to sheets spread beneath the trees, when they can be swept up and destroyed. Warm days should be chosen for this, preferably with a S.W. wind. This has been found to do considerable good where properly carried out.

Stress should be laid on the destruction of fallen diseased blossom. A few days, or even hours, may be sufficient for the beetles to escape, and so give them every chance to continue their work next season.

Strawberry Beetles.

A correspondent of the Board sent an enquiry in September asking for information concerning beetles that had been very harmful amongst the strawberries in parts of Norfolk. The following report was sent in return:—

Several species of ground beetles attack strawberries, including the following: *Harpalus ruficornis*, Fabr.; *Omuscus vulgaris*, Linn.; *Steropus mandidus*, Fabr.; and *Calathus cisteloides*, Panzer.

These beetles attack the berries at night, usually just when the fruit is ripening. The insects remain under the earth, straw, or grass between the rows during the day, making holes in the soil and having regular runs opening through the litter. Green fruit is also attacked, the skin being eaten away, the seeds usually being left intact. There are nevertheless records of the seeds also being eaten, the ground being described as "covered with a powdery deposit," caused by the seeds eaten off the berries.

The most destructive species appears to be *H. ruficornis*, which is winged, and which evidently migrates in large numbers.

These beetles will feed on other substances, such as live worms, cooked and uncooked meat, etc. *Harpalus ruficornis* and others have been recorded before in Norfolk, namely at Walsingham.

TREATMENT.

The only successful plan is that adopted by Messrs. Laxton Bros., namely, to sink small pudding basins in the soil between the plants every few yards and baiting them with "lights" and sugar-water; the beetles swarm to this and are unable to crawl back up the sides of the basins; similar good results have been gained by using ordinary jam pots or glass jars. Probably poisoned baits would act well, but trapping as given above is a well tried and most successful plan.

Slug-worms on Fruit Trees and Hedgerows.

(*Eriocampa limacina*, Cameron.)

The larvae of the Pear and Cherry Sawfly (*Eriocampa limacina*) have been received by the Board of Agriculture from Enfield. They were reported by the correspondent as doing damage to fruit-trees and to the hedgerows. They are frequently very destructive to pear, cherry, and other leaves (*vide p. 72*).

Another correspondent from Willingham reports them in September as damaging the leaves of cherry trees there.

The life-history, etc., of this pest is dealt with in the revised leaflet No. 62. It has not been nearly so abundant as in past seasons.

Maggots in Apples.

A correspondent from Uttoxeter forwarded to the Board an apple that had been damaged by the Codling Maggot (*Carpocapsa pomonella*, Linn.). This pest is dealt with in Leaflet 30.

The correspondent refers to the damage to the apples being due to weevils: "We are suffering in our trees from the effects of a weevil that has spoiled and lost us most of the fruit."

Two weevils have been recorded attacking apples, namely, the Purple Apple Weevil (*Rhynchites bacchus*, Linn.) and the Copper Coloured Weevil (*R. cupreus*, Linn.).

Apples also suffer from another grub which has been very prevalent this year, the Apple Sawfly (*Hoplocampa testudinea*, Klug.).

Small dipterous maggots have also been recorded—possibly the larvae of the Apple Fruit Fly (*Trypetia pomonella*), an introduced pest.

The larvae of the above can be told as follows:—

- (a) Codling Maggot, pink, with six jointed legs in front, four pairs of prolegs in the middle of the body, and an anal pair.
- (b) Weevil Maggots, white, footless, more or less curved, and with a wrinkled skin.
- (c) Sawfly Maggot, white, six jointed legs in front, more than four pairs of fleshy prolegs.
- (d) Fruit Fly Maggot, white, footless, not curved, small.

Maggots in Imported Apples.

Some larvae sent by a correspondent to the Board of Agriculture from Smithfield Market, Manchester, proved to be those of the Codling Moth (*Carpocapsa pomonella*).

The correspondent pointed out the danger of constant fresh importations of this pest from abroad. Some observations have been privately made which confirm this report.

The Codling Moth has been distributed to countries where it was formerly unknown in the way described by the correspondent of the Board. If large numbers occur alive, as recorded, there is undoubtedly much harm being done, and this may account for the great increase of this apple pest during recent years, which in some cases during the past season has completely ruined the apple crop.

As the pest is very abundant in America, and probably the un-ripened apples are shipped to the English market, some steps should be taken, if it proves to be a general rule, to safeguard the apple growers of this country by similar means to those employed in Tasmania.

Apple barrels have been examined and numbers of Codling Maggots have been found. These get distributed over the country, and cannot but help increase this pest in our orchards.

The maggot in Lisbon apples may prove to be one of the fruit flies (*Trypetia* or *Ceratitis*).

Infestation of Fruit Trees by Winter Moth Caterpillars, etc.

Winter Moth (*Cheimatobia brumata*, Linn.) caterpillars were reported destroying the foliage of fruit trees by a correspondent of the Board of Agriculture at Laceby, near Grimsby. Advice as

regards spraying with Paris green and the importance of "sticky banding" was called attention to.

Information concerning this pest is given in leaflet No. 4; but it should be pointed out that the use of quassia or soft-soap wash is now known to be quite useless for these biting-mouthed insects, and also that when Paris green is used animals may be kept under the trees. It may also be pointed out that *Nyssia zonaria* has no importance as a fruit pest, feeding only on yarrow and dog-rose, nor is *Phygalia pilosaria* found on fruit-trees, its food plant being the oak.

The Winter Moth was also reported as damaging the leaves of apple and pear at Glazebrook, near Manchester.

The same correspondent sent some flies belonging to the *Bibionidæ*. They have no connection with the caterpillars as supposed. These dipterous insects belong to the species *Bibio marci* (St. Mark's Fly). The larvæ live in the soil and somewhat resemble small "leather-jackets"; usually they occur in masses, and seem to do no little harm to the roots of grass and other plants. Great numbers of this species and *B. hortulanus* have appeared this year, and have been sent by numerous other correspondents.

The Pear Midge.

(*Diplosis pyrivora*, Riley.)

Pear fruitlets sent to the Board from Brackenwaite, Wigton, Cumberland, were attacked by the Pear Midge (*Diplosis pyrivora*). This same pest was reported from Glazebrook, near Manchester. It is interesting to note the northern extension of this pest and its much later period of reaching the mature larval stage in the north. Drenching the ground under the trees with paraffin emulsion either when the larvæ are falling or as the flies are hatching out is most beneficial. An unobserved feature in the attack of this pest may here be mentioned. When the fruitlets are "struck by the fly," they swell much more rapidly than the sound ones, and can thus always be told on the tree by their being often twice the size of a healthy fruitlet.

Scale Disease and False Scale amongst Fruit Trees and Bushes (Apple, Pear, Gooseberry, Currant, etc.).

Specimens sent to the Board of Agriculture from Hayling Island of apple, pear, quince, gooseberry and currant, all supposed to be

attacked by scale, were in some instances perfectly healthy; in others, scale insects (Coccidae) were causing disease.

The attention of growers is drawn to the normal appearance of bark and rind of the different fruit trees, as it is not an uncommon thing to have questions asked regarding the spots present on the twigs of various fruit trees and bushes, which are often, as in the present case, mistaken for scale insects.

The following specimens sent may be taken as examples of this:—

A. (Apple; an exceptionally bad case of Quarrenden apple—fourth year.)

This specimen was covered with the Apple-bark Louse or Mussel Scale (*Mytilaspis pomorum*) (Fig. 3, a).

B. (Pear, presumed to be scale of a different variety, somewhat like bark blisters.)

This twig was quite clean; the small grey spots (Fig. 3, b) are normal bark spots, but might easily be mistaken for the San Jose Scale (*Aspidiotus perniciosus*), or the Japanese Fruit Scale (*Diaspis amygdali*).

C. (Gooseberry with scale. This scale in most cases has not been noticed to leave a protruded egg trail. Does it? See E.)

This specimen contained two specimens of the Brown Currant Scale (*Lecanium ribis*); no white protruding egg mass, i.e., no white cottony nest is formed so as to protrude from the scale in this species, as in the White Woolly Currant Scale (*Pulvinaria ribesii*). The young scales of this species are much flatter than the old and paler in colour.

D. (Currant with remnants of "egg trail.")

Although no scale is attached to the twig of currant sent it contained a large cottony mass of eggs and wool. This resembles the cottony cushion seen in *Pulvinaria ribesii* (vide C).

This scale can easily be told from *L. ribis* by being raised up off the rind by a pad of white wool.

E. (Gooseberry with remnant of egg trail, etc.)

This spray of gooseberry had two mature scales of *Lecanium ribis* and several smaller ones; also a mass of white wool with no scale attached. The scales are the same as C. Possibly the white wool is due to the same species as D.

F. (Apple Branch, grey spots on bark.)

The grey barnacle-like spots referred to are not scales or any insect, but bark spots.

G. (Quince, red spots on bark.)

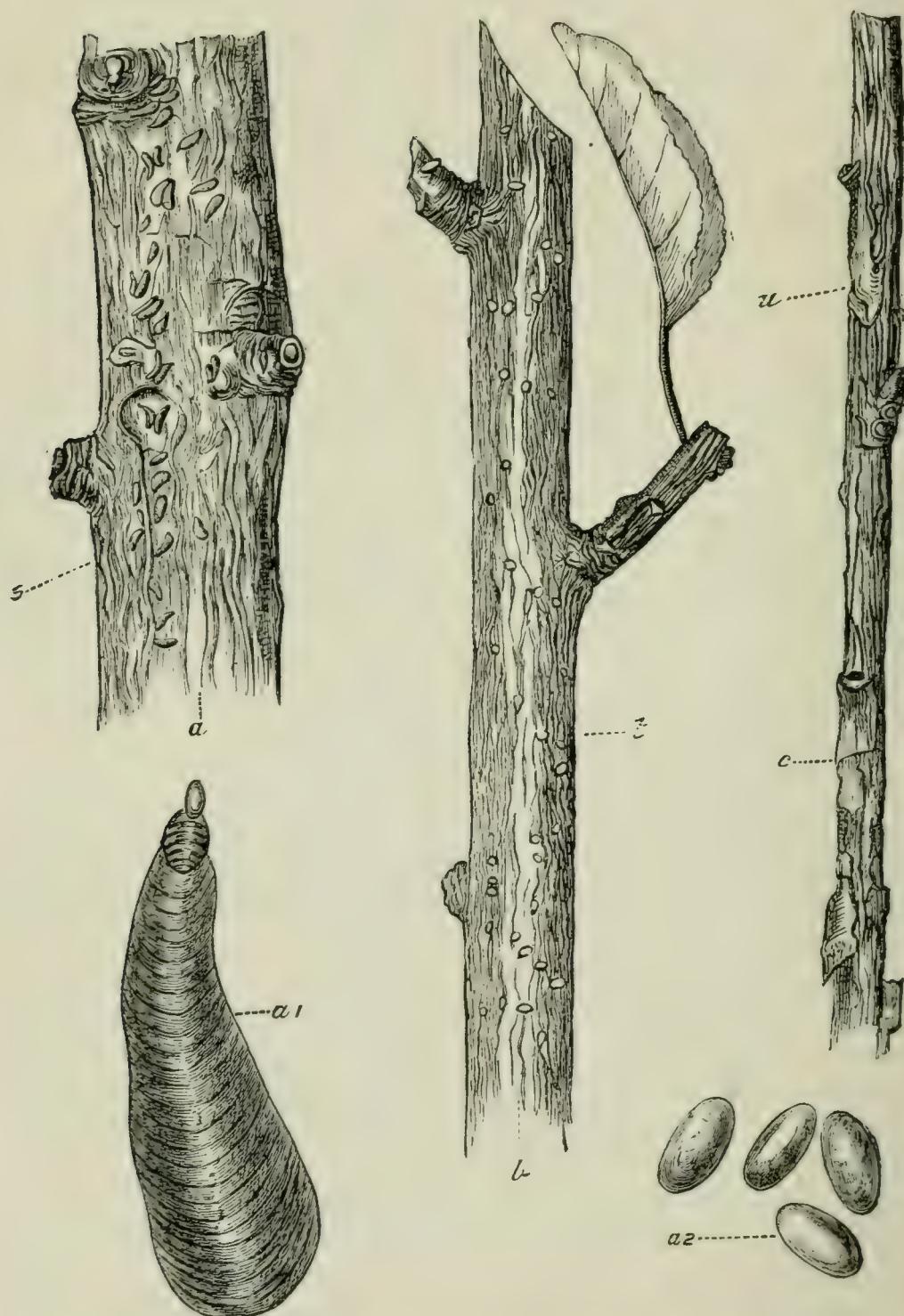


FIG. 3.—SCALE, FALSE SCALE AND EFFECT OF FROST AND CANKER.

a, Mussel scale on apple wood; *s*, the scales; *a1*, mussel scale enlarged; *a2*, its eggs; *b*, pear twig showing grey scale-like spots (normal plant structure); *c*, apple twig blistered by frost and canker (?), not insect work; *u* and *c*, blistered area.

These small red spots are not scales nor the stage of any insect, the quince having red bark spots.

It is important to notice whether we have scale on the tree or whether the markings are normal plant structures. Scales are often very harmful in this country and should be checked before they get the upper hand of the tree and sap its vitality.

Three washes may be used for scale insects :—

1. Paraffin emulsion.
2. Resin wash.
3. Caustic alkali wash.

The first (paraffin emulsion) is chiefly of use when the young scale insects are emerging from beneath the scales; observations personally by the grower must be made, as the times of hatching vary very much.

Caustic alkali wash is the most beneficial to use (vide article in the September number of the Board "Journal").

Fumigation with hydrocyanic acid gas is the best scale remedy, but is difficult to apply to large trees. Should this be employed, full information will always be sent from this Department.

Winter washing with caustic alkali wash is strongly advised.

Life-history of Scales (Coccidae).

The eggs of the Coccidae are found under the scales; the young scales are minute, active, six-legged insects with projecting antennæ ("horns") and often hair-like processes. They can only be seen with a strong magnifying power. Scales (Coccidae) are provided with a long piercing mouth, which the larvae thrust into the bark, leaf or fruit. The larvae then degenerate, and by degrees form over the body a sealy covering—beneath which you find the mature female, which is legless; the male scale insect is rare, and unlike the female is active, having a pair of wings. Scale insects on trees in the open pass the winter in Great Britain mostly in the egg stage beneath the scales, a few as immature females.

Scale Insects on Plum Trees.

Plum trees sometimes suffer from scales. The Oyster-Shell Bark Louse (*Aspidiotus ostraciformis*, Curtis) is found on plum. A brown Lecanium has also been found, but was not identified.

The Japanese Fruit Scale (*Diaspis amygdali*) also occurs on plum, and thus care should be taken to examine all Japanese cherries that

may be bought. Numbers of these fruit trees are introduced and the scales may be also brought over with the plants. If the scale is seen the plants should be fumigated or destroyed.

The Brown Currant Scale (*Lecanium ribis*) has also been found on plum trees, especially in gardens when the trees are grown against walls.

SPRAYERS.

For bush-fruit the best sprayers are the "Knapsack sprayers," the "Eclair," the "Notus," the "Anti-pest," and others.

Ordinary syringes are of no use in washing plants. The insecticide must be sent out in the finest possible spray.

Paraffin emulsion should be used first in April for currant scale and repeatedly every two weeks for at least two months; for mussel scale in May, and likewise onwards.

It is advisable to try caustic alkali wash alone for the first year. This need not be put on by a "mistifier," as the object is to saturate the tree, not to spread a fine even layer of the wash over it as when Paris green or emulsions are used.

The Apple Bark Louse or Mussel Scale.

(*Mytilaspis pomorum*, Linn.)

Several correspondents of the Board of Agriculture have reported damages to apple trees by the mussel scale, namely, from Romsey, Tarporley, Hayling Island, and other places previously mentioned. One correspondent thought the scale connected with thrips and canker fungus.

The best way to destroy this scale is to use the caustic alkali wash in winter, and spray in the spring and early summer with paraffin emulsion.

A full account of this pest is given on page 75.

Eggs on Apple Trees and a further Remedy for Mussel Scale.

(i) Apple shoots sent to the Board of Agriculture from South Norwood were covered with the eggs of (1) the Red Spider (*Bryobia* *uni*), (2) the Apple Sucker (*Psylla mali*). The former are red eggs, the latter are elongated oval and white. Two only of eggs could be detected. The majority of the *Bryobia* eggs

were shrivelled and killed, as also were the two *Psylla* eggs; some of the former, however, had hatched out. *Psylla mali* has been most destructive during the past season, both in Worcestershire and Herefordshire, and has been more or less troublesome in Kent.

For these two pests a combined wash of paraffin emulsion and sulphur should be used. Ordinary paraffin emulsion may be made by mixing equal portions of boiling soft soap solution and paraffin together, and then churning them up by means of a force pump until a creamy emulsion is produced. When required for use, this may be mixed with twenty-five times its bulk of warm water.

To every three gallons of this dilute emulsion, add one ounce of liver of sulphur and well mix. Spray in a fine spray, so that every part of the tree is wetted.

(ii) The only thing to do after the buds have burst to destroy mussel scale is to wash with paraffin emulsion two or three times during the late spring and early summer. Commence at end of April—if possible a look out should be kept—and as soon as any signs of the young active scale insects are noticed crawling about the trees washing should be carried out; the corroding effect of paraffin emulsion is not great on the mature scales, but it soon destroys the immature forms.

The wash recommended for the two former insects will do also for this scale.

Aphides (*A. mali*, Fabr.) on Apple Trees.

Some insects sent by a correspondent of the Board from Chesham proved to be the Apple Aphid (*Aphis mali*), which has been doing an enormous amount of damage this season (1902) in the South of England—many orchards being covered by them. Steps should be taken as soon as the plant lice are seen to destroy them. This can easily be done if the leaves are not too far curled up, but even then some good can be done by spraying.

The best wash to advise for this *Aphis* is soft soap and quassia, but if the operator has proper sprayers, paraffin emulsion. It should be pointed out that the wash must go on the under surface of the leaves. Two washings, at a few days' interval, are usually necessary for this pest.

This pest was also reported as doing considerable damage at Tunbridge Wells, and also from Glazebrook, near Manchester.

The Peach Aphis.

(Aphis amygdali, Fonsc.)

Amongst a number of Aphides sent by a correspondent from Tunbridge Wells were specimens of the Peach Aphis (*Aphis amygdali*). The Peach Aphis also attacks nectarines and causes the leaves to curl up and to fall, often leaving the branches quite bare. It also feeds on the sloe and tobacco plant. Another species, *Hyalopterus pruni*, Fabr., also attacks the peach, but from the remains sent the species in question here is *A. amygdali*. These Aphides have nothing to do with the curled fleshy leaves seen on peach trees caused by the fungus *Exogesius deformans*.

It is advisable to use quassia wash only on peach, as paraffin emulsion might damage the foliage and the young fruit, the peach being much tenderer than the apple or plum.

A General Wash for Fruit Trees.

A general insect wash required by a Gloucestershire correspondent of the Board of Agriculture may be made as follows:—

A. (1) Dissolve 1 oz. of arsenate of soda in soft water and add to 16 gallons of soft water.

(2) Then dissolve 3 ozs. of acetate of lead in soft water and add to above and stir well (= *Arsenate of lead wash*).

B. Dissolve 1 quart of soft soap in 2 quarts of boiling soft water. Then remove from the fire and while still boiling hot add 1 pint of paraffin and churn the whole together for ten minutes with a small hand syringe. (For use alone dilute with ten times its volume of soft water (= *Paraffin emulsion*.)

For mixing with A, add about two pints of the concentrated emulsion (B) and mix well. The combined wash will then destroy both biting or mandibulate and sucking or haustellate insects.

By far the most successful wash for "Apple Sucker" is Quassia wash as used in the Kent hop gardens.

**Further Information re Winter Washing of
Fruit Trees.**

In answer to an enquiry of a correspondent of the Board of Agriculture, *re* winter washing of fruit trees, it was pointed out that "washing" and "spraying" of fruit and other trees are merely

different terms for the same treatment. Hop growers call the process "washing," fruit growers both "washing" and "spraying." In all insecticides it is well to put the wash on the foliage or fruit in as fine a mist as possible, but with the Caustic Alkali wash this is not essential. The wash may be syringed over the trees thickly, but it is advisable to use a proper sprayer or washer such as the Strawson "Anti-pest." After spraying with this wash the machine should be well cleaned out with cold water. No care is necessary regarding the buds as long as they have not commenced to burst.

Three quarters of a pound of soft soap for the ten gallons of wash may be used in place of the treacle previously advised. India rubber gloves are sometimes worn by the sprayer, but are not necessary. It is far better to fix a circular disc pointing downwards on the spraying tube so that any wash that runs down will fall clear of the hands.

Another Board correspondent was informed that ordinary treacle may be substituted for coarse agricultural treacle in this wash.

Certain gardening papers have raised an objection to the use of treacle or soft soap in this wash, but it is certainly a beneficial ingredient.

Canker Fungus (*Nectria ditissima*) on Apple Twigs mistaken for Insect Work.

The effect of "canker" is often mistaken for insect work. Apple twigs were sent to the Board of Agriculture from Bournemouth with brown blister-like patches over them; these were attacked by the canker fungus *Nectria ditissima* (fig. 3). The shoots had been probably damaged by frost early in the season; canker becomes more prominent lower down the tree. Another correspondent from Rugby also sent twigs with the typical canker of apple; the small scarlet fruit or perithecia of the fungus were present on most of the twigs sent. There was a lot of this disease showing these blister-like patches this year (1902).

MAMMALIA.

Enquiry as to Poison for Moles.

Several enquiries have been made regarding Moles. One correspondent wrote asking the best way to poison these animals.

This Department knows of no poison of any use in destroying moles, but probably bisulphide of carbon would be as successful in killing these animals as it is in destroying the Canadian Pouched Rat

or Gopher. This latter animal is most harmful in America, but the mole is not with us and its destruction should not be advocated. If they are very numerous, as on the land of the Board's correspondent they should be trapped alive and spread over the country.

SUB-GROUP B. ANIMALS WHICH CAUSE INJURY AND DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION II.

ANIMALS INJURIOUS TO HORTICULTURE.

Land Bugs on Chrysanthemums.

(*Lygus pratensis*, Fabr.)

The insects sent to the Board of Agriculture by a correspondent from South Norwood, S.E., are Hemiptera-Heteroptera (Bugs) and belong to the species known as *Lygus pratensis*, the *L. campestris* of Linnaeus. This is a very common and widely distributed British species and is sometimes harmful to various garden plants. There is, however, no record of their attacking chrysanthemums.

Several other species of land bugs are injurious to garden plants, including the so-called potato bugs, *Phytocoris pabulinus*, L. and *Lygus contaminatus*, Fallen.

These bugs injure the plants by sucking out the juices, puncturing stem, leaf and blossom.

The life-history of *Lygus pratensis* is not known, but it may be mentioned that the eggs are usually laid on the plants upon which the insects feed—these eggs give rise to the larval or louse stage—a creature much like the adult, but wingless; the next stage, the pupal stage, differs in having two bud-like processes on each side of the body, the wing buds.

These plant bugs are injurious in all three stages. Some winter as eggs, others hibernate amongst rubbish in hedgerows, etc.

TREATMENT.

The only remedies of any avail against these creatures are (i) collecting them by jarring the plants over tarred boards held on each side and (ii) treatment by washing.

In a similar attack in hops by a species known as *Calocoris fulvomaculatus* of De Geer jarring over boards cleared the invaded gardens.

The only washes found of any use are soft soap washes, especially paraffin emulsion with an extra 3 lb. of soft soap to the 100 gallons.

To be of much service the wash must be used when the insects are in the larval or pupal stage. A look-out should be kept in the garden to see where this chrysanthemum pest passes the winter; if the winter quarters are discovered steps should be taken to destroy the insect before spring, if it hibernates in the adult stage. If the species passes the winter in the egg stage on the chrysanthemums, the plants should be sprayed with paraffin emulsion as soon as the young larvae are seen to appear.

The Destruction of Ants.

The following information was sent to a correspondent of the Board of Agriculture at Kingston-on-Thames concerning the method of destroying ants damaging grass and clover.

First find out the ants' nest. This may be under the ground, in which case it can only be detected by following the ants and so finding the opening in the soil down which they descend; nests may also be formed under dome-shaped masses of earth, etc., above ground or they may be under stones and rotting wood, according to the species of ant concerned.

Having located the nests, make a hole in each one about eight inches in depth and then pour into each hole from 1 to 2 ozs. of bisulphide of carbon, according to the size of the nest, and fill up the hole at once with earth. If the ground is regularly undermined with ants' nests and tunnels, treat the soil with the same, making holes every three feet apart, and pour into each hole 2 ozs. of the bisulphide of carbon. This is as a rule not necessary for ants, the nests only needing treatment. Evening is the best time to attack them. Care must be taken not to put a light near the bisulphide of carbon or to let it come in contact with hot metal, as it is highly inflammable. This is the only plan by which ants can be cleared out of the soil and has so far always met with success.

There are very few parasitic enemies of ants. A genus of Ichneumon flies, *Elasmosoma*, is one of the few parasites that attack them, whilst a brilliant Chaleid, *Eucharis myrmecia*, is known to prey on the large Australian *Myrmecia*. A small fly, *Phora formicarum*, Verrall, lays its eggs on ants, inside which the larvae live. Ants

are also attacked by mites. Numerous birds, of course, prey upon them.

The Destruction of Subterranean Insects and other Ground Garden Pests.

A box containing the following creatures was sent by a correspondent of the Board of Agriculture from Glasgow, with a request for information as to how to clear them out of his garden.

i. Wire-worm—The larval stage of the click beetles (*Elateridæ*). These are hard, shiny and bright yellow.

ii. *Julidæ*, including :

- a. Two species of *Julus*.
- b. A species of *Polydesmus*.

iii. *Scolopendridæ*, including *Geophilus longicornis*.

The wire-worms are, of course, very injurious, and so also are the *Julidæ*. A small white *Julus* sent was an immature form, but a different species to the large dark snake millepede (*Julus terrestris*, Linn.).

The *Polydesmus* can easily be told by the sides of the body being notched and by its more or less flattened form. It was too damaged to identify, but was probably *Polydesmus complanatus*, Linn. It is also injurious to plant life. *Geophilus longicornis*, the long snake-like yellow species with one pair of legs to each segment, is a centipede and is beneficial, probably feeding upon the young *Julidæ*. The pests may be destroyed in the following way :—

TREATMENT.

Peat moss manure is always attractive to Myriapoda and other pests and should be avoided. Lime if applied in proper quantity always seems to check the increase of millepedes, but has no effect on the wire-worm. Both wireworms and millepedes are prominent garden pests and can only be treated in two ways, viz :

- (i) By fumigation.
- (ii) By trapping.

(i) Fumigation for subterranean insects and other animal pests is best carried out by using bisulphide of carbon. Proceed as follows : Make a small hole in the flower bed or border every two yards and pour in $\frac{1}{2}$ oz. of the bisulphide of carbon and close up each hole as soon as the carbon is poured in. This must be done so that the bisulphide of carbon does not touch the roots of a plant, that is, it

must be put in the earth between the plants. Care must be taken, as it is of an inflammable nature and the fumes are also poisonous.

(ii) Trapping largely employed for wire-worm consists of placing pieces of carrot, mangel, beetroot or turnips in the ground, and taking them up every few days and collecting the wire-worm that are feeding upon the "bait." Millepedes may also be caught in this way, but for them large hollow, more or less rotten, roots form the best trap. It has also been found that the small millepedes (*Julus pulchellus*) may be caught in numbers by placing cabbage leaves soaked in a solution (1 oz. to the gallon of water) of Paris green on the ground. The millepedes come to the surface at night and feed upon the leaf and are so poisoned.

Bisulphide of carbon treatment is best; failing that, some good may be done by trapping by means of ground bait.

Directions for the Employment of the Gas Treatment under Glass.

Several enquiries have been received concerning the destruction of greenhouse pests.

Various methods of fumigating plants under glass are employed, such as sulphur fumes and tobacco smoke. Neither of these are as good as the employment of hydrocyanic acid gas. For Aphides, Red Spider, and Wood Lice the following quantities are necessary : 2 ozs. of cyanide, 4 ozs. sulphuric acid, 7 ozs. of water per 1000 cubic feet of space. Proceed as follows: Pour the water into a jar, then add the acid to the water. Wrap up the cyanide in a piece of blotting-paper and drop it into the jar of acid and water from outside the house. This can be done by tying the cyanide bag on to a stick with a longish piece of string, then close the door or window. Leave the house shut up for at least three-quarters of an hour, then open all doors and windows to ventilate freely; be careful not to enter the house for at least an hour after the doors and windows have been thrown open. Fumigate at dusk and when the foliage is dry. The temperature must not be above 60° F. The best temperature is 50° F.; above 60° F. the foliage gets scorched, as it also does if you fumigate in bright light. If the house is more than 10,000 cubic feet two jars would be necessary, but up to that size one is ample.

The result of one experiment may be quoted here. Greenhouse, 2,000 cubic feet, containing Chrysanthemums in full bloom, severely infested with Green Fly. Cyanide 3½ ozs., acid 5 ozs., water 9 ozs. Temperature 50° F. Time 25 minutes. 1 hour after sunset.

Result. Every *Aphis* killed, also slugs, flies, wasps and butterflies. Not a petal or leaf injured. Cost 5d. Journal S. E. Agric. College.

The quantities given first are, however, now found most successful.

White Grubs or Maggots (*Phorbia brassicæ*, Bouche) causing great damage amongst Cabbages, Carrots and Broccoli.

The larvæ and puparia of the Cabbage Root Fly (*Phorbia brassicæ*) were reported to the Board of Agriculture from Castle Croft, near Wolverhampton, as doing considerable harm. Several other correspondents reported the same pest. The different reports sent out are here united. This fly is a great pest in most cabbage-growing districts in Great Britain, and also causes endless harm in North America.

The only publication of value on this pest is by Professor Slingerland, of Cornell University Agricultural Experiment Station. ("The Cabbage Root Maggot, etc." Bull. 78, Cornell Univ. Exp. Station, Nov., 1894.)

The flies, which are very like the house-fly, appear all the summer in successive broods. Maggots may be found as late as November. These latter pupate in the soil, but apparently some of the adults also hibernate and come out and lay their eggs in the spring. Generally there are three broods in Great Britain, and undoubtedly the majority pass the winter in the puparium stage either in the ground or in the heaps of cabbage stumps and roots one sees so frequently on the farm.

PREVENTION AND TREATMENT.

The results obtained from a long series of experiments conducted by Professor Slingerland seem to show that only two things can be done to mitigate the evil caused by the Root Maggot. As a preventive the only effective device is to apply around each plant, when it is set out, a disc made of tarred paper or card. These can be cut out by machinery in large numbers, and as placing them around each plant before it is set takes so little time the plan has been adopted on a large scale by many American growers.

A plan of the card disc invented by Mr. Goff is given on page 35.

This disc (A) must lie flat on the surface of the soil to stop the flies from crawling beneath.

The only other plan found to be successful is the use of bisulphide of carbon or carbolic acid, the former injected into the ground. This treatment on a large scale would be costly in Great Britain and need not be referred to here.

Gas-lime has been found of benefit, but to be so it has to be put on strong and may damage the next year's crop to some extent; at other times it is a complete failure. Gas-lime to be of use must be put on so strong that the land often requires a year's rest.

All cabbage stumps and other roots after an attack should be burnt.

A dressing of superphosphate of lime has been found beneficial on the Continent.

Broad-casting soot and lime around the plants soon after planting

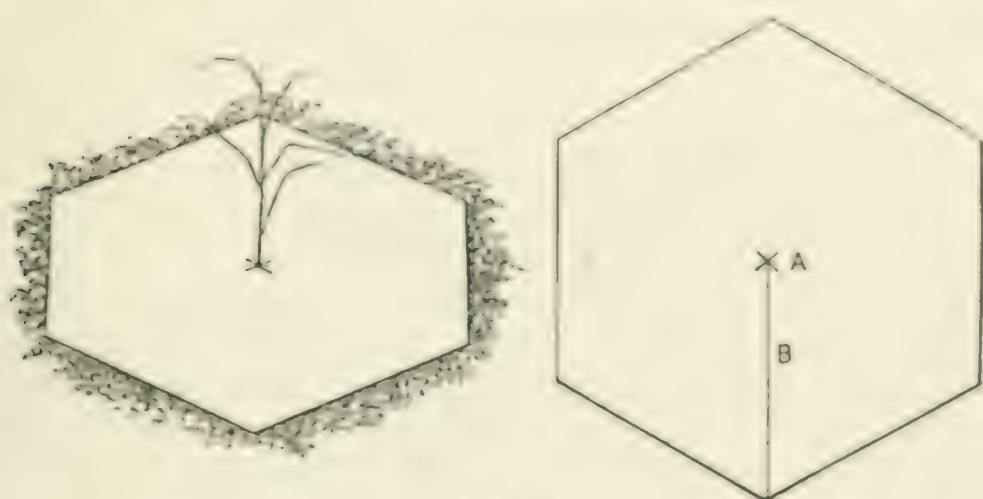


FIG. 4.

Plant passed through soil, leaving hollow on the ground.

A, Star-shaped slit to allow stem to pass through earth. B, Slit to prevent stems up to A.

out has also met with success in preventing the fly from laying eggs, but is by no means certain in action.

By far the best plan is to give up growing cabbage for two years on the land and plough deeply, or if hand cultivation dig two spits deep.

If it is necessary to continue to grow cabbage again and again on land, attention should be paid to the method of discing the plants when being set. A small amount of soot and lime may also be put in at dibbling time with the young plants.

Carbolic acid in soft soap and water as follows was found the next best remedy and preventative after the tarred discs in a large series of experiments in America.

The mixture used was made as follows:—

- 1 lb. hard soap.
- 1 qt. soap dissolved in
- 1 gal. of boiling water, and
- 1 pt. of crude carbolic mixed with the above.

Pour round the roots of each plant.

SUB-GROUP B. ANIMALS WHICH CAUSE INJURY AND DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION III.

ANIMALS INJURIOUS TO FORESTRY.

Willow Beetle at Norwich.

(*Sarperda carcharias*, Linn.)

A beetle received by the Board from a correspondent at Thorpe, Norwich, proved to be one of the longicorn beetles—the largest British species—*Sarperda carcharias*, Linn. It is found chiefly in the Fen districts, and was at one time very common there, but appears to be now more local. It is found in and about old willows. The larvae burrow into the wood of willow, aspen, and poplar; they do considerable damage to a tree, but are seldom sufficiently abundant to call for any remedial measures.

Sirex Flies in Fir Trees.

(*Sirex juvencus*, Linn. and *S. gigas*, Linn.)

Fir trees in the neighbourhood of Bath have been reported to the Board of Agriculture as being seriously attacked by the two common British Wood Wasps (*Sirex juvencus* and *Sirex gigas*), the former popularly called the Steel Blue Sirex, the latter the Giant Sirex. The larvae of these two insects, which burrow into the wood, remain and pupate in the timber and may be found there during the winter.

Infested trees should be cut down and burnt. They should not be cut up into post and rails, as is often done, as many of the larvae and pupae will hatch out after the wood has even been creosoted.

The trees should be cut down and burnt in the winter when the larvæ and pupæ are safely housed in the wood. There are no remedies for the Sirex Flies, but all damaged and diseased timber should be cleared out so as to check their increase. Damaged or unhealthy trees are mainly attacked.

The Poplar Sawfly.

(*Claudius ciminalis.*)

Some larvæ sent to the Board of Agriculture from Brondesbury attacking poplars were those of the Poplar Saw-fly (*Claudius ciminalis*).

The eggs are laid on the leaf-stalk of the poplar, which becomes swollen and bends over on each side so as to cover the eggs.

The young larvæ are green with black heads; at the second moult they become orange and green with twelve large black marks on each side, etc. When full fed they are entirely orange with the black marks very prominent.

The double cocoon is usually spun beneath loose bark or may be between the leaves. They feed in companies and eat the epidermis usually on the under side of the leaf.

There is one brood which occurs in August and September.

The insect is very common and the larvæ sometimes do some harm to the leafage of young trees.

They also occur on the willow and osier.

Sawfly Larvæ on Willows.

Some Sawfly larvæ, sent by a correspondent from Reading, belonging to the genus *Nematus*, were reported as attacking willows. A great number of Sawflies feed on the willow and osier, and several of this genus *Nematus* have larvæ very similar to the two sent. It was not possible to say for certain what the species was unless the perfect insects were bred, but it was probably the species known as *Nematus conjugatus*, Dbm.; but at the same time there were slight differences seen in the larvæ sent and the description of those of that species given by Cameron. Another species has similar green and orange larvæ, *N. croceus*, Fall., but the black markings in those from Reading did not agree.

Nematus paridus, Lep., does most harm to osiers in this country: but they were not that species, as the orange marks are larger, and there were certain black dots which are not seen in *N. paridus*.

Insect Galls on Osier Plants.

Diseased osier-shoots were sent to the Board of Agriculture by a correspondent, infested with the larvæ of one of the Gall Midges (*Cecidomyidae*). The material sent was not sufficient to say definitely the species of Cecid doing the damage, but probably it was *Cecidomyia salicina*, Schrk.

The following Cecid Willow Galls, formed on stems and twigs, may occur in abundance in any part of Great Britain :—

Those that form true leaf galls are not mentioned in this report.

(1.) *Cecidomyia heterobia*, Lw. The larvæ live in the male flowers and in rosettes on the leaves of salix, especially *S. amygdalina*. These larvæ pupate in the galls.

(2.) *C. salicina*, Schrk. The larvæ live in the withered tips of the young shoots of salix—in the terminal leaflets of the shoots which wither away and form a bud-shaped nidus. Three to eight larvæ inhabit each gall.

(3.) *C. terminalis*, Lw. The larvæ are yellowish-red and live in bloated galls on the shoots of salix; 20–30 ova are deposited at a time. When the larvæ leave the shoots, many scars appear between the healthy and galled parts. They pupate in the ground.

(4.) *C. rosaria*, Lw. The larvæ form rose-shaped galls at the ends of the boughs. They pupate in the rosette.

(5.) *C. saliciperda*, Duf. Orange larvæ found, from July to August, in the wood of young willows under the bark, where they form short irregular passages with gall-shaped swellings, and cause the bark to crack and become scabby.

(6.) *C. salicis*, Schrk. The larvæ form large woody galls on the boughs, many in each gall, and pupate in the swellings they form.

On making a careful examination of the material sent, one gall was found to contain four orange-yellow Cecid larvæ. Probably (as most of the galls were empty) they pupate in the earth, and thus some good might be done by a heavy dressing of soot in the spring, or sand sprinkled with paraffin and spread over the stocks or stools. But until the life-history is known little can be done to eradicate the pest.

The Felted Beech Coccus.

(*Cryptococcus fagi*, Barensprung.)

Very few scale insects are sufficiently abundant on forest trees in this country to do much harm. One of the worst is the Felted Beech Scale (*Cryptococcus fagi*) of BarenSprung. This insect has been

reported from Castle Eden, Durham, by Mr. R. Burdon, of the Castle, and a request sent to the Board of Agriculture for information. Mr. Burdon, writing later to me at the British Museum, says: "I have now noticed a large number of trees attacked more or less in the same way. It looks like a regular epidemic, as it certainly has not appeared in the same way for the last few years. My forester tells me that they had the same sort of epidemic on the Tyne, or in Northumberland, some fifty years ago (I think) and lost a lot of fine beeches." It has also been reported to the British Museum from Longwillow Hall, Morpeth, from whence the following note was sent: "At a distance the tree looks as if it had been whitewashed; when it is scraped off, the yellow eggs or insects are to be seen. Two trees are covered on the E. side of their stems. I remember a beech—not an old tree—in Gloucester which was affected in the same way, and died after a time. It smells something like the larva of a Goat Moth."

This scale insect chiefly attacks the trunk, but may ascend into the boughs. The females give rise to larvae in September, and they envelop themselves in a white cottony secretion, and then cast off their antennæ and legs and remain for the rest of their lives devoid of such appendages. The adult female is a small orange-yellow sac, surrounded by a white mass; these white patches often unite and form large felted masses, beneath which the larvae burrow and develop. These scale insects suck out the sap very greedily, and often do much harm when present in large numbers. In time they cause the bark to peel off the tree and then decay and death may ensue. Large numbers of trees are attacked in parts of Surrey; it is also common in Cheshire, Huntingdonshire, and probably occurs in small numbers wherever the beech grows in Europe.

The trees should be sprayed in the summer with strong paraffin emulsion twice at an interval of two days. In the winter they should be sprayed with caustic alkali wash.

The method of scrubbing the tree trunks is too laborious if the attack is on a large scale, and thorough spraying with warm paraffin emulsion is quite effective.

Mr. Burbidge, of the Botanic Gardens, Dublin, has informed Mr. Newstead that the weeping beech, of which there are two kinds, grafted on common beech stocks is not affected by this coccus. The stock may thus be attacked, but the weeping scion is not.

This insect is not attacked by birds and very rarely by insect parasites, according to Mr. Newstead.

Should the trees be cut down they should be burnt at once.

Chermes corticalis, Kalt, on Pine Trees.

Conifer shoots and bark, sent by a correspondent of the Board of Agriculture from Holmleigh, Matfield, Paddock Wood, Kent, covered with a plant louse which belonged to the genus *Chermes*, several of which attack conifers. It is known as *Chermes corticalis*, Kalt.

The apterous female is small, oval and yellowish-brown in colour, the abdomen exuding a large quantity of white, flocculent silky matte mixed with white meal; beneath this the insect conceals itself. It is rather firmly fixed to the bark by its short rostrum with long flexible setæ. The pupal stage is oblong and has transverse brown bars on the abdomen, the wing cases, antennæ and legs also deep brown. These give rise to the winged viviparous female, which has a black, shiny thorax, and abdomen ringed and covered with masses of white wool; the legs are black, and the fuscous wings have coarse brown veins.

The insects are very harmful when present in large numbers; the trees should be sprayed with paraffin emulsion, especially when the larvæ are hatching out, and the disease in consequence rapidly spreading. The larvæ were very active when the specimen arrived in June.

This species is often destructive to the Scotch pine (*Pinus sylvestris*) and Weymouth pine (*Pinus strobus*), both on the twigs and trunk. The white flocculent matter is seen in June around the base of the needles. There the wingless female produces her yellow eggs, which gradually become brown.

Numerous natural enemies occur in this species; the ova are preyed upon, according to Buckton, by the larvæ of *Seymnus discoideus*, and by the Land Bug (*Anthocoris fusca*, Kalt), and by the larvæ of *Agromyza chermivora*, Kalt.

GROUP F.

Animals which concern Man as being injurious to his worked-up Products of Art and Industry, such as (A) his various Buildings and larger Constructions, Habitations, (B) Furniture and Books, Drapery and Clothing, (C) Food and Stores."

SUB-GROUP B.

Furniture Beetles and Clothes Moths.

I. Furniture Beetles.

SEVERAL enquiries have been received from correspondents of the Board concerning Furniture Beetles and Clothes Moths.

The so-called Furniture Beetles are usually known as "Death Watches"; they are beetles belonging to the genera *Anobium* and *Xestobium*. The group of beetles to which they belong, the *Anobiinae*, are mostly found in old wood; several are found in houses, the two commonest being the *Anobium domesticum*, Foure, and *Xestobium tessellatum*, F. Eleven species of *Anobiinae* are found in Great Britain; the two previously mentioned and *A. panicum*, L., and *Ernobius mollis*, L., are the domestic forms. Furniture and wood-work are chiefly damaged by *A. domesticum* and *X. tessellatum*. The species *A. panicum* attacks all kinds of stored goods, such as flour, bread, biscuits, medicinal stores, skins, etc., and has been introduced into most of our towns, but appears not to be common in Scotland.

Anobium domesticum is a most destructive furniture pest, the larvae eating galleries into the solid wood, and often so completely riddling it that it falls to pieces; tables, chairs, and furniture may become so honey-combed by these pests that they suddenly collapse. The exits to these galleries are seen as small round holes in the wood-work. In soft woods they soon cause complete destruction.

Xestobium tessellatum is also generally distributed, and occurs in old trees, such as oaks and willows, but especially in old wood in churches and houses. It is also rare in Scotland.

Both these species make a curious ticking noise, which has given rise to their popular name of "Death Watch." This noise is made

chiefly during the pairing season, and is produced by the beetles striking their heads upon the wood on which they are standing so as to attract their mates, who make a similar noise in reply. This noise is made during the day as well as at night, but is not so noticeable at that time. Several species make this ticking noise, but those most often heard in houses are *A. domesticum* and *X. tessellatum*. It is said that the larva also can produce this sound, but it is not definitely known to do so.

The larvæ make quite long galleries into the wood, and when mature pupate in little chambers from which the beetles escape by eating their way out.

TREATMENT.

Where furniture or woodwork is attacked by these beetles and their larvæ, steps should be taken at once to destroy them, as they return generation after generation to lay their eggs on the same object until it crumbles right away. Amongst the best ways of treating attacked furniture are the following:—

(a) Painting with a brush with corrosive sublimate; this poison kills the beetles as they make their exit.

(b) Fumigating with hydrocyanic acid gas; where small objects, such as chairs, are invaded they may be put in some closed cupboard and left in the fumes for some days. (This gas, one must remember, is a deadly poison, as well as the cyanide of potassium used in its manufacture.)

(c) Benzine may also be applied to polished furniture, but it is best used mixed with carbolic acid; furniture so treated has, of course, the polish taken off and will require repolishing.

(d) Rooms in which these pests are present should be fumigated every week during July, either with sulphur or hydrocyanic acid gas, and then well washed down with carbolic. Of course, during fumigation all windows should have the crevices, etc. papered up and the doors tightly closed. If hydrocyanic gas is used it must be used with care, and should only be employed in certain cases; it could not be used in high attics, as the windows should be opened from the outside so as to allow the fumes to escape from the room before anyone enters. In the case of attics, where windows cannot be opened from the outside, sulphur had best be used. In the hands of an expert a whole house may be treated with the gas.

II. Clothes Moths.

Three species of small moths attack clothes, woollen articles, carpets, etc. These all belong to the group *Tineinæ*, and have now become almost cosmopolitan; in origin they are probably Old World species.

The three species are the following:—

- i. The Case-making Clothes Moth (*Tinea pellionella*, L.).
- ii. The Webbing Clothes Moth (*Tineola biselliella*, Hum.).
- iii. The Tapestry Moth (*Tinea tapetzella*, L.).

They are all common and very destructive in this country, both in private houses and in stores.

1. The Case-making Clothes Moth, *Tinea pellionella*, L., is a small moth with wing expanse of nearly half an inch, the fore wings are yellowish-grey with three indistinct brownish spots, the hind wings grey, and the wing-fringes grey. The larvae feed on all woollen goods, carpets, furs, and feathers. The moth appears in February, and may continue in successive broods until November. In America there appears to be only one brood in the north, the moths appearing from June to August, but in the south there are two or more broods, the moths appearing from January to October.

The eggs are very small and are usually laid on the food material. The larvae are small dull white caterpillars, the head reddish-brown, and the second segment with a dark brown plate behind. They form a tubular, slightly flattish case in which they pass the whole of their existence, the head and first few segments and legs being protruded when the caterpillars move from place to place. This case has frequently to be enlarged as the larva grows; this is done by the insect making a slit half-way down the tube and then inserting a patch of new material, and then a similar slit is made and filled in on the opposite side, and then the same is done at the opposite half of the case, the larva having previously turned round inside the tube; when the tube wants lengthening, additions are simply made at each end of the tube. These larval cases are made from the material upon which the insects are feeding, change of food thus changing the colour of the case; sometimes when feeding on variously coloured fabrics the cases are thus multi-coloured. Inside each case is lined by a fine white silk spun by the larva. When mature these "houses" are either spun to the substance upon which the larvae have been feeding, or more often the larvae wander to the walls and ceilings and then fasten the

tubes firmly to the surface with silk. The pupal stage takes place inside the case and lasts from two to three weeks.

2. The Webbing Clothes Moth, the *Tincola biselliella* of Hummel, is about the same size as the preceding species, and has the front wings pale ochreous, and more or less shining, without any spots; the hind wings are whitish and the head reddish-yellow. The larva feeds on a great variety of substances, such as woollen goods, furs, feathers, the linings of chairs and sofas, and has been found feeding on cobwebs. The moth appears from March to October and produces two broods in the year. The larva is dirty white, and spins a silken webbing as it progresses over its food material; no true case is formed as in the preceding species; but when mature it spins a cocoon of pieces of hair or wool of irregular outline and pupates within it.

3. The Tapestry moth, the *Tinea tapetrella* of Linnaeus, is also known as *Trichophaga tapetrella*; its fore wings are black from the base to the middle, then white clouded with grey towards the tip, the hind wings are pale grey and the head is white; the wing expanse is about three-fourths of an inch. It appears during June and July. The larva forms galleries in the cloth or other substance it attacks, these galleries being lined with silk. It affects carpets, horse cloths, upholsterings, especially in carriages, also furs and skins. The pupal stage takes place inside the galleries. Heavy and coarse materials are attacked mainly by this species, which damages by its actual burrowing into the material upon which it feeds.

TREATMENT FOR CLOTHES MOTHS.

Frequent removal, beating and shaking of clothes, etc., will do much to prevent the harm caused by these three pests. Materials which are liable to be attacked should be put away in boxes and cupboards with pieces of naphthalene in muslin bags placed here and there. Exposure to sunlight and plenty of air in May and June will do much to prevent clothes being spoiled by them. Benzine has a very deleterious effect on these pests and any valuable materials might be treated now and then with this substance.

In the case of cloth-covered furniture spraying with benzine is the most successful way of treatment.

Large dealers of carpets and furs could always keep their stock free from attack by adopting cold storage. A temperature of 40° F. is protective.

Insects and Mites in Furniture.

Some furniture and household pests sent by a correspondent of the Board from Whitechurch, Glamorganshire, proved to be two species. They were (i) the so-called "Death Watch" (*Atropos divinatoria*)—the same name is given to certain furniture beetles, *Anobium tessellatum*, etc.—and (ii) Mites belonging to the genus *Glyciphagus*, and were *G. domesticus*, De Geer, the *Glyciphagus cursor*, Gerv. Specimens have been sent to A. Michael, Esq. for identification. They are both best destroyed by fumigation. Sulphur is usually employed, but if both the pests are particularly abundant the rooms should be fumigated with hydrocyanic acid gas as well. Rooms should be well brushed down and the floors washed with soft-soap and water. Books, etc., which harbour the *Atropos* should be subjected to the fumes of benzine in closed boxes. Fumigation with sulphur answers best for the mites, but is not so effective upon the *Atropos*, hence hydrocyanic gas is mentioned. (A full report on household mites is given on page 120.)

SUB-GROUP C. FOOD.

I. The Larder Beetle.

(*Dermestes lardarius*, L.)

Some insects sent by Mr. Edgar J. Lewis to the Board of Agriculture, and which had been attacking and causing damage to winter-cured bacon, proved to be the Larder beetle (*Dermestes lardarius*). This insect is common to North America, Europe, and Asia. It attacks not only bacon and hams, but cheese, horns, skins, feathers, hair, silk and other dry goods. Fresh hams and bacon are not so liable to be attacked as those that are slightly tainted, improperly cured or injured in any way. The beetles are very disposed to lay their eggs in any crevice, and have probably done so in this case where the muslin bags are sewn up. The larvae are very minute when first hatched and can easily penetrate muslin unless it is very fine. The larvae as they mature bury themselves in the bacon, but at first they feed on the exterior.

TREATMENT.

Bacon is best hung as is sometimes done in America, in thin paper bags, care being taken that all crevices are closed, or else the

minute larvæ coming from the eggs laid on the paper may manage to work their way through.

When the larvæ and beetles are found in the bacon the attacked part should be cut away fairly deep, and well washed with a strong solution of salicylate of soda or salicylic acid. After a bad attack the *store room* should be well white-washed and then fumigated with hydrocyanic acid gas, bisulphide of carbon or with sulphur to destroy the beetles—the first for preference, as it is safer to use than the bisulphide and more effective than sulphur.

The use of bisulphide of carbon to destroy the beetles and larvæ *amongst the bacon* has been suggested and would be quite successful if we had only to deal with those two stages and the pupal stage, but unfortunately the beetles also lay their eggs in and around the attacked parts, and I have not at present obtained any satisfactory results of the action of bisulphide of carbon or hydrocyanic acid gas on insect and mite ova. In all cases experimented with so far the ova have not been harmed to any appreciable extent. The infected bacon or ham had thus best have the attacked parts where many of the eggs appear to be laid cleansed with salicylic acid. A second fumigation fourteen days after the first is the safest plan to follow.

Weevils amongst Stored Corn.

(*Calandra granaria*, L.)

Corn Weevils (*Calandra granaria*) were sent by a correspondent of the Board of Agriculture which had been attacking some oats stored in a barn. This beetle, and a closely related one, the Rice Weevil (*C. oryzæ*, L.), which has also been forwarded by another correspondent, from damaged Indian corn, are the most destructive corn pests in granaries, stores, ships and barns, that are known. Not only do they attack stored corn, but also all cereals in transit. Whole cargoes of wheat, etc., are often destroyed in transit from India, Australia, etc.

One or two instances are known of field attack near mills in Great Britain.

The beetles lay their eggs in the corn, the maggots feed inside the grain and there pupate. They breed fairly rapidly in this country and may attack other stored goods than cereals.

Reproduction may go on all the year in mills, but chiefly takes place in the spring and summer. The warmer the temperature the more rapidly do they breed. In Great Britain we mainly suffer from

the Corn Weevil, the climate not being warm enough for *C. oryzar* to flourish to any extent.

TREATMENT.

1. Well clean out the barn or other building in which the beetles have been at work; walls, ceiling and floors should be cleaned, washed with whitewash and soft soap and all refuse burnt.
2. Keep grain in bulk and constantly stir.
3. Keep well ventilated with *cold air* and plenty of light. In a warm climate ventilation would do no good, but cold air soon checks their reproductive powers.
4. If the store house or barn is fairly air-tight, close up all openings where possible and then fumigate with bisulphide of carbon. Evaporate 1 lb. of the bisulphide of carbon to every 1000 cubic feet of space (about). Put the carbon about the surface of the grain in flat saucers—the heavy fumes penetrate through the grain and kill all forms of life, but do not harm the grain—leave closed for twenty-four hours and then well ventilate and move the grain over.

If the grain could be treated in closed bins so much the better—1 lb. of the bisulphide to every 100 bushels of grain is sufficient, leaving for twenty-four hours.

A caution must be given that this substance is:—

1. Inflammable.
2. Both the fumes and liquid poisons.

A detailed report on this pest is given in the Journal of the S. E. Agricultural College, No. 5, pp. 11–21, 1897.

The infested grain given to poultry would do no harm—the birds would devour the insects as well.

FUNGOID DISEASES.

Fungoid Disease in Black Currant Leaves.

(*Septoria ribis*.)

The currant leaves sent to the Board of Agriculture from Wickham Market, Suffolk, are invaded by a fungus which produces so-called Currant Rust or Leaf Spot. The fungus is apparently *Septoria ribis*. This disease attacks all kinds of currants, and appears, as a rule, about the beginning of July.

It is first noticeable as small brown spots. Dull whitish spots also appear, but these may be due to another fungus. Both may be treated, however, as one, so far as remedies go.

TREATMENT.

The bushes should be sprayed with cupram and Bordeaux mixture some time before and after harvesting ; the first application should be about two weeks before the rust spots usually appear.

Bordeaux mixture may stain the fruit, so that for an early washing before the fruit is picked cupram had best be used, and Bordeaux mixture after harvesting.

Neither should be used for three weeks before the fruit is gathered as they are to a certain extent poisonous.

PREPARATION OF CUPRAM.

Measure out $\frac{1}{2}$ pint of strong ammonia (avoid the fumes), and add it to 2 quarts of water. Weigh out 1 oz. of carbonate of copper, wrap it up in a piece of copper gauze and suspend it by a copper wire in the ammonia liquor. Let it remain all night. When required for use dilute the blue fluid with 12 gallons of water. This is the best fungicide for all ripening fruit.

BORDEAUX MIXTURE.

Copper sulphate	.	.	.	.	1 lb.
Lime	.	.	.	.	1 lb.
Treacle	.	.	.	.	1 lb.
Water	.	.	.	.	10 gallons.

Dissolve the copper in 10 gallons of water, boil the lime and treacle with a quart of water for half an hour. When dissolved, mix them together and stir them up well. The mixture is then ready for use.

Gooseberry Fungus.

(*Puccinia pringsheimiana*, Kleb.)

The gooseberries and leaves sent are attacked by a fungus. This fungus is the aecidium stage of *Puccinia pringsheimiana* of Klebahn.

The cluster cups or aecidia occur on the gooseberry, both on the leaf and fruit ; the other stages affect certain species of *Carex* (sedges).

It is generally seen in damp places, but is rarely in sufficient abundance to do any practical harm. As in the present case it is doing considerable damage, any further notes will be gladly received.

TREATMENT.

All that can be done is to wash as soon as the fruit is gathered with Bordeaux mixture; the best wash is the "Wye Bordeaux mixture," prepared as follows:—

Copper sulphate (bluestone)	1 lb.
Lime	1 lb.
Agricultural treacle	1 lb.
Water	10 gallons.

Dissolve the bluestone in 10 gallons of water, and boil the lime and treacle with a quart of water for half an hour. When the bluestone is all dissolved and the lime and treacle liquid fairly cool, pour the latter into the bluestone liquid and stir well. It is then ready for use and will keep any time.

The soil should be well limed in the autumn, and the bushes sprayed again early next year, about the first week in May.

APPENDIX.

Amongst other enquiries made to the Board of Agriculture, of which short letters only were sent, may be mentioned the following:—

I. Tapeworms in Sheep at Okehampton.

A correspondent of the Board sought information concerning Cestodes in sheep.

The writer was referred to an article dealing with this subject in the "Agricultural Gazette" for Jan. 20, 1902, p. 40. The chief British ovine tapeworm is *Moniezia expansa*, which is very destructive to lambs in many parts of the country. Its life-history is not known.

2. Black Wire-worm in Mangolds.

A correspondent wrote for information concerning Black Wire-worm attacking his mangolds.

No specimen being sent and nothing being known of any creature having this popular name, no information could be given. Further information on this subject will be gladly received.

LIST OF LEAFLETS PREPARED AND REVISED FOR THE
BOARD OF AGRICULTURE.*Prepared.*

- No. 68. Currant Aphides.
- No. 69. Tent Caterpillars.
- No. 70. Winter Washing of Fruit Trees.
- No. 71. The Colorado Beetle.

Revised and Enlarged.

- No. 1. The Currant Bud Mite.
- No. 2. Weevils.
- No. 12. The Gooseberry Saw Fly.
- No. 14. The Raspberry Moth.
- No. 15. The Apple Blossom Weevil.
- No. 16. The Apple Sucker.
- No. 20. The Magpie Moth.
- No. 22. The Diamond Back Moth.
- No. 28. Cockchafers.
- No. 30. The Codling Moth.
- No. 33. Surface Caterpillars.
- No. 34. The Woolly Aphis or American Blight.
- No. 35. The Celery Fly.
- No. 38. The Carrot Fly.
- No. 46. The Stem Eel-worm.
- No. 47. The Asparagus Beetle.
- No. 48. The Pea and other Thrips.
- No. 49. The Fruit Tree Beetle.
- No. 53. The Pear Midge.
- No. 62. The Pear and Cherry Saw Fly
- No. 40. The Kestrel or Windhover.
- No. 42. The Short-eared Owl.
- No. 43. Titmice.
- No. 44. The Common Lapwing or Peewit.
- No. 45. The Starling.
- No. 51. The White or Barn Owl.
- No. 54. The Spotted Flycatcher.
- No. 55. The Swallow.
- No. 6. The Field Vole.
- No. 57. The External Parasites of Poultry
- No. 58. The Internal Parasites of Poultry.

PART II.

REPORTS ON ECONOMIC ZOOLOGY

SENT IN

REPLY TO VARIOUS CORRESPONDENTS.

G R O U P B.

(A) BRITISH.

Animals bred or domesticated by Man for Food or for the use of their products in industry or for their Services as living things.

SUB-GROUP a. ANIMALS BRED AND CULTIVATED FOR THE PROVISION OF FOOD.

Origin and Varieties of Domesticated Geese

An enquiry as to the origin, etc., of Domesticated Geese was received from the Hon. Florence Amherst. No information could be gathered in regard to Pomeranian Geese and little concerning the Strasburg Goose. The latter is a white goose with blue eyes and thus probably of Embleton origin.

There seem to be five well-marked varieties of Domesticated Geese: (1) Toulouse; (2) Embleton; (3) African or Indian; (4) Brown China; and (5) White China.

The main characters of these may be summed up as follows:—

Not yet fully worked out; to be had to Bill.

1. *Toulouse*.—Adult grey; bill reddish, nail white or flesh-coloured. Eye brown or hazel, the colour of bill. Abdominal pouch well developed. Gular sac pale-yellow.

2. *Embleton* or *Brown*.—Adult white; bill yellow to orange; nail white. Eye blue, rim orange. Abdominal pouch small. Gular sac yellowish. Legs orange, claws white.

Bill knobbed, note much harsher than in 1 and 2.

3. *African or Indian*.—Adult with back, wings and tail dark grey; bill and knob black. Eye hazel or brown. Legs orange. Dewlap under bill.

4. *Brown China*.—Plumage much as in African; bill and knob dark brown to black. Eye hazel. Legs dark with greenish tinge. Dewlap under bill.

5. *White China*.—Plumage white; knob orange. Eye blue. Bill orange with white nail. Legs orange with white claws.

There is no doubt that the European Geese are descended from the Grey Lag (*Anser ferus*), which has not only a wide European distribution, but is also Asiatic.

The blue eye of the Embden has a similar parallel in the Blue-eyed White Chinese Goose.

The presence of the twisted or curled neck feathers of the Toulouse, Embden and other Europeans is characteristic of the Grey Lag, and both will revert much to the Grey Lag in appearance.

The two Chinese varieties are evidently clearly descended from the *Anser cygnoides*; the blue-eyed white variety having been obtained from the wild form by selection. Thus we get two parallel cases of blue-eyed white varieties produced from different parent stock.

The African or Indian Goose is due to crossing between the Grey Lag and Chinese (White).

G R O U P D.

Animals which concern Man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character.

Live Dipterous Larvæ in Human Excreta and Notes on Species producing Myiasis.

Mr. J. W. Bridge, of the University, Birmingham, sent two larvae from the excreta of a woman with the following letter, dated Dec. 4th, 1901:—

I ask you to identify the specimens which I am sending herewith. They were sent to me by a doctor at Shrewsbury who states that they were passed per rectum by a patient suffering from cancer. If you can give me any clue to their identification I shall be grateful.

To this the following reply was sent:—

The larvæ you send from the excreta of the woman suffering from cancer are those of one of the Anthomyiidæ and of the genus *Homalomyia*. Certain species of these diptera are responsible for authentic cases of internal Myiasis. They are taken in with vegetable food and retain their vitality and are sometimes passed in the faeces alive. They are in no way connected with cancer.

Most of the cases of human Myiasis are due to the larvæ of *Compsomyia*, *Calliphora*, *Sarcophila*, *Homalomyia*, *Ochromyia*, *Dermatobia* and *Auchmeroyia*. Myiasis may be either (i) cutaneous or (ii) internal.

Homalomyia canicularis, Linn., has been reported by Hagen (Proc. Bost. Soc., N.H. xx. 107) as living in the larval stage in the urethra of a patient. Probably, says Nuttall, a case of pseudo-parasitism.

The following other dipterous larvæ have been known to cause external or cutaneous myiasis.

Sarcophila magnifica, Sehiner, which deposits its eggs in wounds on man and animals.

Lucilia caesar, Linn., also lays its eggs on wounds; probably the sheep-fly, *L. sericata*, Meig., does the same.

The Senegal or Caylor Fly (*Ochromyia anthropophaga*, Blanchard). The larvæ or Caylor worms develop beneath the skins of man and animals and often produce serious Myiasis in Senegal. *Dermatobia noxialis*, Goudot, also lives beneath the skin of man as well as animals, occurring from Mexico to Brazil. It is known under a variety of names, such as the Macaw worm in Cayenne, the Ura in Brazil, the Torcel at Costa Rica, the Mozoquil worm in Mexico.

The Maggot Fly of Natal (*Auchmeroyia (Bengalia) depressa*, Walker), also produces serious cutaneous Myiasis; this pest is one of the Sarcophagidæ. It is not restricted to Natal, but occurs further up the coast, having been recorded from Delagoa Bay. The range of this serious cutaneous parasite seems to be limited to the coast and no further inland than 1000 feet elevation. It is common from the Tugela downwards (*vide* Agri. Journal, Natal Dept. Agri. and Mines, vol. iv. p. 606, 1901. C. Fuller). *Vide* also note on Screw Worm (p. 131).

Correspondence on the Mosquito Annoyance at Blackheath.

The following letter was received on November the 6th, 1901, from the Public Health Department, Borough of Greenwich:—

DEAR SIR,—Complaints have been made to my Committee respecting the inconvenience caused to the inhabitants in this neighbourhood by the bite or sting of insects found in the neighbourhood of Greenwich Park and Blackheath, popularly supposed to be mosquitoes. I shall esteem it a favour if you can give me any information you may have respecting this class of insect found in that immediate neighbourhood.

I am, etc.,

ERNEST GEORGE ANNIS, M.R.C.S., etc., etc.,
Medical Officer of Health.

To F. V. THEOBALD, Esq.,
Natural History Museum.

To DR. ERNEST GEORGE ANNIS, M.R.C.S., etc.,
Medical Officer of Health, Greenwich.

DEAR SIR,—It is somewhat difficult to answer the questions in your letter *re* the annoyance caused by biting insects reported to your Committee without seeing actual specimens of the pests.

Mosquito Annoyance at Blackheath. 57

I know of no records of mosquitoes from either Greenwich Park or Blackheath. Two species occur in abundance in some of the docks (London and Albert), namely, *Culex pipiens*, L., and *Culex dorsalis*, Meigen, and from the latter dock I have received *Culex pulcritarsis*, of Rondani. *Culex dorsalis* is a vicious biter, and I believe occurs all down the river. *Culex pipiens* also bites severely at times, the bites being followed by large red oedematous patches. I am afraid without investigation on the spot I cannot possibly help you further.

I am, etc.,

FRED. V. THEOBALD.

BOROUGH OF GREENWICH

PUBLIC HEALTH DEPARTMENT,

Town Hall, Greenwich Road, S.E.,

12th November, 1901.

DEAR SIR,—Please accept my best thanks for the information you have so kindly supplied to me, and I will endeavour to obtain a few specimens of the insects referred to and submit them to you if you are agreeable.

I am, etc.,

E. G. ANNIS.

BRITISH MUSEUM (Nat. Hist.),

Cromwell Road, S.W.,

21st November, 1901.

To DR. E. G. ANNIS, M.R.C.S., etc.,

Medical Officer of Health, Greenwich.

DEAR SIR,—I shall be pleased to examine the noxious flies that are causing annoyance in your district whenever you care to send them here.

Yours, etc.,

FRED. V. THEOBALD.

BOROUGH OF GREENWICH

PUBLIC HEALTH DEPARTMENT.

26th November, 1901.

To F. V. THEOBALD, Esq.,

British Museum (Nat. Hist.)

DEAR SIR,—Yours of the 21st to hand, for which I thank you, and I am endeavouring to obtain specimens of the insects referred to, but they do not seem to be so prevalent in the colder weather.

I shall, however, be pleased to avail myself of your kind offer when I am in a position to do so.

I am, etc., Yours,

E. G. ANNIS.

Further correspondence on this subject was received from Councillor Walter Dannatt, of Blackheath, who, writing on April 1st, 1902, states that:—

We have been much troubled with gnats and mosquitoes in this neighbourhood, the last two summers especially, and I thought something might be done to abate the nuisance. . . . I proposed to have a solution of petroleum put in the ponds on Blackheath and the neighbourhood to destroy the larvæ, and I thought if all householders who have rain-water tanks and tubs were to put some petroleum into their receptacles that many of the *Culex* would then be destroyed. Will you kindly inform me when the breeding season of these insects is? I may say that these pests have been so troublesome in this neighbourhood that most people dare not sit in their gardens of an evening in the summer. Many people have been laid up by bites from these insects.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, S.W.,
4th April, 1902.

To COUNCILLOR WALTER DANNATT, Blackheath.

DEAR SIR,—Your letter regarding the above subject has reached me. In November of last year I had some correspondence from the Public Department of Health of the Borough of Greenwich on this same subject. I wrote to Dr. Annis, the Medical Officer of Health, saying I could not give any definite advice, as I did not know what the biting insects were. Much depends on the species of *Culex* or *Anopheles*. Do you know, or can you give me any idea of the character of the *Culex*. *C. dorsalis* and *C. pipiens* occur along the Thames. The former is a very vicious biter, and I have known it cause much annoyance in the docks and at Rochester. *C. pipiens* also bites at times, but may never do so in some districts. The two *Anopheles* breed in different ways. *A. bifurcatus* is in the larval stage in the winter, *A. maculipennis* in the spring and summer, but the former occurs again in the summer in larval stage. *C. pipiens* larvæ occur from May onwards in tubs, cisterns, etc., mostly in June, July and September. *Culex dorsalis* I have found in small artificial collections of water in July, but it probably also occurs in May. I am afraid only a careful examination will help you. I should paraffin the ponds for *Anopheles* (1) in winter; (2) in May and June; for *Culex* (1) May and (2) July and September; much depends on local circumstances. For instance, *Anopheles* larvæ occur in ponds, ditches, rivers and canals, in stone troughs and in rain-water barrels. So much ground has to be covered, but I fully expect the pests you have are *Culex*, probably both *C. dorsalis* and *C. pipiens*, which will be much easier to get rid of. I have some exact data of larval appearance at home, and I will look this up and send you. I expect you know all about the way of treating the water to kill the larvæ; if not, I shall be pleased to help you.

Without knowing the district and local conditions I cannot help you as I should wish. I think I said this to the Officer of Public Health.

Any further information I can give you I shall be very pleased to do.

I am, etc.,

FRED. V. THEOBALD.

DONNINGTON, VANBRUGH ROAD,
Blackheath, S.E.,

8th April, 1902.

To F. V. THEOBALD, Esq., M.A.

DEAR SIR,—Many thanks for your kind and interesting letter. I am writing the London County Council on the matter of treating the ponds at Blackheath. I shall be greatly obliged if you will favour me with the *modus operandi* of using the petroleum, and if any particular kind is used, and where obtained. I presume it will destroy any fish that are in the pond?

There are some Culicess about now, but whether they bite or what, I know not. My opinion is, that the species that troubles us most in the summer are rather small, and I have noticed them settle but *never appear to crawl*; whether that will prove what species they are I do not know. Thanks, I shall be very glad of the data you refer to of larval appearances.

I suppose the enclosed large one is a *Culex*; there are plenty in out-houses now. My opinion is, that the summer species is smaller. I have found a couple which were killed against the wall last summer. Are they *Anopheles*?

I am, etc.,

WALTER DANNATT, F.E.S.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, S.W.

To WALTER DANNATT, Esq., F.E.S., Blackheath.

DEAR SIR,—As far as I can judge, the two remains of the Culicidae you send are those of *Culex pipiens*, the perfect one certainly is. No doubt the smaller one is *Culex dorsalis*, a very vicious biter.

The usual times *Anopheles maculipennis* and different *Culex* larvae are found is in June, July, August and September. This would be the time to destroy the larvae, I fancy. *A. bifurcatus*, as I mentioned in a previous letter, occurs in the larval stage in winter also. They breed in rain barrels, small puddles, etc., so the work must be done very thoroughly. I should advise a look-out to be kept for the larvae before the paraffin treatment is started.

The paraffin is best applied by dipping a bundle of rag tied on the end of a stick into the paraffin and then dabbing the pool over in many places, so as to get the whole surface covered with a thin film. I do not think fish would be hurt by the treatment, and doubt if you can get a better substitute at present for paraffin. I will find out from Dr. Daniels, who has bred *Culex dorsalis*, where they live. The only ones I have found were in a small puddle near a tap at Rochester.

The paraffin treatment, I think, should be done two or three times at a week's interval soon after the larvae are first noticed.

I am, etc.,

(Signed) FRED. V. THEOBALD.

G R O U P E.

Animals which concern Man as causing bodily injury or disease, both possibly of a deadly character, to (A) his stock of Domesticated Animals, or (B) his Vegetable Plantations, or (C) to Wild Animals in the preservation of which he is interested, or (D) Plants in the preservation of which he is interested.

SUB-GROUP A. ANIMALS WHICH CONCERN MAN BY CAUSING BODILY INJURY OR DISEASE TO HIS STOCK OF DOMESTICATED ANIMALS.

Horse Worms and the Use of Thymol.

The following enquiry was received from a correspondent at Fort Camden, Crosshaven, Co. Cork, regarding horse worms and their treatment:—

“Seeing several articles lately in the *Field* about the use of Thymol for the eradication of worms in horses, and on the 5th a letter from the Hon. Miss Dillon mentioning your name as having had a large experience in the use of Thymol for that purpose, I would be obliged to you if you would give me information on the following points:—The amount required for a mare 15·2, five years old; the worms are about one inch long, small white ones. The mare has been out on grass all the summer till about a month ago. Should the mare be kept on bran mashes for a day or two before giving Thymol.”

The following reply was sent:—

“From your description I imagine the worms in your mare are the Maw Worm (*Oxyuris curvula*). Thymol has been found of great benefit for these nematodes, as well as for the armed strongyles (*Sclerostomum equinum*, *S. tetracanthum*, and *S. rubrum*). The best plan is to give bran mashes the day before and then give the Thymol in sweet milk. Fifteen grains have been found sufficient early in the morning and again in the afternoon for all horses.

Up to three drams may be given, but in all cases I have known, fifteen grain doses are sufficient, and more simply produce collapse. This can of course always be counteracted by administering stimulants." *

The importance of Thymol as a nematocide is now well-known, it being especially valuable for the armed sclerostomes that cause often fatal epizootics in studs in this country.

Depluming Scabies (*Sarcoptes laevis*) in Fowls.

Amongst the enquiries regarding animal parasitic diseases was one from Mr. K. J. J. Mackensie, Lecturer on Poultry-keeping to the Suffolk County Council, regarding Depluming Scabies in Fowls. Feathers were sent from birds suffering from an ailment with symptoms pointing to this disease. An examination of the feathers sent did not reveal any *Sarcoptes laevis*. This mite, which produces the acariasis, ending in loss of feathers, lives at the base of the quills amongst a white powdery substance. The feathers sent had broken off close to their roots, and any powdery substance attached would have gone. As far as one can say without definite proof (i.e. the actual presence of mites) the feathers looked as if the parasite had been at work. To be sure of this it would be necessary to send feathers pulled out from the diseased bird that do not seem diseased, and also scrapings of the skin from the invaded areas; such material must be fresh or sent in dilute spirit. This disease was found by Italliet in 1886 in a poultry-yard in Normandy, and since in many fresh areas. In this country there is a general idea that "feather-pulling" or eating is due solely to vicious habits, whereas it is nearly always due to the minute Sarcopt mite which lives around and at the base of the feathers. This acarus is most abundant in spring and summer; males, females, and larvae are all found together around the bases of the feathers on any part of the body. A dozen or more mites may often be found in close proximity, causing the irritation which leads to the birds plucking at the feathers.

* Alcohol must not be used as a stimulant after Thymol.

SUB-GROUP B. ANIMALS WHICH CAUSE INJURY OR DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION I.

ANIMALS INJURIOUS TO AGRICULTURE.

FRUIT PESTS.

The Bud Moth.

(*Hedya ocellana*, Fab.)

Numerous enquires have been made during the past summer concerning the larvæ of a small Tortricid Moth which damages the buds of various fruit trees when they are bursting and for some time after. These larvæ which are prevalent to a greater or less extent every year are mostly those of the Bud Moth (*Hedya ocellana*, Fab.). This fruit pest has long been known in Europe, Kollar having described its ravages as far back as 1857. Since that date little has been added to our knowledge in Europe, but in 1896 Slingerland published a detailed account of its life-history. The accounts of Kollar and Slingerland differ in some essential points, but the insect they write about is undoubtedly the same. It is quite probable that both observers are right, the insect living in two ways, as we see may occur in the case of the Colorado Beetle (*vide p. 87*). The Bud Moth not only occurs in Europe, but also on the North American Continent, both in Canada and the United States. The south of England has been most affected by its presence, but it occurs in the western and eastern counties. It has been especially recorded from Bournemouth. Most fruit trees are subject to its ravages, but cherry and apple suffer to the greatest extent. The "Bud Moth" has been described under a great variety of names, some of which are given below:—

- Hedya ocellana*, Fab.
Penthina ocellana, Tr.
Spilonota ocellana.
Pyralis luscana, Fab.
Tortrix comitana, Hb.
Tmetocera ocellana, Schiff.
Penthina oculana, Harris.
Penthina pyrifoliana, Clem.

The following references have been kindly supplied by Mr. John Hartley Durrant :—

TMETOCERA (Ld.)

Tmetocera ocellana, Schiff.

a *OCELLANA*, Schiff.

= *luscana*, F.; = *comitana*, Hb.; = *pyrifoliana*, Clem.; = *oculana*, Harris;
= *oculina*, Pack.

Tortrix ocellana, Schiff, Syst. Verz. Schm. Eur., 130, No. 7 (1776).

Pyralis ocellana, F., Mant. Ins. II., 228.

Pyralis luscana, F., Syst. Ent. (1787); III. (2), 255, (1793).

Tortrix comitana, Hb., Sml. Schm. Ent. (1800).

Grapholita (Tmetocera) ocellana, Schiff.

= *laricana*, Z. Stett. Ent. Ztg., XXXIV., 129-130 (1873).

Zellerana, Borgmann, Forst. N.W. Ztschr. (Tubeuf), IV., 171.

Tmetocera ocellana + *laricana*, Stgr. and Rbl., Cat. Lep. Pal., II., 128,
No. 2255, 9 (1901). M. Europe.

LITERATURE.

Penthina pyrifoliana, Clem., Pr. Ac. Nat. Sc. Phil., 1860, 357 (1860).

Penthina oculana, Harris, Inj. Ins., 482 (1862).

Penthina oculana, Pack., Rp. Mass. Bd. Agr. (1869); Am. Ent., I., 251.

Grapholitha oculana, Sndrs., Can. Ent., III., 13, fig. 9 (1871).

Grapholitha oculina, Pack, Mass. Agr. Rpt. (1870).

Grapholitha oculina, Pack, Am. Nat., IV., 684 (1871).

Tmetocera ocellana, Z., Beitr., 61 (1875).

Tmetocera ocellana, Fern., Tr. Am. Ent. Soc., X., 48, No. 349 (1882).

Tmetocera ocellana, Fletch., Rept. Dep. Agri. Can. (1885).

Tmetocera ocellana, Harvey, Ann. Rp. Marine Exp. Stn. (1888).

Tmetocera ocellana, Tern, Hatch. Exp. Stn. Rp., 1888, 11-12 (1889).

Tmetocera ocellana, Cook, Ann. Rep. Mich. Agri. Exp. Stn., IV. (1891).

Tortrix comitana, Hw., Lp. Br., 434 (1811).

Tortrix luscana, Tröl., Enum. Tortr. Würt., No. 106 (1828).

Penthina luscana, Dp., H.N. Lp. Fr., IX., 203, pl. 245, 10 (1834), and
Supp. IV., pl. 84, 2.

Penthina ocellana, Tr., Schm. Eur., VIII., 40 (1830).

Penthina ocellana, Tr., Schm. Eur., X. (3), 51.

Penthina comitana, Wd., Ind. Ent. (1833-9).

Penthina ocellana, Tr., Treat. Ins. Kollar, 234 (1837).

Tortrix (Penthina) ocellana, HS. and SB., Schm. Eur., IV., 233 (1849).

Hedya ocellana, Wilk., Br. Tortr., 118 (1859).

Tmetocera ocellana, Ld., Wien Ent., III., 367-8 (1859).

Grapholitha (Tmetocera) ocellana, Hein., Schm. Deutsch. Tortr., 206 (1863).

Tmetocera ocellana, Stgr., Cat. Lp. Eur., 260, No. 1210 (1871).

Grapholitha (Padisea) ocellana, Snell, Vlind. Ned. Mier., 325-6 (1882).

Tmetocera ocellana, MP. and FT., Nat. Sc., VIII., 188 (1889); Meyr.
H. B., Br. Lp., 476 (1895).

Tmetocera ocellana, Stgr. and Rbl., Cat. Lp. Pal., II., 125, No. 2255 (1901)..

Hedya ocellana, Theob., Agri. Gaz., 7. 7, and 14. 7 (1902).

β . OCCELLANA, Schiff.; + LARICIANA, Hein.

= zellerana, Brgnn.

lariciana, Hein, Schm. Deutsch. Tortr., 206, No. 371 (1863).

Spilonota lariciana, Knaggs, Ent. Ann., 1866, 166 (1865).

Hedya lariciana, Brit. Ent. Mo. Mag., X., 66 (1873).

Tmetocera ocellana, Tern, Mass. Agr. Exp. Stn. Bull., 12 (1891).

Tmetocera ocellana, Ltnr., Can. Ent., XXIII., 231-2 (1891); Rept. N.Y. VII. (1891).

Tmetocera ocellana, Fletcher, Rp. Dp. Agr. Can., 1891, 195 (1891).

Tmetocera ocellana, Slingerland, Cornell Univ. Agr. Exp. Stn., Ent. Div., Bull. 50, 3-29, figs. 1-8, III. (1893).

Tmetocera ocellana, Slingerland, Cornell Univ. Agri. Exp. Stn., Div. Ent., Bull. 107, 57-66, figs. 32-39 (1896).

Tmetocera ocellana, Ltnr., U.S. Dept. Agr., Div. Ent. (n.s.), Bull. 6, 54, N.Y. (1896).

Tmetocera ocellana, Sndrs., U.S. Dept. Agri., Div. Ent. (n.s.) Bull. 26, 69 (1900).

HOW THE PEST MAY BE DETECTED.

The presence of this fruit pest may be detected by the early destruction of the developing buds, which on partly opening are seen to be eaten and shrivelled and which soon turn brown; these buds will be found to contain a small reddish-brown caterpillar, the cause of the injury. Later the damage is still more noticeable, the opening leaf and blossom being spun together, for both leaf and blossom buds are attacked. There may frequently be noticed a gummy appearance of the opening leaflets. The larva enters the bud, if it has not already burst, by eating down between the bracts, and there, as described by Kollar, a drop of sap forms which tends to hold the bud intact and to stop it from bursting; in any case if it does open the young leaves soon shrivel and turn brown. During the past summer, trees, especially cherry, have been quite ruined in this way. More usually, many of the buds fully open, leaf and blossom appearing as usual, the caterpillars later spinning the bunches of leaves and blossoms into a mass with silk. These leaf nests frequently die right away and turn brown in a very characteristic manner. Slingerland states that in America the larvae also sometimes "burrow down the stalk for two or three inches, causing it to die." This habit has not so far been observed in England; in all cases the larva boring down the top shoots of apple and pear has proved to be that of the Pith Moth (*Lavernea atra*) (*vide p. 68*). When nearly mature the Bud Moth larva forms more or less of a tube by rolling up a leaf and roughly lines it with loose silk. The caterpillar at first only uses this tube as a shelter from which it emerges to feed, gradually drawing the neighbouring leaves together by silken cords. From

observations made during the last few years it seems that the caterpillars chiefly feed at night.

LIFE-HISTORY.

The Bud Moth (Fig. 5, *d*) is one of the *Tortricidae*. It varies in length from half-an-inch to two-thirds across the expanded wings. The front wings are dark grey with a broad greyish-white band across the middle with grey spots and streaks; near the anal angle of the wing is a triangular blackish spot and towards the tip a leaden-grey eye-like spot with several black dots. The hind wings are grey. The

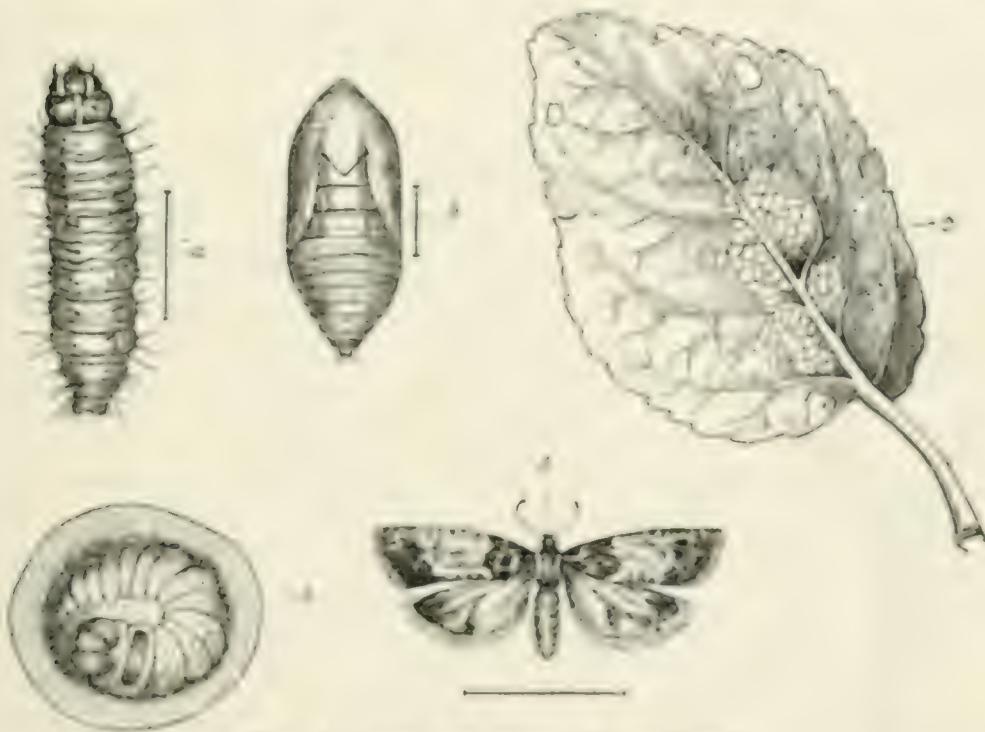


FIG. 5.—THE BUD MOTH (*H. osellina*).

a, The lava; *b*, the pupa; *c*, leaf eaten by larva in autumn; *d*, moth; *e*, egg (after Slingerland).

fore wings are subject to considerable variation; in some specimens the median greyish-white band is distinctly dull slaty-grey.

This moth appears in June and July when it may be seen flying about in orchards, gardens, and lanes at dusk. During the day they rest amongst the leaves of the trees and upon the trunks, their coloration rendering them most inconspicuous, especially when resting on an old moss or lichen grown tree.

The female lays her eggs at night; they may be deposited singly or in clusters, usually upon the upper sides of the leaves. Kollar states, however, that they are placed at the base of leaf and fruit buds and that they remain as ova during the whole of the winter. Both

Fletcher and Slingerland have found that the eggs hatch in late summer and early autumn and that winter is passed in the larval stage. This is undoubtedly the usual case, but that some hibernate in the egg condition I think very probable, as I have found young larvæ in the early spring not more than one-twelfth of an inch long, whilst those that hibernate are considerably larger.

The eggs (Fig. 5, *e*) are flat, round or oval, the centre being slightly elevated, they are very transparent and look like little drops of gum on the leaf. When several are laid together they overlap one another like fish scales. In general appearance they resemble the ova of the Codling Moth; the outer edge is marked with a well defined reticulate sculpturing; the central part of the egg is usually green, the colour being due to the developing larva within showing through.

The egg stage lasts from seven to ten days. The young larvæ on coming from the egg at once commence to feed upon the lower layers of the leaf, forming for themselves a little tube of silk open at each end and attached to the leaf, usually at the mid-rib. When feeding

off the leaf the larvæ form a slight silken web which serves as a protection for them. In this manner the larvæ go on feeding until about the middle of September, by which time they are about half grown. Professors Slingerland and Fletcher were the first to show that these small larvæ pass the winter in small silken cases on the trees, as inconspicuous objects covered with dirt and not more than one-eighth of an inch long. These winter houses (Fig. 6) are found at the base of a bud or under a dead leaf or bud scale. When quite young the larvæ are green, and this is the colour most usually found when they are in their "houses." When the buds commence to swell they crawl out and enter them and become dull reddish-brown with black head and black first segment; when nearly mature they become a more pronounced reddish-brown, the dark head, first segment and legs showing up prominently. When quite mature they reach half-an-inch in length.

During the latter part of their life they feed amongst the leaves, which they spin together, and pupate in a tube of dead leaves as previously described. The pupa is bright brown, with two rows of backwardly projecting spines on each segment.

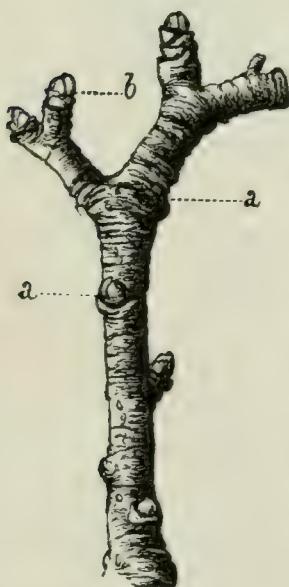


FIG. 6.'

Twig with larval cases (*a*) of Bud Moth and buds (*b*).

One brood only occurs in Great Britain. The moth is very common all over the South of England, but becomes rarer in the North.

FOOD PLANTS.

All fruit trees are attacked by this pest, but it is especially cherry and apple that suffer in this country. It also occurs on the sloe and plum, and has been recorded from the blackberry, whilst in North America it attacks the peach and quince also.

NATURAL ENEMIES.

Five species of Ichneumon flies prey upon the caterpillars of this moth in Europe, but none have been noticed in Great Britain. In North America they also are preyed upon by three species of Ichneumons. Amongst birds we find the blue and great tits (*Parus caeruleus* and *P. major*) picking the larvae out of the buds and leaf nests. The sparrow also has been observed feeding upon them. A large sand-wasp, *Odynerus catskillensis*, stores its nests with these caterpillars in North America. None of these natural enemies, unless it be the Paridae or Tits, do much good in keeping down this Bud Moth.

METHODS OF PREVENTING THE RAVAGES OF BUD MOTH LARVAE.

Now that we know that the larvae feed upon the leafage in the late summer we can to a large extent check the ravages of this pest by arsenical spraying. Larvae are always more easily destroyed when young, and there is not the least doubt that *spraying in the autumn* will kill them. There should also be a second washing in the spring when the caterpillars are to some extent exposed just when the buds are bursting, and this followed by a third dressing to kill those that escape when they are in their leaf and blossom nests. Hand-picking may be resorted to in gardens and nurseries and where single low trees are invaded, the leaf nests being easily seen and picked off by hand before the moths have emerged from the pupal stage.

Washing with caustic alkali wash does not seem to check this pest, for trees so treated last winter (1902) suffered severely from the Bud Moth and also Pith Moth. Probably the larval cases were hidden under the bud-bracts and in such places that the wash does not reach, the larval cases also protecting the caterpillars within from the burning action of the wash.

THE ALLIED BUD MOTH.

(*Antithesia variegana*, Hb.)

Another *Tortrix* lives in a very similar way to the Bud Moth, namely, *Antithesia variegana* or *A. cynosbatella*. This moth is about two-thirds of an inch in width of expanded wings; the fore wings have the basal two-thirds brownish-black, the apical third is white clouded with grey towards the hind margin; there are also two or three black spots projecting from the edge of the central band. The moth appears in June, and lays her eggs on the leaf. The larvæ are thick and dark green with black spots; the head and first segment also being black. They may be found in the early spring on hawthorn and sloe growing in the hedgerows and also in most apple and pear orchards. The winter is passed, according to Mr. Newstead, much in the same way as the Bud Moth.

Penthina pruniana, a closely related species, also probably lives in the same way.

The Pith Moth.

(*Laverna atra*, Haw. ; *putripenella*, Zell.)

Numerous inquiries were made during the past year concerning the larva of a small moth—the Pith Moth (*Laverna atra*). This attack has been known to fruit-growers and gardeners for a long time. It is noticed every year, but in 1902 it was abnormally abundant, and a vast amount of damage was done by it over Great Britain. The moth is not often seen, and probably but few people are acquainted with it. It occurs over a large area of England up to Newcastle.

The damage done by the larvæ is particularly noticeable in nursery stock. They burrow up the terminal shoots and kill them, the result being deformed and stumpy trees. The attacked shoots flag and then die and turn brown, the dead masses varying from two to four inches in length. These dead shoots may remain some time on the tree, or they may fall to the ground naturally, or be beaten off by heavy rain. The attack may readily be told from that of the Bud Moth by the absence of leaves spun together, and the absence of damaged buds and blossom; but the whole shoot dies away. Apple trees are chiefly attacked, but reports of its ravaging pears have also been received. The larvæ are also found on hawthorn and other wild Rosaceæ.

Although it is a wide-spread pest, the following localities may be

mentioned as having been particularly troubled with it : Worcester ; Herefordshire (Ross) ; Gloucester ; Cambridgeshire (Wisbech) ; Bournemouth ; Sussex (especially at Polegate) ; Surrey and Kent generally.

LIFE-HISTORY.

This moth belongs to the group of small moths known as *Tincina* and to the genus *Laverna*. Its wing expanse is a little less than half an inch when fully expanded ; the front wings are almost entirely black, but may be mottled with black, dark brown and rusty brown ; the inner margin of the fore wings is white to beyond the middle, where an irregular oblique white bar proceeds to the tip of the wing, and two branches from this intersect the black apical portion ; the posterior wings are grey and, like all *Tincina*, have long fringes ; the head is almost entirely white. It is subject to much variation. Some specimens are almost black ; these Stainton considers a distinct variety. The moth appears in June according to Stainton, but all those that have been bred or observed appeared in July. Some received in 1898 hatched on July 5th, others not until the 21st. Difference of locality is sure to account for a difference in the time of their appearance.

The eggs are apparently laid on the leaves ; no definite observations have been made, however. In July I found several small batches of eggs on an apple tree previously badly attacked by Pith Moth, but I am not certain if they were those of the Laverna. They occurred in small batches from one-fifth to one-fourth of an inch long ; in form they resembled those of the Bud Moth, viz., flat and scale-like and almost transparent. One batch was composed of twenty eggs overlapping one another like fish scales. The whole surface of the egg is covered with a well-defined reticulate sculpturing, not the outer part only, as in those of the Bud Moth or Codling Moth. *Penthina variegana* was seen near this tree, so that it may be the eggs were of that insect.

In any case the eggs, whatever they may be like, give rise to the larva the same summer, and the young larvæ feed first on the leaves. As winter approaches, the larva, which are still quite small, bore just under the bark of a twig or into the apex of a shoot and remain there most of the winter. During January and February the larva tunnel right into a young shoot and work up the pith (Fig. 8, a). In this tunnel the caterpillar lives until June ; its presence does not stop the leaves and blossom from unfolding, although later they flag, turn brown, and die right off (Fig. 7, b). These dead shoots

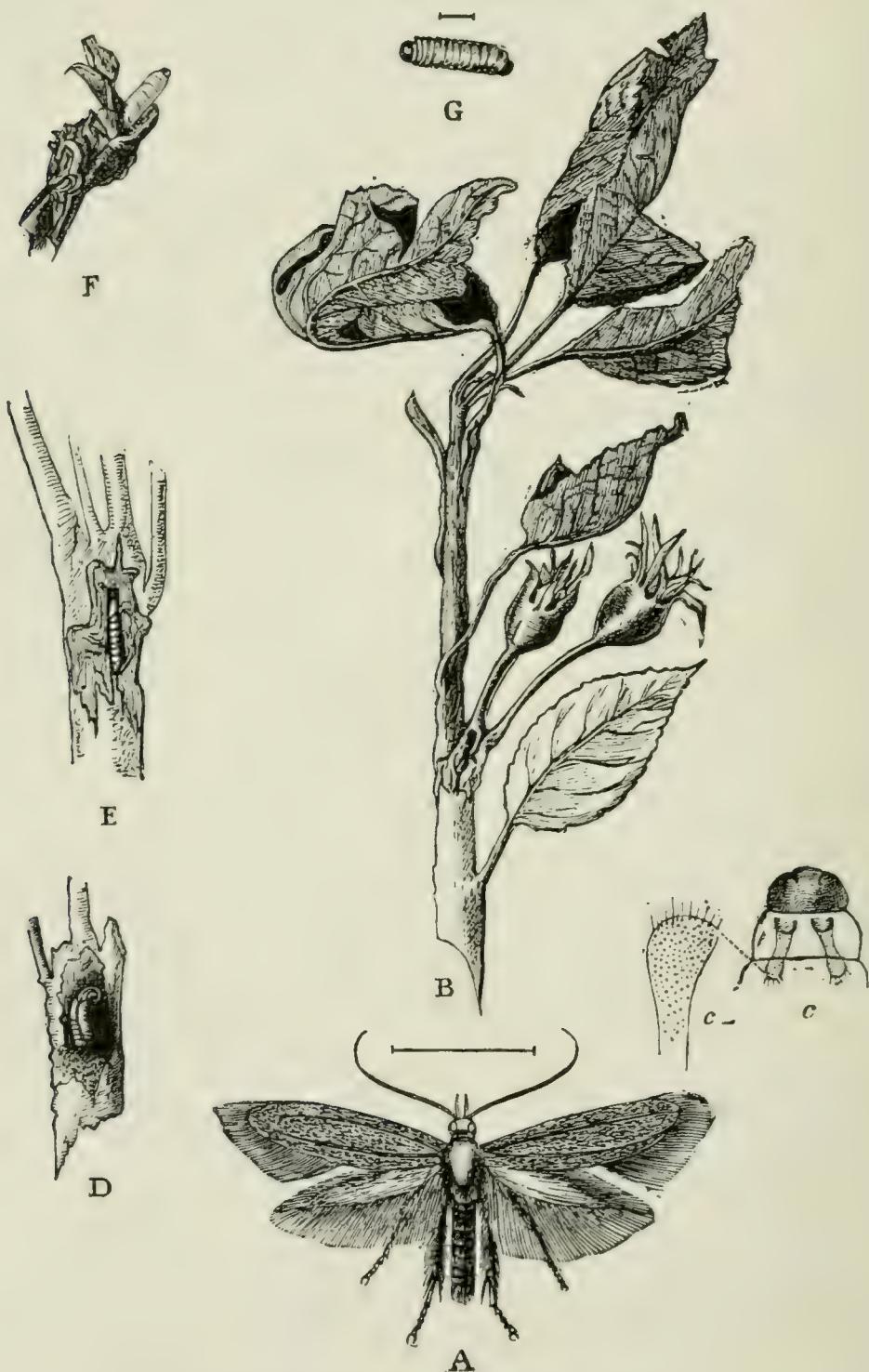


FIG. 7.—THE PITH MOTH (*Laverna atra*).

A, Imago ; B, attacked apple-shoot, the upper portion shrivelling up and dying away ; C, processes on pupa ; D, pupa (enlarged) in situ ; E, showing position of larva (natural size) in situ; F enlarged larva in broken open bud ; G, larva (enlarged).

if broken off will be found to contain the Pith Moth caterpillar or pupa, usually situated near the apex of a shoot.

The larva (5) is dull reddish-brown with a deep brown head and first segment; the other segments show more or less traces of pale brown spots four in a row on the second and third segments and four placed in a quadrangle on the remaining segments. The two anterior segments have two lateral spots and the remainder a single lateral spot. The apex is deep brown. When mature they reach one-third of an inch in length and then pupate near the apex of the shoot they have tunnelled. They reach their full-fed stage during the last two weeks in June. If the dead shoots are picked off, the moth can be easily bred.

The pupa (10) is of an ochraceous hue; the head and front of the thorax and tip of the body mahogany red. It is cylindrical in form and about one-fourth of an inch long. On the ventral surface of the penultimate segment are two blunt processes separate and diverging outwards, hairy at their apices (Fig. 7, c); the eyes are black and the wing cases and legs long, the former pointed. This stage lasts from two to three weeks, the moths emerging from the end of June into July. The pupa may sometimes be seen projecting from the dead shoot. Stainton says the larvae also occur in hawthorn berries in September and that the black variety only is found in apple shoots in February and March.

PREVENTIVE MEASURES.

It is quite obvious that there can be no remedy for this pest, but we can do much in the way of prevention by hand-picking the dead shoots before the moths emerge in June. This can only be done, of course, where small trees are attacked, and it usually happens that it is only on such trees that the attack takes place.

Late spraying with Paris green would probably prove beneficial, as it would kill the young larvae, which seem to feed first of all on the leaves. Of course, care must be taken in regard to the fruit. The trees should be washed not less than four weeks before the fruit is gathered, but as soon as it is harvested a heavy spraying may be given.

The time to spray therefore must depend on the variety of apple concerned. This is certainly worth giving a fair trial, as beyond hand-picking we can do nothing to check the increase of this pest, so noticeable during the past few years.

The Pear and Cherry Sawfly or Slugworm.(*Eriocampa limacina*, Cameron.)

A few enquiries were received during the past year regarding the Pear and Cherry Sawfly (*Eriocampa limacina*). This fruit tree pest has not been so abundant as usual during the past summer and autumn. In some districts where it is usually harmful it has scarcely been noticed. One correspondent writing from Sittingbourne, Kent, asked for information concerning these pests, "found in numbers on and destroying his plum and cherry trees," and for the best means of preventing and destroying them. Their normal food plants are cherry, pear and sometimes hawthorn. It has not been notified before as injurious to plum, although Miss Ormerod mentions plum, and sometimes peach, as being occasional food plants, and on one occasion it is recorded on the quince. Cameron, in his work on "British Phytophagous Hymenoptera" (vol. i. p. 225), mentions other food plants, as *Rubus*, *Amygdalus*, *Quercus* and *Betula*.

There is no doubt that this insect is very susceptible to damp weather and thus has not been nearly so harmful during the past year.

Considerable relief from this pest has been reported by adopting the plan of removing and burning the surface soil during the winter months from beneath trees that had been attacked.

Notes on Fruit Pests in Orchards at Wisbech.

Some interesting notes on the ravages of insect pests were sent, together with an enquiry as to the cause of the damage, from Mr. B. W. Gatherwood, of Wisbech. In this letter he states that—

Plum blossom was cut off by frost, but apple trees mixed with the above were comparatively all right, except for a few caterpillars, of what I took to be the Winter Moth, on the 24th of May, the trees showing every sign of a plentiful crop of apples. I may say in the last week of April and the first week in May we syringed twice with Paris green (1 in 200). When I returned home on the 7th of June my apple trees and some of the plum presented an appearance as if a hot blast of air had passed over the whole garden, withering all shoots, leaves, and flowers ; the few leaves left were all riddled with holes, leaving only the ribs of the leaf. I could find no insects then or since except a few green caterpillars. I am quite at a loss to know the cause of this wholesale destruction. I should be glad to have a reply from you on the subject, and you would be conferring on the district a great boon if you would suggest a remedy. I firmly believe if we had kept dressing the trees with the solution mentioned until the apple blossom had gone we should have had a crop.

To this the following reply was sent :—

From the fact that you sprayed twice with Paris green, and the description you give of the withering plants, leaves, and flowers in your orchards, I feel pretty certain you have been suffering from the combined attack of two of the prominent apple and pear pests this season, viz., the Pith Moth (*Lamoria etrea*) and the Bud Moth (*Hedya ceculana*). The former is most abundant generally, but I have had many reports of the damage done by the latter.

The Pith Moth is in the pupal stage in the dead shoots still and will soon hatch out. On a small scale these should be hand-picked, but I doubt if it could be done in large orchards. But judging from the recorded facts in the life-history of these two moths, I am strongly inclined to believe we can cope with them on a large scale by autumn and late summer spraying, for the eggs hatch out in July and the larvae (small) feed until the winter, when they hibernate. Arsenical spraying then, say in August (depending on the fruit), and again as soon as the crop is harvested would give relief, for at no other time can we get at the Pith Moth, and not at the Bud Moth until it has done the damage. The green caterpillars you refer to, if they are not "loopers," are probably *Penthina variegana*, one of the Tortrices related to the Bud Moth.*

Phyllobius or Leaf Weevils.

A single instance only of the attack of Leaf Weevils has been reported. In districts where they are usually very abundant they have only occurred in small numbers during the past summer. Messrs. James Carter & Co. sent specimens of the species *Phyllobius viridaris* on the 19th of June, stating that they were overrunning the garden of a client, and asked for information how to eradicate the pest. This particular leaf weevil is common on elm hedges as a rule. The following reply was sent :—

With regard to eradicating this pest, the only treatment is as follows :—

1. Spraying with Paris green wherever the foliage can be so treated now (i.e. on apple, plum, pear, and nut).
2. Beating down the beetles on to tarred sacks in early morning has been found to clear a garden speedily of this pest.

But probably spraying will be the least costly treatment if on a large scale.

Insects on Vines in Jersey.

Three kinds of Arthropods have been sent by Col. Sanderson, from Jersey, attacking the vines, with enquiries regarding them. They were the following :—

* Since this report was sent, I have found the treatment advised has cleared apple trees of the young larvae.

- (i.) Two small larval mealy Bugs (*Dactylobius citri*).
- (ii.) A single mite (*Tetranychus telarius*).
- (iii.) Several specimens in larval, pupal, and adult winged stages of one of the Pseudo-Neuroptera belonging to the family *Psocidæ*.

The following note was sent to Col. Sanderson :—

The life-history of the *Psocidæ* is roughly as follows : The females lay their eggs in patches on leaves, bark, etc., of trees and plants and other objects, many on dead and decaying matter and preserved objects. The females cover the eggs with a web. Larvæ and pupæ are much alike ; wing-buds gradually appear on the larva and so the pupal stage is assumed. Dry vegetable matters and lichens form the food of one section (*Phocina*) ; the food of the other section (*Atropina*) is dried insects, plants, books, papers, etc. One of the latter, *Atropos divinatoria*, is sometimes called the Death Watch. A beetle, *Anobium tessellatum*, is also called the Death Watch. The *Psocidæ* do much harm to papers, books, and insect collections. The *Phocina* live more or less in societies on tree trunks, palings, and amongst rough herbage and on trees, especially on Conifers ; both sexes can spin a web of silk. Some species do harm to living plants, but the majority do not. The *Psocidæ* sent belong to the genus *Cœcilius*.

With regard to the male "Mealy Bugs" which you enquire after, they can soon be told, for they have one pair of wings as in all other Coccidæ, and thus differ from the winged Psocids.

The common "Mealy Bug" is known as *Dactylobius citri*, Boisduval, and is the same as *D. destructor* of Comstock. It is a world-wide species. The males are not so very rare ; they are of a dull reddish colour and have two long white thread-like processes at the end of the body ; the single pair of wings are dark iridescent blue, and when the insects are settled these wings overlap and hide the abdomen. They are very different in appearance from the sedentary females.

Two other "Mealy Bugs" occur in Great Britain, namely the Long-fringed Mealy Bug (*D. longipinus*) and the native Laburnum and Gorse Mealy Bug (*Pseudococcus ulicis*). The former can be told by the long margined processes. The latter is really non-injurious.

The other forms you sent with the winged *Cœcilius* were its larval and pupal stages. Many of the *Psocidæ* remain very like the larval stage you send, i.e. in an apterous condition.

The Mussel Scale or Oyster-Shell Back Louse.(*Mytilaspis pomorum*, Bouche.)

Numerous enquiries are constantly being made by fruit-growers and gardeners concerning the Mussel Scale (*Mytilaspis pomorum*). There being no leaflets issued or other ready information for fruit-growers, the following notes have been prepared with a view to meeting this want.

The Mussel Scale is found chiefly on apple, but also on pear, currant, plum and wild *Crataegus*, such as the Hawthorn. I have also found it abundantly on Blackthorn in Devonshire. This

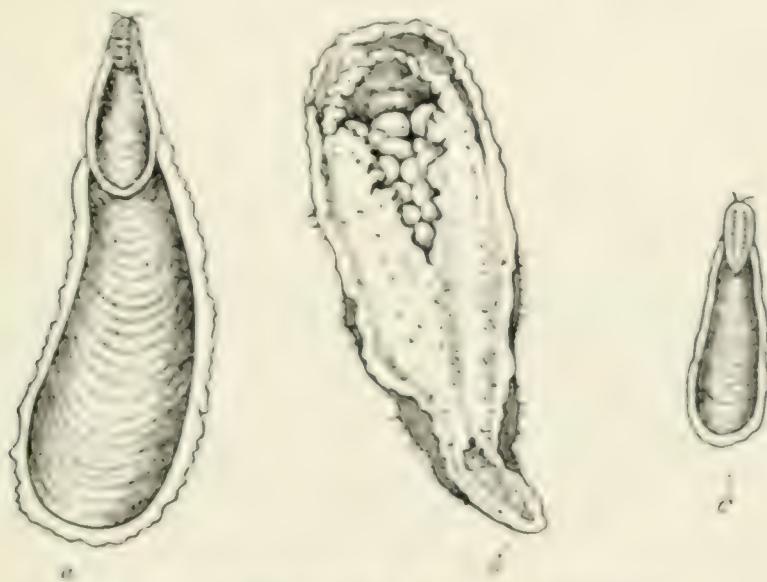


FIG 8.—MUSSEL SCALE (*Mytilaspis pomorum*).
a, Upper; b, lower surface of ♀ scale; c, ♂ scale. (Greatly enlarged.)

pest, the worst scale insect we have in Great Britain, is found in North America, and also in Australia, New Zealand, and South Africa, having been imported on nursery stock. In this latter way it is also largely distributed in this country. The necessity of fumigating young stock before planting is thus rendered essential and should be done by all nurserymen before their stock is sent out. A few scales may easily escape detection and so set up a large colony, to the detriment and even death of the tree. I know of no district in England where this pest does not occur in greater or less abundance. Old trees and neglected orchards chiefly encourage it, but young stock suffer far more than old.

This scale insect is frequently taken for growths on the bark.

The scale is the product of a minute insect belonging to the

Coccidæ; the male and female scales differ in appearance and size; the male scales are seldom observed.

The female scale (Fig 8, *a* and *b*) is about one-eighth of an inch long; in form the scales are rounded behind, but taper to a point at one end—the head end; they may be straight or curved, and even much contorted. In colour they vary from deep brown to almost grey. The male scale is much smaller than the female and of the form shown in fig. 9, *c*. They damage the trees by sucking out the sap by means of long, flexible mouths which they insert into the plant tissues. This scale not only occurs on the trunk and boughs of the trees, but also on the leaf and fruit. Foreign apples are frequently imported covered with this and other scale pests. The scale, as in all *Coccidæ*, is a product formed by the insect which lives beneath it, partly by excretions from its body, partly by the cast skins of the insect, the so-called *exuviae*.

LIFE-HISTORY.

The eggs (Fig. 3, *a²*), are laid by the sedentary female under the scale. They resemble to the naked eye small whitish dust. As many as eighty may be counted under a single scale, but the number varies considerably. The eggs give rise in the early summer to very small active six-legged larvae, which crawl from beneath the scales and may be distributed from tree to tree by the wind, by birds, and by predatory insects, such as lady-birds. They are about one-hundredth of an inch long. In a short time they fix themselves to the plant by their short proboscis and draw away the sap; the scale then commences to form by the excretion of a few waxy threads and gradually grows to the form shown in Fig. 8. During this period the larva loses its legs and becomes converted into a fleshy legless creature; the female remains feeding beneath the scale and is provided with a long flexible proboscis, which is inserted into the tissues of the plant. Towards the end of the summer she deposits her eggs and dies, her shrivelled skin remaining beneath the scale.

If the larva is going to become a male, not only is a different scale produced (most often upon the leaves), but a totally different mature insect. The male undergoes a kind of pupal stage and escapes from the scale as a small winged insect, provided with two rather large wings and a pointed process at the end of the abdomen, which it can insert under the female scale and so carry out fertilisation. The males are very rare, most of the females reproducing asexually. A single brood normally exists in this country.

NATURAL ENEMIES.

Scales have many natural enemies, but this species and those that attack the currant in this country are not materially lessened by them. Anyone trusting to parasites to help the farmer in this respect evidently is not acquainted with these pests in our orchards. Amongst the natural enemies birds alone do any good. The *Paridae* or Tits feed upon this scale, and a few other birds on the Tree-creeper and Wryneck. Lady-birds and their larvae eat scale, but none seem very partial to the Mussel scale in Great Britain. Minute hymenoptera—*Chalcididae*—also live as parasites upon them, but seldom do any appreciable good; in the first instance they occur too late in the attack to prevent the damage, and never are sufficiently abundant to check the pest for the following year. Sound advice to fruit growers is to go on washing and ignore the infinitesimal help given by these minute parasites. Also encourage those useful birds the Tits in orchard and garden.

TREATMENT.

The trunks, etc., of all trees must be kept clean, i.e., free from rough bark, moss and lichens. This can be done by washing in winter with caustic alkali wash, which at the same time corrodes and loosens the scales from the trees. Trees badly infested should also be sprayed in the early summer about the middle of June with paraffin emulsion, two or three times, at intervals of a few days. This kills numbers of the young and corrodes away to some extent any remaining scales. Whitewashing the trunks of the trees as far as the forks of the boughs does some good and keeps the wood in a healthy state. All young stock should be treated to destroy the scale before being planted or soon after. The best method is fumigation with hydrocyanic acid gas, the most valuable scale remedy.

Oribatidæ or Beetle Mites on Forest and Fruit Trees.

The Beetle Mites are frequently sent by fruit-growers with enquiries as to their economy. The records of them on forest trees are few.

Specimens have been sent from the Director, Royal Botanic Gardens, and received by him from Mr. A. S. Birknell, of Barcombe, Sussex, which are recorded by him as damaging chestnut (horse) and

lime trees. There are a number of species of Oribata; one, *O. globata*, is often present in swarms on fruit trees, especially the plum. Instead of finding them injurious, they appear to be either beneficial or non-obnoxious. They have been seen feeding off the spores of the canker fungus and various green vegetal matters on fruit trees. But in one or two instances fruit-growers have noticed that they have done some harm to the leaves. They often swarm in the forks of the boughs and axils of the twigs and buds. The species sent by Mr. Birknell has been identified by Albert Michael as *Oribata orbicularis*, which also occurs on various fruit trees in Kent.

This species has been dealt with in the Journal of the South-Eastern Agricultural College (No. 6, p. 11 (1897)). Albert Michael, the chief authority on Mites, agrees that these Oribatidæ do no practical harm. Several fruit-growers have informed me that they cause the leaves of the plum to die off, however. It is possible this may have been due to other causes. All cases personally investigated have shown *no damage* to the trees, although thousands of these shiny mites were present.

TREATMENT.

Soft soap wash as suggested by a correspondent would be quite useless. The Oribatidæ have very hard chitinous skins, and probably no wash that could be used in the summer would affect them. Late in the autumn caustic alkali wash might be tried and might prove beneficial.

The method of preparing and using the alkali wash will be found in Leaflet 70 of the Board of Agriculture.

The Pear-Leaf Blister Mite.

(*Eriophyes pyri*, Sch.)

Several enquiries were made concerning the Pear-Leaf Blister Mite during 1902. Information was sent that these little acari enter the leaf by the stomata and live in the soft internal tissues, where they soon commence to form a galled patch. They move from leaf to leaf, but spread very slowly. Often one tree in an orchard will be attacked for years before any neighbouring ones show signs of having contracted the disease. Frequently we see a single branch of a tree diseased year after year and yet the rest of the tree remains clean. In nearly all cases I have seen, the fruit becomes hard and gritty and is usually deformed. All we can do is to hand-pick the

diseased leaves in July, not later, and wash the trees frequently in early spring and autumn with liver of sulphur wash—that is paraffin emulsion and liver of sulphur. Dr. Nalepa informs me the mites winter in the buds.

The "Big Bud" Mite.

(*Eriophyes ribis*, Nalepa.)

A correspondent from near Tewkesbury wrote as follows: "A dealer has offered me 6,000 black currants (Baldwin's), but they contained a lot of swollen buds like the enclosed. I want to know if they are infested with Gall Mites, if so whether it would be safe to plant them." The following reply was sent: "The black currant buds you send are badly infested with the Currant Bud Mite (*Eriophyes (Phytoptus) ribis*). This mite is perhaps more prevalent in the Baldwin currant than in any other variety, but the only kind I have never seen attacked is the old cottage-garden one, that is so prevalent in Kent, a light cropper, however."

"It is most unwise to have any infested plants, however cheap. It is really quite useless attempting black currant growing with the 'big bud' pest in the plantations, as at present there is no known remedy for it. It is most essential to be successful to start on land new to black currants and with clean stock."

Hover Flies (*Syrphidae*: APHIS FEEDERS).

A number of enquiries have been made this season (1902) concerning the leech-like larvae of the Hover Flies (*Syrphidae*). The following note was sent to Mr. Bear, of Hailsham, in answer to an enquiry as to the nature of these larvae:—

The three larvae you send feeding on the Apple Aphid are those of one of the Hover Flies (*Syrphidae*) *Cylindromyia pyrastrii*, Linn. They are most beneficial, being ravenous Aphid feeders attacking all kinds of "Dolphins."

There are a good many species, sufficiently abundant to do a great deal in keeping Aphids in check, but unfortunately they come rather late and much harm is often done by the Aphides before they make their presence felt. *Syrphus ribesii*, Linn., and *S. grossulariae*, Meig., seem to be the most abundant after the one you send.

These three species were sent from widely different localities.

ANIMAL PESTS OF HOPS.

Woodlice in Hops.

Specimens of the so-called Monkey-peas were forwarded on the 2nd of June from Macknade, Faversham, by Mr. F. Neame, with the following note :—

I noticed the other day in one of the hop gardens large numbers of the insect commonly known as "Monkey-pea." Are they likely to damage the bine at all by biting it? If you could inform me on this point, I should be much obliged.

The following reply was sent :—

The so-called "Monkey-peas" or woodlice are omnivorous feeders. They sometimes do considerable harm out of doors as well as in greenhouses, especially to soft fruits. I have never heard of them damaging hops in any way, but it is quite probable that they would do so if present in sufficient numbers. They are more likely to eat away on the surface of the ground than upon the bine. Strawberries are often gnawed away around the crown by them. Woodlice can easily be trapped by putting old baskets full of damp moss upside down, beneath which the woodlice congregate and can easily be collected.

CEREAL PESTS.

Beetles on Barley affected with Smut.

Specimens of barley affected with "Smut" and small beetles found with the fungus were received on 26th June (1901) from Mr. Neame, of Faversham. Mr. Neame stated that he found them in a field of barley badly affected with smut; they were of a glistening black colour, and seemed to be only on the ears affected by smut, and occurred on almost every foul ear that had recently speared. Where the smut had begun to blow away he could not find them. They seemed to be eating through the skin of the ears. The following answer was sent to his letter of enquiry :—

The Beetles you send are known as *Phalacrus corruscus*, Paykull. They are common and generally distributed throughout the London and Southern districts, rather common in the Midlands, rarer further North. I do not know anything of the economy of the five British species, but they are certainly not injurious. Two N. American species, *P. politus*, L., and *P. penicillatus*, Say, have been noticed to feed upon the spores of the Smut-fungus on wheat. There is no doubt, I think, that those you notice in your barley are there, as you say, to feed off the fungus attacking the crop, and that they may therefore be looked upon as beneficial creatures; but at the same time it is very probable they carry the spores about with them and so help spread this serious cereal malady.

POTATO PESTS.

The Rosy Rustic (*Hydracia micacea*) attacking Potatoes.

Amongst the numerous enemies from which the potato crop suffered during 1902 were the larvae of one of the noctuid moths known as the Rosy Rustic (*Hydracia micacea*). This attack was reported to the Board of Agriculture from two localities, namely from Winton, Manchester, and from near Wigan, Lancashire, and was also observed personally. The two notes sent with these larvae were as follows :—

(1) Enclosed are grubs that have attacked and are destroying a large patch of potatoes ; will you kindly say what they are and what remedy I can take.

(2) I herewith send two insects that I have found amongst my potatoes. They were looking well to about a week ago. Any information about them will be thankfully received.

In both cases the caterpillars were found to be working in a similar way, namely, by tunnelling up the stalks of the potatoes, completely hollowing them out and so killing the haulm. Should this pest become very numerous it would be a serious matter, as remedies are quite out of the question save hand-picking the attacked haulm. These caterpillars are recorded as feeding in the stems of equisetum, docks, valerian, but probably attack a variety of other plants.

The larva when mature varies from an inch and a quarter to an inch and a half in length. The back and sides are dull purplish-brown, paler on the first three segments and where the segments join, the sides and venter are of a dull flesh colour, the legs pale and the head yellowish-brown ; on the second segment is a brown semi-circular plate broadly margined in front with blackish-brown and a shiny yellowish-brown patch on the anal segment with a posterior border of small dark warts ; on the segments are small dark-brown tubercular warts each with a fine terminal hair ; the spiracles are deep brown and the prolegs pale with black extremities.

Before pupation the larva becomes a paler dull smoky flesh colour all over, with a dusky median dorsal line. The full-fed stage is reached from the beginning to the end of July. During the whole of its life the larva burrows up the haulm and emits a great quantity of green frass ; a round exit hole is made in the stem, the frass being

emitted through this. Buckler quotes a letter from the Hon. T. de Grey as follows :—" I first observed the larva by pulling up, on the 14th May, a sickly-looking plant of *Equisetum arvense*. It appeared to be feeding on the root and stem below the surface of the ground,

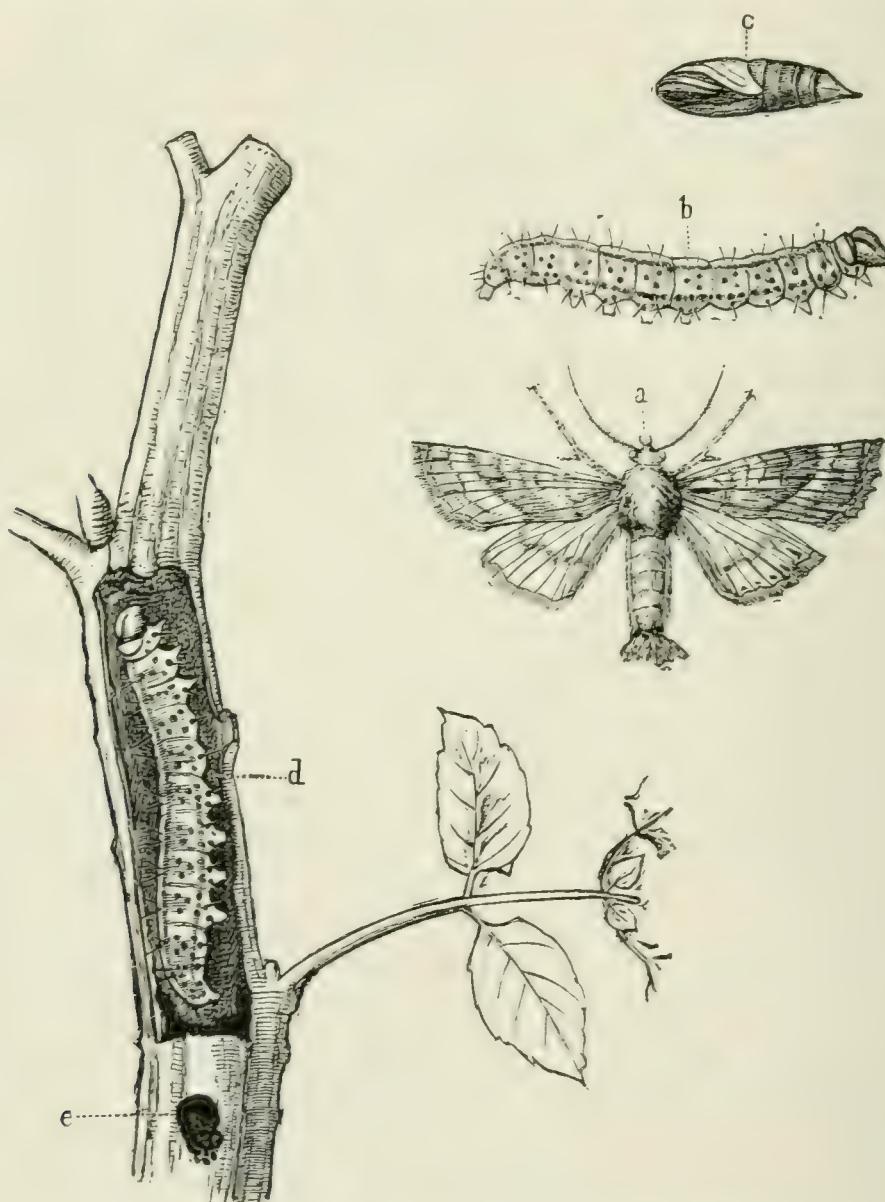


FIG. 9.—THE POTATO STEM-BORER (*Hydracia micacea*).
a, Imago ; b and d, larva ; c, pupa ; e, hole in potato haulm caused by larva.
(Natural size).

but when placed in a bottle with a supply of the food plant, it immediately entered a stem, and fed upon the inner substance, hollowing it completely out, and ejecting the frass at the lower end." This describes the way it has been observed working in potato haulm. They work with great rapidity, eight inches being tunnelled in an

hour by one specimen under observation. The damage caused by a small number in a plot of potatoes will be seen to be very great. The larvæ have been reported as early as May 10th in dock. Stainton says it feeds on the roots of various Cyperaceæ. The pupal stage is found in the ground in an earthen excavation. It is light yellowish-brown in colour, about three-fourths of an inch long, ending in an anal spike and some short stout bristles, pointing backwards, on the last two segments. The imago appears in August and September, a few stragglers even in October. It is particularly found in gardens and lanes and by hedgerows, also along the borders of ditches, marshes and fens. It flies at night and readily comes to light. The fore wings are pale brown with a rosy tinge, a dark broad patch below the upper border between the inner line and the oblique line. The hind wings are whitish-grey with a darker central line. The wing expanse varies from one and a quarter to one and a half inches.

An almost identical attack is recorded from America * by two species, *Hydracia nitela* and *H. nebris*, Guen. The former is known as the Potato Stalkborer and has been recorded doing injury to potatoes in Western Maine, the damage being due to the larvæ boring up the stalk and causing it to wilt. It also attacks wheat and carnations in Ohio (Webster). It also injures tomato, spinach, cauliflower, dahlia, aster, lily, spiraea, salvia, thistle and other plants, and has been noticed in currant, apple, peach and blackberry twigs, and wheat and other corn. No doubt our species has a similar varied diet. I do not know the egg stage of this moth, nor where the eggs are deposited in this country.

PREVENTION.

All we can do is to hand-pick the haulm in gardens and fields where it is seen to wilt and then destroy the larvæ inside; by so doing a great deal of damage will be saved. Poultry should be turned on potato fields, when the crop has been lifted, to devour the pupæ, and the men should be instructed to kill all pupæ they turn up in digging.

Surface Larvæ attacking Celery and Potatoes.

The Heart and Dart Moth (*A. exclamacionis*, Linn.) larvæ, commonly called Surface Larvæ or Cutworms, were reported by Messrs. Carter and Co. as seriously attacking one of their clients'

* "Some Insects injurious to Vegetable Crops," F. H. Chittenden, U.S. Dept. Agri., Div. Ent., Bull. 33, 1902.

celery and potatoes. They have been very abundant this year in many parts of the country, and have caused a great deal of harm to all kinds of roots.

Various remedies have been suggested and used with varied results. Soot and lime broadcasted over the soil and worked in with a prong-hoe in an attack on turnip has been successful. Bran soaked in Paris green and placed in heaps just under or on the soil has been known to destroy them; hundreds being poisoned by eating the arsenic on the bran. Kainit, at the rate of 3 cwt. to the acre, has also been successful. In regard to the attack on potatoes, it is difficult to do any good, but with the celery, soot and lime broadcasted on each side of the rows would prove beneficial.

One grower has recommended watering with paraffin emulsion. If the plants are young this would no doubt be an excellent remedy.

The Pigmy Potato Beetle.

(*Bathyscia wollastoni*, Jans.)

Early in June, Mr. Stains, gardener to F. Monins, Esq., of Ringwould, near Dover, sent some potatoes badly damaged and full of small Snake Millepedes (vide pp. 15, 32, and 86) (*Julus pulchellus*). These often serious pests had undoubtedly done most of the damage. At the same time, either by accident or by intent, there were sent with the potatoes a few small brown beetles. These were identified by Mr. Waterhouse as *Bathyscia wollastoni*.

Canon Fowler, in his "British Coleoptera" (Vol. III., p. 71), says that this species is "found in rotting seed potatoes." Mr. Stains was so informed, and the subject of these little beetles dropped. But early in July they appeared upon the scene again. I noticed some "Up-to-Date" potatoes in my garden with the haulm badly damaged; there were no signs of any larvae to be seen either by day or at night. My gardener said the damage was due to small "brown bugs" in the soil, and on digging up some tubers I found them covered with this small beetle. Rather more than two-thirds of the crop proved unsound, some from "rot," but the majority owing to the ravages of this beetle.

Not only is the *sound* seed potato eaten, but the tubers themselves. The beetles work first of all along the surface of the potato, eating surface galleries, and then tunnel little round holes into the tubers; these tunnels and channels soon decay and turn brown, and so the tuber rots away. An attacked potato cut in two looks as if riddled with fine shot. The seed potatoes seem to be hollowed out; whether

this is due to the beetles or subsequent decay I could not say for certain, but I believe from the latter.

On July 14th, I wrote to this effect to Mr. Staines, to which he replied that he had also come to the conclusion that these beetles were causing much harm.

Not content with damaging potatoes, they spread into an onion

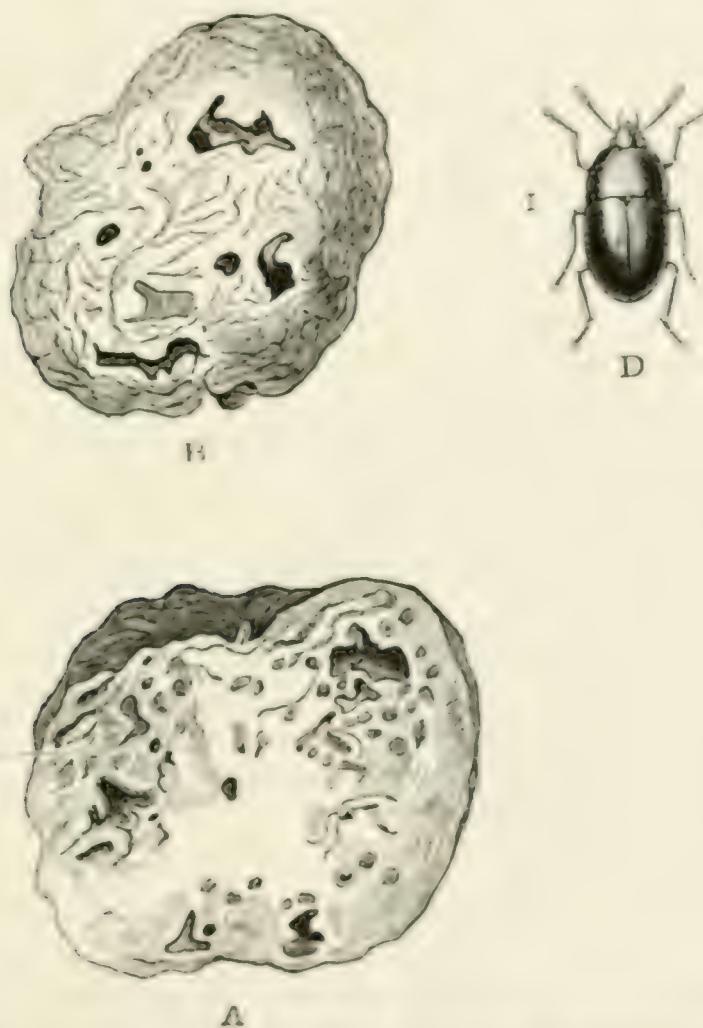


FIG. 10.—THE PIGMY POTATO BEETLE (*Bathyscia wollastoni*, Jans.)
A, Section of damaged potato (c, holes eaten by the beetle, D); B, damaged outer surface.

bed and ruined quite half the crop. Just as in the potato crop, so with the onion, they work underground. The rootlets of the onions were eaten off, so that the plants fell down; the beetles also nibbled at the lower part of the onions and so caused them to split and become worthless. I tried them with numerous other food plants experimentally, and found parsnips the only one they would touch; but if a parsnip, an onion, and a potato were put in the same box, they

invariably sought the potato, and when that was gone the onion. I have not had sufficient time to trace the life-history of this beetle, which can only be looked upon as a serious potato pest in East Kent and probably elsewhere, its small size and peculiar habits rendering it very inconspicuous. From enquiries I have made, it seems to be commonly distributed over that part of the county, and has been connected with the diseased state of potatoes by many local men.

The beetles (Fig. 10D) are very small, never more than 2 mm. long; oval and convex, of a dull, reddish-brown colour, with fine dull yellowish hairs and the surface with minute punctures; the thorax a little broader than the elytra, rounded at the sides and contracted in front; the elytra are narrow behind and rounded at the apex; legs long and slender, and the tibiæ, especially the middle ones, spinose. Canon Fowler records it from Finchley and Hammersmith; all the other records are from Kent.

They are extremely active, both when on the potato and in the ground, running with great rapidity and falling from the tuber at the least shock. Evidently they hibernate as adults, for when going to press (December) they are still alive.

Millepedes attacking Potatoes.

Mr. F. Powers forwarded some potatoes from Great Staughton, badly attacked by small Snake Millepedes (*Julus pulchellus*); but two other species were present, one belonging to the genus *Julus* and the third to the genus *Polydesmus*. These animals breed in the soil and often cause considerable loss; they are probably primarily attracted by the decaying seed.

Another correspondent, Mr. Staines, writing from Ringwould, near Dover, says:—

I am sending you two potatoes which are attacked by some pest, a small, thin, worm-like pest, enclosed with the tubers. As you will see, they attack the old set, also the young tuber. When it attacks the old set, it entirely destroys the crop, the haulm ceases to grow, and eventually disappears. In my opinion, it is quite as bad a pest as *Phythophthora infestans*. If you can give me any information regarding the pest I should be extremely obliged. Last year when planting I dusted round each tuber soot and lime, with good results. This year I did not use soot and lime, and am very much troubled with it.

Liming the soil is the only treatment of practical use on a large scale. There is no doubt Mr. Staines's plan of dusting soot and lime around each tuber when set is a good plan—lime being the great specific against Millepedes. A plan that has met with success where

gardens are troubled with these animals is given in the Report on p. 115.

The small beetles also sent were *Bathyseia wollastoni*, an abundant potato pest in East Kent (*vide* p. 84).

Notes on the Colorado Beetle in England.

The appearance of the Colorado Beetle in England in 1901 was not surprising. Ships from American ports may very easily bring over specimens that have flown on board whilst in harbour on the other side. A single pregnant female would be enough to start a colony. It is probably in this way that the colony established in 1901 in Tilbury Docks originated. It has been surmised that the pest may have come over in American potatoes; that is scarcely likely, for the only American potatoes that are sent to this country are seed potatoes, which are particularly clean. At present there is no infestation of the Colorado Beetle in Europe, so that it can only have been derived from an American source. Two previous outbreaks have been known in Europe, both in Germany.

The outbreak of this beetle in 1901 was reported to the Board of Agriculture during August. The beetles were then very vigorous, eggs and larvae of all sizes being found.

The colony was evidently well established, and looked as if it had been in existence some little time. It was situated inside Tilbury Dock on some potatoes on the workmen's allotments; they extended for about fifty yards, and had materially defoliated the potatoes in some places.

The adults did not readily seem to take wing, but crawled about with great energy. Later on in the year, those taken away for breeding purposes, however, showed a strong disposition to fly; they were constantly flying with great force in the breeding-cage in which I kept them, and beautiful objects they are, too, when their brilliant rose-coloured under wings are expanded. By keeping some specimens in warmth, I succeeded in getting through a complete life-cycle by October, but those kept out-of-doors did not deposit any eggs after I brought them away from Tilbury.

The land where this beetle had taken up its abode was cleared of all potato haulm, and the haulm burnt with paraffin at night on the ground under the superintendence of the Board of Agriculture officials; the ground was also soaked with paraffin, ploughed ten inches deep, and then dressed with gas lime at the rate of 60 tons per acre. Potatoes were planted on and around parts of the area to

serve as baits for any fresh beetles that might appear in the spring of the following year. In spite of the heavy dressing of gas lime, volunteer potatoes and weeds germinated freely, showing how uncertain gas lime is in its action.

The length of the different stages of the beetle in England, as far as my observations go, are as follows : The egg stage, ten days ; the larval stage, from three weeks to a month or five weeks ; and the pupal stage, from a week to ten days in the summer. The eggs are usually laid on the under surface of the leaves in clusters of from nine to forty, but Mr. Craigie has observed the beetles at Tilbury to deposit a few on the upper surface as well. They are very conspicuous elongated oval orange bodies attached to the leaves, after the manner of those of the Lady-birds. The eggs were found at Tilbury also on the leaves of the Sow-thistle (*Sonchus*). There is some variation in their colour : some are deep orange, others pale orange, according to their age.

All the beetles I brought away from Tilbury in the autumn of 1901 went to earth by the middle of October and remained under ground all the time, except during a few warm days in November, when two appeared on the surface of the earth. They made their appearance above ground in April, but did not all come up until May 4th. They were kept until May 20th, when they commenced egg laying. These "check" specimens were then destroyed.

At this date no beetles had made their appearance at Tilbury, so that the probability is that the drastic measures taken last autumn cleared off all those in the adult stage.

According to Riley, the beetle passes the winter only in the adult stage, and thus it was hoped that the measures taken had exterminated the pest in this country.

But in May, 1902, beetles commenced to appear again at Tilbury. Those that I saw alive were certainly not hibernated specimens, so easily told by their dingy appearance. The specimens appearing at this time were without doubt freshly-hatched ones, the elytra being quite pale compared with those that hibernated. It thus seems that the Colorado Beetle passes the winter also in the pupal stage in the soil. This will account for this second outbreak at Tilbury. There is no doubt that some larvae had already buried themselves deep in the soil previous to the plot being treated, and no doubt many of these were below the ten inches ploughed up, and so escaped the effects of the gas lime and paraffin.

Professor Howard informs me that this is known to happen in America as well ; Professor Smith having observed the beetle to

pass the winter in the pupal stage, which, however, is apparently exceptional.

This secondary method of passing the winter makes the insect more difficult to cope with when it makes its appearance in a new country, and should be borne in mind in the destruction of any future colony that is found.

The number of beetles that appeared this year (1902) was not large, but sufficient to show that they can well survive our winter, even under such unfavourable circumstances as existed on the plots at Tilbury.

From specimens in the National collection it seems that there are three closely-related species of *Doryphora*, namely, *D. undecimlineata*, Stål; *D. juncta*, Germ.; and *D. melanothorax*, Stål. The first-named has black legs, but otherwise resembles the Colorado Beetle. *D. melanothorax* has an entirely dark thorax, not yellow with black spots and central mark, as seen in the Colorado Beetle. *D. juncta*, known as the Bogus Colorado Beetle, has two of the black lines on the wing cases very closely united, forming almost one broad single line.

There is a fourth species in the collection, *D. multituberculata*, Stål, but there seems to be no difference between it and *D. undecimlineata*.

The only species likely to be confounded with the potato pest is *D. juncta* in its larval stage; but it can easily be told when young by being much paler than *decimlineata*, and when adult by having a pale head instead of a black one; its eggs also differ, being white instead of orange.

The Reports sent to the Board of Agriculture on visits paid to the infested plots are appended.

First Report on Colorado Beetle Outbreak at Tilbury.

The potato plots in the allotments in Tilbury Dockyard were visited on August 22nd, 1901.

The Colorado Beetle (*Doryphora* 10-lineata) was found to be present. The beetles were not at all numerous, not more than two dozen being observed.

They were, however, very active, and breeding was going on. Larvæ in all stages were found and three batches of ova.

The beetles seemed to be limited to about fifty yards of the allotments, the end nearest the station being quite free from the pest. A single specimen was also found on the Nightshade. None were detected in the rough herbage surrounding the plots, a likely place to harbour hibernators during the winter.

The beetles showed great vitality, but the damage, although noticeable

on the crop, was not as great as one would expect. Amongst the potatoes mentioned were several of the large Ladybird (*Coccinella septempunctata*), which were feeding on the eggs of the beetle. It would be advisable to have all surrounding plots examined, especially those on the other side of the high fence separating the dockyard from the railway. As the beetles occur on poppies and tomatoes both these plants should be searched.

Report of Second Visit to Tilbury re Colorado Beetle.

On September 17th, 1901, I visited Tilbury with Mr. Craigie to make further examination of the allotments upon which the Colorado Beetle had been found breeding.

No signs of any fresh beetles had been noticed by the foreman who had charge of the plot of land. None could be found under boards, sacking, etc., places where they might hibernate. It is extremely improbable that any could live in the ground covered with the gas lime in the way it has been treated. No signs of any damage could be detected on the potatoes, not yet dug, on the railway bordering the infested patches in the docks.

There is a possibility that a few stray individuals might live in amongst the rough grasses near the plots, which although treated with gas lime, still offer many tempting spots for wintering where the lime has not fallen.

It would be well to plant a few batches of early potatoes about, as traps for any that may have escaped ; this would probably stop any stragglers in the spring from straying away.

The specimens taken away at my first visit have now all gone to earth. On placing them amongst fresh leaves and on the soil, even in the sun, they refuse to remain above ground. These will be kept as checks, and as soon as they commence to appear in the spring from the soil, information will be sent to the Board, when a sharp look-out may be kept at Tilbury. For the present nothing further can be done.

Report on the Colorado Beetle at Tilbury (1902).

I have visited the plot of land in Tilbury Dock upon which the Colorado Beetle bred last summer, and found that the beetles were appearing in small numbers and that they had already commenced to lay their eggs (June 2nd). As stated by Mr. Brown, the beetles were coming out of the ground that had been treated with gas lime and paraffin during August, 1901.

The beetles seen by me were quite fresh specimens and presented a much brighter shiny appearance than those I kept alive during the winter at Wye ; one specimen found during my visit on June 2nd was certainly immature. It thus seems that these beetles that are now appearing have passed the winter in the pupal stage. The larvæ had no doubt gone to earth before the land was treated last autumn. A number may well have gone deeper than 10 inches,* so that they would escape the action of the gas lime and paraffin, and thus the appearance of the beetles this year can be accounted for.

* The land was only ploughed to this depth.

It is probable that they may go on appearing for another two weeks, but I think it well to have a watch kept over the plot for at least a month. That a brood may appear over some time we may judge from the fact that eggs and larvae in all stages were found last August at the same time, although it is probable that the first brood would hatch out about the same time.

Recommendations.

1. Constant supervision and hand-picking adults and ova on infested plot in the docks for one month.
2. Very careful examination of the potato plots along the railway line just outside the dock property.
3. Clearing off the rough herbage in close proximity to the infested plot. (It would be as well not to burn this near; smoke very often makes insects fly when they otherwise would be sedentary.)
4. An examination of all potato fields and plots within a three-mile radius of the dockyard plot. This had best be made twice; once as soon as possible, and again about the 21st of June.
5. A visit ought to be paid now as well as later, because some of the beetles may have flown away last year and hibernated, and like those kept at Wye, have appeared during the early part of May and commenced to breed. If this has happened the larvae should be quite large.
6. It would be well to have the leaflet on this pest sent to all potato growers on both sides of the river to distribute to their men.

COLORADO BEETLE ENQUIRY.

(BOARD OF AGRICULTURE.)

Insects sent as Colorado Beetles.

A number of insects were sent to the Board of Agriculture as Colorado Beetles from different localities; it is a matter of interest to note the great variety of creatures sent—none being the pest in question. The specimens are as follows:—

- | | | |
|---------|---|---|
| No. 1. | } | |
| No. 2. | | |
| No. 3. | | The Cockchafer (<i>Melolontha vulgaris</i> , Fabr.). |
| No. 4. | | |
| No. 5. | | |
| No. 6. | <i>Chrysomela marginalis</i> , Duft. | |
| No. 7. | <i>Bibio hortulanus</i> , Linn. (a fly). | |
| No. 8. | Larvae of one of the <i>Chrysomelidae</i> (Colorado Beetle family) of the genus <i>Timarcha</i> . | |
| No. 9. | Burying Beetle (<i>Necrophorus</i> sp.). | |
| No. 10. | The Cockchafer (<i>M. vulgaris</i> , Fabr.). | |

No. 6 is never in sufficient numbers to do much harm. No. 8 feeds chiefly on rank grasses and low herbs, and does no harm. No. 9 is beneficial, the beetles and their larvæ acting as scavengers.

No. 7 is to some extent injurious in the larval stage; the larvæ occur in large masses in the soil and attack the roots of various plants, especially grass; great numbers have appeared in some districts this spring.

No. 11. } *Melolontha vulgaris*, Fabr.
No. 12. }

No. 13. *Pyrochroa serraticornis*, Scop.

This latter is a very common beetle, which passes its larval and pupal stages in rotten oak, birch, beech, willow, and other wood.

Neither beetle nor larva are in the least destructive.

No. 14. *Telephorus rusticus*, Fall.

No. 15. *Telephorus bicolor*, F.

No. 16. *Melolontha vulgaris*, Fabr.

Nos. 14 and 15 are popularly known as "Soldiers and Sailors." They are most voracious, the females even devouring their mates; the larvæ are also carnivorous, feeding on insect grubs, earthworms, slugs, etc., so that these beetles should be protected.

No. 17. *Clytus arietis*, Linn.

No. 18. *Melolontha vulgaris*, Fabr.

No. 19. *Crioceris asparagi*, Linn.

No. 20. *Melolontha vulgaris*, Fabr.

No. 19 is the Asparagus Beetle.

No. 17 is of little importance.

Nos. 18 and 20 are the large Cockchafer.

No. 21. *Bibio hortulanus*, Linn.

No. 22. Larvæ of Chryomelid Beetle (*Timarcha*).

No. 23. *Steropus mandidus*, Linn.

No. 24. } *Melolontha vulgaris*, Fabr.
No. 25. }

No. 26. *Pterostichus vulgaris*, Linn.

No. 23 attacks mangolds and strawberries, eating the fruit of the latter plant.

No. 24 also attacks strawberry; both are somewhat abundant this season.

No. 25. }

No. 30. } The Rosy Rustic (*Hydracia micacea*).

No. 31. }

The pupa sent to the Board of Agriculture, numbered 32, is the pupa of the 7-spotted Lady-bird (*Coccinella septempunctata*).

Reported Colorado Beetle at Hockley.

Some pupæ sent from Hockley were those of the 7-spotted Ladybird (*C. septempunctata*).

There are no records of any of the true Lady-birds, except a single species of *Subcoccinella*, *S. vigintiquatuorpunctata*, Linn., doing any harm to foliage in this country, but many of the large genus *Epilachna*, which does not occur here, do considerable harm, and are all herbivorous and not carnivorous. It is extremely improbable that the potato leaves sent by Mr. Craigie, which appear to be devoured to some considerable extent, have been attacked by the Coccinellids sent. It is much more likely that "Surface Larvae," which are nocturnal feeders, were the cause of the damage, or slugs.

At the same time, it is of course not impossible for carnivorous insects to develop herbivorous habits. Search should be made on the potatoes for Plant Lice, the normal Lady-bird food; if none occur, then there would be more reason to think that the larval Coccinellids had become herbivorous.

Supposed Colorado Beetle at South Benfleet.

Pupæ sent from South Benfleet as Colorado beetles were those of the 7-spotted Lady-bird (*C. septempunctata*).

Suspected Colorado Beetle at Northfleet.

Pupæ also sent from Northfleet were those of the 7-spotted Ladybird (*C. septempunctata*), and not any stage of the Colorado Beetle. Nothing was found in the tube resembling Fig. 2 of the pamphlet, but the pupæ are those figured at No. 7.

There was also sent a small adult Lady-bird (*Hippodamia variegata*).

ROOT CROP PESTS.

The Cabbage Aphis on Turnips.

A correspondent forwarded in September some turnip leaves seriously damaged by aphides from the Isle of Thanet. The leaves were attacked by the Cabbage Aphis (*Aphis brassicae*, Linn.). Nothing can, of course, be done as late as this; as a rule the Ichneumon flies parasitise them in enormous numbers in September. It is not known for certain how they pass the winter—but probably in the egg-stage on wild Cruciferae. This species does not usually attack

turnips or any other root-crop leaves, but Curtis evidently observed it on the stems of turnip leaves. Its normal food plants are the various *Brassicæ*, upon which it may occur in great numbers, causing large crinkled folds and swellings on the leaves, which turn white. The Aphides are covered with a white mealy coat.

Unless one has a field Strawsoniser one can do nothing in such attacks.

Injurious Tipulidæ of Great Britain.

THEIR LIFE-HISTORY AND TREATMENT.

Several enquiries have been received during 1902 concerning Leather-Jackets.

The so-called Leather-Jackets, or the larvae of the Daddy Long-legs, or Crane Flies, that do most harm to crops, belong to five species, namely, the common Crane Fly (*Tipula oleracea*); the Marsh Crane Fly (*Tipula paludosa*); the Striped-abdomen Crane Fly (*T. lateralis*, Meig.); the Yellow-Spotted Crane Fly (*Pachyrrhina maculosa*), and an allied species, *P. quadrifaria*. Some years it is one species that does most harm, in other years another, or all may be equally abundant. During the year 1902 the Yellow-Spotted Crane Fly (*P. maculosa*) was most abundant generally. The larvae of all species work in a very similar way, the grubs feeding upon roots of all kinds of plants, often working into the interior of large roots just below the surface of the ground. In such plants as the dahlias, carnations and hops, they often cannot be detected, as they work so far into the roots. They not only attack plants below ground, but they frequently appear on the surface, and have been noticed to eat through strawberry runners. Their appearance on the surface is chiefly at night. I have frequently noticed those of *oleracea* and *maculosa* feeding in large numbers above ground on damp summer nights. Ritzema Bos has not only observed the larvae of *maculosa* feeding above ground at night, but also "by day in dark, damp weather," and watched them at work on the growing field crop. This habit of coming above ground at night to feed is one we must pay especial attention to from an economic point of view. All these larvae are particularly prevalent in grass land and clover lay, where they find congenial surroundings amongst the tangled growth of roots and in turnip fields; but at the same time we get them in rich, clean garden soil, causing havoc amongst lettuce, cabbage, and tender flowering plants. During the past season (1902) the larvae of *P. maculosa* were observed working into the stems of cornflowers just below and above

ground, and caused complete destruction of beds of quite large size. It is mainly in undisturbed ground that these insects propagate, especially when there is moisture, as in damp meadows, marshes, and amongst the vegetation along dykes and ditches. The smaller larvæ of *P. maculosa* occur most abundantly on light soils, but not by any means entirely, for I have seen them in swarms during the past year on clay land. They occur in hilly districts just as abundantly as in low-lying marshy land, in light and heavy soil; in fact, they have as wide a distribution as the common Crane Fly.

The larvæ of all these and other injurious species live throughout the winter, feeding all the time, except when the ground is frozen; they then pass deeper into the earth to escape the cold. Some seem to reach maturity sooner than others of each species, for it is not infrequent to find adults of some of the species occurring over several months, but the main brood occurs about the same time; others have two or more broods in the year. Grass land and root crops perhaps suffer more than anything else from the ravages of the Leather-Jackets. The following instances may here be recorded. In 1813, according to Kirby and Spence ("Introduction to Entomology"), hundreds of acres of grass land were destroyed by Leather-Jackets. In 1842 the marsh lands by the side of the Thames in the Isle of Grain were so completely destroyed by these grubs that the ground was bare. This occurred again in 1894 in the same area. The larvæ, of course, differ in certain features in each species. In general form they are cylindrical, without any feet, with a distinct horny head, retractile, i.e., it can easily be drawn into the succeeding segments; the posterior end is truncated and ends in a number of fleshy projections, so-called papillæ, which vary in the different species. There are two respiratory orifices on the last segment. The mandibles are dentate and work transversely, not upon one another, but upon two other fixed pieces. They are not only found living in roots, but also in rotting wood and even in water, both salt and fresh. The pupæ of these insects can easily be distinguished by their having two horn-like projections from the head; the segments of the abdomen are encircled more or less with spines, especially beneath, and, like most of the nematocera, are naked, that is they are not enshrouded in a puparial case. This stage in the root-feeding *Tipulidae* is always found in the ground where the larvæ have been feeding, generally at some little distance from the surface. Just before the imago is ready to emerge they wriggle partly out of the ground, the abdominal spines being used for this purpose; usually about half the pupa projects above the level of the earth.

The imagines then escape. It is a very common sight to see hundreds of these empty pupal cases sticking up amongst a few square feet of pasture. They are especially noticeable, projecting from the edges of lawns along gravel paths. These insects do endless mischief to lawns, but never to the same extent that they do to permanent pasture, because the mowing and rolling, especially if carried on late into the autumn, kills so many of the adults, and destroys the eggs, besides compressing the ground so firmly that the Leather-Jackets can move but slowly from root to root.

Very frequently the damage done to grass land by their larvæ is attributed to other causes. Miss Ormerod gives the following instance:—"On May 24th Mr. W. Gray, writing from Langholm, Dumfriesshire, N.B., sent me some quite young caterpillars of the Antler Moth of various sizes, from very small up to as much as a third or half-grown. He mentioned at the same time the injured appearance of the grass, but that on searching for the caterpillars there seemed very little sign of them, which he ascribed to their being still so small that they escaped observation. However, about a month later the true cause of the damage was found." The maggots proved to be the larvæ of *P. maculosa* (Report XIX., p. 33, 1896).

The five chief injurious species may have their characteristics summarised as follows:—

I. THE COMMON CRANE-FLY.

(*Tipula oleracea*).

This species (Fig. 11, 1) is widely distributed over Great Britain, its larvæ and those of the next species being the common forms of large Leather Jackets so destructive to all crops. The adults appear from May to September, the majority being seen during August and September, but they may occur even into October in considerable numbers. They can stand a fair amount of frost, for I have seen them alive after the night temperature has been as low as 28° F. The adult is silvery-grey; the thorax striped; the metathorax silvery-white; the abdomen slaty-grey; the segments becoming testaceous towards their edges, and there is a dark lateral line between the upper part and the testaceous sides; the apex is also testaceous. The long, slender legs are testaceous; the tarsi dark brown. The wings are longer than the body, greyish; the costa brown, and sharply contrasted from the rest of the wing, and beneath it there is a greyish, limpid streak in both ♂ and ♀.

The larvæ when full grown reach an inch in length and about the

thickness of a goose-quill. The skin is quite tough when they are mature, much wrinkled, and of an earthy color. The blunt tail-

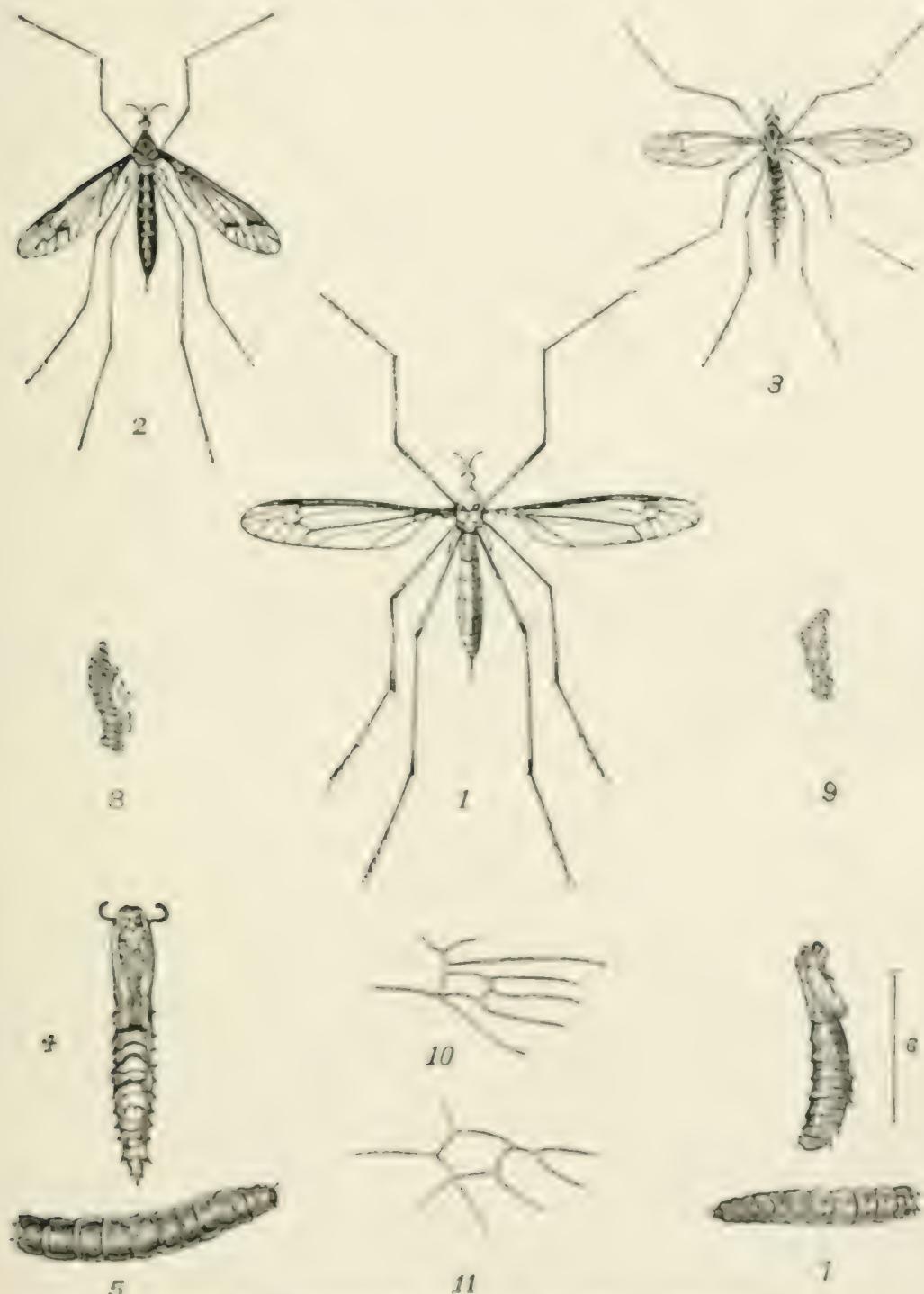


FIG. 11.—INJURIOUS *Tipulidae* OR DADDY-LONG-LEGS.

1, *Tipula obliqua*; 2, *T. lateralis*; 3, *Pachyphasma maculosa*; 4 and 5, pupa and larva of *T. obliqua*; 6 and 7, pupa and larva of *T. maculosa*; 8, eggs of *T. obliqua*; 9, of *maculosa*; 10, basal cell and veins near, in *Pachyphasma*; 11, in *Tipula*.

end is furnished with four large tubercles on the edge with two below, and in the centre the two respiratory openings.

They pupate in July, August and September. The pupa is about as long as the larva, but not quite so thick, and in colour varies from dirty brown to brown; the ventral spines are large, and there are small ones on the dorsal parts of the segments; the tail-end is spiny and acuminate.

The larvæ of this large Tipulid feed on all manner of roots, but are especially prevalent in grass land.

II. THE ALLIED OR MARSH CRANE-FLY.

(*Tipula paludosa*).

This species is nearly as common as the former, which it closely resembles. It appears, however, a little later as a rule, and may be at once distinguished by the wings of the female being shorter than the body and by the absence of the pale streak under the costa in the female; this pale streak, however, occurs in the male, but the *genitalia* differ from those of *oleracea*. The legs are also much stouter than in *oleracea*. The body, especially in the female, is of a general ferruginous colour, with the dorsal stripe weakly developed. The palpi are also stouter than in the common crane-fly. Its larvæ feed in similar situations to the former. I am not acquainted with its structural differences.

III. THE STRIPED-ABDOMEN CRANE-FLY.

(*Tipula lateralis*, Meigen.)

This is a very abundant species which sometimes appears in swarms. I have frequently had the larvæ sent me as damaging grass lands from different parts of England. I have noticed it to be particularly abundant along the grassy roadsides in Huntingdonshire some years, notably in 1890 and 1900, when great numbers of the maggots were attacking the grass in neighbouring fields. Grass roots seem to be the main food of the larvæ. There are no records of it attacking garden produce or other crops, but it doubtless does so. It occurs in the adult stage in June and July and again in September. In the latter month I found the flies swarming in the fields around Sidmouth in 1889.

The thorax of this species (Fig. 11, 2) has three brown stripes and is margined with deep brown; the middle line is broadest anteriorly and has a dark central line in front. The abdomen has chestnut-brown side lines, and each segment has the posterior border with a

fine pale line. The legs are reddish-brown, the tips of the joints dark brown. The wings are tinged with brown and there is an oblique pale mark by the stigma. The cross-veins are clouded with dark brown and the marginal cell yellowish-brown. Its length varies from half to two-thirds of an inch. The larva varies from three quarters of an inch to nearly an inch in length; it is thick skinned, of a dirty brownish yellow hue, often with a coating of earth when it assumes a brownish appearance, and has three dark stripes running down the body on the back interrupted by the segments; there are a few dark short hairs; the anal end with four short thick papillae above, all much the same length, but the two middle ones closer together and a little smaller than the outer pair, and two short, coarse ones on the lower edge. The pupa is nearly an inch in length, of a dirty whitish colour at first, becoming blackish-brown. On the ventral surface of the fifth to the eighth segments is an unequal sized transverse row of bristles near each posterior border; there are also spines on the front parts of the ventral segments; the last segment is surrounded by ten spines, four above, four below, and two on each side.

The larvae are especially fond of damp, wet, muddy earth.

The other two recorded injurious species belong to the genus *Pachyrhinus* of Macquart. The members of this genus can be told by their more fragile form and black and yellow colouring, and they have the three veins from the discal cell, generally starting from separate bases (Fig. 11, 10).

IV. THE SPOTTED CRANE-FLY.

(*Pachyrhina maculosa*, Meigen.)

This is a most abundant species in Great Britain in fields, roadsides, and especially in gardens. It appears in June and July and again in September. After the two large Crane Flies this is the most harmful species, some years it being far more destructive in its larval stage than they are. Its life-history was first worked out by the greatest economic entomologist England has seen—John Curtis.

During the season of 1902 it appeared in enormous numbers in some districts, such as Kent and Huntingdonshire, and has been reported in great abundance elsewhere. I also found it swarming in parts of Devonshire in 1888.

Curtis speaks of it as swarming on the sea coast, and mentions "seeing myriads on sand banks in the Isle of Portland, also at the back of the Isle of Wight, and at Lowestoft in Suffolk."

Most of the small "leather-jackets" infesting gardens are of this species; they especially attack lettuce, peas, young brassicæ, and garden flowering plants.

There are two broods during the year, and in some seasons possibly a third. Curtis records them as early as May. I have taken it in numbers as late as August.

The adult (Fig. 11, 3) is yellow, the abdomen having a broad interrupted dorsal line; the head has a dark triangular patch behind; the thorax three black stripes, the lateral pair curved outwards at the front end; and the sides (pleuræ) before the halteres blackish-brown on three sides. The wings are transparent with a pale brown stigma. The thin delicate legs are testaceous, dusky towards the tips. In length this species varies from a little under to half an inch.

The eggs of *P. maculosa* are oval and jet black. The larvæ when mature are never more than three-quarters of an inch long. In colour they are earthy and the skin is wrinkled, but not tough as in the *Tipulæ*. They are cylindrical, somewhat attenuated at each end; the alimentary canal shows through the skin, above and below, as a broad dark stripe. Each segment has a transverse row of four stiff bristles, the inner ones of each row the shorter; laterally are short, stiff, black hairs. They can at once be told from the large leather-jackets when the latter are immature, *i.e.*, about the size of mature *maculosa* grubs, by the anal processes; in this species the truncated tail has two hooks or papillæ, and two short ones between them, with two blunt tubercles below and two fleshy protuberances capable of dilatation and contraction; there are also two central spiracles; between each stigma and the ventral papillæ a transverse row of three small dark brown spots. They reach maturity in the spring and pupate in the soil. The pupæ are brown to golden brown in colour, slightly narrower than the larvæ, and have the two straight cephalic horns; the abdominal segments have each a row of minute spines above and six large ones beneath, and on either side an elevated spiny line, the penultimate segment has six long spines and two small ones, and there is a large conical process at the tail with a shorter one beneath it. Curtis describes them as not only eating roots, but also eating off trusses of the strawberry flowers close to the crown. He also found them in May at the roots of lilacs and amongst the roots of grass; they also destroyed carrots, raspberry and strawberry roots, lettuces and various flowers. Miss Ormerod, as previously noted, gives records of its damage in the Scottish uplands, where its working was mistaken for that of the larva of the Antler Moth (*Charreas graminis*).

V. THE ALLIED SPOTTED CRANE-FLY.

(*Pachyrhina quadrifaria*, Meigen.)

This is a closely related species to the preceding, and like it is generally distributed over England, but does not seem to occur in such swarms, nor do its larvæ seem to occasion as much harm. It, however, has been sent to me from various parts of Surrey and I have observed its larvæ in great numbers ravaging flower and vegetable plants at Kingston-on-Thames in 1884 and 1886; in the latter year it was especially abundant in the south of England. The adult appears in June and July.

The female is yellow, the abdomen with a black dorsal stripe; the head with a triangular black spot behind. The thorax has three broad black stripes, the lateral pair including two yellow spots, and the metathorax has three black stripes. In the ♂ the abdominal stripe is interrupted on the anterior border of each segment, in the ♀ the dorsal stripe is dilated on the hind border of each segment. The wing is transparent, with the stigma brown, and the hind cross-vein and the last piece of the vein below it infuscated. Legs testaceous; tips of the femora and tibiae black, and the tarsi dusky. Length, half an inch.

The deep brown stigma will at once separate it from the preceding species.

The larva is seldom more than half an inch long, of a greyish-yellow colour, with thick skin, and very like that of *P. maculosa*; four dorsal papillæ, the two inner ones much shorter than the two outer ones; the two ventral papillæ short, also brown stripes beneath the stigma. The pupa is about as long as the larva, brownish-yellow, with sharply indented segments; two short, thin, rather spoutulate cephalic horns; each segment with six or seven dorsal spines; ventral surfaces with five teeth-like spines.

NATURAL ENEMIES OF TIPULIDÆ.

The Tipulidæ are preyed upon by a number of natural enemies which, however, are not sufficiently potent to stop them doing much harm and causing great loss both to the agriculturist and horticulturist. The subject of natural enemies is one to which special attention should be paid, but it is quite useless to expect very great benefit to accrue from any except the birds. People who are acquainted more with the laboratory than the field talk of the use of parasitic hymenoptera (*Ichneumonidæ* and *Chalcididæ*) and of

predaceous insects as if they would do all that is required to check an insect pest. In a few cases predaceous insects have done enormous good, under abnormal conditions, but in a state of nature they never appear in sufficient numbers to make any impression until the pest in question has increased to such an extent that the harm is all done. The introduction of new predaceous forms is, however, always worth trying, as now and again good has resulted, as seen in the case of the *Icerya* scale and *Vedalia cardinalis*. When people commence to talk of stopping spraying for Aphides or scales because the beneficial parasites are killed also, it is sufficient evidence they know little of fruit-growing or the fruit grower's troubles.

In the Tipulidae we find scarcely any record of insects that destroy either larvae or adults. Curtis mentions Ichneumons as attacking the larvae, but says no more. Although I have bred large numbers from different parts of Britain I have never come across a parasite, with the exception of a single ♀ *Tachina*, sp. (?) that appeared in a cage of *T. oleracea*. Numerous birds, however, feed very largely on these insects, not only upon the larvae, but also upon the adult flies.

Amongst those birds which are great "leather-jacket" destroyers are the following: the Rook, the Starling, the Peewit, various Gulls, the Pheasant, and, to a lesser extent, all the Turdidae, or Thrushes, and Blackbirds. Enormous numbers of these larvae are devoured in autumn, winter, and spring by the three former birds, and the pheasant's crop may frequently be found full of them. The decrease in the number of Peewits has been marked by a corresponding increase in this pest as well as in the Wire-worm. All these birds should be encouraged, not only because of their destroying "leather-jackets," but other pests as well.

The adults are devoured by the Spotted and other Fly-catchers, by the Swallow, and even by the Sparrow. The Rook also devours large numbers as they are ovipositing in the fields. Poultry also do much good, for they feed whenever opportunity occurs upon both larvae and adults. These birds all do good because they are always present and are constantly feeding. They are often attracted in greater numbers when hosts of insects appear, but even when normally present, by devouring these and other pests before many of them have done harm, they do inestimable good, whilst on the other hand parasitic and predaceous insects come too late.

Moles also feed off leather-jackets, and do far more good than harm even in pasture land, where their "heaps" cause some inconvenience.

PREVENTIVE AND REMEDIAL MEASURES.

Although there is no known remedy for "leather-jackets" in the field there is much we can do to lessen the amount of harm caused by them and to prevent their undue increase. In garden cultivation, on the other hand, we can destroy them even in the soil, if it is considered worth the while.

In the first place, we can do some good in preventing egg laying. This we may do in three ways; firstly, by keeping down all long herbage during the autumn, long rank growths at the headlands and along hedgerows; secondly, by bush-harrowing pasture land or heavily rolling the same when the swarms of flies are noticed in the fields, hundreds will thus be killed and so prevented from laying their eggs, and the eggs in many cases themselves will be destroyed; thirdly, late mowing and rolling of lawns, croquet grounds, etc., will not only kill large numbers of the adults, but eggs as well. There is no doubt that for preference the flies will go to damp areas to deposit their eggs, and thus drainage will do good. This has been carried out on many occasions and has always been attended with good results. Pasture land and clover lay should be broken up when possible early in the autumn, so that the flies can find no shelter amongst which to lay their eggs. The land may first be dressed with gas lime, spread over it at once and allowed to remain on the surface for a few days. The smell would deter the flies from laying their eggs and would probably affect any small larva present. The effect of gas lime is very variable, however, and it is doubtful from recent experience if it has much effect upon large subterranean insects.

The old plan of "paring and burning" the stubble or grass on breaking up pasture is perhaps the best method of clearing out this and other ground pests. It of course has its disadvantages and is now seldom practised, but there is not the least doubt that it is the only way to lessen these pests in the soil.

Rolling with a cross-kill or Cambridge ring roller does some good by compressing the soil, and so preventing the "leather-jackets" from free movement in the ground. This is especially advantageous where they are attacking wheat or barley. In dealing with their life-history it was pointed out that the grubs come to the surface at night; a heavy ring-roller, of course, would kill any number of their larvæ if passed over them, and could not fail to do much good,

especially where as in grass land we have absolutely no means of controlling them. The extra cost of night work would be amply repaid. It is recorded by Miss Ormerod "that the grubs may be collected by a top dressing of rape-cake and the roller passed over the ground in the morning with good results"; this does not always seem to have the desired effect, however.

Traps may be employed in gardens in the form of heaps of turf, partly buried in the soil; the flies lay their eggs there and the larvæ seem to be attracted to it and can then be collected and killed. Rotting turf-manure and leaf-mould heaps should be kept free from surface weeds and top dressed with gas lime, or else they will form breeding grounds for these *Tipulidæ*, and the larvæ will be carried to field and garden, and so contaminate the soil. Grass-borders in gardens are favourite breeding grounds, and from these the larvæ spread to the bedding plants. In garden borders and beds they can be easily destroyed by injecting bisulphide of carbon into the soil at the rate of half an ounce to every square yard. This should be done in late autumn or early spring. When crops are attacked various stimulating manures should be employed; they do not kill the larvæ, but they hasten on the growth of the plant and repair some of the damage that the grubs have done. Nitrate of soda has the greatest effect upon leather-jackets, but is not permanent in its action. It, however, causes a cachectic condition in these pests, from which they do not recover for some days, if its application at the rate of $2\frac{1}{2}$ cwt. to the acre is followed by rain. Miss Ormerod records an experiment in which at the rate of 2 cwt. to the acre they had not recovered from its ill effects after eight days. The effect of this artificial manure on insects is so extremely variable that one must not rely on it too much. At the same time it must be borne in mind that if it has not the desired effect on the grub, it is still of value as a stimulant to the plant. Hand and horse hoeing have also been recommended and largely followed, but the good done is scarcely sufficient for the outlay.

SUB-GROUP B. ANIMALS WHICH CAUSE INJURY OR DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION II.

ANIMALS INJURIOUS TO HORTICULTURE.

Julidæ destroying Plants in the Gardens of Downton Castle, Ludlow.

In answer to a communication received from Mr. C. Boughton Knight, of Downton Castle, regarding the damage and annoyance caused by *Myriapoda*, the following report was sent :—

The Millepedes that are damaging strawberry and other plants in the gardens at Downton Castle are the small Snake Millepede (*Julus pulchellus*).

These animals live both on healthy and diseased plants. The eggs are laid in the ground; the young *Juli* have but few legs at first. I have found them breeding at all times of the year, but especially in spring and early summer. *Julus pulchellus* is particularly prevalent in damp localities and where decaying vegetation is left about. Heaps of leaf mould harbour it especially. Lilies are particularly subjected to the ravages of this pest, but all roots seem to be liable to its attack.

I have made one or two experiments with the ones sent me from Ludlow, and I find that poisoned bait is very satisfactory. I simply dipped the pieces of mangold and potato in a strong solution of Paris green and covered the baits with a cabbage leaf. This morning all the Millepedes were dead, those not so treated all alive and well.

I think I should adopt this plan to clear them out in preference to any other. The baits should be larger than the pieces sent with the posts and should be left to soak in the Paris green for an hour; of course the poison, which is soluble in water, must be kept stirred up every now and then.

Put the baits down wet and cover over with a green leaf, the best time to start them would be at night (dusk).

Heaps of leaf mould, etc., should have a good dressing of gas lime mixed with them if the creatures are observed there.

There were also a few *Polydesmus complanatus* with the *Julus*; they also are easily poisoned.

Woodlice in Gardens.

In answer to a letter sent by Sir William Thiselton-Dyer, from Mr. Thomas A. Lance, of Sydenham, Surrey, the following reply was sent concerning Woodlice :—

The scientific name of the woodlouse most commonly found in Great Britain is *Porcellio scaber*, Linn. There are two other common species

that do harm, viz., *Oniscus asellus*, Linn., and *Armadillidium vulgare*, Lat. *Oniscus asellus* is omnivorous, but does much harm in hot-houses and to soft wall-fruit ; it also eats away at strawberry roots. This species rolls itself up into a ball and can be told from the *Armadillidium* and *Porcellio* by having eight-jointed antennæ, the two latter having seven-jointed ones.

Armadillidium vulgare is larger and of a uniform slaty blue and rolls itself up very readily.

Porcellio scaber is brown, much variegated in colour, with a rough shell and two long spines behind.

Probably they have been spread in the manure from the heap you refer to.

You might cover the manure heap with lime—gas lime (hot) in preference—but it must be left on the heap for some four weeks before it is put on the land. I should put a layer an inch thick of gas lime over the heap and let it stand for some time.

Woodlice may easily be trapped along borders by putting here and there pots filled with moss and horse dung. They can be collected in the day-time and so destroyed.

Many plants are harmed by these pests ; as a rule the harder the leaf the more the plant escapes.

There are some twenty species of Woodlice found in Great Britain. These land isopoda are included in twelve genera. They may mostly be found under moss, decaying wood, and leaves, both out-of-doors and in greenhouses. Some few, such as *Ligia oceanica*, Linnæus, and *Philoscia couchii*, Kinahan, seem to be partial to the neighbourhood of the sea.

A New Phytoptid Disease in Violas.

Quite a new disease in violas has been reported by Mr. Charles J. Gleed, of Cliveden Gardens, Maidenhead. The specimens sent had most of the leaves curled tightly over at each side and were quite hopelessly deformed.

Mr. Gleed wrote that he "thought it was the cold weather ; but the attack is not general, two or three plants here and there, about 30 per cent. of the plants and both young stuff struck this spring, and old plants off which cuttings have been taken, are attacked indiscriminately."

At first sight one would say the damage was due to *Diplosis violicola*—the Violet Gall-Midge described by Mr. Chittenden* and excellently figured—but an examination soon revealed the real cause of the disease. There were found in all the leaves examined a number of short, thick green phytopti which seemed especially to congregate towards the apex of the leaves. As many as fifty of this large species were counted in one leaf. It is larger than the Currant

* "Some Insects injurious to the Violet, Rose, and other Ornamental Plants," Bull. 27 (n.s.), U.S. Dep. of Agriculture, 1901, p. 47.

Gall Mite, and can easily be seen with a hand lens. Specimens were sent to Dr. Nalepa, who informs me it is a new species which he is going to describe.†

Information was sent to Mr. Gleed to destroy the plants that were attacked and all cuttings taken from them, and to burn the earth in which they were growing.

If allowed to spread, this mite would probably form a serious source of loss to nurserymen.

The Narcissus Fly.

(*Merodon equestris*, Fabr.)

A correspondent, Mr. T. J. Leney, sent the larvæ of the Narcissus Fly, from Chertsey, with the following note: "They play havoc with the narcissus bulbs and are evidently the maggot of some fly. They commence boring from the base of the bulb upwards, eating out the centre. I cannot quite understand their beginning operations at the base of the bulb; one would have thought the eggs would be deposited at the top and the maggots work down the bulb, whereas the point of entrance is in nearly all cases as shown by the dot in the drawing."

The larvæ were of the dipterous genus *Merodon*, several of which are known to feed upon the bulbs of the narcissus, etc., in Europe. One species only is so far recorded from Great Britain, namely, *Merodon equestris*, Fabr., according to Mr. Verrall, but Walker in his work on "British Diptera" also gives *Merodon claripes*, Meigen, probably in error. There are three varieties of *Merodon equestris*, viz., var. *narcissi*, F., var. *validus*, Meig., and var. *transversalis*, Meig. These three were at one time treated as distinct species. Which variety the larvæ sent belong to it is not possible yet to say.

This Narcissus Fly has frequently attacked the bulbs in Cornwall, and I have had it reported to me from Ham, in Surrey.

The fly appears in May, and may be seen flying over daffodils and other similar plants. The fly resembles to some extent a bee in form; it is three-fourths of an inch long; the body is deep bluish-black with transverse bands of golden yellow; the wings grey, fringed with dull yellow; legs black, short and stout.

The female probably lays her eggs near or upon the bulb. The larvæ, however, always seem to enter from the lower part of the

† This is recorded under the name *Eriophyes violae*, n. sp. (Mitteilung des mathematisch-naturhistorischen Instituts, Classe von H. Den. 1862, Kaiserliche Akademie der Wissenschaften in Wien).

bulb as you describe. Those I have kept attacked as many as ten bulbs before becoming mature. When one bulb is destroyed they crawl through the soil and enter the next one at its base. The grubs seem to reach maturity during November, but some kept under observation lived until January. When full fed they form a cell in the earth near the last bulb attacked and line this cell with silk, forming a perceptible cocoon. The puparium is dark brown, oval in form, and has two projecting processes in front.

It is probable that this pest is constantly being imported from the Continent.

It is very desirable to lift all bulbs in a bed that is invaded before October ends, even if it is not the year for their removal. All bulbs should be examined and any showing decay destroyed, or the fly will go on increasing and may do endless harm. Where beds have been invaded and the bulbs lifted, the ground should be deeply dug and the top spit buried so as to prevent the flies emerging next year. Mr. Leney informs me that on lifting the bulbs to have them examined and to kill the larvæ no more than two full-grown larvæ occurred in each bulb, but more frequently only one in a bulb; when, however, the larvæ are in a younger stage and about half the size of those sent (fully mature) he invariably found from seven to eight in a single bulb.

The Marguerite Fly and its Destruction.

Specimens of Marguerite leaves tunnelled and generally damaged were received from Great Staughton, near St. Neots, on the 4th of June. The following reply was sent in answer to a request for information in regard to destroying the culprits:—

The white daisies that are attacked are being tunnelled by the little grubs of a small fly, the Marguerite Fly (*Napomyza lateralis*, Fall.). The only thing one can do is to pick off all the diseased leaves, and if they are very bad destroy (burn) the whole plant. There is no remedy, and if left alone they go on spreading very rapidly. When the plants are young spraying with paraffin emulsion will keep the fly away, but when it has once laid its eggs on the leaf you can do nothing for it.

The Carrot Fly (*Psila rosæ*, Fabr.) and Aphides on Carrots.

The Carrot Fly (*Psila rosæ*) was very destructive during the summer of 1902. One correspondent, Mr. Hammond, writing from Canterbury, states as follows: "I have since looked at my neigh-

bour's carrot-bed ; every carrot has been ruined ; his bed is utterly ruined." Together with the work of the Carrot Fly in this neighbourhood was a bad attack of *Aphis*. "People about here," writes Mr. Hammond, "are complaining that their carrots are very much infested with *Aphides* at the roots." This was early in October. By the 20th Mr. Hammond found that they had nearly all disappeared. They are to be found generally on the crown of the carrot ; they do not cause the cracks, but shelter in them. These *Aphides* were too shrivelled to identify when they arrived ; they were probably *Schizoneura fodiens*.

Correspondence and Report on Insects in Orchid Houses.

GATTON PARK, SURREY,
8th July, 1902.

To PROFESSOR E. RAY LANKESTER, M.A., etc.,
Natural History Museum, South Kensington, S.W.

MY DEAR SIR,—I am a collector of orchids and somewhat largely interested in their hybridization, but our efforts are materially interfered with by a little fly or its grub (specimens of which I enclose), and whose ravages we have found no means of preventing. It is no uncommon thing for them to clear off the whole of the contents of a pot of seed as soon as it is sown and germinates. We have made the following observations in regard to it :—

They seem to frequent and thrive most where they have damp moss to dwell in, which unfortunately is an essential feature of successful orchid growing.

Being often found on plants that have no seed on them, they of course have other food, but apparently they have largely increased in my houses, which, however, may be due rather to the amount of moist moss about than to the amount of orchid seed which they have to feed on. They are equally troublesome in what we know as the "Cool House" (50° to 60° F.) as in the hot ones (65° to 85° F.). They devour the seed immediately it commences to germinate, and if not devoured in this stage they attack the small bulblet as soon as it is formed, eating it from the base and leaving the shell only. They are harmless to plants after the early stages and so are not troublesome to orchid growers generally.

Careful search has failed to discover a grub. Hence it is assumed (possibly erroneously) that it is the fly which does the mischief. Further, the winged one (♂ male) is rarely found on the pots, which leads to the assumption that it is the wingless one which does the mischief. If we are wrong in the assumption that the male only has wings our observation would lead to the suggestion that the fly is harmful only before it develops its wings. The body of the wingless one on the pots is much larger than the one found with wings. When the seed is sown on a flat surface without harbour we are not troubled ; but directly the seed is removed, which it has to be soon after germination, it becomes liable to attack.

I IO First Report on Economic Zoology.

Various methods have been unsuccessfully tried, particularly the following :—

Fumigation, either with tobacco or a compound known as "X.L. All" (this is supposed to contain nicotine, camphor, methylated spirits, etc.), but neither has any material effect. Quassia affects them only for a short time, as they leave the pots and return in a few days. The pots have been placed under water for hours, but upon being taken out the flies are equally as lively as before. Fly-paper and strings similarly covered are of no avail.

(N.B.—The houses are regularly fumigated for pests, in general about every ten days.)

I should be very glad to know if there is any method of ridding ourselves of the pest by destruction or of making it harmless to the germinating seed and bulblet by driving it from the pot or otherwise. Any information as to its known habits might help us to work out its destruction if no remedy is known. It is of course important that any remedy shall be harmless to the orchid seedlings themselves. They are extremely delicate and porous and have to be kept in a constant state of moisture.

I must apologise for having troubled you with so long a letter, but the ravages of this insect are most annoying and often rob us of results which have promised to be of great interest in the horticultural world, and I should feel much indebted if you could let me know of a remedy or of any one who would be likely to advise me should you personally be not acquainted with one.

I beg to remain, etc.,

(Signed) JEREMIAH COLMAN.

Report on Insects in Orchid Houses.

The insects sent by Mr. Colman, of Gatton Park, Surrey, causing harm to orchids, are in too broken a condition to identify accurately. The small flies are *Sciarinae* and belong to the genus *Zygoneura*, of which only one species occurs in Britain—*Z. sciarina* (Meigen), found in summer and autumn in underwoods and moss—but without seeing fresh and perfect specimens it is not possible to be certain of the species. The life-history is not known, but probably they breed in the damp moss. The larvae do not seem to have been observed; they would possibly be in the form of small white footless grubs.

The flies can do no harm—it would be the larvae—but there is no doubt that the damage is done to the orchids by the wingless creatures sent at the same time. There is no connection between the wingless insects and the *Sciarinae*. The wingless forms are *Collembola*, or Spring-tails. Some of these are certainly very injurious, but little is known of them, however. The young of these Spring-tails resemble very closely the adult, and live and grow in similar situations and under similar conditions and are injurious during the whole of their existence. Preparations have been made of this *Collembola*, and attempts will be made at its identification.

The majority of species live under damp moss and stones and are no doubt encouraged by the methods necessary in orchid cultivation. All that can be suggested is that Mr. Colman experiments on a small scale

with some common orchids and hydrocyanic acid gas. This gas can be used for such delicate plants as maidenhair fern without injury and is fatal to all forms of animal life, but its effect on orchids has not been observed. If there is much moisture on the plants this gas loses much of its potency, and the air during fumigation should be dry. Its effect in an orchid house might not therefore be as successful as under other circumstances. It is certainly worth trying, however, as fumigation with tobacco, etc., would have little effect on these creatures that are causing the annoyance.

Great care should be exercised in the use of hydrocyanic acid gas, as it is a most dangerous poison to man.

Should Mr. Colman think it advisable to experiment with this insecticide, information as to procedure can be sent him.

There does not seem to be any other way in which these pests can be eradicated under the conditions necessary for orchid cultivation.

FRED. V. THEOBALD.

GATTON PARK, SURREY,

29th July, 1902.

To PROFESSOR LANKESTER,
British Museum (Nat. Hist.)
Cromwell Road, S.W.

DEAR SIR,—In further reply to the interesting report of Mr. Theobald of the 21st, I have had an opportunity of a careful discussion of the points raised with my gardener.

I understand the report to throw considerable doubt upon the probability of the larvae of the Sciarinae being harmful. Under the circumstances, and as it seems certain that the Collembola or Spring-tails are, I suggest that we ignore the former, especially as we have not been able to observe them and have no actual evidence of their causing mischief.

There will be no difficulty in adopting the suggestion that the effect of hydrocyanic acid gas upon orchids shall be ascertained by experiments. It is believed, however, that, used in moderation, it will not be harmful to them. It is certainly unfortunate that its effect is likely to be minimised by moisture. The moisture on the moss, etc., can be reduced, but it is such an essential feature in the early stages of orchid growing that it would have to be done with great care and not for any length of time. Should it be the young Spring-tails which are most largely responsible for the mischief, material relief from these pests might be secured by an application of the gas before the seed is sown or before the germinating plants are transferred thereto and when the compost is in a perfectly dry state. A good deal depends upon their habits, but I am writing on the assumption that the young may not develop very quickly or be able to reach the pots before the plants are sufficiently strong to take care of themselves. It seems difficult to place the pots in such a position as to be out of reach of the adult Spring-tails, but we will gladly experiment if any suggestion can be made. We have now placed some of the pots on a zinc tray on stands, which seems to have minimised the mischief somewhat. Although the more orthodox way of raising the seed seems to be to sow it

upon the moss surrounding growing orchids, it is quite possible to raise it and transfer it to very small pots, so that if we have the means of preventing the depredations of these Spring-tails over a small area a great deal would be accomplished.

Apologising for troubling you, etc.,

(Signed) JEREMIAH COLMAN.

Fumigation under Glass for Mealy Bug and other Pests.

Frequent enquiries have been made as to the use of hydrocyanic acid gas under glass for the destruction of Mealy Bug. This treatment will be found to far surpass the old methods of fumigating with tobacco and various patent compounds.

The method of fumigating with hydrocyanic acid gas (HCN) for Mealy Bug, Scale, etc., under glass, is as follows :—

For every 1,000 cubic feet of space use 5 ozs. sulphuric acid, 8 ozs. water, 3 ozs. cyanide of potassium.

The water should be put into a jar and then the acid added to it; remember to always add the acid to the water, and not the water to the acid; the cyanide should be in small lumps and wrapped up in blotting-paper; the cyanide is then dropped into the jar of water and acid and the fumes allowed to generate for an hour. It, of course, has to be done quickly and with care, owing to the poisonous fumes being so deadly to all forms of animal life. The cyanide should be dropped into the acid and water from outside the house; this can easily be done by putting the jar close to the door or window, so that it can be shut as soon as the packet of cyanide touches the mixture. When wrapped in blotting-paper, some seconds elapse before the fumes generate.

If the glass-house is more than 10,000 cubic feet another jar will be required, and for every additional 10,000 feet.

The foliage of all plants to be treated should be as nearly dry as possible.

The temperature never more than 60° Fahr. 50° Fahr. is the best temperature. At heat over 50° Fahr. there is a risk of harming the foliage.

Do not fumigate in a strong light, as foliage may then be damaged; fumigate always after sunset.

Do not fumigate vines when in bloom or just before the grapes have commenced to ripen.

The times to fumigate for Mealy Bug are (*a*) before the vines bloom; (*b*) after the crop has been gathered.

The house should be well ventilated for at least one hour after fumigation before anyone should go into it, the windows being arranged so as to open from the outside, and also the door.

The cost comes to about 4*d.* per 1,000 cubic feet. This treatment has been found not to damage even maiden-hair ferns if carried out properly, and there is no danger if proper precautions are taken. It is not advisable to leave the treatment to ignorant people, as the fumes and the cyanide are of course deadly poisons.

SUB-GROUP *B.* ANIMALS WHICH CAUSE INJURY OR DISEASE TO MAN'S VEGETABLE PLANTATIONS.

SECTION III.

ANIMALS INJURIOUS TO FORESTRY.

Goat Moth Larvæ attacking Willows.

Mr. W. S. Mockett, of Ramsgate, wrote in September regarding the damage to willows by the larvæ of the Goat Moth. Several other correspondents have also applied for information both in regard to their life-history and ways of destroying the larvæ. Ash, oak, elm, as well as fruit trees, are attacked by these large larvæ, and they frequently kill the trees outright.

If there are not many Goat Moth larvæ in a tree it is quite possible to destroy them. This may be done in several ways; the old plan was to insert a wire into the opening of the tunnel to find out which way the tunnel goes, and if downwards use a fluid, if upwards a gas.

The best fluid is paraffin emulsion, with a little Paris-green injected by means of a syringe, the nozzle being forced into the hole and surrounded by clay until the injection is over. If a gas or fume is used, sulphur acts well; use bee-bellows and blow the fumes in, fixing the nozzle as before with clay.

About June, smear the trunk of the tree with cow-dung and clay, mixed with paraffin, as far up as holes are found; this prevents egg-laying. By far the best plan has recently been found in the use of cyanide of potassium. Place a small piece of stick cyanide in each hole and then close up with clay. The fumes soon kill the larvæ within their tunnels.

Insects on Osiers and Willows.

In answer to a request for names of insects observed by Mr. Marsh, of Milford School, near Godalming, who gives instruction in Basket-work, and who is growing the different varieties of Willows and Osiers with a view of comparing them, and also finding out something about their culture and what insects affect them, the following reply was sent :—

As far as one can say from your descriptions of the insects attacking your willows and osiers, they are as follows :—

(1) The Minor Shoulder Knot Moth (*Epunda viminalis*). The moth appears in July and August, the larva in May; the pupa is subterranean. All the larvæ of this genus live exposed and extended along the stems of plants.

(2) The larvæ of Syrphidæ or Hover Flies ; they are not injurious, but beneficial, being *Aphis* feeders.

(3) A green *Aphis*, undoubtedly *Siphocoryne capreae*, Fabricius. It is found on all willows and occurs from April to July. It is fairly common round Guildford, Godalming and that part of Surrey.

(4) This *Aphis* is called *Melanocanthus salicis*, Linn. It is especially found on *Salix viminalis*. The wingless forms appear in April, the winged females from the end of June throughout July. It is recorded from your district (Guildford) and I have found it in abundance on osiers at Wye ; it is also recorded from Kentish Town.

(5) This *Aphis* is *Chaitophorus salicivorus*, Walker. It varies much in hue. They are often seen brick red in colour.

The osier has a great number of insect pests, especially amongst the sawflies, cecids or gall midges, moths and beetles.

A list of the more important is being prepared.

Insects on Elm and Willow.

(*Schizoneura lanuginosa*, Hartig., and *Lachnus viminalis*, Fonsc.)

Specimens of Aphides attacking elm and willow were received in October, 1901, from Miss J. Burroughs Norgate, from Enfield. One, a large gall on the elm, proved to be the work of an *Aphis* of the same genus as the White Woolly *Aphis* or American Blight. It is known as *Schizoneura lanuginosa*. The Willow Aphides *Lachnus viminalis*, Fonsc. The correspondent stated that her attention was called to this aphis by the number of wasps hovering over a lilac bush beneath the willows. They were feeding off the gummy honey-dew. The large masses of aphides were then discovered on the willow in their typical position. William Curtis noticed that

wasps feed readily off the honey-dew excreted by this species of aphid, and also that bees totally disregarded it. The flow of honey-dew produced by this species is very copious and does much damage to the trees and those beneath. It is not at all unusual for willows and osiers to be killed outright by it.

The effect of the punctures of these plant lice is to leave distinct brown scars in stripes. This plant louse is also known as the *Aphis saligna*, Walker, other synonyms being *Aphis salicis*, Curtis, *Aphis riminalis*, Boyer de Fonscolombe, and *Lachnus riminalis*, Pasterine. The wingless viviparous female is dark yellowish-brown to greyish-brown; the antennae red at the base, black at the tips, and there are two dark spots on the thorax. The abdomen is much rounded and in the centre is a curious horn-like projection; the cornicles are large and short and there are five to six rows of large black spots on it. The legs are deep brown, rather long and hairy. In length they are about 0·16 of an inch. The pupa is much like the larva, but rather longer and with bright brown wing cases, and the dorsal tubercle is very large.

The winged female is quite a large insect, 4 to 5 mm. in length, of a dull brown colour with darker marks, the abdomen being spotted with black, one large spot placed centrally; this spot apparently is the representative of the tubercle seen in the wingless female; the short cornicles are almost conical. The long wings always seem to be carried horizontally when the insect is at rest; the stigma is long, narrow and black; the insertion and cubitus orange-yellow. The legs are long, the tibiae yellowish-red, the two-jointed tarsi deep brown.

As this is certainly a very harmful species steps should be taken to destroy them by washing the willows with paraffin emulsion.

This species is very common in some districts on willows and osiers. They congregate in masses often half a foot in length and an inch or more wide; they are usually grouped side by side with their heads pointing downwards. When disturbed these sedentary insects become most active, yet do not leave their abode; they throw their long hind legs up and wave them about in an erratic manner, with the probable intention of frightening off the enemy, especially hymenopterous parasites. The effect of this species on the trees is very strange. Some osiers observed this year were killed by them, whilst others close to only presented a yellow-leaved appearance; some shed their leaves, others recovered in a few weeks. Cameron records a case where this *Lachnus* swarmed in such numbers at Carshalton that trees thirty to forty feet high had been killed by their poisonous

influence. It is in osier cultivation that it proves most dangerous and it should be destroyed when noticed by hand-picking or spraying.

Pissodes notatus, Fabr., ravaging Austrian Pines.

Damage to Austrian Pines by the Banded Pine Weevil (*Pissodes notatus*, Fabr.) has been reported by Mr. R. Hyne and others during the past year.

According to the reports of Continental foresters, *Pissodes notatus* almost exclusively follows the Pine Weevil (*Hylobius abietis*, Fabr.). It is usually found on trees rendered unhealthy by the *Hylobius* and

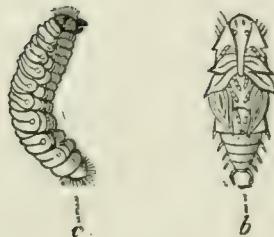


FIG. 12.
Larva (c) and pupa (b) of
Pissodes notatus.



FIG. 13.
The Banded Pine Weevil
(*Pissodes notatus*).

finishes the damage begun by that beetle. *Pissodes notatus* occurs in all manner of places, in wood split for fuel, in young living stems, in pine cones and in the bark at the base of old trees. The chief damage it does is where it attacks young unhealthy trees. Planted pines suffer more than those self-sown, (1) because the planting often throws them back, (2) on account of the crowding in the nurseries which makes the young trees sickly. The *Pissodes* chiefly feeds then on trees attacked by the *Hylobius* and those grown on unkindly soil and thus more or less unhealthy. If the supply of unhealthy trees fails then these beetles will attack sound ones.

The beetle (Fig. 13) is about one-third of an inch long and of a reddish-brown colour, irregularly covered with bright hairs; the prothorax has eight yellowish spots; the elytra with two broad pale bands running transversely across them. The beetles appear in April and

May and again in August and September. There seems to be one brood only in the year.

The female beetle lays her eggs singly, daily or at intervals of a few days, egg-laying lasting over a period of several weeks up to two months. The eggs are generally laid just above the root up to as much as six feet above the ground. Egg-laying commences early in April and in May and may occur again in the autumn, but usually the females oviposit in the spring. This beetle prefers four to eight year old plants, but may attack those of much greater age. The larvae eat their way between the wood and the bark, forming slightly winding passages which increase in size as the larvae grow. When mature they construct oval fibrous cocoons composed of wood fibres in which they pupate. The larvae also live inside pine cones, which they turn yellowish-grey. As many as three larvae may occur in a single cone. Attacked plants may be told by small drops of turpentine on the bark and by the premature death of the needles. The winter is passed in the beetle stage and also in the larval and pupal stages. The beetles hibernate in the chinks of the bark, as near the inner bark as possible, mostly where the root and trunk join, generally above ground, but sometimes below.

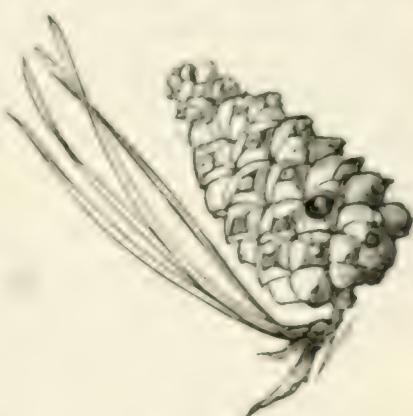


FIG. 14.

Pine cone damaged by *Pissodes notatus*.

PREVENTION AND TREATMENT.

As there is no doubt that the *Hylobius* is often followed by this *Pissodes*, and that the latter does not often occur without the former, steps should be taken to destroy the *Hylobius* if it occurs; then the *Pissodes* will cease to increase.

The causes of *Hylobius* attack are (1) leaving old stumps in the ground and dead felled timber about; (2) the presence of sickly trees from either (a) bad planting, (b) unkindly soil, or (c) growing the trees too close together.

Destruction of all diseased timber (roots and all) when larvae and pupae are in the tree in May and June should always be carefully attended to.

Laying newly cut stems of pine in open parts in April and May

forms an excellent trap; in a few hours, says Kollar, they will be found covered with beetles, particularly so when the stem (of each trap) has been pressed into the earth.

These decoys must not be laid too late and must all be burnt before the brood escapes. This plan has frequently been known to clear a forest of *Hylobius* pest.

Billets of unbarked fire-wood laid about will attract the beetles to lay their eggs. These should be destroyed from the end of June to the middle of July.

Smearing the lower parts of the trunks with a mixture of mud and lime early in April would probably check egg-laying or perhaps it would be better still carried out in March.

Young trees containing *Pissodes* larvæ should be pulled up and burned in June and July.

All cones attacked should be collected and burned; they may easily be told by the exuding turpentine. Wood-peckers (*Picadæ*) should be encouraged.

The Spruce Gall Aphis.

(*Chermes abietis*, Linn.)

Deformed growths on Spruce were sent by Mr. J. Saunders, of 49, Rothesay Road, Luton. These proved to be caused by the Spruce Gall Aphis (*Chermes abietis*, Linn.). These galls are at first bright green and rosy and shaped like a small pine-cone. The "mother" Chermes is oval, wingless, and woolly, green and purple in hue with blackish legs. This form is found in the spring and inserts her proboscis into the tissue of the plant just below a bud. This causes the irritation which commences the diseased growth.

The female lays her eggs amongst a woolly secretion on the gall; the young larvæ coming from the same stick their proboscides into the gall which still further swells and grows up more or less around each larva. The larvæ are really enclosed by the unnatural swollen leaves of the bud overlapping them. Later these galls harden, become brown, the chambers split open, and the Chermes make their exit. These soon turn to pupæ, and then yellowish-green winged females, which fly from spruce to spruce and deposit about twenty eggs each. These eggs give rise to larvæ which grow into the "mother-queen" in the spring. The male is a small apterous louse found in the galls, very sedentary in habits.

TREATMENT.

It is most important that all gall-bearing trees in young spruce plantations should be felled and the galled boughs burnt in the summer. In fresh planted areas the trees should be gone over in the summer and the galls carefully picked off and burnt.

They are always most abundant where the trees are too thickly planted and on cold clay soils; both thick growth and clay soil should be avoided for spruce plantations.

G R O U P F.

Animals which concern Man as being injurious to his worked-up Products of Art and Industry, such as (A) his Buildings and larger Constructions and Habitations, (B) Furniture, Books, Drapery and Clothing, (C) Food and Stores.

SUB-GROUP A.

Earwigs causing Annoyance Indoors.

Mr. F. W. Carter, of the Board of Agriculture, writes that his house at Boxmoor is infested with Earwigs (31.vii.02), which come into the house each night in large quantities; they appeared to be living in the crevices between the window-frames and the brickwork, and also they seemed to be in the soil.

What I am anxious to know, writes Mr. Carter, is what they feed upon, their habits, etc., and also what, if any, chemicals could safely be employed to eradicate them from the window frames. I have tried syringing with paraffin and water, but no use. I have also tried spreading unslacked lime under the window sills to prevent them creeping into the house, but of no use. Can you suggest any means of eradicating them, etc.

The following reply was sent:—

"Judging from the description you give of the Earwig misnomer, I should say the species is the large Earwig (*Forficula auricularia*), which

seldom flies. A smaller species, *Labia minor*, uses its wings much more freely. The food of earwigs is very varied, they are both carnivorous and herbivorous ; hops, fruit, snails, slugs, flowers, leaves, etc., form their bill of fare as a rule.

"They are mostly nocturnal in habits, hiding away during the day in crevices in walls, woodwork, etc., under the bark of trees, under clods of earth, and any shelter upon the ground. They lay their eggs in a hole in the ground, about twenty to thirty yellowish ova being placed together. Some authorities say the female looks after these eggs and the young for some time. They take from two to four weeks to incubate. The young are at first very pallid and wingless, but after several moults they reach the mature winged form. The winter is passed in the adult stage, the insects hibernating under the bark of trees, beneath rubbish, etc. They become noticeable in the latter part of the summer, especially in August, but may be found much sooner. The small Earwig (*Labia minor*) flies in the day-time as well as at night.

"With regard to their destruction, 'trapping' is the most successful method. Place some baskets filled with straw or dry moss under the windows and some flower pots filled with moss on the window sills. These should be examined in the day-time and the insects collected and destroyed. I do not think you could employ any chemical, as they get into so many places of a day-time ; but by 'trapping' you will get rid of the nuisance, especially if you put a plum or other fruit in each pot."

SUB-GROUP B.

Acarine Household Pests.

(*Glyciphagus domesticus* and *G. spinipes*).

Several instances of acarine pests have been reported. Mr. White writes from Birmingham, "This mite is a veritable plague in my house." It proved to be the *Glyciphagus domesticus*, De Geer (the *G. cursor* of Gervais).

Another correspondent wrote from Walthamstow as follows :—

"I have upholstered a suite for my firm which has been sent into the country, and since it has been in the customer's possession it has developed a small insect as sample sent on enclosed piece of banding . . . my firm seem to think I have been using dirty material, but it is nothing of the kind."

The mites sent were identified by Albert Michael, Esq., as

Glyciphagus spinipes of Koch, and *G. domesticus*, De Geer. *G. spinipes* is an abundant and widely distributed mite, and feeds chiefly on dried animal and vegetable matter. It is found abundantly in straw and hay, also in flour, meal, cantharides, horsehair, etc. *G. domesticus* is also an abundant acarus in houses, sheds, stables, etc., and feeds on hay, straw, bran, on dried fruits, dead insects, cork, tobacco, and unclean horsehair. It is frequently found in furniture. Oudemans found it "literally covering the furniture of the whole house," and states that they fed on the animal fat which adhered to the not thoroughly cleaned horsehair with which the furniture was stuffed.

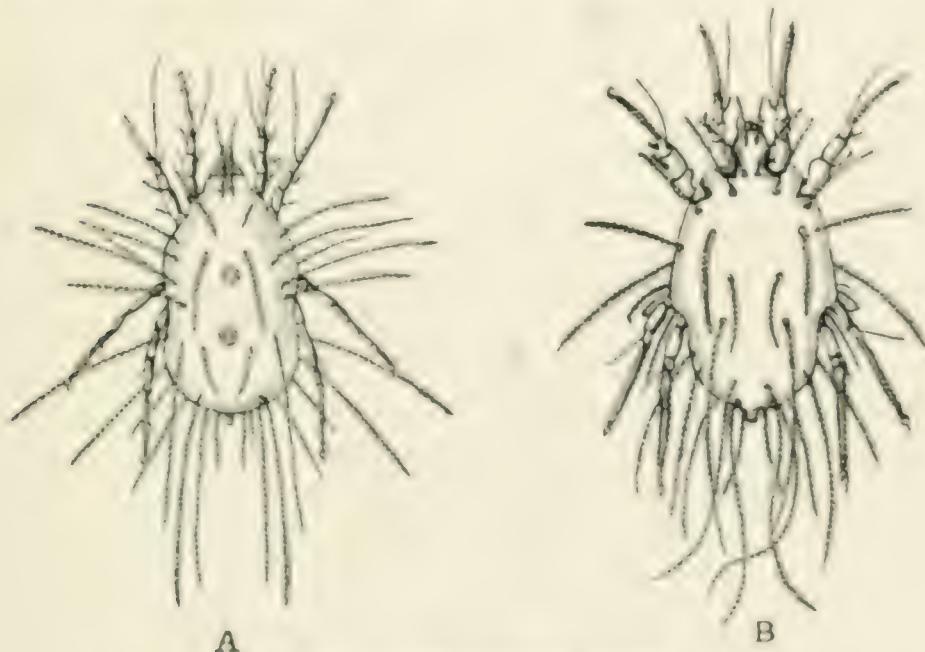


FIG. 15.—HOUSEHOLD MITES.

A. *Glyciphagus domesticus* (De Geer).B. *G. spinipes* (Koch).

(After Albert Michael.)

It is thus likely they often originate from the stuffing used, but it is not possible to say.

Nine species of this genus of mites occur in Great Britain. Three species (*G. dispar*, Michael; *G. crameri*, Michael; and *G. platygaster*, Michael) live in moles' nests; one (*G. sciurus*, Haller), in squirrel nests; the others (*G. palmifer*, Robt. Fum.; *G. cunestrini*, Armanelli; and *G. plumiger*, Koch), commonly in stable fodder and in dust and sawdust.

LIFE-HISTORY.

These minute acari deposit their eggs amongst the substances upon which they feed. The eggs are comparatively large, oval and smooth-shelled, of a dull grey or white, the outer covering being

more or less soft, not a hard, rigid shell. The egg gives rise to the so-called larval stage, which resembles the adult, except that it has six instead of eight legs, and they are usually colourless and semi-transparent. This larval stage does not last long, a single ecdysis bringing it to the third or nymph condition.

The nymph resembles the adult when nearing maturity, but when young it has the appearance of the larva. This is the period when the mite grows, and it assumes its fourth pair of legs. The nymph casts its skin twice. Another curious stage exists in these acari, namely, the hypopial stage, in which the mite assumes a different appearance—a stage in which it can more easily be distributed from place to place by becoming attached to flying insects, etc., but in the two furniture pests this stage is rudimentary; in *G. domesticus* it never emerges from the young nymphal skin, and in *G. spinipes* it seldom does so. This "skin-like" case protects the mite and so enables it to withstand heat, moisture, etc., and in this stage it may very easily be distributed from place to place by the wind. The wind may also spread these minute creatures in other stages as well.

The "feather-bristle" mites, or *Glyciphagi*, may often be noticed in houses suffering from dry rot. They do not seem to do any material damage in a house except to stored goods, unless it is by carrying the spores of dry rot fungus about. Mr. White stated in one of his communications, "the white insects give considerable trouble on my furniture; perfectly harmless, but unpleasant." They may also be noticed in abundance in furniture attacked by the furniture pest—the Death Watch (*Anobium tessellatum*)—living amongst the dust and débris these pests produce.

TREATMENT.

Washing well all likely corners where they may shelter with a strong solution of "Chinosol" was recommended. Failing this, fumigation with hydrocyanic acid gas or disulphide of carbon might be tried. These, of course, are poisonous, also the fumes, and bisulphide of carbon is also inflammable, so must be used with care (*vide p. 126*).

A further letter regarding fumigation for this pest was received from Mr. Howard White, to which the following answer was sent:—

Your letter has not been answered because I was waiting the result of some experiments Prof. Hall was making for me *re* bisulphide of carbon. He finds it will not hurt gold picture frames, etc., unless there are impurities in the gold. Nor will it hurt furniture, foods or draperies

if well aired afterwards ; but as it is highly explosive he advises the use of hydrocyanic acid gas as used for destroying insects under glass, etc.

The cyanide treatment is deadly to all insect life and does not harm food or anything ; but care has to be taken that the poison is not eaten or the fumes inhaled by any person.

You could only use the Chinosol for floors and crevices.

Directions for using Hydrocyanic Acid Gas Indoors.

The following are instructions sent to Mr. White with regard to the gas treatment.

The proportions for hydrocyanic acid gas treatment are as follows :

2 ozs. of cyanide of potassium.

4 ozs. of sulphuric acid.

7 ozs. of water.

for 1,000 cubic feet of space.

Proceed as follows : Add the 4 ozs. of acid to the 7 ozs. water in a deep saucer or jam-pot ; then roll up the small lumps of cyanide in blotting-paper and drop into the acid and water. Leave for a couple of hours ; then freely ventilate the room ; do not enter it for an hour after ventilation, as, of course, you must not breathe the fumes, as they are deadly, and so is the cyanide. It would be safest to bury the residue, but it is innocuous. You can easily manage windows for ventilation, so as not to have to enter the room to do so. I should put the saucer just inside the door, so the arm can reach it, and drop the cyanide in blotting-paper into the saucer, shutting the door immediately. Of course, do not let people stand about outside the door, as some fumes may come through crevices, etc. Get the room as air-tight as possible.

The proportions I give have been found sufficient in greenhouses to kill Red Spider, Woodlice, Slugs, Aphis, and Caterpillars.

The employment of this gas for Bud Mite in Currants (*Eriophyes ribis*) has not proved it to be successful. *Sulphur in some form alone seems to affect acari.* It is thus interesting to learn that fumigation with hydrocyanic acid gas did not affect this household pest, but Mr. White tells me he cleared it out by sulphur fumigation.

Anobium tessellatum in St. Alban's Cathedral.

An insect, sent by Mr. Nathaniel Hicks, in oak from the roof of St. Alban's Cathedral, proved to be one of the common Wood-boring Beetles—a serious furniture pest—known as the "Death Watch" (*Anobium tessellatum*).

Judging from the destructive habits of this pest and the great difficulty in ridding furniture of it when once it gets well into the wood, it is extremely dangerous to use such wood unless it is treated to destroy all the pests in it first.

For treatment: corrosive sublimate alone seems of any avail. Paraffin has been found practically useless.

SUB-GROUP C.

The Indian Meal Moth (*Plodia interpunctella*, Huebn.) attacking Almonds.

Almonds sent to the Museum from stores in the Docks, proved to be attacked by one of the Meal Moths (*Plodia interpunctella*, Huebn.), popularly called the Indian Meal Moth.

The Indian Meal Moth caterpillar often spins a mass of silk such as sent with the attacked almonds. It is recorded as attacking beans, peas, peanuts, walnuts, dried fruits, almonds, and various other dried products, including cinnamon-bark, dried dandelion roots, etc.

The moth is about three-fourths of an inch across the expanded wings; some specimens, however, only reach half an inch. The outer two-thirds of the front wings are dull reddish-brown; the basal part and all the hind wings dull grey. The moth deposits her eggs over the articles destined for larval food, and also on boards, on walls, and on floors; these white ova are laid both singly and in groups of from three to twelve. In a few days, variously estimated at from three to seven, they hatch. The larva varies from dull white to pale reddish or dull yellow, with brown head, and is more or less hairy. When mature it reaches half an inch in length, and then spins a loose cocoon in which it changes to a pale brown pupa. The whole life-cycle takes four or five weeks; so that a number of broods may appear under favourable conditions.

Fumigating with bisulphide of carbon, or hydrocyanic acid gas, is the only treatment.

Notes and instructions on fumigation with bisulphide of carbon and hydrocyanic acid gas are appended; neither harm food if freely ventilated afterwards (*vide p. 126*).

The Cigar Beetle.

(*Lasioderma testaceum*, Duf.)

Dr. Christy, of St. James Place, forwarded some Indian cigars, a case of which were being seriously damaged by a small beetle. The pest is known as the Cigar Beetle (*Lasioderma testaceum*, Duf.), and is closely related to the American, West Indian, and almost cosmopolitan Cigarette Beetle (*Lasioderma serricorne*). It is recorded from India as attacking cheroots, rice, saffron, the leaf coverings of opium balls, etc.

They have been noticed largely in Burmah cheroots, and are frequently found in Manilla cigars and cheroots. It is almost cosmopolitan, and attacks most dry vegetable substances. I do not remember having seen it in Havana cigars. The egg stage lasts from eight to sixteen days. The grub stage normally takes six weeks, but under unfavourable conditions it may last for a year or more. The pupal stage lasts about eight days.

The beetles may live for two months. The development of the larvae is hastened and retarded by heat and cold. Both larvae and beetles do the damage : a single tunnel into the cigar, as a rule, stops it drawing, so that the damage done by a comparatively small number of beetles and their larvae in a case may often be considerable. This pest, when a case is opened and found to be infested, may easily be checked by bisulphide fumigation.

The Larder Beetle.

(*Dermestes lardarius*, Linn.)

The Larder Beetle previously mentioned (p. 45) was sent with various enquiries by a correspondent from Wantage.

This beetle is also known as the Bacon Beetle. As far as personal observations go it lays its eggs first in May and on through the year in successive broods, under favourable conditions.

No observations have been made on the length of egg-life. The larvae that I have kept under observation took nearly five weeks to reach maturity, but I believe they may do so in four weeks.

Hams and bacon affected by this pest should have the parts invaded by the insects cut away and washed with a strong solution of salicylate of soda. Store rooms in which this pest has occurred should be well swept out and either fumigated with bisulphide of carbon or hydrocyanic acid gas.

Instructions for the Fumigation of Stores with Bisulphide of Carbon.

1. Obtain the best bisulphide of carbon.
2. Remember that it is both poisonous and highly inflammable ; no light of any kind should go near it, nor should it be used where electric wires run.
3. Dried goods are best placed in a large air-tight bin, and then the bisulphide placed in saucers on the substance to be fumigated. The bin should be closed and kept shut for four or five hours ; the treated commodities should then be freely ventilated.
4. The quantity to use is 1 lb. to every 1000 cubic feet of space.

If you are much troubled with insects in stores it would be well worth having large bins (air-tight) made for the treatment. The vapour given off is heavier than air, and hence penetrates into the stuff below.

As there may be eggs (which I do not think are affected), a second fumigation two weeks later would be advisable.

You want to pour the bisulphide out rapidly, so as not to inhale much of the fumes ; a small quantity breathed in will not affect one, but it is well to be very careful.

Treatment in bins is far safer and better than fumigating the whole room, which may be well cleaned out by scrubbing with hot soft-soap and water.

Hydrocyanic Acid Gas.

The fumes of this gas are also deadly poisonous to all animal life, with the exception, it seems, of Mites or Acari. It is safer in one way to use than the former, owing to its not being inflammable.

It is formed by the mixture of (1) cyanide of potassium ; (2) sulphuric acid ; and (3) water.

The fumes do not harm substances for food ; but in applying this remedy you must be careful the men do not breathe the fumes. Rooms can be fumigated, and the stores in bulk, in bins, as before. The following rules should be remembered :—

(1) Cyanide of potassium (*a*) and the fumes when mixed with sulphuric acid (*b*) are very poisonous. Therefore do not breathe the latter.

(2) Use the following proportions :—

2 ozs. of cyanide,
4 ozs. of sulphuric acid,
7 ozs. of water,

for every 1,000 cubic feet to be fumigated.

(3) Work as follows: Add the 4 ozs. of acid to the 7 ozs. of water in a saucer (never add the water to the acid); then put the 2 ozs. of cyanide in small lumps wrapped up in blotting-paper into the saucer and close the bin up quickly; the fumes do not come off for a few seconds, so there need be no danger of inhaling them. If fumigating a room, put the saucer close to a door and drop the cyanide into it and shut the door rapidly; manage so that you need only put your arm into the room.

Leave the stores in the fumes for two hours at least, and then open the windows from outside; do not go into the room for at least an hour after the doors and windows have been thrown open. Night-time is the best time to fumigate; a man should keep guard to stop people going near when either method is employed, if many people are about and used to entering the room.

If you can put the stores in bins, I should use bisulphide; if to fumigate a room or store, the hydrocyanic gas. With reasonable care there is no danger in the use of either.

GENERAL SUBJECTS.

Green Matter in Lewes Public Bath.

To an enquiry received by the Director from the Lewes Town Council regarding the inconvenience caused by quantities of green matter appearing in the Public Baths, the following report was sent:—

The green matter sent from the public bath at Lewes is mainly composed of algae—the majority are Desmids and Diatoms—but the slime masses are formed by a *Leuconostoc*. There are no traces of any of these in the sample of water sent taken direct from the pump.

The bottom and sides of the bath are probably covered with these organisms, which increase with great rapidity; the slime mass formed by the *Leuconostoc* forming on the floor and sides of the bath, and when disturbed by swimmers float to the surface. The green colour is due to certain of the "blue green" algae contained with the Desmids and Diatoms in the slime. A few protozoa and diptorous larvae and seeds of elm, etc., were also present, but the cause of the green floating masses is undoubtedly the slime-forming algae referred to.

The remedy found successful in cases of a similar nature is the employment of sulphate of lime. The bath should be well cleaned and washed out a few times with a strong solution of the above, the sides as well as the floor.

OTHER SHORT REPORTS SENT ON THE FOLLOWING SUBJECTS.

GROUP F.

The Death Watch (*Anobium domesticum*), which were reported as appearing in large numbers on the walls of a room that had been shut up for a year full of boxes, at Eastbourne. (Miss E. Branscombe.)

The Clothes Moth (*Tineola biselliella*), also reported by the same observer, with a note that "They do not fly about as ordinary moths, but sit on the walls and ceilings with folded wings, waiting for me to kill them. Sometimes I kill ten in a room, then find none for a day or two; then eight or ten make their appearance in a room which is shut up and no window opened. I am thinking of shutting up the house, so it is important for me to know what to do." (*Vide Report*, p. 43.)

Method of destroying insects (sp.?) in Acacia wood. (T. Christy & Co., London.) Letter containing a note that "they always submit drugs with weevils and insects in them to a process of baking." We have therefore made arrangements for them to receive the whole of our parcel (of acacia wood) to treat it in the ordinary way.

GROUP E.

Sub-Group A. Animals Injurious to Domesticated Animals.

Filariasis in Lambs. (W. H. Hammond, Esq., Canterbury.)

A Parasite in Fowls' Eggs. (Dr. Humphrys, Marychurch, Torquay.)

GROUP E.

Sub-Group B. (Section I.) Agriculture: Fruit.

The Wood Leopard (*Zeuzera aesculi*) attacking Apple Trees at Hailsham.

The Pith Moth (*Laverna atra*) attacking Apple Shoots at Hailsham. (Mr. Bear); at Swanley. (Mr. Cecil Hooper.)

The Bud Moth (*Hedya ocellana*) attacking Apple and Cherry at Hailsham and Swanley.

Winter Moth (*Cheimatobia brumata*) from Swanley. (Mr. Cecil Hooper.)

Red Plum Maggot (*Opalia funebrana*) in fruit in Kent. (Mr. W. H. Hammond.)

Apple Sawfly (*Hoplocampa testudinea*) at Guestling, Sussex. (Rev. E. N. Bloomfield.)

Pear Midge (*Diplosis pyrivora*) attacking Pears at Guestling. (Rev. E. N. Bloomfield); at Swanley (Wilkinson); at Ross (Getting).

Scale Insects on Currants (*P. ribesiae*, and *L. ribis*). (G. B. King, Lawrence) Massachusetts, U.S.A.)

Regarding *Pulvinaria, ribesiae* Professor King writes as follows:—"The Pulvinaria is what I believe to be *P. vitis*, L.; in fact, it is identical with what I have written of (MS.) a species common on grapes in Germany."

Information re Currant Scale and caustic alkali wash, advising use of same to be continued. Good results reported by correspondent, J. Riley, Esq., Putley Court, Ledbury.

Winter Moth and Grease Banding. Information sent to Mr. R. Amos, Perry Court, Wye, as to date, etc., for keeping bands on the trees.

Sub-Group B. (Section II.) Horticulture.

Acari attacking Roots of Flowers (*Tetranychus*). (James Nimms, 17, Great Tower St.)

Leaf-Cutting Bee (*Megachile williamsiella*) tunnelling Apple wood. (Sir Joseph Hooker, per the Director, and Mr. Towns-Smith, Yalding, Kent.)

Thysanoptera: Correspondence regarding Haliday's types. (Mr. Froggatt, Gov. Ent., N. S. Wales.)

Leaf Miners (*Phytomyza*, sp. (?)) in Melons. (Mr. Staines, Ringwould, Dover.)

Sub-Group B. (Section III.) Forestry.

Cecidomyia salicis, on Willows near Canterbury. (Mr. W. H. Hammond.) Goat Moth attacking elm. (Brondesbury.)

GROUP B.

Sericulture, list of works on. (H. A. Kelly, Casale Litta, Lombardy.)

General.

List of books, &c., useful for the Herefordshire Fruitgrowers' Association. (S. E. Agri. College.)

G R O U P D .

(B) EXTRA-BRITISH.

Animals which concern Man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character.

A Poisonous Land Bug from Singapore.

A large land bug received by Dr. Cantlie from Singapore proved to be one of the Hemiptera heteroptera, known as *Conorhinus rubrofasciatus*, De Geer. It is neotropical and oriental in distribution.

Some of the foreign bugs are very poisonous. The note sent to Dr. Cantlie is of considerable interest. It is as follows:—

(From "THE JOURNAL OF TROPICAL MEDICINE," November 1, 1901).

INSECT BITE.

To the Editor of "THE JOURNAL OF TROPICAL MEDICINE."

DEAR SIR,—I beg to forward you an insect which I shall be glad if you will kindly get identified. It inflicts a very nasty sting, which is done by a huge proboscis capable of being folded up beneath the maxilla and neck. Acute pain and inflammation follow in a few minutes. In one case the whole leg became swollen.

Yours, &c.,

LIM BOON KENG, M.B., C.M.Edin.

Singapore.

IDENTIFICATION OF THE INSECT REFERRED TO BY
DR. LIM BOON KENG.

To the Editor of "THE JOURNAL OF TROPICAL MEDICINE."

DEAR SIR,—The insect you send from Singapore is one of the Hemiptera-heteroptera known as *Conorhinus rubrofasciatus*, De Geer. It is neotropical and oriental in distribution.

Yours, etc.,

FRED. V. THEOBALD.

BRITISH MUSEUM (Natural History).

A full account of Hemiptera-heteroptera obnoxious to man has recently been compiled by Raphael Blanchard entitled, "Sur la Piqûre de quelques Hémiptères." Archives de Parasitologie, V. No. 1, p. 139 (1902).

Screw Worms in Human Beings.

A note regarding the Screw Worm (*Compsomyia macellaria*) in human beings was sent by Dr. St. George Gray. Screw Worms were taken from the mouth and nose of a female patient dying of phthisis in the Victoria Hospital. "I am not at all sure that they are the larvæ of *Compsomyia macellaria*, which is very common in some parts of this island and which attacks cattle, for I have never seen a single specimen of the adult fly in the vicinity of the hospital, but there are innumerable flies of other species about. I am trying to breed out a few of these in a jar of earth, so that I may be absolutely certain of the fly. I may mention one fact about them which may be of interest. Out of four patients who were attacked by Screw Worms two occupied the same bed, one after the other, and a third the next bed to it. The other case was in a more remote part of the hospital."

About a month after, specimens of the fly and its puparia arrived with the following interesting notes by Dr. St. George Gray: "I notice that those bred from the larvæ have a more decided bluish colour than those caught in the open. This may be due to the fact that the former had never fed. During life the eyes are of a brick-red colour, but this changes after death." The larvæ of *C. macellaria* have frequently been known to attack human beings, entering the external orifices.

G R O U P E.

Animals which concern Man as causing bodily injury or disease, both possibly of a deadly character, to (A) his stock of Domesticated Animals, or (B) to his Vegetable Plantations, or (C) to Wild Animals in the preservation of which he is interested, or (D) Plants in the preservation of which he is interested.

SUB-GROUP A. ANIMALS WHICH CONCERN MAN BY CAUSING BODILY INJURY OR DISEASE TO HIS STOCK OF DOMESTICATED ANIMALS.

The Screw Worm in Cattle in St. Lucia.

Two diptera sent by the Director of the Imperial Department of Agriculture of the West Indies that are injurious to cattle in St. Lucia proved to be the well known "Screw Worm" Fly. The scientific name of the fly is *Compsomyia macellaria*, of Fabricius. There is any amount of literature on this pest, its life-history being well known.

The fly is common from the Argentine to Canada. It especially attacks the natural openings of animals, notably the "sheaths" of horses and the navel of newly-born animals; but the fly will lay its egg upon any abraded surface of the skin. Where ticks, etc., have been killed on an animal is a favourite place for the fly to deposit her eggs, the fly being attracted by the blood. Abrasions from contact with barbed wire form favourite localities. Human beings are also subject to its ravages, especially in the nose and ear (*vide* "Psyche" iv., pp. 27-30, 1883, and page 131). Amongst the many excellent accounts issued by American stations is the following:—

Bulletin of the Agricultural Station of Louisiana, No. 2, second series. "The Texas Screw Worm," by Prof. H. A. Morgan, 1890.

All animals seem to be attacked by it.

Pony Flies.

(*Lyperosia*, sp. ?)

Mr. E. E. Green forwarded some small flies that were causing annoyance in the pony-breeding establishments in Ceylon. They were examined by Mr. Austen and found to belong to the family Muscidae and to the genus *Lyperosia*, sp. (?). The species is probably new.

SUB-GROUP B. ANIMALS INJURIOUS TO MAN'S VEGETABLE PLANTATIONS.

SECTION I.

ANIMALS INJURIOUS TO AGRICULTURE.

Scale Insect (*Mytilaspis citricola*, Packard) on Orange Trees in Monte Video.

Dr. E. S. Miller, R.N., sent from Monte Video a scale insect affecting the orange trees there and asking for information as to destroying it. This scale proved to be *Mytilaspis citricola*, Packard. It occurs in the United States, West Indies, China, Brazil, Southern Europe, Ceylon, Fiji, etc. It has been recently introduced into South Africa. Fruit from Southern Europe, Canary and Madeira is usually infested.

Its food plants are all citrus fruits and probably all Rosaceae. In Jamaica, Cockerell records it on the Murraya. Its original home was probably the West Indies or South America. It occurs on leaf, fruit, stems and twigs.

This scale is about $\frac{1}{8}$ th of an inch long, and is about three times as long as it is wide, and like the Apple Mussel scale in outline, the anterior end being narrow and the posterior broad and rounded, the whole scale somewhat curved.

The colour is variable, some are dull purplish, others almost brown. Beneath the scale is white; this lower white portion coming away with the scale retains the insect or eggs within.

The male scale is almost straight and $\frac{1}{16}$ th of an inch long.

The eggs, which vary from twenty-five to seventy under each scale, are white. All the specimens examined from Monte Video had eggs within them.

Three or four broods may occur in tropical climates. It is known under a variety of popular names, such as the Purple Scale and the Orange Mussel Scale.

TREATMENT OF AFFECTED TREES.

There are two ways of treating scale-insect attack:—

- I. Spraying, with either paraffin emulsion or resin wash.
- II. The gas treatment.

1. Spraying for scale attack.

A. Paraffin emulsion. This is used to kill the larval scale insects when they are crawling from beneath the scales and to corrode the scales away. The time of migration of the larvae should be noticed when this wash is used, and the wash applied when they are crawling about, to do most good. But it has been found more or less satisfactory at any time if applied on several occasions during the year, best at intervals of two weeks.

Paraffin emulsion is made as follows:—Mix equal portions of soft soap dissolved in boiling water and paraffin, and then churn them up by means of a force pump until a creamy emulsion is produced. When required for use mix with twenty times its bulk of water.

B. Resin wash. There are many recipes for this—the following is a good one:—dissolve 1 lb. of caustic soda in $1\frac{1}{2}$ gallons of soft water, then dissolve 2 lbs. of resin and 1 lb. of tallow by moderate heat, and as it is cooking stir in gradually 1 quart of the dissolved caustic soda solution, and then add water until you have 22 pints of liquid. This forms a thick brown soap which is sufficient for 44 gallons of wash; it being added to the water and well stirred; warm water, if possible, should be employed. This should be applied before the blossom bursts, but in bad attacks it may be used later as it is well to clear out the scale, even at the loss of all that year's crop, through destroying the blossom.

2. Gas treatment. This is largely employed for scale in the United States, the Cape of Good Hope, etc. The trees have to be covered with a tent of gas-proof canvas; the hydrocyanic acid gas is generated by putting water and sulphuric acid in a saucer or jar and then putting lumps of 60 per cent. grade cyanide of potassium into the mixture. The fumes may be allowed to ascend for an hour or more—evening or dull days are the best times to fumigate. The slower the gas generates the better; the greater the quantity of

water and the larger the lumps of cyanide used the slower the gas comes off.

Experiments conducted by Mr. Cowans in England show that the following quantities are required per cubic foot of space—3 ozs. of cyanide, 5 ozs. of acid, 8 ozs. of water per 1000 cubic feet. Both the cyanide and the gas generated are poisons.

If gas treatment cannot be carried out owing to lack of material or apparatus, then spraying should be employed.

Scale on Pineapples.

(*Diaspis bromeliae*, Kerner.)

Pineapples are frequently damaged by a scale insect, which now and then causes the fruit to rot. Specimens have been sent by Mr. Hammond, of Kingston, Jamaica, for identification and information concerning it. This scale is the Pineapple Scale (*Diaspis bromella*, Kerner). The scale is thin, circular and pure white—the females yellow or orange. Like most Diaspids, they burrow beneath the epidermis of the plants and become almost entirely hidden.

It chiefly attacks the leaves, but now and then the fruit.

It should be destroyed as soon as the fruit is cut.

S U B - G R O U P B.

SECTION III.

ANIMALS INJURIOUS TO FORESTRY.

The Pine Beetle.

(*Hylesinus piniperda*, Linn.)

Some pine wood sent by R. E. Haslam, Esq., from Monroe, was found to be attacked by the Pine Beetle (*Hylesinus piniperda*, Linn.). It had killed an old tree and two young ones. This insect chiefly attacks diseased and damaged timber; but if no unhealthy trees are about it will attack healthy ones. As a rule one sees this pest working in plantations of about thirty years' standing.

Scotch and Weymouth Pines are chiefly attacked, but cluster and other species of pines are frequently recorded as being damaged by this pest.

This insect does harm in three ways, (i) the beetles and larva attack bark and boughs, the former making longitudinal galleries with

one to three air holes — the larvae eat out secondary galleries in the bast which branch out at right angles to the primary gallery ; (ii) the beetles in August and September bore into the pith of young pine shoots at a distance of from one to three inches from their extremities, eating out a tunnel up to the terminal bud. The holes where the entrance is made are surrounded by a ring of opaque resin ; (iii) the beetles bore into the sap wood of the root-stock of quite sound trees to hibernate, and thus trees may become sickly that were formerly quite sound, and so attract beetles during the following year.

The beetles appear in April and May, and again in June and July. The larvae hatch in April and May, and pupate in June or July and even August.

Those that hatch in June may produce a second brood in August, and this second brood attacks the terminal shoots and branches. The whole life cycle lasts from sixty to eighty days.

It should be remembered that the beetles hibernate in the adult stage in the root stocks and roots of standing trees, also in old stumps.

Schlich * gives the following protective and remedial measures :—

- i. Timely and frequent thinnings of woods and quick removal of all sickly wood.
- ii. Clearance of felling areas by the middle of April.
- iii. Uprooting of stumps and broken trees or barking the same.
- iv. Pine woods if damaged by fire should be felled.
- v. Insect-eating mammals and birds should be protected.
- vi. All standing trees containing larvae and pupae should be felled and barked and the bark burned.
- vii. Trap trees should be felled from February to September, so as to supply trees which are not too dry for the beetles to breed in. These should be barked at the middle of May, and others at intervals of four to six weeks, and the bark burnt.

Of these rules the most important are ; (A) the destruction of attacked trees at the proper time ; and (B) using certain unhealthy trees as "trap" trees. If there are no unhealthy trees in the plantation, certain of them should be made into "trap" trees by ringing the worst trees. This is done by cutting strips of bark round the trees in the early spring so as to produce an unhealthy state, and so attract the beetles to lay their eggs and thus keep them away from the surrounding ones.

These "trap" trees should be burnt later, before the larvae and pupae have matured.

* "Manual of Forestry," Vol. IV., p. 242.

INSECTS INJURIOUS TO COFFEE, ETC.

Beetles Damaging Coffee-Berries.

Two samples of coffee-berries damaged by small beetles have been received during the past year. One was sent by a correspondent in London with the following information : "I enclose a small sample of coffee taken from a bag recently imported from Costa Rica, and shall be glad if you can tell me the life-history of the creatures with the coffee, and whether they are likely to spread to other goods in the warehouse, either coffee or cocoa or goods of a kindred nature." On examination the sample was found to contain a number of live beetles, and most of the berries were greatly damaged.

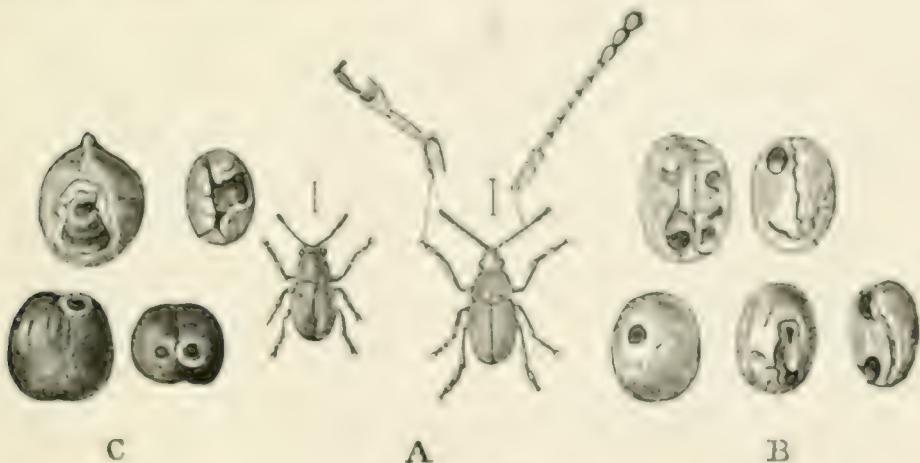


FIG. 16.

B, Coffee damaged by (A), *Araocerus fasciculatus*, De Geer (♂ and ♀); C, by *Scolytus*, sp. (?)

The beetles sent are known as *Araocerus fasciculatus*, De Geer (Fig. 16, A). Their life-history is well known. They are cosmopolitan and abundant in the Old and New Worlds.

The larvæ live in coffee-berries, and will attack cocoa, ginger and other commodities, as also will the adult beetles.

It is well known in Central America, in India and the Cape of Good Hope, but does not seem abundant in Europe. It has also been found on *Tamariscus gallicus* and in and on packages of *Tegenaria*. The larva is short and cylindrical, with distinct legs and about one-fourth of an inch long; its movements are slow. It has

been observed in branches of a kind of ginger from China, eating the woody parts, making long galleries deep into the branches, which become full of dust (frass). When they are ready to pupate they make a large nest or cell near the bark, so that the beetle can escape easily. The pupal stage lasts from ten to fifteen days. The beetles are very agile, jumping often nearly an inch ; they also fly readily, so that they might soon spread themselves over a storehouse. They also feign death when touched. They were breeding in the coffee berries sent as well as having damaged them by eating them. If such a consignment is not destroyed, it should be treated at once to kill the beetles. This may be done either by heat (if possible in this case) or by fumigating the mass with hydrocyanic acid gas in closed receptacles.

The life-history of this pest has been fully described by M. R. Lucas in the Annales of the Entomological Society of France (tom. 1, 4th se., p. 399, 1861).

The other sample of coffee berries (Fig. 16, c) was received at Kew from Uganda and sent on to the British Museum. The following note was sent back to Kew regarding the cause of damage :—

" Some coffee berries from Uganda have been handed to me by Sir George Hampson. They have been damaged by *Scolytidae*. Mr. Waterhouse says it is most probably a new species. As only a few fragments of the beetle could be found, it is not possible to refer to it in detail. Could you obtain fresh specimens of the beetle and have them sent here ? I can find no record of any similar pest attacking the berries.

" A Rhyncota—*Stachia geometrica*, Motsch (MS.)—attacks young coffee berries in Ceylon and does some harm."

These berries were eaten into, many hollowed right out, the outer shell often perforated in two or three places.

Weevils (*Hypomeces squamosus*, Fabr.) Defoliating Rubber.

Some Weevils sent by the Curator of Selangor Museum that were reported to him as defoliating Para Rubber (*Hevea brasiliensis*) proved to be the *Hypomeces squamosus* of Fabricius.

Insect Pests of the West Indies.

In answer to Mr. Hammond, the following list of West Indian insect pests has been forwarded. The Orange Pests are not given in this list. Probably the Museum of the Jamaican Institute has records, as they have published catalogues under the title of Museum Notes. This list is further augmented by the identification of specimens sent over by the Imperial Department of Agriculture of the West Indies. The names of these species and their food plants are given in the following pages.

A. INSECTS INJURIOUS TO SUGAR CANE.

1. Large Sugar Cane Borer (*Diatraea saccharalis*). ("Ins. Life," Vol. iv. pp. 95, 103.)
2. Sugar Xyleborus or Pin Borer (*Xyleborus perforans*). ("Ins. Life," Vol. v. p. 31.)
3. Sugar Cane Pin Borer (*Xylborus putescens*). Barbados, Trinidad, St. Vincent.
4. Boring Weevil (*Sphenophorus*).
5. Tropical Sugar Cane Borer (*Chilo saccharalis*).
6. Scale (in Jamaica) (*Aspidiotus sacchari*, Ckll.).
7. Mites, *vide* Bull. 40, Royal Kew Gardens, April, 1890.

<i>Histiostoma rostroserratus</i> (decaying plants). Immature Gamasids (predaceous). <i>Damacus</i> or <i>Motaspis</i> , sp. <i>Tarsonymus bancrofti</i> , Miller, does damage to canes.
--

B. COTTON.

1. *Dactylobius virgatus*, Ckll. = Mealy Bug on under side of leaves. Jamaica.
2. Cotton Stainer (*Dysdercus andreae*), attacks bolls. Jamaica.

C. COFFEE.

1. Scale (*Aspidiotus articulatus*). Jamaica. Leaves.

D. ALLSPICE.

1. Pimento Borer (*Cyrtomerus pilicornis*), bores into twigs. Jamaica.

E. BANANA.

1. *Aspidiotus articulatus*, on leaf.
2. *Ceroplastes floridensis*.
3. *Aspidiotus personatus*. } rare. } Jamaica.
4. *Aspidiotus fieci*.

F. CONGO PEA PESTS.

Vide No. 54, Inst. Jamaica Mus. Notes.

G. COCOA PLANT.

1. Cocoa Bug (*Membracidae*). Leaf-hopper found in Trinidad.
2. Leaf-cutting Ant (*Atta pediculus*, L.). Trinidad.
3. Longhorn Beetle (*Sterastoma depresso*), on young plants.
4. Palm Weevil (*Rhynchophorus palmarum*).

140 *First Report on Economic Zoology.*

5. *Diaspis boisduvalii*. Trinidad.
6. *Fiorinia gallucida*, Sig.
7. *Mytiiaspis buxi*, Sig.
= *M. pandani*, Cou. Abundant on leaves in Jamaica.

H. COCOANUT PALM.

1. *Autocarpis boisduvalii*. Jamaica.
2. *Aspidiotus pumicæ*, Ckll. Jamaica.
3. *Dactylopius longifilis*. Jamaica.
4. *Dactylopius virgatus*, on leaves. Jamaica.
5. *Diaspis vandalicus*, Galvoz. Jamaica, abundant; and Santiago de Cuba.
6. Rufous Scale (*Aspidiotus articulatus*), Morgan. Jamaica. ("Ins. Life," iv. 380.)
7. *Aspidiotus minutus*, Ckll.
8. *Aspidiotus rapax v. palmæ*, Ckll.
9. *Fiorina camelliae*, Cou.

I. CHINCONA PESTS.

1. *Diaspis pelargonii*, Ckll. Jamaica.
2. *Lecanium decidrophthora*, Ckll. Jamaica.

J. MANGO.

1. *Ceroplastes floridensis*, leaves.
2. *Vindonia stellifera*.
3. *Aspidiotus personatus*.
4. *Aspidiotus articulatus*.
5. *Lecanium oleæ*,
6. *Lecanium mangiferae*, } leaves.
7. *Dactylobius longifilis*, Cou.
8. *Aspidiotus*, sp. (?), pale patches on fruit.
9. *Planchonia pustulans*, Ckll. Montserrat.

K. POMEGRANATE.

1. *Ceroplastes floridensis*, on leaves.
2. *Aspidiotus pumicæ*, Ckll. Jamaica.

L. PEACH.

1. Bermuda Peach Maggot (*Ceratitis*, sp. (?)), attacks fruit

M. PINEAPPLE.

1. Pineapple Scale (*Diaspis bromelia*).

N. ORANGE.

1. *Aspidiotus citricola*. Bermuda.
2. *Chionaspis citri*. Bermuda.

O. ANIMAL PESTS.

1. The Screw-worm Fly (*Compsomyia macellaria*). St. Lucia.

NAMES OF ECONOMIC INSECTS SENT BY THE IMPERIAL
DEPARTMENT OF AGRICULTURE OF THE WEST INDIES.

NOTE.—(A.) Aptera; (C.) Coleoptera; (B.) Blattidæ; (L.) Lepidoptera;
(H.) Hymenoptera; (He.) Hemiptera.

SUGAR CANE.

Myochronus armatus, B. On leaves. Barbados. (C.)

ARROWROOT.

Calpodes ethlius, Cram. Barbados. (L.)

Megachile flavitarsata, Smith. Barbados, St. Vincent. (H.)

Megachile martinduli, Ashmead. Barbados. (H.)

ANDIRA, sp.

Cleogonus rubetra, F. Grenada and Trinidad. (C.)

Diorymerus, sp. (?)

BANANA.

Tomarus bituberculatus, Beard. St. Lucia. (C.)

CASSAVA.

Dilophonota ello, Linn. Montserrat. (L.)

COCOA.

Cryphalus, sp. (?) Grenada. (C.)

COWPEAS.

Bruchus chinensis, Linn. Barbados. (C.)

CROWN-PEAS.

Carpophilus dimidiatus, Fabr. Barbados. (C.)

CASTILLA ELASTICA.

Taniotes scalaris, Fabr. Grenada. (C.)

DIVI-DIVI (*Cesalpinia coriaria*).

Bruchus, sp. (to fruit). Antigua. (C.)

FICUS.

Phrynetes verrucosus. Barbados. (C.)

Leucophana surinamensis. Barbados. (B.)

FIDDLE-WOOD.

Pyraustra mellinalis, Hubn. Barbados. (L.)

GRASSES.

Remigia repanda, Fabr. Trinidad. (L.)

GUINEA CORN.

Calandria oryzæ, Linn. Antigua. (C.)

GRANDILLA.

Lactica pallens, Fabr. Montserrat. (C.)

INDIAN CORN.

Trogosita mauritanica. Antigua. (C.)

Aphis maidis, Fitch. Montserrat. (He.)

Spodoptera frugiperda. Barbados. (L.)

142 First Report on Economic Zoology.

LIME TREE (*Citrus acida*).

Naupractus, sp. (?) Antigua. (C.)

MANGO.

Platypus parallelus, Fabr. Grenada. (C.)

MALPIGHIA.

Podagrion amoenissima, Chen. MS. Antigua. (C.)

ORANGE.

Lagochirus arauciformis, L. Grenada. (C.)

PIGEON PEA BUSH.

Rhynparobia maderæ, F. Barbados.

PIGEON PEAS (Dried).

Bruchus 4-maculatus, F. Antigua.

PALM SEEDS.

Coccotrypes dactyloperda, Fabr. Trinidad. (C.)

SWEET POTATOES.

Cryptorhynchus batatus, G. Waterh. To tubers. Barbados. (C.)

Coptocyccha trisignata, Bohem, var. *bistripunctata*, B. To leaves. Antigua. (C.)

Chætocnema amazona, Baty. Eats leaves. Barbados.

SOLANUM MELONGENA.

Epitrix parvula, Fabr. On leaves. Barbados.

Corythaica monacha, Stål. On leaves. Barbados.

TAMARIND.

Cathartus cassiae, Reich. To pods. Barbados. (C.)

Cryphalus, sp. To pods. Barbados. (C.)

TANNIA.

Tomarus bituberculatus, Beard. St. Lucia. (C.)

WOOLLY PYROL.

Thermesia gemmatalis, Hubn. Barbados. (L.)

WOOD (Dry).

Tribolium ferrugineum. Barbados. (C.)

Platypus, spp. Barbados. (C.)

STORED GOODS, ETC.

Lepisma, sp. Starch, Gum, etc. Barbados. (A.)

Calandra oryzæ, Linn., var. *pallida*. To macaroni. Barbados. (C.)

Tribolium ferrugineum. To corn-flour. Barbados. (C.)

Lasioderma serricorne, F. (C.)

Periplaneta americana, L. (B.)

BEES.

Galleria mellonella, Linn. To honeycomb. Antigua. (L.)

BENEFICIAL INSECTS.

Megilla maculata, var. De Geer. Eats various insects.

Scymnus ochroderus, Mulsant. Feeds on *Aphis maidis*. Montserrat and Barbados. (C.)

Exochomus nitidulus, Fab. Feeds on Coccidae. Barbados. (C.)

Chrysopa, sp. Feeds on various insects in Barbados. (N.)

G R O U P F.

Animals which concern Man as being destructive to his worked-up Products of Art and Industry, such as his various (A) Buildings and larger Constructions and Habitations, (B) Furniture and Books, Drapery and Clothing, (C) Food and Stores.

SUB-GROUP A.

Teredos and Canadian Timber.

A communication was received on 23rd November, 1901, from the Imperial Institute in regard to the wood-boring Teredos and Canadian timber (*Abies canadensis*). In this communication the following was stated:—"This Department has supplied full information with reference to the general characteristics of the wood and its mechanical properties. It appears, however, that other wood so employed in South Africa is liable to be attacked by the Teredo worm. The Canadian wood is known not to be readily attacked by worms or insects of any description in Canada, but the question is, does this particular worm occur in Canada?" The following replies were sent to the Institute:—

(1.) The Teredo worm, one of the mollusca, attacks all manner of wood. Canadian fir, judging from the specimens so frequently washed up on the shores of England, Norway, etc., seems very liable to the attack of Teredo. One species, *Teredo megotara*, Hanley, found in England, both on fixed, floating and drift timber (especially in Canadian fir), occurs in America. Stimpson described it as (*T. dilatata*) infesting fixed wood and harbour buoys at Lynn, New England. Tryon states that this species extends from Massachusetts to South Carolina—it also occurs in Greenland and Iceland—so has a very wide range, as one would expect, being transported on floating wood, aided by the Gulf Stream.

I do not know any exact localities to give for Teredo in Canada, but the one I mention and others occur there.

It is surprising to find that *Abies canadensis* is not subject to boring mollusca in Canada, as drift wood of that fir appears particularly prone to the attack of the pest.

(2.) Since I last wrote you re Teredo and Canadian pine I find the following species occur in Canada: *Tereda dorsalis* (the commonest species), *Xylophaga fimbriata*, and *X. bipinnata* on the West Coast, and *Teredo megotara* on the East Coast.

The species occurring on the United States coast (Massachusetts) are *T. navalis*, *T. norvegica*, *T. dilatata*, *T. chlorotica* and *X. fimbriata*.

T. norvegica occurs in oak, fir, and birch, and is found in Europe as well. *T. navalis* in fir, elm, etc.; also in Europe. *T. megotara* in any wood; also European. *X. bipinnata* occurs in Europe, West Indies, etc., in almost any wood. *X. fimbriata* has also occurred in teak in Europe.

The only Teredo quoted from South Africa is *T. (Hyperotus) nucivora* of Spengler, which bores into floating cocoa-nuts. This species Mr. Edgar Smith says he believes to be only tropical and sub-tropical. Teredos which bore into wood, floating or otherwise, may be found anywhere, and doubtless have a very wide range. They may be carried very great distances by ocean currents.

OTHER SHORT REPORTS SENT.

The Rat Flea (*T. musculi*); Information concerning it, and its connection with Plague. (Dr. Cantlie.)

Tapeworms in the Bile Duct of Sheep in Transvaal (Dr. Theiler). A new species under investigation.

Hippo and other Flies (*Tabanus dorsovitta*, *Lucilia marginalis*, and *Lucilia*, sp. (?)) from Zambesi. (L. Lloyd Prichard, M.R.C.P., etc., Jersey.)

Ticks (*Ixodidae*) on Toads in Para, and their connection with Drepanidium found in Toads. (Dr. Durham.)

Tsetse-fly in Gambia (*Glossina longipalpis*, Wied., var. *tachinoides*, Westwood). (Dr. Dutton.)

The Swift Tick, intermediate host of *Filaria cypseli*. (Dr. Dutton.) A new species of Mallophaga.

Melolonthid Larvae (*Apogonia rauca*) attacking Coco Palms in Ceylon. (E. E. Green.)

PART III

REPORTS

TO

(A)—THE FOREIGN OFFICE

AND

(B)—THE COLONIAL OFFICE.

A.—REPORTS TO THE FOREIGN OFFICE.

1. TSETSE-FLY AND BUFFALO CORRESPONDENCE.

FOREIGN OFFICE,
15th June, 1901.

SIR,—I am directed by the Marquess of Lansdowne to transmit to you the accompanying copy of a letter from the Colonial Office on the subject of the Tsetse-fly, forwarding a copy of a letter from a Mr. Val Gielgud to the British South African Company remarking on the special virulence of this fly in districts where Buffalo are principally to be found, and I am to request that you will favour His Lordship with your observations on the subject.

I am, Sir,

Your most obedient humble servant,

CLEMENT L.L. HILL.

PROFESSOR E. RAY LANKESTER,
British Museum (Nat. Hist.)
South Kensington, S.W.

DODGEON BRUNNER,
11th June, 1901.

The Under Secretary of State for the Colonies presents his compliments to the Under Secretary for Foreign Affairs, and is directed by the Secretary of State to transmit, for the information of the Marquess of Lansdowne, a copy of the letter noted in the subjoined schedule on the subject of the Tsetse-fly and Buffalo.

MWENGA R.,
"Hook of the Kafue,"
N.E. Rhodesia,
24th February, 1901.

MR. VAL GIELGUD to the BURGH SOUTH AFRICAN COMPANY.

SIR,—I see from the papers that the international conference for the preservation of big game has decided to recommend that buffalo be

placed on the list of game to be absolutely protected. I, therefore, wish to bring to your notice my observations on the Tsetse-fly and the Buffalo, the correctness of which are, I believe, borne out by the experience of Mr. George Gray when travelling through a fly country in 1899 and also by information obtained from native sources.

The Tsetse-fly has always abounded in districts where Buffalo were numerous, and since the almost total destruction of Buffalo by rinderpest these flies have not disappeared, although, perhaps, not so numerous as formerly. The bite of the insect, however, appears to have become much less deadly to domestic animals, and stock and dogs not only survive the bites for a much longer period than formerly, but in many cases suffer no ill at all.

This has been my personal experience, and I think I am correct in saying Mr. Gray's is similar.

The natives say that now the Buffalo are dead the Tsetse-fly no longer kills stock, but of course natives are notoriously careless and loose in their statements. It is a fact also that in many places where Buffalo have become extinct the Tsetse-fly has also vanished ; this is the case in parts of Sebungwi and Zankie districts. As there are large fly districts in northern Rhodesia I call your attention to these facts, as it appears to me that the protection of the Buffalo and the Tsetse-fly are identical, and I would doubt if the benefit accruing from the preservation of the former will compensate for the disadvantages arising from the existence of the latter.

I am, etc.,

VAL GIELGUD.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, London, S.W.,
24th June, 1901.

To SIR CLEMENT LL. HILL, K.C.M.G., C.B.

SIR,—I have the honour to acknowledge the receipt of your letter of the 15th instant, enclosing a copy of a letter from Mr. Val Gielgud with reference to Tsetse-fly and Buffalo.

In accordance with your request that I should furnish the Marquess of Lansdowne with some observations on the subject I would wish, first of all, to draw your attention to the powers given by Article IV. of the "dispositions" adopted by the Conference of Plenipotentiaries on the preservation of African wild animals, May 1st, 1900. The final clause of that article was inserted on my suggestion with a view to such a case as that reported by Mr. Gielgud, and gives power to dispense with the principles agreed upon "dans un intérêt supérieur d'administration."

It is, therefore, within the provisions of the agreement signed by the Plenipotentiaries for the Government to authorise the British South Africa Company to destroy Buffalo, in order to protect domesticated cattle from disease.

A question, however, of a very serious nature arises as to whether there is sufficient ground for concluding that the parasite of the blood, which is introduced by the bite of the Tsetse-fly into domesticated animals, is *specially and abundantly* harboured in the blood of the wild Buffalo.

The *theory* is held that the parasite (*Herpetomonas naganæ*) of the blood is comparatively harmless to wild indigenous forms, such as Buffalo,

Anulope, etc., although multiplying in their blood, but that it is deadly to introduced domesticated animals. Hence, it is supposed, it flourishes in the wild game and is more abundant among them than it would be if its presence caused death. I am inclined to believe this theory correct, but it has not been properly tested.

Before the destruction of Buffalo in the vicinity of herds of domesticated cattle is authorised, it ought to be *clearly shown* by experiment and observation of competent medical men that the Buffalo harbours the parasite, or at any rate that it *can* harbour it without being killed off as are domesticated animals. It would be a matter of small expense, in comparison with the enormous pecuniary interests involved, for the British South Africa Company to employ a medical authority to experiment on wild Buffalo, captured and kept in a paddock for the purpose of settling the question.

And it seems to me that authority to destroy the Buffalo should not be granted to the Company until they have furnished satisfactory scientific evidence of the harbouring of the Nagana parasite by the Buffalo.

I am, Sir,

Your most obedient humble servant,

(Signed) E. RAY LANKESTER.

FOREIGN OFFICE,

15th October, 1901.

SIR,—With reference to your letter of the 24th June, I am directed by the Secretary of State for Foreign Affairs to transmit to you for your information the accompanying copy of a despatch from His Majesty's Commissioner in the East Africa Protectorate relative to the connexion between Tsetse-fly and the Buffalo.

I am, Sir,

Your most obedient humble servant,

(Signed) MARTIN GOSSELIN.

PROFESSOR E. RAY LANKESTER.

MOMBASA,

6th September, 1901.

To the MARQUESS OF LANSDOWNE, K.G., etc., etc.

MY LORD,—In reply to Your Lordship's despatch, No. 259 of July 20th, respecting the connection between the Tsetse-fly and the Buffalo, I have the honour to transmit letters from Messrs. Storck and MacClellan and Doctor Radford.

After reading this correspondence and discussing the question with other persons, my own opinion is that where there are Buffaloes, Tsetse-flies are usually (but not always) found, but that the flies also occur in districts where there are no Buffaloes. Hence it would appear that the Buffalo cannot be the only host of the parasite which the Tsetse-fly introduces into the blood of domestic animals with fatal results.

I have, etc.,

(Signed) C. ELIOT.

NAIROBI,
East Africa Protectorate,
3rd September, 1901.

To SIR CHARLES ELIOT, K.C.M.G., C.B.,
His Majesty's Commissioner and Consul General, Mombasa.

SIR,—I beg to acknowledge receipt of a copy of the correspondence *re* Tsetse-fly and the preservation of the Buffalo which you forwarded to me for my opinion, and I have the honour to transmit to you herewith my observations on the subject.

The Tsetse-fly belt of British East Africa, exclusive of Jubaland, may be said to extend from Mtoto Andes to Simha, a distance of roughly ninety miles ; it is situated in a densely wooded, low-lying part of the country, about 3000 feet to 3400 feet above sea level.

Driajani, an old camping ground, within this area, was considered by the late Captain Haslam and myself to be the most dangerous place for fly, on the old transport route, but strange to say it was practically devoid of game of any kind.

In my opinion, Buffalo and other big game are not the only factors in the Tsetse-fly theory, and we must first consider the question of climate and humidity before we condemn the *Bos caffra* as the true and only source of the Tsetse-fly and Tsetse-fly disease.

I believe that the distribution of the fly is entirely influenced by the physical aspects of the country and that for its existence it must have a humid, low-lying position.

Major Bruce in his excellent report says (see p. 20. Further report on Tsetse-fly disease in Zululand, 1896), "That the presence of wild animals in the vicinity of horses and oxen is not the only factor in the problem is shown by the fact that in the old days when big game was numerous and roamed over the whole country, hunters and travellers never complained of fly until they encountered the disease in low-lying tracts of country or along the large river valleys."

As in the Hermansdorp district of Cape Colony herds of Buffalo are still to be found, yet Tsetse-fly with its concomitant disease is unknown, so in the high altitude of the Kedong (6000 feet), in this Protectorate, herds of Buffalo are to be met with, greatly reduced in numbers by rinderpest within recent years it is true, yet neither Tsetse-fly nor Tsetse-fly disease have ever been known to occur, nor has the fly or its disease been heard of in the Baringo district of the Uganda Protectorate, where herds of Buffalo and other big game exist.

When studying the causes which rendered the Island of Mombasa uninhabitable for horses, I ascertained that an organism, the morphology of which was identical with that found in animals suffering from Tsetse-fly disease, was found in donkeys which had never left the island.

I expressed an opinion then (*vide* Preliminary Report as to the causes which rendered the Island of Mombasa uninhabitable for horses in 1899) with regard to African Nagana and Indian Surra being one and the same disease, and as the occurrence of Surra cannot be attributed to the presence of wild animals or Tsetse-fly, we must explain, ere we destroy the buffalo in an attempt to stamp out Nagana, why a disease identical with that

caused by the bite of the *Glossina morsitans* occurs in places such as Mombasa, where Tsetse-fly and Buffalo are non-existent.

I have, etc.,
(Signed) ROBERT J. STORDY, M.R.C.V.S. (Vet. Officer, E.A.P.).

NAIROBI,

East Africa Protectorate,

3rd September, 1901.

To R. STORDY, Esq., M.R.C.V.S.

DEAR MR. STORDY,—Many thanks for sending me the communications you have received from Sir Charles Eliot, re the Buffalo and Tsetse-fly.

That the two should be associated is not extraordinary when one remembers that both inhabit densely-wooded, damp, inclined districts, but the arguments advanced to prove that the *Bos Caffa* alone is the host of the Tsetse, and that the extirpation of the former leads to the disappearance of the latter do not appear to me to be convincing. From my own observation I am inclined to the opinion that hosts other than the one species mentioned (or some other factors) are necessary for the propagation of the fly, and that the haematozoon is in all probability to be found in many species of diptera.

During my residence in Jubaland, East Africa Protectorate, which extended over two years, I had ample opportunity of studying the habits and distribution of the Tsetse-fly and the effect it produced on domestic animals.

Speaking generally, the fly belt is confined to two distinct areas in that province.

(1) The valley of the Juba River within the forest belt. Here fly abounds for a distance of upwards of 400 miles—in fact, so general is it in places that it is a source of annoyance to Europeans and natives. Yet within the whole of that great tract of country Buffalo are few and far between. The late Mr. Jenner and I came across them in one place only (Lake Galey and district). Within this belt is the district of Gosha, 80 to 100 miles in length, where the fly is peculiarly abundant, yet Buffalo are not found; notwithstanding this, the haematozoon is very virulent, and on the occasion of the late Mr. Jenner's expedition to Langi in 1899, he lost every camel and pack-ox that went through (*vide* my report, May 16th, 1899, forwarded to the Secretary of State for Foreign Affairs, No. 53, May 31st, 1899).

(2) The region of Lake Kumbi to the north-east of Desek Wama (Lake Hardinge), where the distribution of the fly is restricted to the dense forest belt in the neighbourhood; yet Buffalo are not known to frequent this district. It appears to me reasonable to assume that where fly is abundantly found extending over a large tract of country that its natural host (if one only) should be in large numbers also; or else the fly must be possessed of extraordinary migratory powers.

If that host be the Buffalo, it is strange that it is particularly conspicuous by its absence in the extensive districts mentioned, while waterbuck and bushbuck are common in most parts, and yet again in

others no animals of any sort are found save monkeys and rodents. Amongst other pests that affect camels very seriously in Jubaland is a species of gadfly which is restricted in its distribution to the open plains and sparsely-bushed country in the districts of Deseck Wama and Derib. This fly, unlike the Tsetse, attacks animals during the day at all hours, and the symptoms produced by it (in camels) are identical in every particular with those produced by Tsetse, but I was unable at the time to substantiate this theory microscopically owing to lack of the necessary materials, etc., for carrying on investigations.

Yours truly,

WILLIAM S. RADFORD,
Medical Officer, East Africa Protectorate.

NAIROBI,

4th September, 1901.

SIR,—Referring to our conversation on the subject of Tsetse-fly in the Jubaland Province, I would state that along the Juba River where low-lying forest exists (my observations cover a distance of some hundred and twenty miles from Bulbula to Gele) Tsetse-fly abounds. The worst places are damp, dark, and low-lying, shaded chiefly by the Ndoma Palm. In many such localities there is little or no game and certainly no Buffalo.

On the other hand, from Mtudo northwards buffalo are found, especially in rainy weather and in the heat of the day frequent the thickest depth of the forest ; here, too, Tsetse-fly is found in large numbers, as also in the dry lake beds adjacent to the river. At the same time half a mile or so away from the river and lake beds in the dense dry bush, where Buffalo feed in the early mornings and evenings, the fly does not appear. In many places the areas in which fly exist are quite small, possibly only a few hundred yards in extent, and I have seen a watering place made entirely free of fly for the time being by cutting down forest and undergrowth and burning the grass in the immediate vicinity. Again, at Lake Hardinge (now dry), where little or no forest exists, where buffalo are frequently seen, and always large herds of waterbuck, and Somalis graze their cattle at all times of the year without ill effects. Passing on, however, some thirty miles to the Rumbi forest on the Affmadu road, Tsetse-fly abounds, especially in wet weather.

My opinion, therefore, is that Tsetse-fly is to be found in certain dark, damp, low-lying localities, irrespective of big game of any kind.

I have, etc.,

(Signed) J. W. P. McCLELLAN.

FOREIGN OFFICE,

20th November, 1901.

SIR,—With reference to my letter of October 15th last, I am directed by the Secretary of State for Foreign Affairs to transmit to you for your information the accompanying copy of a despatch from His

Majesty's Commissioner in the British Central Africa Protectorate respecting the supposed connexion between Tsetse-fly and Buffalo.

I am, etc.,

CLEMENT LL. HILL.

To THE DIRECTOR,
Natural History Museum.

THE RESIDENCY, ZOMBA,
British Central Africa Protectorate,
30th September, 1901.

To HIS MAJESTY'S PRINCIPAL SECRETARY OF STATE FOR FOREIGN AFFAIRS.

MY LORD,—With reference to your Lordship's despatches Nos. 141 and 155, enclosing copies of correspondence on the subject of the connection between the existence of Tsetse-fly and the preservation of Buffalo, I have the honour to append a few notes which give my own experience during the past fourteen years in Africa on this subject.

(1) Tsetse-fly would appear to depend upon wild game for their existence, as I have never found Tsetse in any locality where game was totally non-existent.

(2) Tsetse does not appear to be in any way specially dependent upon buffalo. On the plains at the north end of Nyussi, before rinderpest made its appearance, there were vast herds of Buffalo, but no Tsetse. The natives at the north end at that time owned large quantities of cattle which could be seen grazing in close proximity to Buffalo. When rinderpest came it killed practically all the cattle and all the Buffalo.

In other districts of British Central Africa Tsetse are found in large quantities where Buffalo, at the present date, at any rate, do not exist.

(3) Tsetse are not found (in British Central Africa) in open plains, although such plains may have large quantities of game on them, and in spite of the fact that at the edges of the plains, where forest abounds Tsetse are found.

It would appear, therefore, that what regulates the presence of Tsetse-fly is the description of the country almost as much as the abundance or scarcity of game.

I have, etc.,

(Signed) ALFRED SHARPE,
His Majesty's Commissioner and Consul-General.

FOREIGN OFFICE,

27th November, 1901.

To THE DIRECTOR, Natural History Museum.

SIR,—With reference to my letter of the 20th instant, I am directed by the Secretary of State for Foreign Affairs to transmit to you for your information a copy of a despatch which has been received from the acting British Commissioner in Uganda, respecting the supposed connection between Tsetse-fly and Buffalo.

I am, etc.,

CLEMENT LL. HILL.

ENTEBBE, UGANDA,
27th September, 1901.

To THE MARQUESS OF LANSDOWNE, K.G.

MY LORD,—I have the honour to acknowledge the receipt of your Lordship's despatch No. 190 of July 20th, with enclosures regarding the question of the existence of the Tsetse-fly in connection with the preservation of the Buffalo, and in reply to submit the following remarks, in so far as my own experience has taught me, on this vexed question.

I may say at once that I am firmly of the opinion that in East Africa the existence of the Tsetse-fly was never in any way connected with the presence of the Buffalo more than any other species of game.

I first met with the true Tsetse, in any great numbers, and consequently suffered much from their needle-like bite, in German East Africa, about eighty miles inland from Saadani, in February, 1886.

At that time impala, hartebeest, zebras, and warthogs were found in large numbers, also a few sable antelopes, but there were no Buffaloes anywhere in the vicinity of my shooting grounds.

In 1887 I again found this fly in great numbers in a small patch of thick bush, about a mile and a half long and three quarters of a mile wide, about ten miles west of Taveita.

In this bush which projected from the forest I certainly found buffaloes occasionally, but as a rule they preferred to lie up for the day in the thick and cooler forest, in which there were no Tsetse-flies.

The bush in question was a favourite resort of impalas, and a small dik-dik (Modoqua), the latter in great numbers, and also a few bush-bucks and waterbuck. At that time (1887) Buffaloes may be said to have swarmed in the vicinity of Tareita, but I never saw a Tsetse-fly in this one particular patch of bush.

Later on, in 1888–89 and 1890, the fly was met with, also in great numbers, along the old caravan road from about two miles south of the Tsavo river, as far as Kibwezi. Between these two points there were practically no Buffalo, but a great number of dik-dik and a few impala. The flies and the small game are still there, but there are certainly no Buffaloes.

In 1891–2, after rinderpest had carried off nearly all the Buffaloes (at least 90 per cent.) throughout East Africa, Mr. Rogers, the present sub-commissioner of the Tanaland province, and myself found the Tsetse-fly existing in considerable numbers in a narrow belt of forest, not more than a mile wide, between Mkonumbi and Witu, and we were told by the natives that the Gallas, when driving cattle to Lamu for sale, always drove them through the forest by night, and that the herdsmen carried smoking firebrands to keep the flies off.

With the exception of a few bushbuck and duikers, there was no game in the vicinity of this belt of forest.

These four places are the only areas, the first and third ones only being of any considerable extent, in which I have myself met with the true Tsetse-fly, and yet, until they were decimated by rinderpest, Buffaloes were more or less common throughout East Africa, and perhaps in no part of the Continent were they ever more plentiful than the Masai country between Kilimanjaro and Lake Baringo, Mau Plateau, and Turkwell. Throughout the whole of this vast area the Tsetse was, and is, non-existent.

I may add that there is a species of Tsetse-fly found along the wooded portion of the lake shore here at Entebbe.

A specimen of this fly I gave to Sir Harry Johnston, and I believe he sent it home. It is plentiful in the botanical gardens. In these gardens, with the exception of a few monkeys and squirrels, and certain small nocturnal beasts, such as the ichneumons, etc., and an occasional hippopotamus, there are no mammals, and if, as is supposed, the fly is necessarily dependent on the presence of suitable mammals on which to feed, the blood of these animals, and occasionally man, must necessarily form its food supply. In conclusion I may add that I have ventured to hold the opinion that the Tsetse is like the mosquito, only a bloodsucker by proddition, and, in support of this view, I may state that on my return to Kibwezi in April, 1892, at a time when the whole of the fly "belt" was parched and dried up—there being no water between Msongoleni and the Tsavo river, a distance of fifty miles; and consequently there was no game of any kind—the Tsetse was more plentiful than at any other time, before or since, I have passed through that area.

Between Mtoto-Ndoi and Kinani I caught on my own person thirteen of these flies, and my half-naked porters suffered even more than I did from their bites.

I can, therefore, not readily believe that all these flies could exist in such a dried-up and at this time intensely hot locality if solely dependent on the blood of a very infrequent passer-by or a stray dik-dik.

I have, etc.,

(Signed) F. J. JACKSON.

2. WHITE ANTS OR TERMITES IN THE SUDAN.

CORRESPONDENCE AND REPORT PREPARED FOR THE FOREIGN OFFICE.

SUDAN GOVERNMENT,

Civil Secretary's Office, Cairo.

7th August, 1901.

To THE BRITISH AGENT AND CONSUL-GENERAL, Cairo.

SIR,—We are much troubled in the Sudan by White Ants. They destroy not only wooden telegraph poles, boxes, furniture, timber, etc., but in the Khartoum district green and growing plants.

This is in our experience an unusual procedure for the Sudanese White Ants (who mostly confine themselves to wood), and shows that there must be several varieties of the pest. This particular form of White Ant has its nest about the size of a small melon, 4 or 5 feet under ground; but it is very difficult to extirpate him completely without digging up and spoiling a great deal of ground.

156 *First Report on Economic Zoology.*

As Lower Egypt is not troubled by these insects, I have applied in vain to the School of Agriculture at Cairo for information as to the best method of getting rid of them. I may add that we have planted a good number of Casuarina trees, which are supposed to be proof against the attacks of White Ants ; but they eat the trees with the greatest impartiality.

I have the honour, therefore, to suggest that you will have the kindness to forward a copy of this letter to the proper quarters with a request that I may be supplied with any information there may be on the subject, or that I may be referred to any books or papers on the same.

I am, etc.,

(Signed) GLEICHEN, MAJOR,
Assistant Civil Secretary for Governor-General.

CAIRO, 9th August, 1901.

To THE MARQUESS OF LANDSDOWNE, K.G., etc., etc.

MY LORD,—I have the honour to transmit to your Lordship herewith copies of a note which I have received from the Civil Secretary to the Soudan Government, asking for assistance in procuring information as to the best means for combating the ravages of the White Ant, which is extremely destructive in the Soudan.

I am informed that, in certain parts of America, the White Ant is very prevalent, and that considerable attention has been directed to this subject by the Department of Agriculture in the United States. It is probable also that the Colonial Office are in possession of valuable information, and more might perhaps be obtained from the Horticultural Gardens at Kew.

I should be most grateful if your Lordship would render me any assistance which is possible, in obtaining such information as may be available, for the use of the Soudan Government.

I have, etc.,

(Signed) RENNELL RODD.

FOREIGN OFFICE,

22nd August, 1901.

To THE DIRECTOR OF THE ROYAL GARDENS, KEW.

SIR,—I am directed by the Marquess of Lansdowne to transmit to you the accompanying copy of a despatch from His Majesty's Acting Agent and Consul-General in Egypt, relative to the ravages committed in the Sudan by the White Ant.

I am to enquire whether the Director of the Royal Gardens can furnish any information on the best means of combating the ravages of these insects.

I am, etc.,

T. H. SANDERSON.

ROYAL BOTANIC GARDENS, KEW,

23rd August, 1901.

To Sir T. H. SANDERSON, G.C.B., K.C.M.G.,
Foreign Office, Downing Street.

SIR,—I have the honour to acknowledge the receipt of your letter of yesterday's date enclosing a copy of a despatch from His Majesty's Acting Agent and Consul-General in Egypt relative to the ravages committed in the Sudan by the White Ant.

In reply I have to state that Kew is not in possession of anything but the most general information on the subject and is therefore unable to furnish any advice which would be of any practical utility to Sir Rennell Rodd. I have forwarded the correspondence to the Director of the Natural History Museum, South Kensington, and requested him to examine the question and communicate with you.

I am, etc.,
(Signed) W. T. THISELTON-DYER.

BRITISH MUSEUM (Nat. Hist.),

Cromwell Road, S.W.,

7th September, 1901.

To Sir T. H. SANDERSON, G.C.B.,
Foreign Office, S.W.

SIR,—I am directed by Professor Ray Lankester to acknowledge the receipt of your letter of the 22nd ult. addressed to the Director of the Royal Gardens, Kew, enclosing copy of a despatch from His Majesty's Acting Agent and Consul-General in Egypt, relative to the ravages committed in the Sudan by the White Ant.

I am to state, for the information of the Marquess of Lansdowne, that Professor Ray Lankester is giving his attention to the question, and that he will further communicate with you in regard to the matter.

I am, etc.,
(Signed) C. E. FAGAN.

BRITISH MUSEUM (Nat. Hist.),

Cromwell Road, S.W.,

5th November, 1901.

To Sir T. H. SANDERSON, G.C.B.,
Foreign Office, S.W.

SIR,—Referring to your letter of 22nd August last to the Director of the Royal Gardens, Kew, and to my acknowledgment of the 7th of September, relative to a despatch from His Majesty's Acting Agent and Consul-General in Egypt on the subject of the ravages committed in the Sudan by the White Ant, I have the honour to enclose herewith, for the information of the Marquess of Lansdowne, a report prepared by Mr. F. V. Thoburn, of this Department, on the Termites or White Ants, dealing generally with their prevention and destruction.

I am, etc.,
(Signed) E. RAY LANKESTER.

**Report on Termites or White Ants, and methods
of checking the ravages of the same, prepared
at the request of the Sudan Government.**

Without having specimens of the White Ants or Termites that are causing havoc in the Sudan not only to wood-work, telegraph poles, etc., but also to green crops in the vicinity of Khartoum, it is not possible to give a satisfactory account of any methods for combating the pests. Investigation to be of any practical use must be made on the spot. Information has been, however, collected from all sources concerning any measures that have been taken in various parts of the world with a view of checking the serious damage these insects do. This information is embodied in this report. The various African Termites are also enumerated—their various ways of working pointed out and detailed methods of destroying them given. A number of suggestions for preserving articles from their attack and possible new remedies are also given.

AFRICAN TERMITES.*

The following Termites are common in Africa ; the species found in Central and Northern Africa being separately tabulated at the end of the list.

1. *Calotermes flavigollis*, T., Ent. Syst. Fabr., 11, 15, p. 91.
2. *Hodotermes ochraceus*, Burm.
= *Termes ochraceus*, Ramb., Egyp. Neurop., pl. 2, fig. 21, Ramb.
3. *Hodotermes mossambicus*, Hagen, Linn. Ent., 12, p. 94.
4. *Termes bellicosus*, Smeathman, Phil. Trans., Vol. 71, p. 141.
5. *Termes angustatus*, Ramb., Neuropt., p. 306, No. 11.
6. *Termes capensis*, De Geer, Memoirs, VII., p. 47, tab. 38, fig. 7.
7. *Termes destructor*, Smeathman, Phil. Trans., Vol. 71, p. 141, No. 4, tab. 10.
8. *Termes lucifugus*, Rossi, Mant. Etr., 1, p. 107.
9. *Termes (Eutermes) atrox*, Smeathman, Phil. Trans., Vol. 71.
10. *Termes (Eutermes) lateralis*, Walker, Lin. Ent., 12, p. 216.
11. *Termes (Eutermes) trinervius*, Ramb., Neuropt., p. 308.
12. *Termes (Eutermes) mordax*, Smeathman, Phil. Trans., Vol. 71, p. 141.
13. *Termes viator*, Lat., Hist. Nat., XIII., p. 51, 8.
14. *Termes (Eutermes) arborum*, Smeathman, Phil. Trans., Vol. 71, p. 141.
15. *Termes incertus*, Hagen., Linn. Ent., 12, p. 230.

Species found in N. Africa, Egypt, Sudan, etc., down to the Equator.

The following species occur in North and Central Africa and along the seaboard :—

<i>C. flavigollis</i>	{	Algeria.
<i>C. lucifugus</i>		
<i>T. trinervius</i> , Tripoli.		
<i>C. flavigollis</i>	{	Egypt.
<i>T. atrox</i>		
<i>T. lucifugus</i>		
<i>H. ochraceus</i>		

* A complete list of African Termites is given in the Appendix (p. 184).

<i>T. bellicosus</i>	Dongola, Darfur, Kordofan, Sennar, and Abyssinia.
<i>T. destructor</i> , Kordofan.	
<i>H. viarum</i>	Sierra Leone and Gambia.
<i>T. bellicosus</i>	
<i>T. destructor</i>	
<i>T. mordax</i>	
<i>T. atrox</i>	
<i>T. arborum</i>	
<i>T. trinervius</i>	
<i>T. lateralis</i>	
<i>T. fatale</i> , Arabia.	

DAMAGE CAUSED BY TERMITES.

The usual way of working is to destroy wood-work of all kinds. In all instances Termites work in the dark ; they enter wood-work from the ground, working up inside the wood from where the poles, supports and tinders are placed in the soil. Furniture, books and papers are attacked and destroyed, the wood-work being completely hollowed out, nothing but a thin papery outer shell left, which naturally can stand no pressure and so, soon collapses.

Damage to living substances and crops is by no means unusual. The American *T. flavipes* has been recorded destroying turnip roots, by gradually eating out the interior.* In Florida they damage living trees by eating away the bark about the collar and root, but growing wood is only attacked by them under exceptional circumstances when there is no dead wood or when they wish to escape from the heated soil.† This species also attacks potatoes growing in rich soil or where there is a considerable quantity of decaying vegetable matter. The insects form scars or pits covering the surface, often over-hung by the dead and dying skin.

Termes fatale is very destructive to trees in Arabia.‡ In Ceylon tea and coffee plants are attacked by them, the stems being gnawed through just below the ground.

Termes australis, according to French ("Handbook of Injurious Insects of Victoria," pp. 11, 137, 1893), attacks vines and fruit trees in Victoria. Damage to living plants is therefore not unusual.

VARIETIES OF NESTS (*Termitaria*).

Termites or White Ants form variously-shaped nests. The ways of destroying Termites differ according to the type of Termitaria. The following types of nests seem to occur (1) large mound-nests, often six to ten feet high (*T. bellicosus*), (2) small dome-shaped nests over tree stumps, seldom more than two feet high (*Rubneria* sp.), (3) Arborescent nests, on live and dead trees, approached by a covered tunnel up the tree trunk (*Eutermes arborum* and *Eutermes* sp.), (4) Small round nests in the soil mentioned by Major Count Gleichen in his letter of inquiry (sp.?).

* "Insect Life," II, 283.

† "Insect Life," I, 341.

‡ "History of Arabia, Ancient and Modern," A. Crichton, 1833.

Termitaria of the arboreal species are also found on the roofs of houses, stables, etc. The nests occur both above and below ground. Methods of extermination must therefore depend on the species causing destruction.

METHODS OF PREVENTION AND REMEDIES.

As the White Ants nearly always work under cover, the damage they do is often not detected until too late. It is therefore necessary to protect objects from being attacked. This can be done (1) by making ground wood-work either obnoxious, poisonous or inaccessible to the Ants ; (2) by lessening the number of Termites by poisoning and destruction of their nests.

MAKING GROUND WOOD-WORK OBNOXIOUS AND POISONOUS TO TERMITES.

Steeping posts, poles, timbers of houses, etc., in various smelling substances has met with more or less success.

Use of Creosote.—In India creosote was used by the Government for treating all the railway sleepers before they were laid.

In the outskirts of Columbia great damage has been done by White Ants (*T. flavipes*) to board fences : “The chief damage is done where the boards meet on the posts. It is particularly noticeable where a batten is nailed on at a joint. Professor Atkinson states that tar poured on between the posts and the boards soon after building the fence will act as a preventive.”*

Experiments conducted with wood-boring insects and creosote-soaked posts has not invariably met with success with Termites or other insects after the wood has been “planted” some time. It cannot therefore be recommended for telegraph poles, etc., that are being destroyed in the Sudan.

Use of Arsenious Soda.—Of more lasting effect is steeping the parts of poles, etc., that are placed below ground in arsenious soda dissolved in mineral oil.

Protection of Telegraph Poles and Buildings.—Telegraph poles might easily be protected by having the part buried either embedded in cement or encased in zinc or tin. The metal should be painted with non-corrosive paint. Cement casing would be best, as the tin would probably corrode rapidly unless carefully painted, and the least hole would let the pests into the wood. Zinc casing has been employed for foundation wood-work in buildings with success, the zinc passing up the timbers out of the ground and then bent over (Fig. 17, 2) so as to prevent the ants crawling upwards. Complete dryness in buildings is also essential in regard to checking some species of White Ants. All floors of houses in the districts where White Ants are destructive should be made of concrete (or raised well above ground, as shown in Fig. 17, 3). No furniture should be allowed to stand against a wall. Where wooden floors are essential, the furniture may be protected by standing the legs in small tins with paraffin oil in them.

* “*Insect Life*,” I. 353.

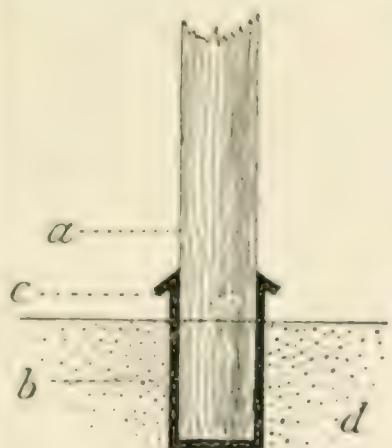


Fig. 2.

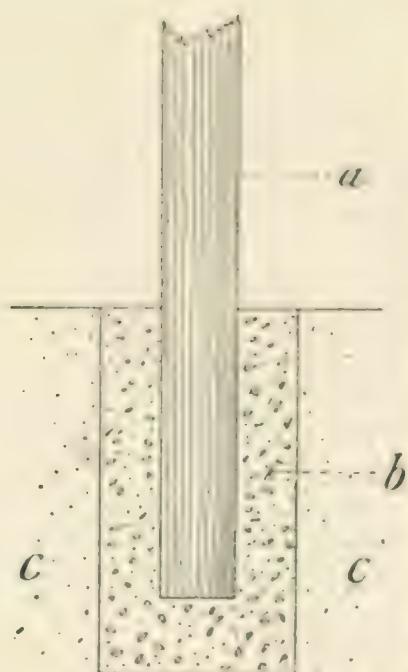


Fig. 1.

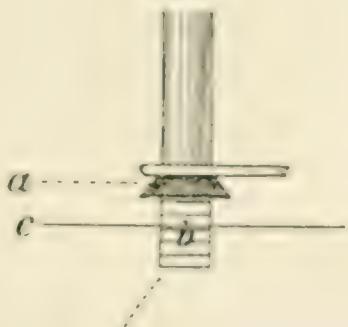


Fig. 3.



FIG. 17.

1. Base of telegraph pole protected from Termites; *a*, pole; *b*, cement; *c*, sand.
2. Another method of protecting poles; *b*, metal casing; *c*, ledge; *d*, sand.
3. House with Termite protection; *a*, metal guards; *b*, brick or cement corners; *d*, floor separated by space *e* from ground *c*.

DESTRUCTION OF TERMITES AND THEIR NESTS.

When the nests can be located much good can be done by destroying the nests and inmates. This may be done by pouring kerosene oil or carbolic into the nests. The action is temporary, however, for it only drives many of the ants away to form fresh nests.

USE OF ARSENIC POISONS FOR THE INSECTS.

A far better plan is to put arsenic and syrup into the openings of their tunnels or into the nests. The arsenic may be mixed up with sugar into a thick syrup. Paris green would probably answer well. The insects will feed off this and soon die, and it has been found that the dead Termites are devoured by other Termites which themselves become poisoned, and so great numbers are destroyed. Experiments should be made in this direction and if successful should be carried out on a large scale. Where this plan has been tried in isolated nests it has met with marked success.

CLEARING WHITE ANTS FROM WOOD-WORK.

When present in wood-work of a house or other building, Riley* suggests injecting steam or hot water or kerosene wherever an opening seems to lead into their burrows in timber.

DESTRUCTION AND PREVENTION WHERE DAMAGING LIVING TREES.

When the Termites attack trees by eating away the bark about the collar and root, the earth should be removed from the infected parts and the ground should be exposed to the depth of several inches, and the dead wood and bark cut off with a knife. A liberal supply of hot water will destroy those that cannot be reached with a knife. Pyrethrum and kerosene emulsion in extreme dilute solution can be applied with success, but the latter should be used with great caution. Trees which have been girdled may be saved by inserting scions between the root below and the stalk above, thus re-establishing the connection between the two. A poultice of mud and cow-dung applied to the affected part will protect it and assist in the formation of new bark.†

WOODS NOT ATTACKED BY WHITE ANTS.

From a report concerning the ravages of the White Ant in St. Helena it is gathered that certain woods resist the attack of these pests better than others. The wood of *Myrtaceæ* and teak were found to be the last attacked and to resist their ravages. A correspondent in West Africa informs me that they will not touch pitch-pine as much as other woods. Californian red wood also appears to be free from attack.‡

* "Insect Life," II. 253.

† Riley, "Insect Life," I. 341.

‡ Bull. 30 (N.S.), Dept. Agric., U.S.A.

CONCLUSION.

Beyond these points nothing is known regarding the destruction and prevention of Termites. It is certainly (1) advisable to set all foundations of wood-work in cement so as to prevent the entry of the ants; (2) to adopt the precaution of steeping wood-work for the ground in arsenious soda, and (3) to employ arsenic as a poison in the nests near all habitations, works and railways. The probability is that by such precautions the ravages of these pests in the Sudan would be greatly lessened.

(Signed) FRED. V. THEOBALD.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, S.W.

15th November, 1901.

To THE CIVIL SECRETARY,
Sudan Government, Cairo.

DEAR SIR,—Referring to my letter of the 17th ultimo, I have to inform you that a full report on White Ants, dealing generally with their prevention and destruction, was forwarded to the Foreign Office on the 5th inst. to be transmitted to His Majesty's Agent and Consul-General in Cairo.

I shall be glad to learn that it has reached you.

I remain, etc.,

(Signed) C. E. FAGAN.

SUDAN GOVERNMENT,

Civil Secretary's Office, Cairo,

24th November, 1901.

DEAR SIR,—I have the honour to acknowledge your letter of the 15th instant and to thank you for the "Report on White Ants," which was received through H. B. M.'s Agency here.

This report will eventually be of the greatest use as a guidance in fighting these pests.

I remain, etc.,

E. G. BLUNT, Lieut.-Colonel.

THE CIVIL SECRETARY AND SUDAN AGENT, CAIRO.

3. LOCUST PLAGUES IN THE SUDAN.

CORRESPONDENCE AND REPORT PREPARED FOR THE FOREIGN OFFICE.

SUDAN GOVERNMENT,
Civil Secretary's Office, Cairo,
2nd October, 1901.

To THE DIRECTOR,
Natural History Museum,
Cromwell Road, S.W.

DEAR SIR,—I wrote to you in August last asking for such information as you could kindly give me about the different species of locusts, the means of distinguishing them, and their habits. I am sending you by this mail a proof copy of the instructions that have been drawn up for the use of officers in the administration of the Sudan, in which it is proposed to include your notes.

Any remarks you might think fit to make would be of great interest, as the instructions will not be printed until your notes have been received and included.

These notes are being published with the shortest possible delay, and I should like if possible to have them circulated by the beginning of next month. I should, therefore, be very much obliged to you if you could let me have your notes and remarks as soon as possible.

I must apologise for the trouble I am giving you, but the question of the destruction of locusts is so important in the Sudan that I feel it my duty to collect as much information as I possibly can before publishing the notes.

I remain, etc.,
(Signed) GLEICHEN,
Assistant Civil Secretary and Sudan Agent, Cairo.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, S.W.,
12th October, 1901.

To THE CIVIL SECRETARY,
Sudan Government, Cairo.

SIR,—I am desired by the Director to acknowledge receipt of Count Gleichen's letter of the 2nd inst., enclosing proof of printed instructions for the use of officers in the administration of the Sudan, with regard to the destruction of locusts.

A full reply thereto will be sent as soon as possible.

I have the honour to be, etc.,
(Signed) C. E. FAGAN, Assistant Secretary.

BRITISH MUSEUM (Nat. Hist.),
Cromwell Road, S.W.

To THE CIVIL SECRETARY,
Sudan Government, Cairo, Egypt.

DEAR SIR,—Referring to Count Gleichen's letter of the 2nd inst. (No. C.S.S. 4 1259), I am desired by the Director to send you herewith a report on the subject of locust plagues in the Sudan, with notes and suggestions for the destruction of the locusts.

I am to point out that while Count Gleichen's letter of the 2nd inst. refers to locusts, his letter of the 7th August is on the subject of White Ants. A separate report will be forwarded to you in due course in regard to this last question, which is forming the subject of investigation by the Museum.

I remain, etc.,

(Signed) C. E. FAGAN.

Report on Locust Plagues in the Sudan.

At the request of the Foreign Office, the following information regarding the Locust Plagues in the Sudan has been despatched for the use of the Sudan Government.

Particular attention is called to sections B. 2, 3, and 4 in the Report. Experiments should certainly be tried in connection with the African Locust fungus and the use of "poison-baits."

Prevention and Remedies for Locust Plagues.

A. Destruction by capture in, 1, trenches; 2, traps; 3, by burning. This was fully dealt with in the proof of a paper sent from Egypt.

B. 1. Destruction of the eggs.

2. Collection of "hoppers" by special machines.
3. "Poison-baits."
4. Fungoid disease.
5. Plants poisonous to locusts.
6. Natural enemies.

Appendix (p. 179).

Various locusts, North African.

B. 1. DESTRUCTION OF EGGS.

(a) By cultivation.

The eggs are usually laid in firm ground to guard them against natural enemies.

By turning up and loosening the soil to a depth of three inches, the eggs can be exposed, and numbers are destroyed by birds, parasitic insects, etc.

(b) *By collecting.*

Egg masses may be collected where plenty of native labour can be obtained.

The authorities in Cyprus in 1881 had 1300 tons of eggs collected by natives at so much per pound.

A look-out should be kept to see where the females deposit their eggs, and those particular parts of the district should be searched soon after.

B. 2. MACHINES FOR CATCHING LOCUSTS ("Hopper Dozers").

These machines of various patterns resemble a shallow earth scoop or long tray. They are largely employed in America in Locust plagues.

A "hopper-dozer" is usually a flat iron or zinc tray, containing tar or paraffin. This tray is dragged or pushed along by a horse or man against the wind—the young locusts jumping out of the way get blown in, and are thus killed.

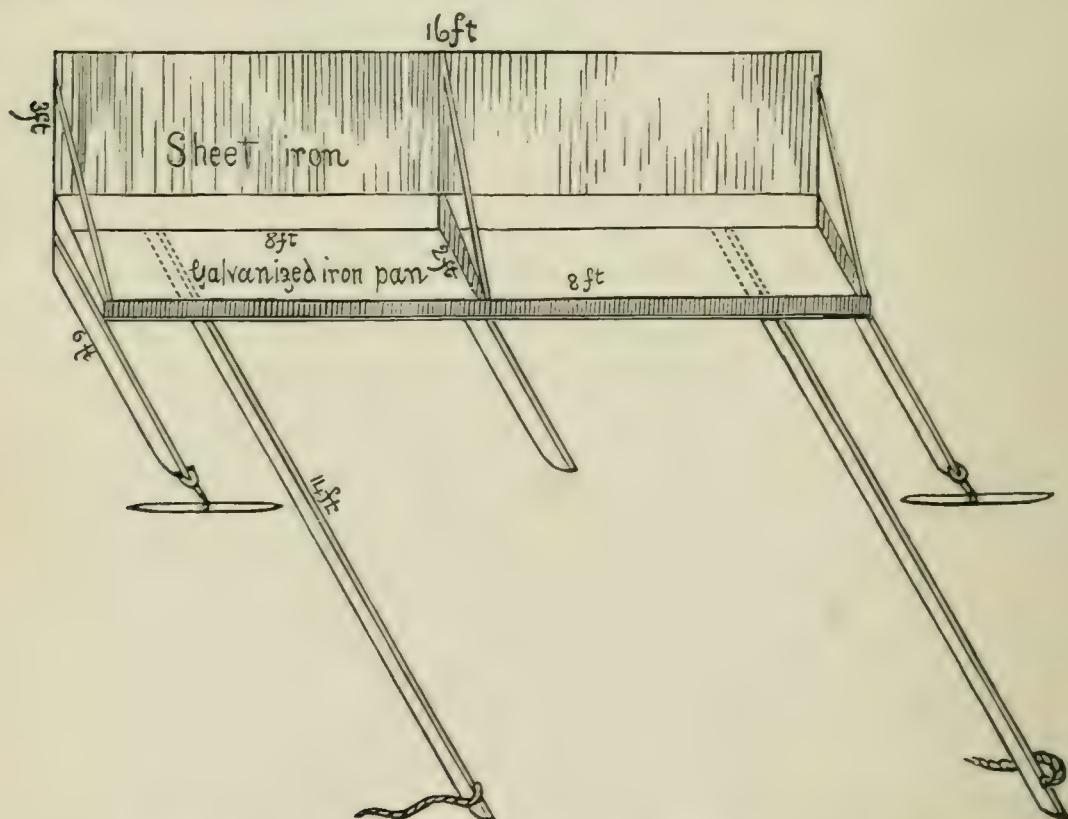


FIG. 18.—A HOPPER-DOZER USED FOR COLLECTING LOCUSTS.
(After S. J. Hunter, Kansas).

One machine mentioned in "Insect Life" is 15 feet long, 2 feet deep, and 4 to 5 feet wide; this box is divided into sixteen compartments filled with lime water.

A plan of one of the most recent and most successful machines used in America is here appended. This machine was used by the Hon. Thos. H. Ford, of Syracuse, U.S.A., and cost ready for use five dollars.

The pans should be 2 feet wide, 4 inches deep, and 8 inches at the

back; they are laid on 1×4 boards, previously nailed to runners; the height of the pans above the ground varies with the height of the crop over which the "hopper dozer" will be taken.

The pan should be partly filled with paraffin and water and taken across the infected crops until full, when fresh oil and water must be added.

These machines can be made of any size.

B. 3. MINERAL POISONS.

Arsenical poisons can be employed to advantage where animals are not likely to touch them. In America poisoned bran is successfully employed. Mr. Coquillett (U.S. Dept. Agriculture) has found the following formula the best: 1 lb. arsenic, 1 lb. sugar, 6 lbs. bran. Add water to make an ordinary mash.

This is prepared as follows: Mix the dry bran and arsenic in a tub, dissolve the sugar in warm water, and mix with the arsenic and bran. Place this mixture about in little heaps; its action is not rapid, but always fatal in about twenty-four hours.

B. 4. THE AFRICAN LOCUST FUNGUS (*Empusa grylli*).

(Destruction by Fungoid Disease.)

A fungus known as *Empusa grylli* found on grasshoppers and locusts has been used as a remedy with more or less success. Its introduction into Egypt might probably be very beneficial, and certainly should be tried.

It has been imported into America from Natal, and has destroyed injurious swarms of locusts in Colorado and Mississippi.

Dr. Lounsbury (Cape of Good Hope Rept., 1896) refers to this disease and its employment, and says it causes destruction to the swarms when proper conditions of moisture are present.

It has been introduced into Australia and has met with some success there also.

The method of employment adopted by Mr. Froggatt, Government Entomologist to New South Wales, is here appended.

The fungus must be cultivated in a laboratory on gelatine and sent out to operators in test tubes.

The operator proceeds as follows:—The fungus should be sent out in definite quantities, enough of the culture to make a tumbler full of liquid being a useful proportion. The operator should boil sufficient water and let it cool down to luke-warm. The contents of the tube are then extracted and mashed up with two teaspoonfuls of sugar and well stirred up in the water with several bits of cork, which have been previously placed in the glass as indicators. Cover the tumbler with a sheet of paper and then place it in a warm room and leave for twenty-four hours. When examined, if fit for use, the cork indicators should show mycelium growing on them. This culture is taken to the infested land. Then proceed to catch some locusts by means of a net. The culture placed in a tin is spread over the locusts and they are released, when they carry infection to others and so destroy myriads of the pests.

Mr. Froggatt, Government Entomologist of New South Wales, states that one tumbler full of liquid is sufficient for 1000 locusts.

The most favourable time to treat them is in the evening—damp weather if possible being chosen—as the increase of the fungus is doubtful unless the air is moist.

Further experiments should be conducted, however, before this is definitely considered satisfactory.

B. 5. PLANTS POISONOUS TO LOCUSTS.

1. Common Garden Larkspur (*Delphinium*).
2. Castor Oil Plant (*Ricinus communis*).

These might be employed around gardens, orchards, etc., as a barrier to the advance of locust armies.

It should be pointed out, however, that stock will eat Larkspur and are thereby poisoned (*vide* Dr. E. V. Wilcox's Rept., Bull. 15, Montana Exper. Station, 1897, on "Larkspur Poisoning of Sheep").

B. 6. NATURAL ENEMIES.

Locusts suffer from many natural enemies, both vertebrate and invertebrate. Amongst the former may be mentioned fowls and turkeys. Doves of the latter clear off locusts very rapidly, as many as fifty being found at once in a turkey's crop. Encouragement of these birds should be given in all districts where locusts abound. Numerous wild birds also feed off locusts.

Amongst insect enemies are numerous diptera or flies, especially Tachina Flies (*Tachinidae*), and Flesh Flies (*Sarcophagidae*), whose larvæ or maggots live inside and destroy the young locusts.

Many carnivorous flies, such as the Asilidæ, or "Wolf Flies," feed off the young "hoppers."

Predacious beetles and their larvæ devour locusts in different parts of the world, especially the locusts' eggs.

In North America a species of mite, *I. locustarum*, Riley, is the most effective enemy of the various locusts. These mites feed off the eggs and also the winged adults.

No natural enemies are able to cope with locusts, however, unless it be the Locust Fungus (*Empusa grylli*) (*vide* B. 4).

(Signed) FRED. V. THEOBALD.

SUDAN GOVERNMENT,
Civil Secretary's Office, Cairo,
3rd November, 1901.

To C. E. FAGAN, Esq., Assistant Secretary,
Natural History Department, British Museum.

DEAR SIR,—I beg to thank you for your letter of the 17th October enclosing some very valuable suggestions for the destruction of locusts. They should eventually prove of the greatest use, though as yet the Sudan is too new and too thinly populated to permit of operations being carried out very effectively.

My first letter on locusts, dated 28th August (copy enclosed) addressed to you, must have been lost in the post, as it was carefully sent to your address.

I note that a separate report *re* White Ants will be forwarded to me later. I have received a copy of the "Bulletin" for July, 1896, of the Botanical Department of Trinidad through the Colonial Office; but the "Bulletin" deals with the West Indian White Ants only, which present no resemblance whatever to the Sudan White Ants.

I am anxiously awaiting the result of the investigations kindly undertaken by the Museum before taking any further steps.

I remain, etc.,
(Signed) GLEICHEN.

B.—REPORTS TO THE COLONIAL OFFICE.

1. THE MARINE RESOURCES OF THE WEST INDIES.

COLONIAL OFFICE,
Downing Street, S.W.,
29th April, 1901.

To PROFESSOR E. RAY LANKESTER, LL.D., F.R.S.

SIR,—I am directed by Mr. Secretary Chamberlain to transmit to you the accompanying copy of a letter which he has received from Dr. Morris, the Imperial Commissioner of Agriculture for the West Indies, relating to a paper, of which a copy is also enclosed, on the Marine Resources of the West Indies, by Dr. J. E. Duerden, Curator of the Museum of the Institute of Jamaica, together with the copy of a despatch on the same subject from the Governor of Jamaica.

2. Mr. Chamberlain would be glad if you would be so good as to take these papers into your consideration and favour him with your opinions upon the subject.

3. In accordance with Dr. Morris's request, copies of these papers have also been referred to Professor Howes.

I am, etc.,
(Signed) H. BERTRAM COX.

IMPERIAL DEPARTMENT OF AGRICULTURE FOR
THE WEST INDIES,
Barbados,

14th March, 1901.

To THE UNDER SECRETARY OF STATE,
Colonial Office.

SIR,—I have the honour to forward, herewith, a copy of a paper on "The Marine Resources of the West Indies," read before the late West Indian Agricultural Conference by Dr. J. E. Duerden, Curator of the Museum of the Institute of Jamaica.

2. Owing to the special interest attached to the subject, the paper has been issued as an extra number of the "West Indian Bulletin." It will also appear amongst the Conference papers to be published in the second volume of the Bulletin now in the press.

3. Although the British West Indian Islands are surrounded by wide seas, inhabited by large numbers of edible fish of excellent quality, the methods employed in capture are somewhat primitive, and in no instance is advantage taken of modern improvements. At present a considerable trade in salt fish is carried on between these islands and British North America, the annual value of which is estimated at £234,000.

4. Dr. Duerden, so far as I am aware, is the first to draw attention from the scientific point of view to the potentialities of the marine resources of these islands. It would, in my opinion, be most valuable if the subject could be taken up as a part of the research work entrusted to this Department. This would be in harmony with what has been done with considerable advantage at Cape Colony and in connection with the recently created Board of Agriculture in Ireland. I estimate that the cost of adding a Fishery Branch to this Department would be about £800 to £1000 per annum.

5. I commend for special consideration the résumé given at the close of Dr. Duerden's paper (pp. 18 and 19). He rightly points out that the West Indian Fisheries and the men associated with them have been wholly neglected by the agencies devoted to the improvement and extension of the industrial resources of these Islands," and he concludes as follows : "The directions along which development and investigation in fishery matters are most needed at present within the West Indies may finally be summarised :—(1) The best methods of capturing and curing tropical fish ; (2) Knowledge of the life-history and habits of the edible and migratory fish ; (3) Encouragement of enterprise in fisheries generally ; (4) The best means of shipping live turtle. Artificial hatching and rearing of the green turtle and the hawksbill ; (5) Restocking of the exhausted grounds around Barbados with artificially reared sea-eggs ; (6) Oyster, sponge, and lobster culture. One of the great endeavours of to-day in the West Indies is to supplement in as many directions as possible the old industries of sugar and rum by the introduction and encouragement of other products ; and in the undeveloped resources of the sea the Colonies have a possession which, if rightly used, will constitute a valuable adjunct to the many agricultural efforts."

6. In order that the subject may be placed before the Secretary of State in a complete form I suggest that a copy of this letter and of Mr. Duerden's paper be referred for their opinion as Zoological Experts to Professor Ray Lankester, F.R.S., Director of the British Museum (Nat. Hist.), and to Professor Howes, F.R.S., of the Royal College of Science, South Kensington.

7. In the meantime copies of Dr. Duerden's paper have been communicated to the Governors and to all the leading officials and residents in these Colonies.

8. I forward, under separate cover, five extra copies of the Report for the use of the Colonial office.

I have, etc.

(Signed) D. MORRIS,
Commissioner of Agriculture for the West Indies.

KING'S HOUSE, JAMAICA,

8th March, 1901.

To THE RIGHT HON. J. CHAMBERLAIN, M.P., etc.

SIR,—I have the honour to transmit to you a copy of a pamphlet by Dr. J. E. Duerden on the subject of Fisheries in the West Indies and to commend it to your consideration.

2. I understand from Dr. Duerden that Dr. Morris has expressed himself very favourably with regard to the suggestions contained in the paper, and that it is possible he may recommend that experiments for giving effect to them should be carried out in connection with, and under the auspices of, the Imperial Department of Agriculture for the West Indies.

3. Were the financial circumstances of Jamaica different to what they are, I should consider it desirable that efforts should be made by the Colonial Government to improve and develop the fisheries of the island. Any such efforts are, however, for the present, at all events, "beyond the range of practical politics."

4. I feel, however, that it would be of great benefit to the Colony if experiments in the directions suggested by Dr. Duerden, particularly with regard to the artificial breeding and culture of turtles, could be carried out, and I shall be very glad to learn that you have found yourself able to sanction any recommendation which Dr. Morris may make for the matter being taken in hand by the Imperial Department of Agriculture.

I have, etc.,

(Signed) AUGUSTUS W. L. HEMMING,
Governor.

BRITISH MUSEUM (Nat. Hist.),

Cromwell Road, S.W.,

3rd May, 1901.

To H. BERTRAM COX, Esq.,

Colonial Office, Downing St., S.W.

SIR,—In accordance with Mr. Secretary Chamberlain's request, conveyed in your letter of April 29th, I have considered the letter of Dr. Morris and Dr. Duerden's Report on the Marine Resources of the West Indies, of which you were good enough to send me copies.

The matter referred to has been for some time under my consideration, and I find myself in entire agreement with Dr. Morris. I think it would be a most valuable step in the public interest were the Marine Resources of the West Indian Islands taken up as a part of the research work entrusted to the Imperial Department of Agriculture for the West Indies.

The paper by Dr. Duerden on "The Marine Resources of the West Indies" is a valuable one. The various sources of wealth in the seas of the West Indies are each carefully sketched. By the references made to marine investigations carried on elsewhere, Dr. Duerden shows that he is well informed in the subject, whilst his observations and suggestions and general handling of the subject show originality and full comprehension. Dr. Duerden has had a thoroughly sound training as a scientific biologist. His original papers, as well as the present report on the Marine Resources of the West Indies, prove him to be a trustworthy scientific adviser, who

would be regarded with respect and confidence by scientific men in this country were he further employed in connection with this subject.

I am of the opinion that the carrying out of the investigations suggested by Dr. Duerden's Report, under the auspices of the Imperial Department of Agriculture for the West Indies, would lead to economic results of practical value and justify the expenditure of public funds in that direction.

I have, etc.,

(Signed) E. RAY LANKESTER.

Abstract of Dr. Duerden's Report on the Marine Resources of the West Indies.

In an extra number of the West Indian Bulletin issued in 1901, Dr. J. E. Duerden reviews the chief marine resources of the British West Indies. In this he gives an account of the fisheries of the West Indies, and points out that in a few instances only are the marine products of any export value to the Colonies, whilst on the other hand there is an enormous import trade in dried and preserved fish.

The principal marine resources are as follows : *Turtles*, Jamaica being the chief centre of the West Indian turtle trade, the exports for 1900 being about £10,000. The industry is concerned with the two well-known species, the Green Turtle (*Chelone midus*) and the Hawksbill (*Chelone imbricata*). The supply is chiefly obtained from around the Cays and Mosquito coast of Central America. The Report shows that there is an evident diminution in the supply, merchants never being able to obtain sufficient to meet the export demands. The two subjects dwelt upon concerning turtles of great importance are their artificial rearing so as to produce them in greater numbers to meet the demand and the best method of shipping them. The mortality from capture to landing in England varies from as much as 25 to 50 per cent. !

Under the heading of "fishing" is given a general account of the industry, and stress is laid on the primitive methods adopted by the fishermen : "fishing as adopted elsewhere is comparatively neglected and undeveloped." The amount of coral prevents trawling, and moreover there are evidently not enough flat fish to make this method pay. The use of seine and other nets along the shore and shallow banks is very profitable ; but unfortunately the habits of the schools of migratory fish, such as June fish, herring, sea mullet, etc., are not known, nor the best means of catching them, nor of preserving them when caught. The fishing industry appears to be mainly in the hands of natives. Amongst the chief fish of good quality are various species of Snappers (*Mesoprion*), Yellow Tail (*Ocyurus chrysurus*), Grunts (*Hæmulon*), Silks (*Tropidiurus dentatus*), King and June fish, river and marine mullet and Caliperus (*Mugil*), and Snook (*Centropomus*). They occur around Jamaica, where the average price of fish is 6d. a pound. Barbados is celebrated for its large flying-fish industry. The Flying-Fish (*Eroctetus roberti*) is estimated to yield annually £13,000. Snappers and Brines (*Centropristes oculatus*) are also taken in numbers by line fishing around Barbados.

Under the heading *Oysters* we find that the West Indies have an oyster in abundance, *Ostrea parasitica*, Gmelin, which grows on the roots of mangrove trees. There is no system of cultivation at present. They are much appreciated and find a ready sale. Many other edible mollusca occur, including the Mussel (*Mytilus crustos*, Linn.), the Scallop (*Pecten zigzag*, Chemn.), various "ark" shells, *Arca* spp.? and *Codakia tigerina*.

Lobsters, shrimps and *crabs* are also amongst the marine resources, the most abundant lobster being *Palinurus argus*, Latr. They and other species are caught in fish-pots from amongst the coral. It is pointed out that successful cultivation of lobsters might be carried out just as in Newfoundland and Canada.

Sea-eggs. Barbados occupies an almost unique position in having an important industry founded on the marine forms of life called sea-urchins, or sea-eggs. Its annual value is estimated at nearly £4,000. The roe or reproductive organs, are the part used as food. There is unfortunately a great decrease in the number of these Echinoderms. The chief species is known as *Hipponoe esculenta*, Leske. They form a staple food for a few months along the coast. Before any remedial measures can be adopted, it is necessary to know the life-history of this sea-egg.

Holothurians, Bêche-de-Mer, Trepang, etc. Great numbers of these echinoderms occur on the floors of the seas in the West Indies. The species have not been identified, but the Jamaican ones are of the genera *Holothuria* and *Stichopus*. Experimental shipments of Bêche-de-Mer were carried out a few years ago at the Caicos Islands with the object of supplying the American Chinese with their favourite article of diet. To show the importance of this marine animal, the report mentions that the annual export value to Queensland is about £23,000.

SPONGES.

The West Indies and Florida, along with the Mediterranean, are the principal sponge producing areas of the world; but fine bath sponges also come from Australia.

The shores around the Bahamas are the best known sponge grounds in the West Indies. They form the greatest industry of that Colony. Drilling and diving for them have been prohibited. They are gathered by means of two-pronged forks attached to staves 25 feet in length. The sponge exchange is at Nassau. The annual value is nearly £100,000. The United States Government has undertaken the investigation of the Florida sponge grounds with a view to the better development of the industry. Successful experiments in the artificial propagation of sponges by transplanting and by cuttings have been carried out in the Mediterranean and in Florida.

Amongst other industries mentioned in the report are the whale oil industry, still carried out in a small degree around some of the islands of the Lesser Antilles. Ambergris is occasionally found on the coasts of the Bahama Islands.

Companies of dolphins are often seen traversing the length of Kingston Harbour, but no attempt is ever made to secure them. The Manatee is also sometimes caught and the flesh sold, but they breed too slowly to become of much economic importance.

The résumé is given in Dr. Morris's letter, p. 188. The report has three appendices :—

(1) The Fisheries of Barbados, where we learn the approximate income is £19,500.

(2) The Jamaican Fisheries ; an account of the operations in Jamaica of the Caribbean Sea Fisheries Development Syndicate, Limited, which does not appear to have been financially successful.

(3) A Report on the Sea-egg Industry of Barbados.

2. CEYLON PEARL FISHERIES.

COLONIAL OFFICE,

Downing Street,

7th August, 1900.

To THE DIRECTOR OF THE BRITISH MUSEUM (Nat. Hist.).

SIR,—I am directed by Mr. Secretary Chamberlain to enclose for your consideration copies of a special Report on the Ceylon Pearl Fisheries and of the last report on the inspection of the pearl banks, which have been received from the Governor of that Colony.

Mr. Chamberlain would be much obliged if you would be good enough to advise him on the subject generally, but I am to state that he doubts whether the Colonial Government would be well advised to incur any considerable expense in the matter, unless it is considered to be of great scientific interest, as the local conditions seem to be well known for practical purposes.

The Governor of Ceylon has suggested that the opinions of the Royal Society, British Association, and Zoological Society should be invited as to whether it is desirable that these fisheries should be inspected by a scientific expert, and also that Dr. Herdman, F.R.S., should be consulted, but no application has yet been made to these Societies or to Dr. Herdman, pending an expression of your opinion.

I am to add that various prints relating to Pearl Fisheries in Ceylon can be seen in the Library of this Office.

I am, etc.,

(Signed) C. P. LUCAS.

BRITISH MUSEUM (Nat. Hist.),

Cromwell Road, S.W.,

13th August, 1900.

To THE RIGHT HON. JOSEPH CHAMBERLAIN.

SIR,—I have read the Special Report on the Ceylon Pearl Fisheries forwarded to me by Mr. Lucas at your request. I am of opinion that the recommendations made by Sir W. Twynam are well based and should, so far as I am able to judge, be carried into effect.

The questions connected with the proper management and fishing of pearl oyster banks and other similar submarine sources of wealth are of great scientific interest, and should, in my opinion, be continually investigated and dealt with in the interest of the community. Results

obtained in Ceylon may be found to be of value from a commercial point of view in Queensland or again in the West Indies (Sponge fisheries).

I am decidedly of the opinion that the expenditure of a certain proportion of the revenue derived from the Ceylon Pearl Fisheries, upon thorough and authoritative study of the questions raised in Sir W. Twynam's report by the best scientific naturalists whose services can be obtained must in the course of time—if persisted in and sufficiently supported by money needed for experiments and investigation—produce a valuable return to the State in the form of increase in commercial results.

A brief inspection of the banks by a capable scientific naturalist or the employment of a second-rate man of no real scientific knowledge or training would, in my judgment, be a waste of public money.

I should myself like to see Professor Herdman, of Liverpool, entrusted with a two or three years' mission in connection with the Ceylon Pearl Fisheries. He has given special attention to oysters and oyster fisheries, and is a man of genuine knowledge and also possessed of energy and initiative. It would be possible for him to give three or four months in each year to his professional work in England and to spend the rest of the year (at the proper season) in Ceylon.

I think that Sir W. Twynam's report might very well be submitted to Professor Herdman for his opinion, and that before taking a definite step it might be well to submit his proposals to the Council of the Royal Society for their advice. But I should not recommend that either the Zoological Society or the British Association be consulted.

It is evident from Sir W. Twynam's report there are many matters connected with the pearl banks upon which a competent naturalist versed in marine biology could at once clear up doubt. For instance, the mysterious enemy of the oysters mentioned in the report, which drills a small round hole in their shells. Every marine biologist knows at once that this must be one of the whelk-like gastropods, which preys upon the pearl oyster as do its congeners in European seas prey upon European oysters and comb-shells.

Were a competent naturalist, such as Professor Herdman, entrusted with a thorough study of the Ceylon pearl banks, and provided with a well-fitted steam cruiser for dredging, sounding, diving, etc., there can be no doubt that, in the first place, zoological results of great general interest would be obtained, as well as collections of value to the national Museum, and new facts of the most varied kind tending to advance our knowledge of marine life.

I believe, moreover, that in the second place such knowledge of the facts would be definitely gained as would enable the Ceylon Government to improve the pearl fisheries and to manage them in the best possible way with a view to getting the proper commercial return from them.

It is impossible to foretell what results a clever naturalist might obtain. The artificial rearing of the spat of the pearl oyster and the nursing and transference of the young oysters as carried out in regard to European oysters might be found possible and of immense commercial value. Finally the artificial production of pearls is always, as far as zoological science enables us to form an opinion, a possibility. Perhaps I may, in conclusion, be allowed to point out that, some thirty-five years

ago, an experimental inquiry into the pearl fisheries of Ceylon, which was initiated by Government, ended in failure and disappointment, owing to the fact that the matter was entrusted to a gentleman who, though acquainted with sea-fishing as a sportsman, had no scientific knowledge or training.

During the past thirty-five years our knowledge of the treatment of oysters and similar questions has vastly increased.

If a naturalist who is really worthy of trust and conversant with the subject is sent to Ceylon to study the pearl banks, it is, in my opinion, highly probable that the expenditure involved will be amply repaid by the results. Such a man could not be obtained for a less payment than one thousand pounds a year, exclusive of all expenses; and it would be necessary to employ him for three years at least.

I am, etc.,

(Signed) E. RAY LANKESTER.

COLONIAL OFFICE,

Downing Street,

23rd August, 1900.

To THE DIRECTOR, BRITISH MUSEUM (Nat. Hist.).

SIR,—I am directed by Mr. Secretary Chamberlain to acknowledge the receipt of your letter of the 13th instant and to thank you for your advice on the subject of the Pearl Fisheries of Ceylon.

2. Mr. Chamberlain will communicate with Dr. Herdman and subsequently with the Royal Society, as you suggest.

3. I am to ask that you will be so good as to return the Reports enclosed in the letter from this Department of the 7th instant, as there are no other copies of these prints available. The Governor of Ceylon has been asked to send further copies, which will be forwarded to you as soon as they are received.

I am, etc.,

(Signed) C. P. LUCAS.

Abstract of Report on the Ceylon Pearl Fisheries.

By SIR W. C. TWYNAM, K.C.M.G. (Colombo, 1899).

In this long report of sixty-six pages, Sir W. C. Twynam first points out the injurious nature of currents and foul water to the pearl oyster.

For some years the real spat of the pearl oyster does not seem to have been known, the spat of other *Aviculae* being taken for young pearl oysters.

The enemies of the oyster are given, amongst them the following: shellfish, the chank of commerce (*Turbinella pyrum*), the horse and elephant chanks (*Pyrula carnaria* and *Murex regius*).

A small mussel (*Modiolu*) known as the Suran spreads a kind of blanket over the oysters and suffocates them; this is, however, rare in the Ceylon

beds. The crab is also said to be injurious, cutting the byssus of the oyster. A note is given on page 6 regarding an enemy that makes a round hole in the oyster shell; this mysterious enemy is one of the carnivorous whelks.

Evidently, from the report, numerous small mollusca prey on the pearl oysters. Two fish, the Trigger Fish (*Balistes mitis*) and skates (*Trigla warnak*), also do much harm. On page 5 it is stated that "the numerous rock fish which abound on the Arippu banks feed on oysters . . . the quantity devoured by these voracious fish must be considerable." Later, it is stated to be useful, as it preys on the injurious Suran or mussel. Skates of several unknown species are referred to as very destructive. Divers, both European and native, give various tales as to the damage done by sea snakes, but nothing authentic is given.

Floods of fresh, muddy water are stated to be most injurious.

Little definite seems to be recorded as to the age of pearl oysters, but it is stated "that oysters may be profitably fished at the age of four years, and that they are in their prime at five years, and may be kept till that age if circumstances permit of it, but if they are kept until the sixth year they are almost certain to be found dead." The best time to fish them however, does not appear to be settled.

The advisability of retaining native divers is entered into at some length, their superiority over the European at this work being clearly pointed out. Their reward is now raised to one-third of the oysters collected. Recommendations to start a chank fishery in the neighbourhood of the pearl banks are given. One fishery exists north of Manar Islands, about 2,000,000 chanks being exported from Jaffna to Calcutta. The chanks are used as ornaments by the Hindus.

The main body of the report (30 pages) is taken up by eight appendices. The first dealing with spat, true and false; enemies of the oyster; chank fishery; age of the pearl oyster and artificial culture; being extracts from the report of Mr. Thomas, Madras Civil Service, to the Government of Madras, on the Pearl Banks and Fisheries of Tuticorin.

The most important part in this report regarding the true spat is here reproduced:—

"The challenged spat in the largest shell which I have seen is $4\frac{1}{2}$ sixteenths of an inch from hinge to contour rectangularly at its widest point, and the largest drawing in Sir J. Emerson Tennent's work is no more; it is, therefore, so small as to need very close examination. Looked at under a hand lens and under a low power microscope, I made it out to differ from the shell of the pearl oyster in being much more convex, more oblique; in having the ear on the short side, not produced in an almost straight line, but rounded off and turned up instead of being flat; in having the right valve fitting deeply into the left valve, with the edge of the right valve turned back at about an angle of 45° for the whole contour in some, for others only from the sinal ear to half way round the contour, instead of the *two valves meeting each other nearly flat, as in the pearl oyster*; in having none of the spines with which the pearl oyster is covered, and distinctly different flanges; in having no *algae* adhering to it; in having the umbones more anterior or advanced beyond the hinge line; in adhering to weed, said to be *Sargassum vulgare*, instead of to rock and such-like hard substances.

in being differently coloured, the dark lines of colour radiating as in the drawing from the convexity to the contour. Again, it is only the concave part of the shell that is coated with glistening nacre, the broad deflected margin being dull. It is not so in the pearl oyster, in which the nacre comes close to the margin. In the *aviculæ*, of which our pearl oyster *Avicula (Meleagrina) margaritifera* is one, the prolonged hinge line, straight at the hinge, is brought in below with a curve that gives it a similitude to the wing of a bird, and the sinal ear, though shorter, is also slightly curved in below. In some *aviculæ* this formation is more expressed than in others, so that they are divided into two sections of the long-winged and short-winged *aviculæ*. *Avicula macroptera* is the type of the former, and *Avicula heteroptera* and *A. crocea* are illustrations of it; of the latter *A. margaritifera* is the type, but still has the peculiarity distinctly present. In the challenged spat it is wholly absent. At the same time, however, that it is said in Reeve's "Conchologia Iconica" that this feature is always present in the *aviculæ*, it is not shown in the small shell of *A. vexillum*, figured magnified in this work, which, as far as the drawing goes, has a general similitude to the challenged spat and has against it the remark "Habitat, Ceylon (in deep water), Gardner," but beyond this the text description, though very brief, hardly tallies, and there are to my thinking three, if not four, forms among the challenged spat, all of which show under the microscope "the prismatic cellular structure of shell found in most of the *aviculæ*" (Carpenter). My belief is that they have been so long sailing under the false colours of being the pearl oyster spat, that they are unnamed and seemingly mature *aviculæ*, but I am not concerned to name them; all my contention for the purposes of this report is that they are not pearl oysters.*

This is pointed out as having an important bearing on the supposed disappearance of young pearl oysters from certain beds.

* The figures given in Tennent's 'Natural History of Ceylon' are therefore wrong.—F.V.T.

APPENDIX.

I. LIST OF NORTH AFRICAN LOCUSTS.

(After Mr. W. F. KIRBY's forthcoming "Catalogue of Orthoptera.")

PHASGONURIDÆ.

STENOPELMATIDÆ.

- Lezina*, Walk.
concolor, W. Egypt.
Magrettia, Brunn.
abominata, Brunn. Suakim, Dongola.
obscura, Burr. Somali.

HETEROIDÆ.

- Gymnoproctus*, Karsch.
Maurelii, Luc. Senegal, Soudan.
abortiva, Serv. S. and W. Africa.
Anepisceptus, Fieb.
horridus, Burm. Egypt, Syria, Arabia.
Servillei, Reiche, Abyssinia, Somali.
Revoilii, Luc. Somali.
Hippolyti, Kb. (*Servillei*, Luc.).
Ruspolii, Schult. Somali.
Suakimensis, Kb. Suakim.
Robeckii, Schult. Somali.
Eugaster, Serv.
spinulosus, L. Morocco.
Woodii, Kb. Somali.
Powysi, Kb. Morocco.
Guyoni, Luc. Algeria.

- Lucasii*, Kb. Tunis.
inornata, Krauss. Oran.
Madiga, Kb.
aberrans, Schult. Somali.
Bradyopisthius, Karsch.
paradoxurus, Karsch.

ERIPPIPPIDÆ.

- Uromenus*, Bol. S. France, Corsica, Sardinia, Algeria.
rugosicollis, Serv. S. France, Corsica, Sardinia, Algeria.
costaticollis, Luc. Algeria.
laticollis, Luc. Algeria.
Finoti, Br. Algeria.
agarena, Bol. Ceuta.
latipennis, Fisch. Algeria.
Ephippigera, Latr.
transfuga, Brunn. Algeria.
nigromarginata, Luc. Morocco, Algeria.
compressicollis, Fisch. Algeria.
antennata, Brunn. Algeria.
innocentii, Fin. Tunis.
oudryanus, Bonn. Tunis.
vosseleri, Krauss. Algeria.
trilineata, De Haan. Tripoli.
Vaucheriana, Sauss. Morocco.

- Mauretanica*, Sauss. Morocco.
maroccana, Sauss. Morocco.
lobata, Sauss. Algeria.
tenuata, Sauss. Morocco.
hastata, Sauss. Morocco.
Steropleurus, Bol.
selliger, Charp. Spain, Portugal,
 N. Africa (?)
Lucasi, Brunn. Algeria.
Algerica, Brunn. Algeria.
Platystolus, Bol.
pachygaster, Luc. Algeria.
Pycnogaster, Graells.
Finoti, Bol. Algeria.

DECTICIDÆ.

- Drymadusa*, Stein.
fallaciosa, Fin. Algeria.
Pterolepis, Ramb.
Gessardi, Bonn. Tunis.
indigena, Fin. Algeria.
Rhacocleis, Fieb.
maura, Borm. Tunis.
Ariagona, Krauss.
Margaritæ, Kr. Teneriffe.
Ctenodecticus, Bol.
Bolivari, Targ. Sardinia, Oran.
Vasorensis, Fin. N. Africa.
Pholidoptera, Wesm.
punctifrons, Burm. Egypt, Syria.
Decticus, Serv.
griseus, L. Europe, Madeira.
laticauda, Brunn. Sicily, Algeria.
tessellata, Charp. Europe, Algeria.
senia, Fin. N. Africa.
Kabyla, Fin. N. Africa.
Tettigonia, Linn.
albifrons, Fabr. Europe, Madeira.

PHASGONURIDÆ.

- Phasgonura*, Westw. Europe, N. Africa.
viridissima, L. N. and W. Africa.
Savignyi, Luc. Algeria.
marginifera, Walk. Africa.
maroccana, Bol. Tangier.
algerica, Bol. Algeria.
Eumenymus, Pict.
Vaucherianus, Pict. Morocco.

- Calliphona*, Krauss.
Königi, Kr. Canaries.
Alluaudi, Kr. Canaries.

SAGIDÆ.

- Saga*, Charp.
ornata, Burm. Egypt.

CONOCEPHALIDÆ.

- Ruspolia*, Schultz.
pygmæa, Sch. Somali.
Conocephalus, Thunb.
nitidulus, Scop. S. Europe, Africa
 Algeria, Canaries, etc.

- Xiphidium*, Serv.
concolor, Burm. Hungary, Egypt.
stramineum, De Haan. Egypt.
lugubre, Redt. Egypt.
somali, Burr. Somali.
conocephalus, L. N., W. and E.
 Africa, Madagascar.

MECOPODIDÆ.

- Pachysmopoda*, Karsch.
abbreviata, Tasch. Sokotra.
Euthyphlebia, Schultz.
parallela, Sch. Somali.

MECONEMIDÆ.

- Orophila*, Krauss.
nubigena, Kr. Teneriffe.

PHANEROPTERIDÆ.

- Odontura*, Ramb.
spinulicauda, Ramb. S. Europe,
 Algeria.
Borrei, Bol. Algeria.
algerica, Brunn. Algeria.
quadridentata, Krauss. Algeria.
terniensis, Fin. Algeria.
Pseudisotima, Brum.
punctata, Br. Somali.
Peropyrrhicia, Brunn.
Massaiæ, De Borm. Abyssinia.
maculata, Schulth. Somali.
Leptophyes, Fieb.
Antinorii, De Borm. Shire.

- Epiphlebus*, Karsch.
crypterius, Karsch. Somali.
Ruspolii, Schult. Somali.
- Peronura*, Schult.
Somali, Sch. Somali.
Rivæ, Sch. Somali.
- Rhegmatopoda*, Brunn.
Peeli, Burr. Somali.
- Acrometopa*, Fieb.
Servillei, Brullé. S. Europe,
 Egypt.
- Conchotopoda*, Karsch.
Ruspolii, Schult. Somali.
- Euthyphobia*, Schult.
parallela, Sch. Somali.
- Myrmeocophana*, Brunn.
fallax, Br. Soudan.
- Gonatoxia*, Karsch.
maculata, Karsch. Somali.

- Phaneroptera*, Serv.
salcata, Scop. S. Europe, N. Africa,
 W. and Central Asia, Madeira.
nana, Charp. S. Europe, E., W.
 and S. Africa (can hardly fail to
 occur in N. Africa).
minima, Brunn. Egypt.
punctata, Burr. Somali.
- Milititsa*, Burr.
Somaliensis, Burr. Somali.
- Diogena*, Brunn.
Fausta, Burm. Nubia, Aden.
- Tylopsis*, Fieb.
lilifolia, Fabr. Mediterranean
 Region, Egypt, etc.
perpulchra, Burr. Somali.
Karschiana, Schult. Somali.
- Debrona*, Walk.
angustipennis, Burr. Somali.

LOCUSTIDÆ.

ACRIDIDÆ.

- Acrydium*, Geoff.
Nobrei, Bol. Portugal, Morocco (?)
bipunctatum, L. Europe, Algeria.
ceperoi, Bol. Cadiz, Tangier.
depressa, Bris. Europe, Zanzibar
 (certainly all N. Africa).
- Paratettix*, Bol.
meridionalis, Ramb. S. Europe,
 Egypt, Nubia.
- Coptotettix*, Bol.
rufipes, Bol. Somali.

TRYXALIDÆ.

- Tryxalis*, Bol.
turritus, L. S. Europe, Asia,
 Africa (Egypt, Nubia, Algeria,
 etc.).
- gigantens*, Fuessly. S. Europe,
 Egypt.
- lineatus*, Thunb. Morocco.
- bicolor*, Th. Egypt, Arabia.
 [N. G. (near last, but h. w. rudi-
 mentary).]
- tereticornis*, Brullé. Canaries.
- Acrida*, Linn.
Pharaonis, Klug. Upper Egypt,
 Baghdad.
- ensis*, Burr. Sokotra.

- nasutus*, Linn. Morocco (?), Somali.
miniata, Klug. Upper Egypt.
annulata, Thunb. Algeria.
variabilis, Klug. Egypt, Syria.
nebulosa, Thunb. (= *unguiculata*,
 Ramb.). Arabia, Old World,
 Algeria, Egypt, etc.
- grandis*, Klug. Egypt, Nubia,
 Quetta.
- scalaris*, Klug. Africa, W. Asia,
 Egypt, Canaries, etc.
- Oxycoraphus*, Fisch.
compressicornis, Latr. S. Europe,
 W. Asia, Egypt, Algeria, Senegal.
- venustus*, Walk. Cairo.

- Duronia*, Stål.
fracta, Krauss. Egypt.
lucasi, Bol. Algeria.
lauræ, Burm. Tunis.
savignyi, Krauss. Egypt.
- Chirista*, Karsch.
flexuosa, Schult. Somali.
- Paracinema*, Fisch.
tricolor, Thunb. S. Europe, Africa,
 Algeria.
- sylvestris*, Thunb. Algeria.
- Ochrilidia*, Stål.
tibialis, Fieb. S. Europe, Egypt,
 Syria.

Appendix.

- Brachycrotaphus*, Krauss.
tryxalicera, Fab.
- Arcyptera*, Serv.
hispanica, Ramb. S. France, Spain,
 Algeria.
- Stenobothrus*, Fisch.
pulvinatus, Fisch. S. Europe,
 Algeria.
- lætus*, Walk. Cairo.
- Bonneti*, Bol. Tunis.
- amoena*, Bris. Algeria.
- Lucasi*, Bris. Algeria.
- Simonyi*, Krauss. Canaries.
- Stauronotus*, Fisch.
cruciatus, Pall. S. Europe, Morocco,
 Egypt, Algeria.
- Genei*, Oesk. S. Europe, W. Asia,
 Algeria, Egypt.
- Epacromia*, Fisch.
strepens, Lat. S. Europe, Algeria,
 Asia Minor, Canaries.
- thalassina*, Fabr. Europe, Egypt,
 Madeira.
- lucasi*, Brunn. Algeria.
- LOCUSTIDÆ.
- Chlæbora*, Sauss.
Kollari, Schulth. Somali.
- gracilis*, Schulth. Somali.
- Quiroguesia*, Pant.
notabilis, Walk. Canaries, Spain,
 S.W. Asia.
- Blanchardiana*, Sauss. Somali, etc.
- Edaleus*, Fieb.
flavus, Linn. Europe, Asia, Africa,
 (Algeria, etc.).
- Locusta*, Linn.
inornatus, Schulth. Somali.
- danica*, Linn., Old World (all W.
 Africa, Egypt, etc.), Canaries,
 Madeira, and Azores.
- migratoroides*, Reiche. Africa
 (Abyssinia, etc.).
- Heteropternis*, Stål.
Savignyi, Krauss. Egypt.
- Pycnodictya*, Stål.
Galinieri, Reiche. Abyssinia.
- Forbesi*, Burr. Sokotra.
- Œdipoda*, Latr.
gratiosa, Serv. S. Europe, Asia,
 Egypt, Canaries.
- cærulescens*, Linn. Europe, W.
 Asia, Africa, Zanzibar.
- fuscocincta*, Luc. Sicily, Algeria,
 Canaries, Tunis.
- canariensis*, Krauss. Canaries.
- Mauretania*, Luc. Algeria.
- Thalpomena*, Sauss.
Algeriana, Luc. Algeria.
- Maderæ*, Serv. Madeira.
- Picteti*, Krauss. Teneriffe.
- Aerotylus*, Fieb.
insubricus, Scop. Mediterranean
 Region, W. Asia, Canaries,
 Algeria, Egypt.
- patruelis*, Sturm. S. Europe, Africa,
 Algeria, Egypt.
- longipes*, Charp. S. Europe, W
 Asia, E. Africa, Abyssinia,
 Algeria, Canaries, Sokotra.
- errabundus*, Fin. Algeria.
- Egnatius*, Stål.
cærulans, Krauss. Algeria.
- Leptoscirtus*, Sauss.
aviculus, Sauss. Egypt.
- Savignyi*, Sauss. Egypt.
- Sphingonotus*, Fieb.
cærulans, Linn. Europe, W. Asia,
 Egypt, Madeira.
- azurescens*, Ramb. Spain, Egypt,
 Algeria, Abyssinia.
- Clausii*, Kitt. S. Russia, Egypt.
- callosus*, Fieb. S. Europe, Algeria,
 Syria.
- asperus*, Brullé. Canaries.
- granulatus*, Brullé. Canaries, Al-
 geria.
- Sefræ*, Fin. Algeria.
- Savignyi*, Sauss. Egypt, Nubia.
- Canariensis*, Sauss. Canaries,
 etc.
- arenarius*, Luc. Algeria.
- niloticus*, Sauss. Egypt.
- latifasciatus*, Walk. Egypt, Arabia.
- tricinctus*, W. Egypt, Arabia.
- octofasciatus*, Serv. Egypt.
- variegatus*, Walk. Egypt.

Leptopternis, Sauss.

Rhamses, Sauss. Egypt.
canescens, Sauss. Egypt.

Helioscirtus, Sauss.

capitanus, Borm. Tunis.
Finotianus, Sauss. Algeria.

EREMOIID.E.

Eremobia, Serv.

cisti, Fabr. S.W. Europe, Algeria.
Clavelli, Luc. Syria, Tunis.
pulchripennis, Serv. Egypt.
continuata, Serv. Cairo.

Eremochoris, Sauss.

insignis, Luc. Algeria.

PYRGOMORPHID.E.

Chrotogonus, Serv.

Bormansi, Bol. Shoa.
angustatus, Blanch. Egypt.
Savignyi, Bl. Egypt.
Blanchardi, Krauss. Egypt.
homolodema, Bl. Sennaar.
lugubris, Bl. Egypt.

Pyrgomorpha, Serv.

conica, Oliv. S. Europe, Algeria,
Egypt.
debilis, Fin. Algeria.

Parasphepha, Bol.

picta, Bol. Massowa.

Povilocera, Serv.

hieroglyphica, Klug. Dongola.
vittata, Kl. Dongola.
bifonia, Klug. Egypt, Syria.
vulcanus, Serv. Egypt.
vignaudii, Guér. Abyssinia.

Phymateus, Serv.

Hildebrandti, Bol. Somali, Zanzibar.

Maura, Stål.

apicalis, Bol. Massowa.

Dictyophorus, Thunb.

griseus, Reiche. Abyssinia.

Pamphagodes, Bol.

Riffensis, Bol. Morocco.

PAMPHAGID.E.

Prionosthenus, Bol.

galericulatus, Stål. Egypt.

Eumigus, Bol.

monticolus, Ramb.

Finotia, Borm.

spinicollis, Borm. Tunis.

Ocnerodes, Brunn.

Durieui, Bol. Morocco.
microptera, Bris. Algeria.
nigropunctatus, Luc. Algeria.
Volxemi, Bol. Algeria.
longicornis, Bol. Algeria.
Acinipe, Ramb.
hispanica, Ramb. Spain, Algeria.
Saharw, Pict. Biskra.
Muelleri, Krauss. Algeria.
Foreli, Pict. Gabes.
Algerica, Brunn. Algeria.
expansa, Brunn. Gibraltar, Algeria.
Mauritanica, Bol. Morocco.

Eunapius, Stål.

Brunneri, St. Algeria.
sitifense, Bris. Algeria.
Numidæ, Sauss. Tunis.
Maroccanus, Sauss. Morocco.
granosus, Stål. Algeria.
quadridentata, Bris. Algeria.
Vaucherianus, Sauss. Morocco.

Pamphagus, Thunb.

elephas, Linn. Algeria.

Xiphocera, Latr.

Brunneriana, Sauss. Somali,
Abyssinia.

CYRTACANTHACRID.E.

Dericorys, Serv.

acutispina, Stål. Egypt.
albidula, Serv. Egypt.
Millieri, Borm. Tunis.

Platyphyma, Fisch.

rufipes, Brunn. Algeria.

Armindia, Krauss.

Brunneri, Kr. Teneriffe.

Xenipa, Stål.

aridula, St. Khartum.

(*N.G. = Acridium* (auct. nec Geofr.))
Egyptium, Linn. S. Europe,
N. Africa (Egypt, Algeria, etc.).

Schistocerca, Stål.

peregrina, Oliv. S. Europe, W.
Asia, N. Africa (Egypt, Algeria,
etc.).

Cyrtacanthacris, Walk.

compta, Walk. Suakim.

<i>Robeckia</i> , Schulth.	<i>orientalis</i> , Schulth. Somali.
<i>obesa</i> , Schulth. Somali.	<i>signatus</i> , Walk. Suakim.
<i>Sphodromerus</i> , Stål.	<i>Heteraris</i> , Walk.
<i>decoloratus</i> , Fin. Algeria.	<i>Somali</i> , Schulth. Somali.
<i>inconspicuus</i> , Schulth. Somali.	<i>Tylotropidius</i> , Stål.
<i>serapis</i> , Serv. Egypt, Sinai.	<i>Somalicus</i> , Schulth. Somali.
<i>Calliptamus</i> , Serv.	<i>Thisoicetrus</i> , Brunn.
<i>italicus</i> , Linn. S. Europe, W. Asia, N. Africa (Algeria, Tunis), Madeira, Massowa, Sokotra.	<i>littoralis</i> , Ramb. S. Europe, Egypt, Nubia, Algeria, Arabia, etc.
<i>ictericus</i> , Serv. Spain, Algeria.	<i>cærulescens</i> , Stål. Massowa.
<i>vulcanius</i> , Krauss. Canaries.	<i>grossus</i> , Schulth. Somali.
<i>discoidalis</i> , Walk. Egypt.	<i>Euprepocnemis</i> , Fieb.
<i>mutator</i> , Walk. Egypt, Arabia.	<i>plorans</i> , Charp. S. Europe, Africa, Asia, Egypt, Algeria.
<i>similis</i> , Brunn. Egypt, Syria.	<i>cinerea</i> , Blanch. Teneriffe.
<i>turbidus</i> , Walk. Egypt.	<i>morbosus</i> , Serv. Egypt, Arabia.
<i>calcaratus</i> , Stål. Massowa.	

II. LIST OF AFRICAN TERMITES.

(Compiled from Sjöstedt's "Monograph" (Svenska Ak. Handlingar, 34 (4) (1900), by Mr. W. F. KIRBY.)

<i>Hodotermes</i> , Hag.	<i>pallidus</i> , Ramb. Mauritius.
<i>mossambicus</i> , Hag. Damara, Cape, Caffraria, Natal, Mozambique, German E. Africa.	<i>voeltzkowi</i> , Wasm. Madagascar.
<i>ochraceus</i> , Burm. Egypt, Tunis, Morocco, Persian Gulf.	<i>Rhinoterme</i> , Hag.
<i>viator</i> , Latr. Cape (Hex River, etc.).	<i>putorius</i> , Sj. Cameroons, Fernando Po, Gaboon, Congo.
<i>Wasmanni</i> , Sjöst. N. Africa (Wady M'bellem).	<i>Acanthoterme</i> , Sj.
<i>Havilandi</i> , Sharp. (= <i>mossambicus</i> : see Sjöstedt).	<i>acanthothorax</i> , Sj. Cameroons.
<i>viarum</i> , Smeathm. Phil. Trans. lxxi p. 189 (1781). Sierra Leone.	<i>militaris</i> , Hag. Togo, Congo, Angelo.
<i>Aurivillii</i> , Sjöstedt. Cape (Darling).	<i>spiniger</i> , Sj. Congo.
<i>Calotermes</i> , Hag.	<i>Termes</i> , Linn.
<i>flavicollis</i> , Fabr. Palæartic Region; Mediterranean; Algeria, Egypt.	<i>niger</i> , Sj. Cameroons.
<i>Camerunensis</i> , Sj. (= <i>robustus</i> , Sj.). Cameroons.	<i>gratus</i> , Sj. Togo.
<i>Madagascariensis</i> , Wasm. Nossi Bé, Durban (= <i>Durbanensis</i> , Hav.: sec. Sj.).	<i>vitrialatus</i> , Sj. Congo.
<i>Havilandi</i> , Sj. Cameroons, Fernando Po, Congo.	<i>Goliath</i> , Sj. Kilimanjaro, Masai Land, Dar-es-Salaam, British Central Africa.
<i>Howa</i> , Wasm. Madagascar.	<i>Natalensis</i> , Hav. (= <i>termiticola</i> , Sj.). Liberia, Gold Coast, Togo, Congo, Soudan, Angola, Caffra, Natal, N. Transvaal.
<i>cryptops</i> , Sj. Ugalla (Ituri-Fähro) [? Uganda].	<i>bellicosus</i> , Smeathm. (cf. <i>infra</i>).
	<i>crucifer</i> , Sj. Sierra Leone, Togo, Cameroons, Congo.
	<i>cavithorax</i> , Sj. Cameroons.
	<i>lucifugus</i> , Rossi. Mediterranean, Algeria, Egypt.

- destructor*, Smeathm. (= *flavicollis*, Walk.). Senegal, Sierra Leone, Natal (?), Kordofan, Bahr-el-Abiad.
- Cafraria*, Sj. Cafraria, Natal.
- latericius*, Hav. Natal, Mozambique.
- aquaticus*, Sj. Togo, Cameroons.
- microps*, Sj. Usambara.
- latialatus*, Sj. Congo.
- capensis*, De Geer. Gambia (?) Cape, Cafraria.
- Buchholzi*, Sj. Liberia, Fernando Po, Gaboon.
- angustipennis*, Sj. Congo.
- vulgaris*, Hav. Natal.
- angustatus*, Ramb. Cape, Natal, Cafraria.
- Lilljeborgi*, Sj. Cameroons.
- amplus*, Sj. Congo.
- Gabonensis*, Sj. (= *Mülleri*, Sj.). Gaboon.
- nobilis*, Sj. Cameroons.
- bailius*, Hav. Natal.
- simplicidens*, Sj. Cameroons.
- busidens*, Sj. Togo.
- unidentatus*, Wasm. Gold Coast, Zanzibar.
- incertus*, Hag. Mozambique, Natal.
- monodon*, Gerst. Mozambique, Usegaba, Usagara, Transvaal.
- aquaticus*, Sj. Togo, Cameroons.
- (*bellicosus*; synonyms: var. *Mossambica*, Hag; subsp. *Sansibarica*, Wasm.; *fatale*, Fabr.; *capensis*, Latr.; *subhyalinus*, Ramb.; *viator*, Walk.; *sulciger*, Gerst.)
- bellicosus*; localities: Senegal, Kerry Coast, Sierra Leone, Gold Coast, Togo, Cameroons, Congo, Angola, Natal, N. Transvaal, Delagoa Bay, Mozambique, Usegaba, Usambara, Zanzibar, Tan-
- ganyika, Tangier, Sennaar, Kordofan, Abyssinia.
- Eutermes*, Hav.
- fungifaber*, Sj. S. Leone, Cameroons.
- bilobatus*, Hav. Natal.
- atrox*, Smeathm. S. Leone, Cape.
- macrothorax*, Sj. Gold Coast, Cameroons.
- longiceps*, Sj. Cameroons.
- albotarsalis*, Sj. Cameroons, Congo.
- Aurivillii*, Sj. Cameroons.
- lateralis*, Walk. Sierra Leone, Cameroons.
- truncatus*, Wasm. Madagascar.
- arboricola*, Sj. Cameroons.
- mordax*, Smeathm. Sierra Leone.
- pallidipes*, Sj. S. Leone, Cameroons.
- Camerunensis*, Sj. Cameroons.
- Sikorae*, Wasm. Madagascar.
- fuscotibialis*, Sj. Cameroons, Gaboon.
- subtilis*, Wasm. Aldabra, Mauritius.
- parvus*, Hav. Gold Coast, Natal.
- heterodon*, Sj. Cameroons.
- rectangularis*, Sj. Cameroons.
- hastatus*, Hav. Cape.
- socialis*, Sj. Gold Coast, Cameroons.
- capricornis*, Wasm. Madagascar.
- baculi*, Sj. Cameroons.
- hospes*, Sj. Cameroons.
- trinervius*, Ramb. Pal. Region, Sierra Leone, Congo, Damara, Cape, Natal.
- mauricianus*, Ramb. Mauritius.
- togoensis*, Sj. Togo.
- geminatus*, Wasm. Gold Coast.
- arborum*, Smeathm. Senegambia Cameroons, Cape.
- laticeps*, Wasm. Madagascar.
- latifrons*, Sj. Togo, Cameroons, Fernando Po.
- chrysopleura*, Sj. Cameroons.
- canaliculatus*, Wasm. Madagascar.
- nigrita*, Wasm. Madagascar.

INDEX.

A.

Acacia Wood, method of destroying insects in, 128
Acari at roots of flowers, 129
Agromyza chermivora, 40
Agrotis exclamatoris, 7, 83
Agrotis segetis, 7
Allied Bud Moth, 68
Allied Spotted Crane Fly, 101
Allspice, Pimento Borer in West Indies, 139
Almonds, attacked by Indian Meal Moth, 124
Andira, insect pests of, 141
Anobium domesticum, 41, 128
Anobium panicum, 41, 45
Anobium tessellatum, 41; in St. Alban's Cathedral, 122, 123
Anthocoris fusca, 40
Anthomyia radicum, 11
Anthomyidae, 11
Anthonomus pomorum, 18
Antipest sprayer, 26
Antithesia variegana, 68
Ants, destruction of, 31
Aphides, on apple trees, 27; on carrots, 27; on osiers and willows, 114
Aphis amygdali, 28
Aphis atriplicis, 10
Aphis brassicae, 93
Aphis mali, 27
Apogonia rauca, 144
Apple Blossom Weevil, 18; Sucker, 26; *Aphis*, 27; Fruit Fly, 21
Apples, maggots in, 20; maggots in imported apples, 21; Lisbon, 21; Scale on, 22, 29; Bark Louse, 26; eggs on apple trees, 26; Aphides on apple trees, 27; Sawfly, 20, 128
Arca, 173
Aræocerus fasciculatus, attacking coffee-berries, 137
Ark Shells, edible, in West Indies, 173

Armadillidium vulgare, 106
Armed Strongyles, 60
Arrowroot pests of West Indies, 141
Arsenate of lead wash, 28
Aspidiotus ostreæformis, 25
Aspidiotus perniciosus, 23
Atomaria linearis, 8, 11
Atropos divinatoria, 45, 74
Auchmeroyia, 55
Auchmeroyia depressa, 56
Austrian pine, *Pissodes notatus* on, 116
Aviculae, 176
Avicula crocea, 178
Avicula heteroptera, 178
Avicula macroptera, 178
Avicula margaritifera, 178
Avicula vexillum, 178

B.

Balistes mitis, 177
Banana, insects on, in West Indies, 141, 144
Banded Pine Weevil, 116; prevention and treatment, 117
Bark spots, 23
Barley, affected with smut and beetles, 80
Barley, smut and insects in, 5, 80
Bathyscia wollastoni, 84, 87
Bêche-de-Mer in West Indies, 173
Beech Coccus, 38
Beet Carrion Beetle, 6
Beetle Mites, 77
Benzine, use of, for furniture pests, 42; for clothes pests, 44
Bibio hortulanus, 11, 22, 91
Bibio marci, 22
Bibionidæ, on mangolds, 11; on fruit, 22
Bisulphide of carbon, use of, 126
Black Fly on mangold, 10
Black Wireworm, 49
Bordeaux Mixture, 48
Brown Curiant Scale, 26

Bryobia pruni, 26

Bud Mites in Black Currant, 18, 78

Bud Moth, 62; literature on, 63; life-history of, 65; at Wisbech, 73; at Hailsham and Swanley, 128

C.

Cabbage Aphis on Turnips, 93

Cabbage Root Fly, 34

Cæcilius, 74

Caitophorus salicivorus, 114

Calandra granaria, 46

Calandra oryzæ, 46

Calathus cisteloides, 19

Caliperus, 172

Calliphora, 55

Calocoris fulvomaculatus, 31

Canker fungus mistaken for insect work, 29

Carpocapsa pomonella, 20

Carrian Beetles, 6

Carrot Fly, 108

Carrots, Aphides on, 108

Case-making Clothes Moth, 43

Cassava, insects on, in W. Indies, 141

Cattle, Screw Worm in, 132

Caustic Alkali wash, 25

Caylor Fly, 56

Cecidomyia, 38

Cecidomyia heterobia, 38; *rosaria*, 38; *salicis*, 38, 129; *saliciperda*, 38; *salicina*, 38; *terminalis*, 38

Cecidomyidae, 37

Centropomus, 172

Centropristes oculatus, 172

Ceratitidis in apples, 21

Cereal Pests, 3, 80

Cetonia aurata, 13

Ceylon, Pearl Fisheries, 174; abstract of Report on, 176

Chafer, Green Rose, 13; garden and summer, 12

Chafer Larvae, 12

Chafers, 12

Chanks of commerce, 176

Cheimatobia brumata, 21

Chelone imbricata, 172

Chelone midas, 172

Chermes abietis, 18

Chermes corticalis, 39

Cherry Sawfly, 21, 72

Chincona pests, 140

Chinosol, use of, 123

Chrysanthemum, land bugs on, 30

Chrysomela marginalis, 91

Cigar Beetle, 125

Cinnabar Moth, 15

Cladius riminalis, 37

Clothes Moths, 43, 128; treatment for, 44, 126

Clytus arietis, 92

Coccidae, 29; life-history of, 25

Coccinella septem-punctata, 92

Cocoanut Palm, insects on, in West Indies, 140; Melolonthid larvae on, in Ceylon, 144

Cocoa Plant, insects on, in West Indies, 139

Codling Moth, 20

Coffee berries, damaged by Beetles, 137

Collembola in orchid houses, 110

Colorado Beetle, notes on, in England, 87; First Report on outbreak at Tilbury, 89; Report of second visit to Tilbury re, 90; Report on, 1902, 90; insects sent as, 91; reported at Hockley, 93; at South Benfleet and Northfleet, 93

Common Crane Fly, 96

Compsomyia, 55, 131

Compsomyia macellaria in man, 131; in cattle in St. Lucia, 132

Conorhinus rubrofasciatus, 130

Cornweal, insect pest in, 141

Corn Weevil, 46

Corrosive sublimate, use of, 42

Cotton, insect pests of, in West Indies, 139

Cowpeas, insect pest in, 141

Crabs in West Indies, 173

Crane Flies, 94

Crioceris asparagi, 92

Cryptococcus fagi, 38

Cupram, preparation of, 48

Currant Scale, brown, 26; white woolly, 23, 129

Cutworms, 7, 83

D.

Dactylobius citri, 74

Dactylobius destructor, 74

Dactylobius longipinus, 74

Dart Moth, 7

Death Watch, 41, 45, 122, 128

Depluming Scabies, in fowls, 61

Dermatobia, 55

Dermestes lardarius, 45, 125

Diaspis amygdali, 23; on plum, 25

Diaspis bromeliæ, 135

Diplosis pyrivora, 22, 128

Diplosis violicola, 106

Dipterous larvae in human excreta, 55

Doryphora decemlineata, 89

Doryphora juncta, 89

Doryphora melanothorax, 89

Doryphora undecimlineata, 89

E.

- Earwigs, causing annoyance indoors, 119
 "Eclair" sprayer, 26
 Eel-worm disease in oats, 3
 Eggs on apple trees, 26
Elasmosoma, 31
 Elephant Chanks, 176
Epilachna, 98
Epunda viminalis, 114
Eriocamia limacina, 21, 72
Eriophyes pyri, 78
Eriophyes ribis, 18, 79
Eriophyes violæ, 107
Ernobius mollis, 41
Eucharis Myrmeciae, 31
Euchelia jacobææ, 16
Exocætus roberti, 172

F.

- Felted Beech Coccus, 38
Ficus, insects pests of, in West Indies, 141
 Fiddlewood, insect on, 141
 Filariasis in lambs, 128
 Fish and fishing in West Indies, 172
 Flying Fish in West Indies, 172
 Foreign Office, Reports to, 145
Forficula auricularia, 119
 Fowl's eggs, a parasite in, 128
 Frit Fly in oats, 4
 Fruit pests, 18; Bud Mites in black currant bushes, 18; Apple Blossom Weevil, 18; Strawberry Beetles, 19; Slug Worms, 21; Maggots in apples, 20; Pear Midge, 22; Scale and False Scale, 22; Apple Bark Louse, 26; in orchards at Wisbech, 73
 Fruit trees, infestation of, by Winter Moth, 21; a general wash for, 28; winter washing of, 28
 Fumigation, with hydrocyanic acid gas, 33; for subterranean pests, 32; for Mealy Bug under glass, 112; with bisulphide of carbon, 126.
 Fungoid disease in black currant leaves, 47
 Furniture Beetles, 41; treatment of, 42
 Furniture Insects, 45
 Furniture Mites, 45

G.

- Galls on osier plants, 37
 Garden Chafer, 12
 Gas treatment, under glass, 33; for scale, 134

- Geese, African, etc., 54
 Geese, domesticated, origin and varieties of, 53
 General wash for fruit trees, 28
Geophilus longicornis, 32
Glossina longipalpis, v. tachinoides, in Gambia, 144
Glyciphagus canestrini, 121
Glyciphagus crameri, 121
Glyciphagus cursor, 45, 120
Glyciphagus dispar, 121
Glyciphagus domesticus, 45, 120
Glyciphagus palmifer, 121
Glyciphagus platygaster, 121
Glyciphagus plumiger, 121
Glyciphagus sciurus, 121
Glyciphagus spinipes, 121
 Goat Moth attacking willows, 113
 Gooseberry Fungus, 48
 Grandilla, insect pest on, 141
 Grasses, insect pest of, 141
 Grease-banding and Winter Moth, 129
 Green Turtle, 172
 Ground garden pests, 32; treatment of, 32
 Grunts, 172
 Guinea Corn, insect pest of, 141

H.

- Hæmulon*, 172
Harpalus ruficornis, 19
 Hawksbill Turtle, 172
 Heart and Dart Moth, 7, 83
Hedya ocellana, 62, 73, 128
Hippodamia variegata, 93
 Hippo Flies, 144
Hipponoë esculenta in Barbados, 173
 Holothurians in West Indies, 173
Homalomyia, 55
Hoplocampa testudinea, 20, 108
 Hops, pests of, 81
 Horse Chanks, 176
 Horse Worms, 60
 Household Pests, Acarine, 120
 Hover Flies, 79, 114
Hydræcia micacea on potatoes, 81, 92
Hydræcia nebris, 83
Hydræcia nitela, 83
 Hydrocyanic acid gas, fumigation with, indoors, 123; under glass, 33; for Household Mites, 123; for Larder Beetle, 126; under glass for Mealy Bug, 112
Hylesinus piniperda, 135; treatment of, 136
Hylobius, 116
Hylobius abietis, 116
Hypomeces squamosus, 138

I.

- Indian Corn, pests of, in West Indies, 144
 Indian Meal Moth, 124
 Insect Pests of West Indies, 139
Ixodidae on Toads in Para, 144

J.

- Japanese Fruit Scale, 23; on plum, 25
 Jersey, insects on vines in, 73
Julidae in potatoes, 15; destroying plants at Downton Castle, 105
Julus pulchellus, 33, 84, 86, 105

K.

- "Knapsack" Sprayer, 26

L.

- Labia minor*, 119
Lachnus viminalis, 114
Lacon murinus, 15
 Lady-bird, 7-spotted, 92
 Lambs, Filariasis in, 128
 Land Bug, on chrysanthemums, 30; poisonous, 130
 Larder Beetle, 45, 125
Lasioderma testacea, 126
Laverna atra, 64; at Wisbech, 68; at Hailsham and Swanley, 128
 Leaf-Cutting Bee, 129
 Leaflets, prepared, for Board of Agriculture, 50; revised and enlarged, 50
 Leaf Miners in melons, 129
 Leaf Weevils, 73
 Leather Jackets, 13
Lecanium ribis, 23, 129; on plum, 26
Leuronostoc, 127
Ligia oceanica, 106
 Lime tree, insect pest of, in West Indies, 142
 Lobsters, in West Indies, 173
 Locusts, African, 184; machines for catching, 166; fungus attacking, 167; plants poisonous to, 168; natural enemies of, 168
 Locust Plagues, in Sudan, Report on, 164
Ludilia ovata, 50
Ludilia setosa, 50
Lygus contaminatus, 30
Lygus pratensis, on chrysanthemums, 30; treatment of, 30
Lyprosia, 133

M.

- Macaw Worm, 56
 Maggot Fly, of Natal, 56
Malpighia, insect on, in Antigua, 142
 Mammalia, 29
 Mango, insects on, in West Indies, 140, 142
 Mangold, Pigmy Beetle on, 8; Black Fly on, 10; Flies (*Bibionidae*) on, 11; Black Wire Worm in, 49
 Marguerite Fly, 108
 Marine resources, of West Indies, 169; Dr. Duerden's Report on, 172
 Marsh Crane Fly, 94, 98
 Maw Worm, 60
 Mealy Bug, 74; fumigation for, under glass, 112
Megachile Willoughbiella, 129
Melanocanthus salicis, 114
Melolontha vulgaris, 12, 92
Melolonthidae, 12
 Melons, Leaf-miners in, 129
Merodon claripes, 107
Merodon equestris, 107
Mesopriion, 172
 Millipedes, 87, 105
 Minor Shoulder Knob Moth, 114
Modiola, 176
 Moles, poison for, 29
Moniezia expansa, 49
 Monkey-peas, 80
 Mosquito annoyance at Blackheath, 56
Mugil, 172
Murex regius, 176
 Muscid larvæ, attacking roots, 34
 Mussel, edible, in West Indies, 173
 Mussel Scale, 23, 26, 75; further remedy for, 26; life-history of, 75; natural enemies of, 77; treatment of, 77
 Mustard Beetle, 16
 Mustard pests, 16
 Myiasis, human, 55
 Myriapoda, 15, 105
Mytilaspis citricola, at Monte Video, 133
Mytilaspis pomorum, 23, 26, 75
Mytilus exustus, 173

N.

- Napomyza lateralis*, 108
 Narcissus Fly, 107
Nectria ditissima, 29
Nematus conjugatus, 37
Nematus pavulus, 37
Nyssa zonaria, 21

Index.

O.

- Oats, eelworm in, 3
 Oats, Frit Fly on, 4
Ochromyia, 55
Ochromyia anthropophaga, 56
Ocyurus chrysurus, 172
Omaseus vulgaris, 19
Oniscus asellus, 106
 Orange pests, West Indies, 140, 142
 Orange trees in Monte Video, attacked by scale, 133; pests in Grenada, 142
 Orchid houses, insects in, 109
Oribatidae, 77
Oribata globata, 77
Oribata orbicularis, 77
Oscinis frit, 4
Oscinis vastator, 4
 Osier plants, insect galls on, 37; insects on, 114
Ostrea parasitica, 173
 Oyster-shell Bark Louse, 25, 75
 Oysters in West Indies, 173; pearl in Ceylon, 176
Oxyuris curvula, 60

P.

- Pachyrrhina maculosa*, 13, 99
Pachyrrhina quadrifarsa, 13, 101
 Palm seeds, pest on, 142
 Paraffin emulsion, 25, 27, 28, 134
 Paris Green, 7
 Peach Aphis, 28
 Peach pest, in West Indies, 140
 Pear Midge, 22; at Guestling, etc., 128
 Pear-leaf Blister Mite, 79
 Pear Sawfly, 21, 72
 Pearl Fisheries, Ceylon, 174; abstract of Report on, 176
Pecten ziczag, 173
Penthina pruniana, 68
Phaedon betulae, 16
Phalacrus, 5, 80
Phalacrus corruscus, 80
Phalacrus penicillatus, 80
Phalacrus politus, 80
Philoscia Couchii, 106
Phora formicarum, 31
Phorbia brassicæ, 34
Phygalia pilosaria, 21
Phyllobius, 73
Phyllobius viridaris, 73
Phyllopertha horticola, 12
Phytochoris pabulinus, 30
Phytomyza, 129
 Phytoptid disease, new, in Violas, 106
 Pigeon pea bush, pest on, in West Indies, 142

- Pigeon peas (dried), pest in, 142
 Pigmy Mangold Beetle, 8, 11
 Pigmy Potato Beetle, 84
 Pineapples, scale on, 135
 Pine Beetle, 135; treatment for, 136
Pissodes notatus, 116
 Pith Moth, 68; at Wisbech, 73; at Hailsham and Swanley, 128; preventive measures, 71
Plodia interpunctella, 124
 Plum Maggot, Red, 128
 Poison Baits, 7
Polydesmus complanatus, 32, 105
 Pomegranate Pests, of West Indies, 140
 Pony Flies, 133
 Poplar Sawfly, 37
Porcellio scaber, 105
 Potatoes, *Myriapoda* in, 15, 87; Wire Worm in, 15; A new potato feeder (*Euchelia jacobæa*), 16; The Rosy Rustic (*Hydræcia micacea*), 81; Surface Larvæ, 83; Pigmy Potato Beetle, 84; Millipedes, attacking, 87
 Potato pests, 15, 81
Psila rosæ, 108
 Psocidæ, on vines, 74
Psylla mali, 26
Pterostichus vulgaris, 92
Puccinia pringsheimiana, 48
Pulvinaria ribesii, 33, 129
 Purple Apple Weevil, 20
Pyrochroa serraticornis, 92
Pyrulla carnaria, 176

R.

- Rat Flea and connection with plague, 144
 Red Plum Maggot, 128
 Red Spider, killed by gas treatment, 33
 Resin Wash, 25, 134
Rhizotrogus solstitialis, 12
Rhynchites baccus, 20
Rhynchites cupreus, 20
 Rice Weevil, 46
 Root Crop Pests, 6, 93
 Rose Chafer, 13
 Rosy Rustic, attacking potatoes, 81, 92

S.

- St. Alban's Cathedral, *Anobium* in, 123
 San José Scale, 23
Sarcophagus magnifica, 55
Sarcophila, 55
Sarcopeltis laevis, 61
Sarperda carcharias, 36
 Sawfly, on poplar, 37; on willows, 37

- Scale Disease and False Scale amongst fruit trees, 22; treatment of affected trees, 134
- Scale Insects, on plum trees, 25; on orange trees at Monte Video, 133; on pineapples, 135; washes for, 25
- Schizoneura fodiens*, 109
- Schizoneura lanuginosa*, on elm, 114
- Sclerostomum equinum*, 60
- Sclerostomum rubrum*, 60
- Sclerostomum tetracanthum*, 60
- Scolopendridæ*, 15, 32
- Scolytidae*, attacking coffee berries, 138
- Screw Worms, in human beings, 131; in cattle in St. Lucia, 132
- Scymnus discoideus*, 40
- Sea Eggs in Barbados, 173
- "Segging," 3
- Senegal Fly, 56
- Septaria ribis*, 47
- Sericulture, Works on, 129
- Sheep, Tapeworms in, 49, 144
- Shrimps in West Indies, 173
- Silks, 172
- Silpha atrata*, 6
- Silpha opaca*, 6
- Silpha rugosa* on turnips, 6
- Siphidæ*, 6
- Siphocoryne caprea*, 114
- Sirex Flies in fir trees, 36
- Sirex gigas*, 36
- Sirex juvencus*, 36
- Slug Worms, 21
- Smut in barley, 5
- Snappers, 172
- Snook, 172
- Solanum melongena*, pests on, in West Indies, 142
- "Soldiers and Sailors," 92
- Sponges, in West Indies, etc., 179
- Spotted Crane Fly, 99
- Sprayers, 26
- Springtails, 110
- Spruce Gall Aphis, 118
- Stachia geometrica* on coffee berries, 138
- Steropus mandidus*, 19, 92
- Stichophus*, 173
- Stored goods, pests on, in West Indies, 142
- Strawberry Beetles, 19
- Striped-abdomen Crane Fly, 94, 98
- Subcoccinella*, 93
- Subcoccinella vigintiquatuorpunctata*, 93
- Subterranean Insects, destruction of, 32
- Sudan, Termites in, 158; Locust plagues in, 164
- Sugar cane, insects injurious to, in West Indies, 139, 141
- Summer Chafer, 12
- "Suran" pearl-oyster pest, 176
- Surface larvae, on turnips, 7, 83
- Syrphidae*, 79, 114
- Syrphus grossulariarum*, 79
- Syrphus ribesii*, 79
- Sweet potatoes, pests on, in West Indies, 142
- T.
- Tamarind, pests on, in West Indies, 142
- Tannia*, pest on, in West Indies, 142
- Tapestry Moth, 43
- Tapeworms, in sheep, 49; in bile duct of sheep in Transvaal, 144
- Telephorus bicolor*, 92
- Telephorus rusticus*, 92
- Teredo chlorotica*, 144
- Teredo dilatata*, 143
- Teredo dorsalis*, 144
- Teredo megalara*, 143
- Teredo navalis*, 144
- Teredo norvegica*, 144
- Teredo nucivora*, 144
- Teredos and Canadian timber, 143
- Termites, in Sudan, 155; Report on, to Foreign Office, 158; damage caused by, 159; methods of prevention and remedies, 160
- Tetranychus telarius*, 74
- Thymol, use of, for Horse Worms, 60
- Thysanoptera (Haliday's types), 129
- Ticks on toads in Para, 144; on swifts, 144
- Tinea pallionella*, 43
- Tinea trapetziella*, 43
- Tinola biselliella*, 43, 128
- Tipula lateralis*, 94, 98
- Tipula oleracea*, 13, 94, 96
- Tipula paludosa*, 94, 98
- Tipulidæ, injurious, 13, 94; natural enemies of, 101; preventive and remedial measures for, 103
- Trapping, for Wire Worm, 33
- Trepang, in West Indies, 173
- Trichophaga tapetziella*, 43
- Trigger Fish, 177
- Tropidiurus dentatus*, 172
- Trygon warnak*, 177
- Trypeta pomonella*, 21
- Tsetse-fly in Gambia, 144; and Buffalo, correspondence, 147
- Tulip root, in oats, 3
- Turbinella pyrum*, 176
- Turnip Moth (*Agrotis segetis*), 7
- Turnips, *Silpha rugosa* on, 6; caterpillars on, 7; Cabbage Aphis on, 93
- Turtles in West Indies, trade of, 172
- Tylenchus devastatrix*, 3

U.

Ustilago nuda, 5
Ustilago jensenii, 5

V.

Vines, insects on, in Jersey, 73

W.

Washes, for scale insects, 25; general wash for fruit trees, 28
Webbing Clothes Moth, 43
Weevils amongst stored corn, 46; treatment of, 47; defoliating rubber, 138; Leaf, 73
West Indies, insect pests of, 139
White Ants in Sudan, 155
White Grubs in cabbage, 34; prevention and treatment of, 34
Willow Aphides, 114
Willow Beetle, 36
Winter Moth, 21; at Swanley, 128
Willows, attacked by Goat Moth, 113; Sawfly larvæ on, 37; insects on, 114

Winter washing of fruit trees, 28
Wire Worm in potatoes, 15
Wood Leopard Moth, 128
Wood Lice, killed by gas treatment, 33; in hops, 80; in gardens, 105
Woodpeckers, 123
Wood, pests on, in West Indies, 142
Wood Wasps, 36
Woolly Pyrol, insect pest on, at Barbados, 142

X.

Xestobium tessellatum, 41
Xylophaga fimbriata, 144
Xylophaga bipinnata, 144

Y.

Yellow Spotted Crane Fly, 13, 99
Yellow-tail Fish, 172

Z.

Zeuzera cesculi, 128
Zygoneura, 110
Zygoneura sciarina, 110

**PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET**

UNIVERSITY OF TORONTO LIBRARY

