BRITISH MUSEUM (NATURAL HISTORY)

A MONOGRAPH OF THE IMMATURE STAGES OF ORIENTAL TIMBER BEETLES (*CERAMBYCIDAE*)

BY

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Zool.

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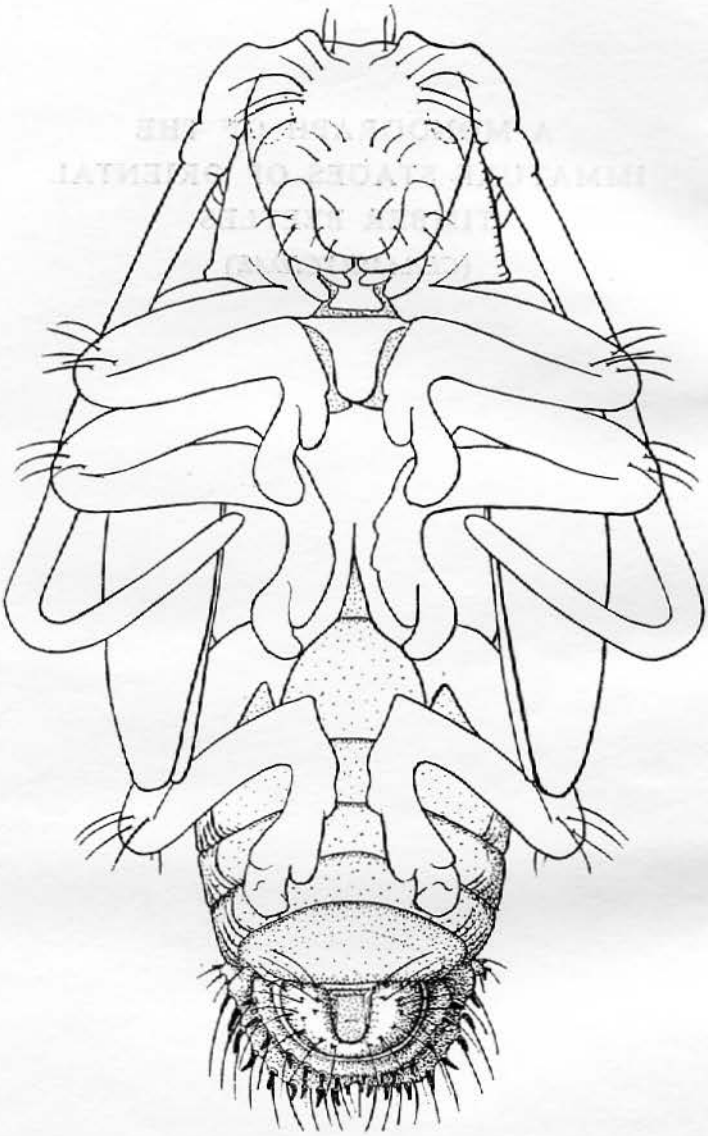

Diaxenes dendrobii Gahan. Male pupa. Ventral aspect.

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PREFACE

THIS volume, the fifth in the series which Mr. Duffy has prepared on the immature stages of timber beetles together with their differentiation, economic importance, distribution, biology and control, is probably the last which will appear. The only remaining area to be covered by him is the Nearctic Region, for which monographic literature is already available. Thus there are now standard works of reference for applied entomologists in the field for the timber beetles of the world. Once again the author has based the work largely on first hand studies and has himself drawn nearly all the text-figures. He is to be especially congratulated in maintaining such a high standard for so comprehensive an undertaking.

J. P. DONCASTER,
Keeper of Entomology

INTRODUCTION

IN this volume the author deals with the immature stages of cerambycids of the Oriental region, which embraces that part of southern Asia (fig. 11) extending eastward from India and the neighbouring countries of East and West Pakistan, Jammu and Kashmir, Nepal, Ceylon, Burma, Thailand, Malaya, Singapore, Indo-China, Borneo, Sarawak, Java, Indonesia, Celebes, the Philippines, Hongkong, China, Formosa, and the smaller islands, notably the Andaman and Nicobar Islands. Records and bionomic information of species from other Asian countries falling within the Palaearctic region have also been included where their distribution extends southwards to the Oriental region, as in the case of Japan, Korea and the Ryukyu Islands to China, and Afghanistan and Tibet to East and West Pakistan, Nepal and India. The territory of Papua and New Guinea has also been included, particularly since Gressitt (1959) has found that the LAMIINAE occurring there show a closer relation to those of the Oriental region than to Australia (see also Duffy, 1963, p. 1).

It is likely that this work, the fifth monograph of the present series dealing with the immature stages of timber beetles (CERAMBYCIDAE) on a regional basis, will be the final volume, unless it should later be decided to include a volume on the Nearctic region. But at this juncture it is not possible to estimate how much material could be obtained on loan or to decide to what extent the preparation of such a work would be justified, in view of Craighead's (1923), "North American Cerambycid Larvae" and Linsley's *magnum opus*[1] on the cerambycids of North America, which contains a wealth of distributional and bionomic information. As an alternative, a comparable monograph on the immature stages of the timber-boring BUPRESTIDAE might be attempted, again subject to the availability of material.

The larval and pupal keys in this volume deal with 124 genera and 186 species, and 40 genera and 46 species respectively. The greater part of the material from India has previously been described by Gardner (see "References") but has here been redescribed with numerous original figures, so that new and more significant tribal and generic characters could be incorporated. Much of the material from countries other than India is described and illustrated for the first time. Bionomic information and/or host plants are given for over 600 species. An assessment of their economic importance has been included in many cases.

Some, if not most, of the control measures recommended for the numerous species of economic importance listed herein no doubt appear rather primitive by present-day standards, and criticism for their inclusion may be levelled accordingly; but it should be borne in mind that at the beginning of this century the demand from forest departments was for measures and remedies that were, above all, inexpensive, simple in application and which would in no way conflict with current silvicultural procedure. Some of these measures, despite their crudity, have proved to be reasonably effective

[1] Linsley, E. G., 1961, The Cerambycidae of North America. Parts I (Introduction), II and III. *Univ. Calif. Pub. Ent., Berkeley*, (1961) **18**: 1–97, 35 pls., 16 figs.; (1962) **19**: 1–103, 1 pl., 34 figs.; (1962) **20**: 1–188, 56 figs.

(as in *Hoplocerambyx* epidemics, for example) and certainly economical in outlay. Within the Orient, widespread poverty and illiteracy have not only continued to exist but have undoubtedly increased in many areas and the acquisition of modern chemical insecticides and apparatus is economically impossible; but with populations increasing at so alarming a rate, resource to these less effective but nevertheless considerably cheaper techniques is now of even more vital importance.

A brief description of the adult, usually illustrated, has been included in the cases of species of exceptional economic importance, mainly for the guidance of field workers.

References to the immature stages, biology and control of Oriental cerambycids are extremely numerous, a fact which is obviously reflected in the bibliography of well over 700 references. An appreciable number of these, however, refer to the House Longhorn, *Hylotrupes bajulus* (Linnaeus), and the equally notorious but non-domestic *Xylotrechus quadripes* Chevrolat, the Coffee Borer. Moreover, many of the references are to a great extent repetitive, among these being the numerous papers by Duport (1913–1926).

Information on larval and pupal taxonomy, however, is much more limited and is largely the result of the invaluable series of papers by Gardner, Beeson, Kojima and a few others. This would seem to be a very appropriate opportunity to pay tribute to the pioneering work of J. C. M. Gardner, formerly Systematic Entomologist, at the Forest Research Institute and (now) College, Dehra Dun, whose work on the immature stages of Indian insects, particularly the CERAMBYCIDAE, has been such an inspiration to others, the present author not least, and whose meticulous observations and aptitude for the recognition of significant characters have done so much to stimulate further research on immature stages of many orders of insects. It is the present author's belief that far greater effort should be made to obtain as much information as possible about *existing* species and their immature stages and bionomics instead of describing endless "new species" based, more often than not, on a single, often incomplete or teneral specimen, which has become a tendancy nowadays.

Host plant names have been checked with Willis (1948), Howard (1951) and Kelsey and Dayton (1942). The preparation of the host plant catalogue proved to be quite an onerous undertaking but the timely publication of lists of insect pests of forest plants in India by Bhasin and Roonwal (1954), Bhasin, Roonwal and Balwant Singh (1958) and Mathur and Balwant Singh (1959–1961) made the author's task considerably easier from the point of view of verification.

All original figures of larvae, pupae and adults have been prepared by the author with the aid of a Bausch and Lomb binocular dissecting microscope and/or a Leitz monocular microscope, both in conjunction with an Abbé *camera lucida*. Certain figures have been reproduced from the author's previous monographs and a few other figures have been copied from other sources. In all such cases acknowledgement has been made in the legends. The photographs, except where otherwise indicated, have been carefully prepared by Mr. F. Greenaway, Photographer, British Museum (Natural History). A few photographs of infested or damaged timber have been kindly provided by Mr. H. T. Pagden (formerly Department of Agriculture, Malaya) and Dr. J. D. Bletchly (formerly of Forest Products Research Laboratory, Princes Ris-

borough). Dr Bletchly also kindly allowed the author to borrow timber samples damaged by *Rhaphipodus hopei* Waterhouse, *Chlorophorus annularis* (Fabricius) and *Stromatium barbatum* (Fabricius) for photographing.

In conclusion, it gives the author great pleasure to express with gratitude his indebtedness to the following persons for their kind co-operation in sending material on loan or as a presentation from their respective institutions. Firstly the author is most deeply indebted to Dr. P. N. Chatterjee, Director of the Forest Research Institute and College, Dehra Dun, for his great kindness in sending on loan the greater part of his Institute's collection of named cerambycid larvae, involving about 100 species, the majority of which had originally been collected and/or studied by Mr. J. C. M. Gardner. This gesture obviously involved Dr. Chatterjee and his staff in a great deal of inconvenience through the temporary deprivation of their reference collection and also because of the work of listing and dispatching. It would have been desirable to have borrowed pupae as well but the author was loath to exploit Dr. Chatterjee's kindness any further.

Much smaller but extremely interesting collections of immature material were also kindly lent by Dr L. G. E. Kalshoven (formerly of the Instituut voor Plantenziekten, Buitenzorg), Dr. Sv. G. Larsson (Universitetets Zoologiske Museum, Copenhagen), Mr. H. T. Pagden (formerly of the Department of Agriculture, Malaya), Dr. T. Fujimura (Shimane Agricultural Experiment Station, Izumo City, Japan), Dr. J. L. Gressitt (Bernice P. Bishop Museum, Honolulu), Dr. J. F. Gates Clarke (Smithsonian Institution, Washington), Dr. G. B. Vogt (Insect Identification and Parasite Introduction Research Branch, U.S. Department of Agriculture, Washington), Dr. Aphirat Arunin and Mr. Boonsom Meksongsee (Department of Agriculture, Bangkok), Prof. Dr. H. Weidner (Zoologisches Museum, Hamburg), Mon. J. Rondon (Vientiane, Laos) and Dr. R. A. Crowson (Department of Zoology, The University, Glasgow).

The author also wishes to thank the following persons for kindly sending larval material for presentation to the British Museum (N.H.): Dr. C. B. Chen (Taiwan Sugar Experiment Station, Taiwan, China), Mr. N. Dutt (Jute Agricultural Research Institute, West Bengal), Dr. J. J. H. Szent-Ivany (formerly of the Department of Agriculture, Stock and Fisheries, Konedobu, Papua), Mr. P. J. M. Greenslade (Department of Agriculture, Honiara, British Solomon Islands Protectorate), Mr. G. S. Dun (Department of Agriculture, Stock and Fisheries, Lowland Agricultural Station, Keravat via Rabaul, New Britain), the Director (The Forest Department, Colombo, Ceylon), Mr. F. A. Hunter (Ministry of Agriculture, Fisheries and Food, Liverpool), Dr. C. S. Wang (Machia Sugarcane Improvement Station, Taiwan, China), and the Chief Research Officer, Forest Research Institute, Kepong, Selangor, Malaysia.

Finally, the author particularly wishes to acknowledge his indebtedness to Mr. E. O. Pearson, O.B.E., Director of the Commonwealth Institute of Entomology, for kindly permitting this work to be undertaken as part of official duties, and to Mr. R. G. Fennah, Assistant Director, for his sustained interest and help in soliciting the loan of material. Grateful acknowledgement is also expressed for appreciable help with proof-reading and checking by Mr. D. E. Kimmins.

ORIENTAL CERAMBYCID LARVAE

FAMILY CHARACTERS

Form elongate, usually subcylindrical, occasionally cylindrical or rather strongly depressed. Cuticle thin, often rather leathery, especially on prothorax; never deeply pigmented or extensively sclerotized; usually greyish or milky white or pale testaceous and pubescent, especially on lateral regions.

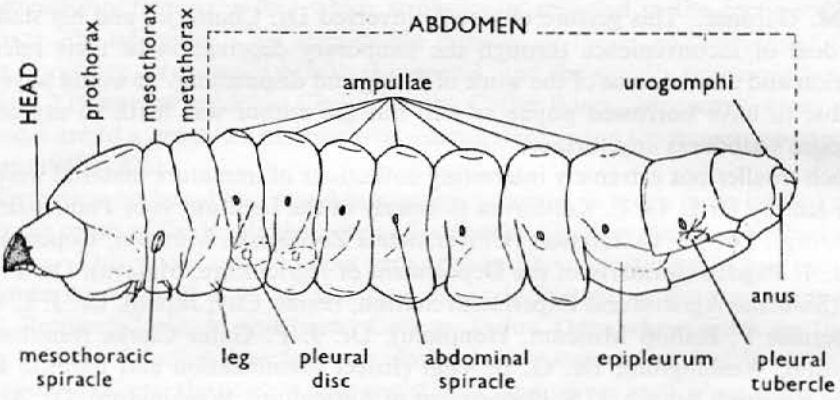


Fig. 1. Diagrammatic figure of a cerambycid larva. Lateral aspect (Duffy, 1953a)

Head extensible, usually deeply invaginated into prothorax; occiput large, occipital foramen very large, ventral and often divided into two portions by the tentorial bridge. Ventral surface with a broad, transverse bridge formed completely or mainly by the large hypostoma, the front margin of which is never strongly curved or retracted. Clypeus distinct, membranous, usually glabrous. Mandibles short, cutting edge either oblique or gouge-like; never with molar part or prostheca. Antennae usually strongly retractile with segment 2 usually bearing a tapering hyaline process; generally 3- but sometimes only 2-segmented (see p. 7); basal membrane often large and conspicuous. Maxillae protracted but compact; maxillary stipes movable only in one plane; maxillary articulating area distinct, generally fleshy. Labial palpi distinct, conical.

Prothorax large, with a wide collar; mesothorax, metathorax and abdomen narrower, never with hypopleural sclerites and always with a rectangular, sclerotized, dorsal plate which is generally more or less glabrous but sometimes micro-pubescent, micro-spiculate or asperate.

Abdomen extended; dorsally, and usually ventrally, bearing fleshy ambulatory ampullae on segments 1–6 or 1–7; segment 9 often with a sclerotized plate or process (figs. 151, 170, 191) or with rigid unsegmented urogomphi (figs. 35, 39). Anal region nearly always trilobate, exserted but occasionally with only a transverse cleft (fig. 129).

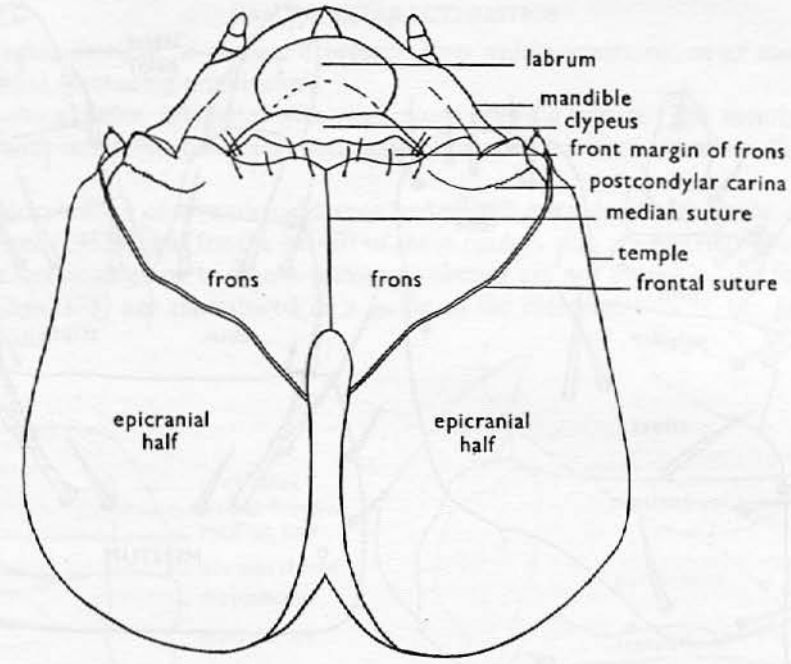


Fig. 2. Diagrammatic figure of a cerambycid larval head. Dorsal aspect. (Duffy, 1953a)

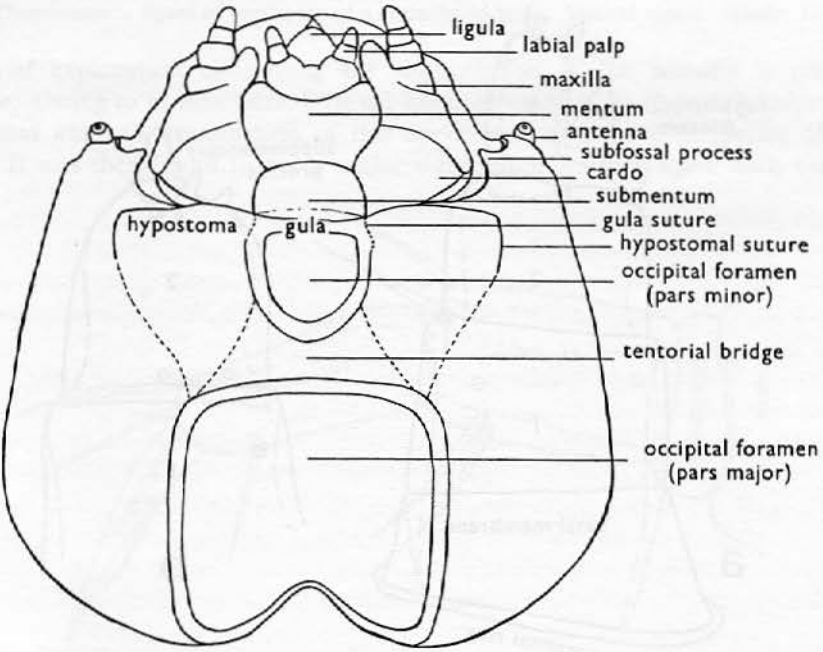


Fig. 3. Diagrammatic figure of a cerambycid larval head. Ventral aspect. (Duffy, 1953a)

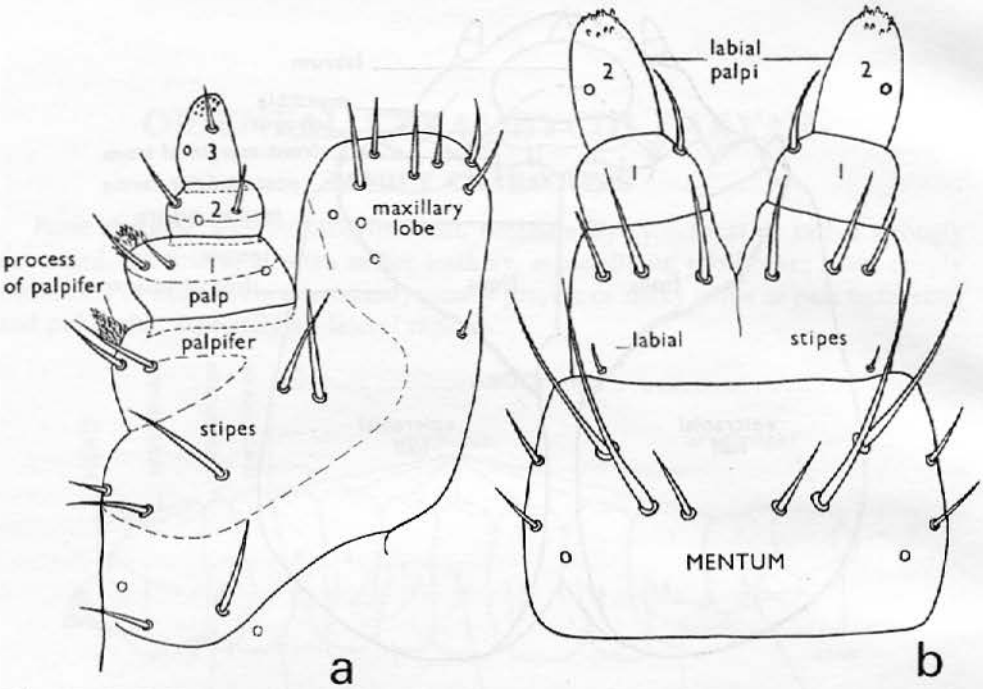


Fig. 4. Diagrammatic figure of ventral mouth-parts of a cerambycid larva. Ventral aspect. (*a*) maxillary palp, (*b*) labial palpi. (Duffy, 1953a)

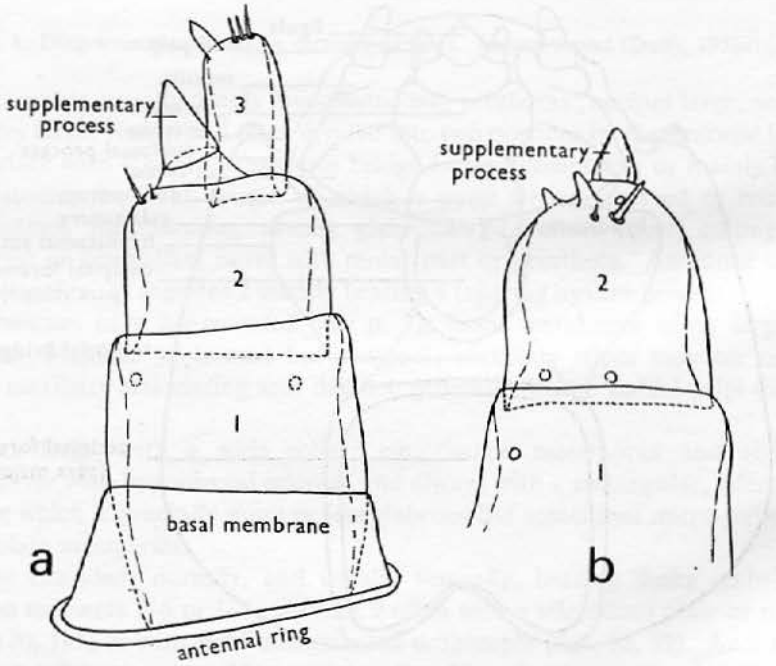
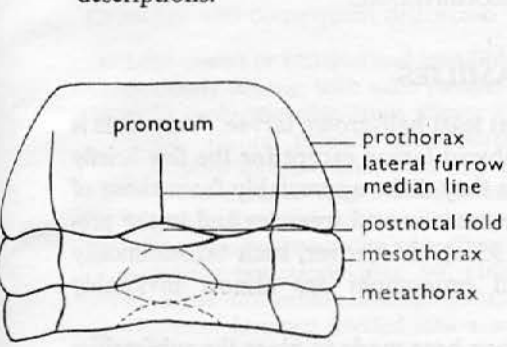


Fig. 5. Diagrammatic figure of (*a*) a 3-segmented and (*b*) a 2-segmented antenna of a cerambycid larva. Lateral aspect. (Duffy, 1953a)

Legs often vestigial or absent; if present, then widely separated; never more than 4-segmented (excluding unguiculus).

Spiracles annular, bilabiate, with respiratory opening narrow; lips membranous, clothed with setigerous tubercles; peritreme often with marginal chambers (figs. 197, 198).

The morphology of cerambycid larvae has already been dealt with in the author's first volume (1953a), but for the benefit of those readers who are not fully acquainted with the terminology or to whom previous volumes are not available, the following figures (figs. 1–8) are reproduced as a guide to the interpretation of the keys and descriptions.



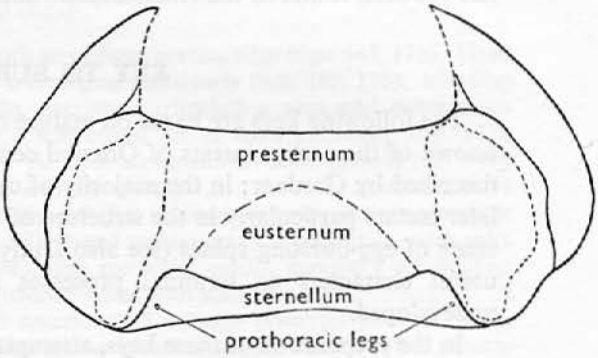


Fig. 6. Diagrammatic figure of pro-, meso- and metathorax of a cerambycid larva. Dorsal aspect. (Duffy, 1953a)

Fig. 7. Diagrammatic figure of prothorax of a cerambycid larva. Ventral aspect. (Duffy, 1953a)

A brief explanation concerning the segmentation of the antenna is perhaps desirable. Owing to its small size, little use has been made of its diagnostic value until the present author's examination of this appendage in the British species of this family. It was then found to be of major significance and has again been used to

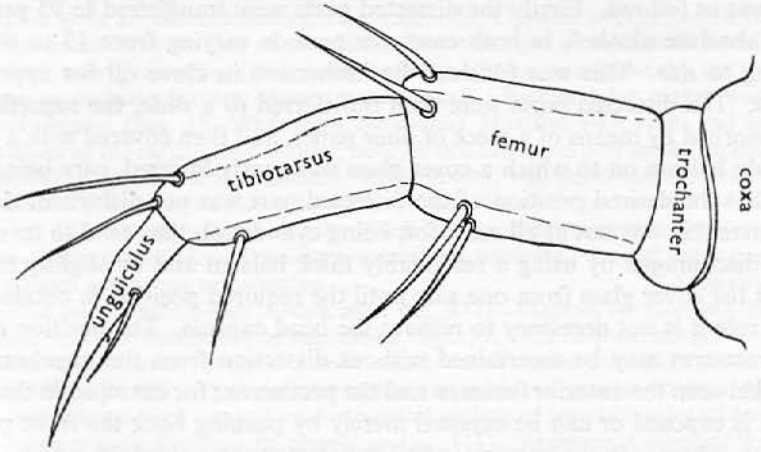


Fig. 8. Diagrammatic figure of a leg of a cerambycid larva. Lateral aspect. (Duffy, 1593a)

advantage in the present work. It is now evident that there are many genera and at least several tribes in which the antenna is only 2-segmented, the "third segment" being minute, hyaline, conical and devoid of setae (fig. 5b), and now regarded merely as a supplementary process. It is in fact the presence or absence of the third segment which is of great diagnostic importance. This segment is invariably cylindrical, strongly sclerotized and setose apically, and is thus quite distinct from the accompanying supplementary process which is usually much shorter and is always tapering, hyaline and devoid of setae (fig. 5a). The third antennal segment is absent in certain tribes of the PRIONINAE, ASEMINAE, LEPTURINAE and LAMIINAE, but no reduction in segmentation has yet been found in the PARANDRINAE and CERAMBYCINAE.

KEY TO SUBFAMILIES

The following keys are based on mature or at least half-grown larvae. Very little is known of the earlier instars of Oriental cerambycid larvae except for the few briefly described by Gardner: in the majority of cases they differ appreciably from those of later instars particularly in the structure of the antenna and spiracles and in the presence of egg-bursting spines (see also Duffy, 1953a). Moreover, such taxonomically useful characters as terminal processes and urogomphi are almost invariably undeveloped.

In the preparation of these keys, attempts have been made to place the subfamilies and genera in a phylogenetic sequence rather than in an artificial order, and whenever this has proved to be at variance with the generally accepted sequence of adult classification, an explanation has been given under the appropriate family, tribal or generic heading of the section dealing with descriptions and bionomics.

The examination of larvae is best carried out in shallow glass receptacles filled with 80 per cent alcohol. It is often essential to examine critically the antennae or ventral mouthparts, in which case, if very small, they should be detached by means of a dissecting needle and made into a slide preparation. The technique adopted by the author was as follows. Firstly the dissected parts were transferred to 95 per cent and then to absolute alcohol, in both cases for periods varying from 15 to 60 minutes according to size. This was followed by immersion in clove oil for approximately 24 hours. The dissected parts were then transferred to a slide, the superfluous fluid being absorbed by means of a piece of filter paper, and then covered with a few drops of Canada balsam on to which a cover glass was gently lowered, care being taken to ensure that the desired position of the dissected part was not disturbed. In the case of antennae this was not at all easy, for, being cylindrical, they tend to revolve. This may be discouraged by using a reasonably thick balsam and by slightly raising and lowering the cover glass from one side until the required position is obtained.

As a rule it is not necessary to remove the head capsule. The position of the tentorial cross-arm may be ascertained without dissection from the membranous connection between the anterior foramen and the prothorax; for example, in the ASEMINAE the gula is exposed or can be exposed merely by pushing back the front part of the prothorax, whereas in the PRIONINAE and CERAMBYCINAE a skinfold, which is attached to the front margin of the gula, is revealed when the prothorax is pushed back. In

order to see whether the postero-lateral area of the head capsule is pigmented or sclerotized, the lateral area of the prothorax may easily be pressed back with a needle.

The dorso-external process of the palpifer, which is often concealed between the maxilla and the mandible, may easily be exposed by slightly raising the maxilla with a needle.

The critical examination of many larvae demands the temporary transference from spirit on to filter paper. By absorbing the excess fluid in this manner, minute structures such as pleural discs, asperities, spicules and setae become more conspicuous, as they are often indiscernible when the larva is wet. Care must be taken, however, not to keep the specimen out of spirit for more than a few minutes at a time, otherwise shrinkage and consequent distortion will occur.

1. Legs absent or vestigial and mandible with an oblique cutting edge (figs. 148, 176). Head distinctly oblong, with sides parallel or converging posteriorly (figs. 148, 176). Maxillae rigid, only movable from stipes; cardo, maxillary articulating area and submentum fused. Pleural tubercle often bearing a sclerotized pit at each extremity (fig. 132). [Occipital foramen undivided (fig. 176). At least six epistomal setae present (fig. 148). Pronotum and/or ampullae often asperate or spiculate.] . . 7. LAMIINAE, p. 21
– Legs usually present and well developed (fig. 34), but if absent or vestigial then mandible with a gouge-like cutting edge (figs. 90, 97). Head transverse to subquadrate, with sides diverging posteriorly (figs. 90, 110). Maxillae movable; cardo, maxillary articulating area and submentum distinct. Pleural tubercle never with sclerotized pits. . . 2
2. Occipital foramen divided into a small anterior and a larger posterior portion by the tentorial bridge which is in the same plane as the hypostoma (fig. 110). Ventral mouthparts attached to hypostoma by little more than the width of the gula. Maxillary palpifer with outer margin strongly rounded and protuberant (fig. 111); maxillary lobe apparently borne on stipes. Epipleura strongly protuberant on abdominal segments 7–9 only. Four to six epistomal setae present. Postnotal fold usually present. 3
– Occipital foramen not divided into two portions, the tentorial cross-arm being internal. Ventral mouthparts attached to hypostoma for nearly its entire breadth. Maxillary palpifer with outer margin not strongly rounded and protuberant; maxillary lobe apparently borne on palpifer. Epipleura slightly protuberant on all abdominal segments; seldom protuberant on segments 7–9 only, but if so, then tergite 9 with urogomphi. From six to twenty epistomal setae present. Postnotal fold absent. . . . 4
3. Mandible with an oblique cutting edge (fig. 19). Clypeus wide (fig. 19), filling space between dorsal articulations of mandibles. Front margin of frons with lower boundary projecting over the clypeus (except *Sarmydus* and *Macrotoma*) and the upper boundary dentate or carinate (except Macrotomini (pars)). Postcondylar carina and subfossal process present (figs. 18, 19) (except *Sarmydus*). Maxillae with palpi and lobes in the same plane as the cardo; lobe slender, subcylindrical and densely setose on inner margin. Abdominal segment 9 long, extended. Legs present, well developed and at least as long as maxillary palpi; unguiculus stout and straight. Six epistomal setae present. Antenna (figs. 12, 18) with or without a sclerotized, setose, third segment. Prothoracic coxae almost meeting medially. Pronotum sometimes asperate. Dorsal ampullae with two very distinct transverse impressions. . . . . 1. PRIONINAE, p. 10
– Mandible with a gouge-like cutting edge (fig. 117). Clypeus narrow, not filling space between dorsal articulations of mandibles (figs. 97, 112). Front margin of frons with lower boundary never projecting over clypeus and upper boundary never dentate or carinate (figs. 79, 112). Postcondylar carina and subfossal process absent. Maxillae with palpi and lobes curved upward against ventral surface of mandibles; lobe broad and flat, with inner margin glabrous or almost so (fig. 111). Abdominal segment 9 never long and extended. Legs smaller, seldom as long as maxillary palpi and sometimes absent;

unguiculus slender, usually flagelliform. Four epistomal setae present. Antenna always with a strongly sclerotized, setose, third segment (figs. 112, 122). Prothoracic coxae widely separated. Pronotum non-asperate. Dorsal ampullae with posterior transverse impression generally rather indistinct. [Palpifer and/or first palpal segment often with a dorso-external process (fig. 4a).]. . . . . 6. CERAMBYCINAE, p. 13

4. Prothoracic skin attached ventrally to base of submentum, thus concealing hypostoma. Occipital foramen postero-dorsad (fig. 29). Anus a transverse cleft (fig. 30). [Form very slender, cylindrical and attenuated posteriorly (fig. 30).].
3. DISTENIINAE (**Distenia dravidiana** Gahan), p. 70

– Prothoracic skin attached ventrally to posterior margin of hypostoma which is fully exposed. Occipital foramen ventral. Anus trilobate. 5

5. Posterior emargination of head deep, often extending to frons. Prothorax with pronotum never velvety spiculate. Ampullae always tuberculate and sometimes spiculate. Maxillary palp with segment 1 small, only slightly larger than segment 2. Prothoracic coxae almost meeting medially. Unguiculus with a very short stout seta near base. Tergite 9 sometimes with a terminal spine, very seldom with urogomphi but usually with a sclerotized process. Ligula longer than labial palpi. Antenna with or without a strongly sclerotized, setose, third segment. General form moderately to strongly depressed.
2. LEPTURINAE, p. 12

– Posterior emargination of head very shallow (fig. 31). Prothorax with pronotum velvety spiculate. Ampullae never tuberculate, usually micro-spiculate. Maxillary palp with segment 1 large, about twice size of segment 2. Prothoracic coxae widely separated. Unguiculus never with a basal seta. Tergite 9 always with a pair of short, often blunt urogomphi (figs. 35, 39). Ligula shorter than labial palpi. Antenna always with a strongly sclerotized, setose, third segment. General form sub-cylindrical. [Predominantly in Coniferae.] . . . . . 5. ASEMINAE, p. 13

KEYS TO GENERA AND SPECIES

1. PRIONINAE

1. Frons with upper boundary of front margin non-carinate, smooth and roundly declivous (fig. 12); lower boundary not produced over clypeus (fig. 12). Antennal basal membrane strongly produced beyond foramen, the latter smooth, evenly rounded and closely surrounding the membrane. . . . Macrotomini (pars I) and Anacolini. 2

– Frons with upper boundary of front margin transversely carinate (figs. 14, 19); lower boundary (except *Megopis* (pars, irregularly produced over clypeus (figs. 14, 19)). Antennal basal membrane not or only slightly produced beyond inner margin of foramen, the latter carinate, dentate or unevenly rounded. 4

2. Postcondylar carina absent (fig. 22). Antenna 3-segmented (fig. 23). One pair of rather indistinct ocelli present. [Labrum strongly transverse.] . . . Anacolini 3

– Postcondylar carina present (fig. 12). Antenna 2-segmented (fig. 12). Ocelli absent. Macrotomini (pars I). . . . . **Macrotoma,** p. 11.

3. Abdominal ampullae densely micro-spiculate. Pronotum transversely plicate posteriorly (fig. 24). . . . . **Anoeme** sp. (African sp.), p. 63.

– Abdominal ampullae glabrous. Pronotum non-plicate. . . . **Sarmydus,** p. 12.

4. Antenna 3-segmented (figs. 15, 19); segment 3 small but distinct and strongly sclerotized. 5

– Antenna 2-segmented; segment 2 strongly elongate and obliquely truncate apically (fig. 17). [Three pairs of subcontiguous ocelli present (sometimes obscured by sclerotization of gena).]. Macrotomini (pars II) and Acanthophorini. . . . 8

5. Three pairs of distinct ocelli present. Labrum cordate (as in *Macrotoma* (fig. 12)). Segment 3 of antenna slightly to strongly elongate (figs. 14–16). [Spiracular peritreme with posterior half entirely lined with sub-contiguous marginal chambers.]
Megopis, p. 12.

– Ocelli indiscernible or only one pair present. Labrum transversely oval (fig. 19). Segment 3 of antenna at most slightly elongate (fig. 19). . . . Prionini 6

6. Antennal segment 3 short, transverse and obliquely truncate (fig. 18). Upper boundary of front margin of frons strongly carinate and slightly produced anteriorly. Subfossal process strongly and acutely produced. Mandible with a raised, curved carina on apical third of outer face. Pronotum with a very distinct, median cleavage line. . . 7

– Antennal segment 3 slightly elongate and dome-shaped. Upper boundary of frons subcarinate and not produced anteriorly. Subfossal process feebly produced and rounded apically. Mandible without a raised carina. Pronotum with median cleavage line indiscernible. . . **Dorysthenes (s.g. Cyrtognathus) hydropicus** Pascoe, p. 59.

7. One pair of rather large, oval ocelli present. Postocular carina absent. Mouthframe mainly ferruginous. Head capsule with posterior margin rounded. Antenna with segment 2 strongly elongate; segment 3 quadrate to transverse, truncate apically. Length up to 62 mm.; maximum breadth 11 mm. . . **Logaeus subopacus** Waterhouse, p. 56.

– Ocelli indiscernible. Postocular carina present. Mouthframe mainly pitchy. Head capsule with posterior margin distinctly emarginate. Antenna with segment 2 slightly elongate, segment 3 slightly elongate and dome-shaped apically. Length up to 85 mm.; maximum breadth 16 mm. . . . . **Prionus corpulentus** Bates, p. 59.

8. Mandible without a basal tooth. One to three pairs of distinct ocelli present. Vertical (postocular) carina absent. Labrum about as long as broad. Front margin of frons narrowly pitchy, with upper margin produced (at least very feebly) into a pair of paramedian processes (fig. 13). Spiracular peritreme with approximately the median third of posterior half lined with subcontiguous marginal chambers. Macrotomini (pars II) 9

– Mandible with a distinct basal tooth near dorsal condyle (fig. 17). Ocelli indistinct owing to strong sclerotization of gena. A well-defined vertical (post-ocular) carina present beneath antennal foramen. Labrum strongly transverse, about half as long as broad. Front margin of frons extremely broadly pitchy to ferruginous, with upper boundary not produced paramedially (fig. 17). Spiracular peritreme extremely thick, without marginal chambers. Acanthophorini. . . . **Acanthophorus serraticornis** Olivier, p. 54.

9. Presternum of prothorax with each lateral area bearing at least 20 subconical or rounded tubercles, the innermost and largest one of which is strongly sclerotized, ferruginous and dentate. . . . . **Olethrius tyrannus** J. Thomson, p. 46.

– Presternum of prothorax non-tuberculate. 10

10. Abdominal segments 9 and 10 finely but rather densely setose (almost pubescent). One pair of large or two pairs of smaller, subcontiguous ocelli present.
Archetypus fulvipennis (Pascoe), p. 47.

– Abdominal segments 9 and 10 not conspicuously setose, almost glabrous. Three pairs of subcontiguous ocelli present. . . . . **Rhaphipodus,** p. 11.

Rhaphipodus

1. Head with paramedian processes on upper boundary of front margin of frons acutely dentate and strongly protuberant (fig. 13).
R. (Remphan) hopei Waterhouse, p. 47.

– Head with paramedian processes of frons feebly rounded and only slightly protuberant.
R. (Rhaphipodus) suturalis Serville, p. 48.

Macrotoma

1. Frons with a small dentate process near inner termination of postcondylar carina (fig. 12). Subfossal process robust but bluntly rounded apically.
M. crenata (Fabricius), p. 44.

– Frons without dentate processes. Subfossal process small and pointed apically.
M. plagiata Waterhouse, p. 45.

Sarmydus

1. Subfossal process absent. Antennal segment 3 slightly more than twice as long as basal breadth. . . . . **S. antennatus** Pascoe, p. 62.
– Subfossal process well defined, acutely dentate (fig. 22). Antennal segment 3 slightly less than twice as long as basal breadth. . . . **S. subcoriaceus** (Hope), p. 63.

Megopis

1. Lower boundary of front margin of frons acutely produced over clypeus at lateral angles (figs. 14, 15). [Pronotum and abdominal ampullae shining, not micro-granulate or micro-spiculate.] 2
– Lower boundary of front margin of frons linear, not produced over clypeus (fig. 16) 4
2. Upper boundary of front margin of frons very strongly carinate, with the median emargination deep and broad (figs. 14, 15). 3
– Upper boundary of front margin of frons moderately strongly carinate, with the median emargination shallow. . . **M. cephalotes** Bates (after Gardner, 1942), p. 53.
3. Antennal segment 3 subquadrate, slightly longer than breadth at base. Upper boundary of front margin of frons strongly dentate or bidentate on each side of median emargination (fig. 15). . . . . **M. buckleyi** Gahan, p. 51.
– Antennal segment 3 elongate, nearly twice as long as breadth at base. Upper boundary of front margin of frons simply rounded on each side of median emargination (fig. 14). **M. tibialis** White, p. 49.
4. Pronotum and abdominal ampullae matt, micro-granulate, the latter also micro-spiculate. **M. cingalensis** White, p. 51.
– Pronotum and abdominal ampullae shining, glabrous. **M. marginalis** (Fabricius) and **M. costata** (Lansbury), p. 52.

2. LEPTURINAE

1. Abdominal segments 1–8 each with paired, rigid, lateral projections which resemble legs (fig. 28). Head strongly angulate laterally (fig. 28). Anus ventral (used as pseudopod?). Form extremely depressed. Three pairs of ocelli present. [Legs extremely long, protruding laterally (fig. 28).]. 2
– Abdominal segments without lateral projections. Head rounded laterally. Anus caudal. Form cylindrical to subcylindrical. Ocelli absent or only one pair present. [Antenna 3-segmented. Dorsal ampullae with moniliform tubercles arranged in four transverse rows.] 3
2. Prothorax with two lateral teeth on each side (fig. 27). Head more bluntly angulate laterally (fig. 27). . . . . **Apiocephalus licheneus** Gahan, p. 67.
– Prothorax without lateral teeth. Head more sharply angulate. **Capnolymma cingalensis** Gahan, p. 69.
3. Abdominal segment 9 produced into a large conical caudal process which terminates in a pair of spine-like tubercles (one above the other), which are both bifid and sclerotized apically (fig. 26). . . . . **Teledapus dorcadioides** Pascoe, p. 66.
– Abdominal segment 9 without a caudal process. 4
4. One pair of distinct ocelli present (fig. 25). Abdominal ampullae bearing well defined moniliform tubercles, which are arranged in transverse rows. Mandible acutely and abruptly produced at apex. [Antennal segment 3 bearing a digitiform apical process.] **Leptura**, p. 12.
– Ocelli absent. Abdominal ampullae closely and entirely covered with very small tubercles. Mandible shorter, the apex not abruptly produced. [Prosternum extensively matt, micropubescent. Form very slender.] . . . **Necydalis indicola** Gardner, p. 70.

Leptura

1. Labrum bearing four (two pairs) of long discal setae. Proeusternum dull, micro-spiculate posterolaterally. . . . . **L. succedanea** Lewis, p. 66.

– Labrum bearing two (one pair) of long discal setae. Proeusternum shining, non-spiculate.
L. rubriola Bates, p. 65.

5. ASEMINAE

1. Labrum transversely oval. Mandible without an oblique plate along dorsal surface. Spiracular peritreme with two or three large marginal chambers. . . . 2
– Labrum cordate, at most slightly wider than long (fig. 31). Mandible with an oblique plate along inner part of dorsal surface. Spiracular peritreme with three to six much smaller chambers. Urogomphi longer, acutely conical (fig. 35). . . . 3
2. Front margin of frons with declivity deep, almost vertical and feebly but distinctly bilobed paramedially. Thoracic spiracle about twice as large as that on abdominal segment 1. Urogomphi widely separated basally, broadly rounded apically (fig. 39).
Tetropium oreinum Gahan, p. 80.
– Front margin of frons with declivity shallow and smoothly and regularly rounded. Thoracic spiracle small, not much larger than that on abdominal segment 1. Urogomphi subcontiguous basally, acutely produced and ferruginous apically (fig. 41).
Nothorhina gardneri Plavil'shchikov, p. 82.
3. Gular sutures slightly raised and almost as darkly pigmented as hypostomal sutures. Urogomphi as long as or longer than basal width, subcontiguous at base, and with not more than apical third strongly sclerotized. Pronotum very finely micro-spiculate (spicules not individually distinguishable with a ×15 lens). Maxillary palpi with segment 3 almost as long as segment 2. Head with sides rather strongly diverging posteriorly.
Asemum (striatum (Linnaeus)), p. 79.
– Gular sutures not raised and much lighter than hypostomal sutures. Urogomphi shorter than their basal width and widely separated (fig. 35). Pronotum more coarsely micro-spiculate (spicules individually distinguishable with a ×15 lens (fig. 33)). Maxillary palpi with segment 3 not more than half as long as segment 2 (fig. 32). Head with sides only slightly diverging posteriorly. 4
4. Proeusternum completely spiculate. Urogomphi conspicuous and separated by at most three times their basal width. Labrum slightly longer than broad. **Arhopalus** p. 13.
– Proeusternum with spiculae confined to two small paramedian areas, the median area being smooth and shining. Urogomphi minute and separated by at least four times their basal width. Labrum slightly wider than long.
Spondylis buprestoides Linnaeus, p. 79.

Arhopalus

1. Abdominal spiracle with only three marginal chambers. Length not exceeding 15 mm.
A. unicolor (Gahan), p. 78.
– Abdominal spiracle with six or more marginal chambers. Length 30–43 mm. . 2
2. Abdominal spiracle with 10–12 marginal chambers. Length up to 43 mm.
A. tibetanus (Sharp), p. 78.
– Abdominal spiracle with six to eight marginal chambers. Length up to 35 mm. . 3
3. Supplementary process of antenna distinctly shorter than its basal width. Urogomphi small and separated by two or three times their basal width. Genal setae not occurring beyond level of posterior end of frontal sutures. Prothorax with lateral setae pale golden yellow; posterior part of pronotum pale yellow. . . **A. rusticus** (Linnaeus), p. 77.
– Supplementary process of antenna at least as long as its basal width. Urogomphi longer (fig. 35), seldom separated by more than their basal width, usually less. Genal setae occurring beyond level of posterior end of frontal sutures. Prothorax with lateral setae ferruginous; posterior part of pronotum orange-yellow. **A. ferus** (Mulsant), p. 73.

6. CERAMBYCINAE

1. Three pairs of subcontiguous ocelli present (figs. 50, 51, 53) and head capsule rectangular (with sides not or scarcely diverging behind middle). Temple (figs. 51, 53, 54) with a

distinct postocular carina (except *Plocaederus*, *Trachylophus* and *Rhytidodera*). Dorsal abdominal ampullae usually either with large, flat, moniliform tubercles or micro-spiculate, but if non-tuberculate and glabrous (*Pachydissus*, *Trachylophus*), then anal lobes encircled by a fringe of fine setae; always with two distinct transverse impressions. Legs large, 4-segmented. Prothorax without distinct presternal plates. Cerambycini . 2

– Usually none or less than three pairs of ocelli present but if three pairs present (*Hylotrupes*, *Ceresium* (pars) and *Rosalia*), then head capsule distinctly trapezoidal, with sides distinctly diverging posteriorly and anal lobes sparsely setose. Temple without postocular carina. Dorsal abdominal ampullae never distinctly tuberculate or micro-spiculate (except *Xystrocera globosa* (Olivier)) but then submentum with a pair of longitudinal, corneous ridges; posterior transverse impression indistinct (except some Callichromini). 13

2. Posterior area of pronotum and abdominal ampullae dull, densely micro-spiculate; abdominal ampullae with tubercles rather indistinct. Postocular carina absent.
Plocaederus obesus Gahan, p. 114.

– Posterior area of pronotum and abdominal ampullae shining, glabrous; abdominal ampullae with or without moniliform tubercles. Postocular carina present or absent. 3

3. Front margin of frons with a pair of conspicuous dentate processes (fig. 44); a simple dentate process present behind each dorsal mandibular condyle. Abdominal ampullae with four rows of strongly protuberant, moniliform, glabrous tubercles, which in mature larvae are sclerotized and testaceous. Upper margin of antennal foramen dentate. Postcondylar carina present. Spiracles with marginal chambers absent. Anal lobes bearing sparse pale setae. . . . . **Hoplocerambyx spinicornis** (Newman), p. 89.

– Front margin of frons without conspicuous dentate processes; no dentate process present behind dorsal mandibular condyles. Postcondylar carina absent. Abdominal ampullae with tubercles, if present, not sclerotized and pigmented. Upper margin of antennal foramen not produced and dentate (except slightly in *Aeolesthes* and *Margites*). . 4

4. Posterior area of pronotum (fig. 52) covered with flattened or imbricated tubercles or asperities. [Antennal segment 2 distinctly elongate. Abdominal segments 4–7 with intersegmental skin. Temple without a postocular carina. Abdominal ampullae distinctly tuberculate.] 5

– Posterior area of pronotum without flattened or imbricated tubercles or asperities. . 6

5. Posterior area of pronotum (fig. 52) covered with small separate tubercles, each tubercle somewhat flattened and with a prominent posterior edge; setal pores absent. Frons with a single row of setae across front margin. Abdominal ampullae with tubercles small and moniliform. Spiracular peritreme without marginal chambers.
Dialeges pauper Pascoe, p. 105.

– Posterior area of pronotum covered with imbricated tubercles resembling asperities, each tubercle strigose; numerous deep setal pores present. Frons bearing numerous scattered setae extending behind ferruginous mouthframe. Abdominal ampullae with tubercles large and conical. Spiracular peritreme with a pair of subcontiguous marginal chambers dorsally. . . . . **Cyriopalus wallacei** Pascoe, p. 107.

6. Dorsal anal lobe with a fringe in the form of a transverse band of fine, short, dense, decumbent setae, which strongly contrasts with the 6–12 long, coarse, widely separated setae which are present behind it; ventral lobes with long coarse setae only (fig. 57). [Posterior part of pronotum rather coarsely and regularly striate.] . . . 7

– All three anal lobes with both short, fine, dense and long, coarse, sparse setae . 8

7. Abdominal ampullae with tubercles distinctly separated and very strongly protuberant. Gula with anterior margin almost as broad as mentum and sides not diverging posteriorly (fig. 56). Posterior striate area of pronotum distinctly embossed. Antennal foramen more or less evenly rounded. . . . . **Rhytidodera**, p. 20.

– Abdominal ampullae with tubercles confluent or indistinct and flattened. Gula with

anterior margin about one-third width of mentum and with sides strongly diverging posteriorly (fig. 56). Posterior striate area of pronotum not distinctly embossed. Antennal foramen with upper margin thickened and slightly protuberant.

8. Two or three pairs of vestigial ocelli present (fig. 50).[2] Antennal foramen more or less evenly rounded. Prothorax with distinct orange-testaceous pronotal plates. Temple without a broadly pigmented or carinate postocular area. [Abdominal ampullae subtuberculate.] . . . . . **Trachylophus approximator** Gahan, p. 98.
– Vestigial ocelli absent. Antennal foramen with upper margin feebly dentate or sinuate (fig. 51). Prothorax without distinct pronotal plates (except *Margites exiguus* Gahan, but then hypostoma longitudinally carinate). Temple with a broad postocular carinate and/or pigmented area (fig. 51) which is ferruginous to pitchy. 9
9. Abdominal ampullae with four rows of distinct moniliform tubercles. Segment 3 of antenna shorter than segment 2. Temple with a strongly protuberant postocular carina (fig. 51). Antennal foramen with upper margin distinctly dentate or conical.
Aeolesthes holosericia (Fabricius), p. 99 and **A. sinensis** Gahan, p. 102.
– Abdominal ampullae feebly and irregularly tuberculate or non-tuberculate. Segment 3 of antenna not shorter than segment 2. Antennal foramen with upper margin sinuate (fig. 53) or dentate. 10
10. Anal lobes encircled by a fringe of short setae, behind which are scattered longer setae. Temples with the raised ridge at posterior end of sclerotized area much more strongly protuberant than postocular carina. [Dorsal boundary of antennal foramen scarcely produced and not raised. Dorsal ampullae non-tuberculate.]
Pachydissus (African spp.), p. 105.
– Anal lobes without a fringe of contrasting setae. Temples without a strongly raised ridge. 11
11. Postocular pigmented area pitchy and with two or three deep vertical impressions and a strongly protuberant carina posteriorly. Form robust; length up to 50 mm.
Diorthus cinereus (Fabricius), p. 107.
– Postocular pigmented area ferruginous and with impressions and protuberances very feebly defined (fig. 54). Form slender; length up to 25 mm. [Abdominal ampullae feebly or non-tuberculate.] 12
12. Antennal foramen with upper margin sinuate (fig. 54). Temple and hypostoma smooth (fig. 54). . . . . **Derolus volvulus** (Fabricius), p. 109.
– Antennal foramen with upper margin dentate or subconical. Temple striate or hypostoma carinate. . . . . **Margites**, p. 20.
13. Hypostoma distinctly tuberculate, having a transverse row of 8–12 oval or elongate tubercles on anterior margin (figs. 64, 70, 71). Antenna with a very long basal membrane. Gena protuberant and irregularly swollen around enclosed ocellus. Pigmented presternal plates present. Median and sublateral pronotal impressions impressed for almost entire length of prothorax. [Legs long, 4-segmented.] Hesperophanini and Stenaspini. . 14
– Hypostoma without distinct irregularities (except *Thranius*, in which it is feebly tuberculate or subcarinate, but then ocelli absent). Antenna with basal membrane much shorter. Gena never protuberant or irregularly swollen around enclosed ocellus. Pigmented presternal plates present or absent. Median and sublateral pronotal impressions much shorter (except Callichromini (pars) but then anal clefts with sclerotized pits (*Quettania* (fig. 108)). 16
14. Front margin of hypostoma and gula entirely broadly sclerotized and ferruginous (fig. 72). Temples broadly sclerotized and ferruginous to testaceous behind ocellus. Labrum subcircular, with anterior margin strongly rounded. . . . Stenaspini. 15

[2] Two or three pairs of rather indistinct vestigial ocelli are usually discernible. Two pairs are placed close together well behind and slightly above the true ocelli and another pair is placed slightly nearer but well below the true ocelli. These vestigial ocelli vary from being a pale brown weal to a semi-opaque lens, through which a minute, deeply set, pigmented spot is usually visible.

– Front margin of hypostoma and gula pale testaceous, with only the tubercles ferruginous (figs. 64, 70). Temples pale testaceous behind ocellus. Labrum transversely oval, with front margin almost straight medially. [Anterior part of pronotum with presternal plates pale testaceous and sparsely covered with short pale setae.] Hesperophanini.
Stromatium, p. 20.

15. Temple very broadly sclerotized and ferruginous behind ocellus. Dorsal abdominal ampullae unevenly micro-granulate, the granules distinctly larger medially. Form robust (maximum breadth at prothorax 11·5 mm.).
Euryclelia cardinalis (Thomson), p. 129.
– Temple rather narrowly sclerotized and dark testaceous behind ocellus. Dorsal abdominal ampullae evenly micro-granulate (except for one or two pairs of setal pores). Form slender (maximum breadth at prothorax 7 mm.).
Sternoplistes temmincki Guérin-Méneville, p. 131.

16. Temple with one to three deep vertical impressions (connecting paired setal pores) behind ocellus, where it is broadly sclerotized and ferruginous (fig. 74). Ocelli absent or one pair present. Phoracanthini (pars major). 17
– Temple without deep vertical impressions (and paired setal pores) and not as broadly sclerotized and pigmented (a very shallow vertical impression with three setal pores is present in *Aglaophis* but then legs very small, less than half length of maxillary palp). Ocelli absent or one to five pairs present. 18

17. One pair of large distinct ocelli present laterad and ventrad of antenna (fig. 74). Front margin of frons rather broadly pitchy to black. [Ocellar lens large and broadly oval (fig. 74). Temples deeply impressed.] . . . . . **Phoracantha**, p. 20.
– Ocellus with lens greatly reduced, resembling in size and colour one of the setal pores on gena (fig. 77). Front margin of frons less broadly pigmented, ferruginous.
Coleocoptus senio Newman, p. 137.

18. Ocellar lens large, oval and pale ferruginous, the pigmented spot being discernible as a greyish linear blotch (fig. 80). Gena with the short, dark, ferruginous area between the antennal ring and ocellus bearing a small but quite distinct oval tubercle (fig. 80). [Head capsule with sides widest behind middle. Pronotum very feebly and irregularly strigose posteriorly.] Phoracanthini (pars minor I). . **Nyphasia apicalis** Gahan, p. 140.
– Ocellar lens and gena without these characteristics. 19

19. Lateral regions of prothorax with a large median area which is dull and micro-spiculate[3]. Ocellus with pigmented spot visible through cuticle (there being no distinct lens) as a minute greyish blotch (fig. 79). Phoracanthini (pars minor II).
Coptocercus biguttatus (Donovan), p. 139.
– Without these characters combined. 20

20. Submentum with a pair of longitudinal, parallel, corneous ridges. Abdominal ampullae if micro-granulate, then also micro-spiculate. . . . . **Xystrocera**, p. 21.
– Submentum without corneous ridges. Abdominal ampullae if micro-granulate, then glabrous. 21

21. Posterior margin of pronotum strongly retracted medially, revealing a triangular skin-fold ("pre-postnotal fold") (fig. 88). Proeusternum dull, micro-granulate. Cleomenini (pars I). . . . . **Dere**, p. 152.
– Without this combination of characters. 22

22. Two pairs of subcontiguous ocelli present. Prothorax with lateral furrows strongly diverging anteriorly. Posterior area of pronotum strongly embossed and extremely finely and regularly striate (fig. 87). [Abdominal segments 3–7 with rather long intersegmental skin.] Cleomenini (pars II). . . **Artimpaza obscura** Gardner, p. 151.
– Ocelli absent or one or three pairs present. Prothorax with lateral furrows parallel to slightly converging anteriorly. Posterior area of pronotum not embossed, and if striate then striae coarser and less regular. 23

[3] This is only apparent when the larval cuticle is dry.

23. Head strongly transverse, with sides strongly rounded and widest at or just beyond middle (fig. 90); usually strongly sclerotized and pigmented postero-laterally[4]. Legs vestigial or absent. Genae bearing numerous long, slightly curved setae (fig. 90). Eusternum distinctly triangular. Form very slender. [Ocelli absent or one pair present.] Molorchini, Obriini and allied genera. 24
– Head subquadrate to trapezoidal, with sides feebly rounded and widest posteriorly; not strongly sclerotized and pigmented postero-laterally. Legs present (except Clytini (pars) but then form more robust and eusternum with a pair of paramedian round or semicircular, shining, glabrous areas). Genae with short straight setae or glabrous. Eusternum indistinct and usually with a pair of oval, glabrous, shining areas (except *Hylotrupes* and *Rosalia* but then three pairs of ocelli present). Form more robust. . . 26
24. Abdominal segments with wide intersegmental skin. Ocelli absent. Dorsal and ventral ampullae on segments 1 and 2 dull. Proeusternum with a pair of paramedian, circular, glabrous, shining areas. [Legs vestigial.] . **Merionoeda phoebe** Gardner, p. 157.
– Abdominal segments without intersegmental skin. Ocelli present. Dorsal and ventral ampullae shining and glabrous on all segments. Proeusternum without paramedian, circular, shining areas. 25
25. Legs absent. Pronotum feebly striate posteriorly. Abdominal ampullae slightly protuberant. . . . . **Molorchus darjeelingensis** Gardner, p. 155.
– Legs present though minute (one- or two-segmented). Pronotum distinctly longitudinally striate posteriorly. Abdominal ampullae bilobed and very strongly protuberant. **Obrium** (Palaearctic spp.), p. 159.
26. Ocelli absent. Ventral front margin of head with a pair of small rounded tubercles on acetabulum. Basal part of mandible with a protuberant, transverse, rim-like, apical margin (fig. 93). Spiracles of abdominal segment 8 distinctly larger than those on segment 7. Hypostoma with front margin sub-tuberculate to sub-carinate paramedially (fig. 93). [Legs long, well developed. Antennal membrane well developed. Abdominal ampullae micro-granulate. Pronotum milky white and finely micro-granulate posteriorly.] Thraniini. . . . . **Thranius triplagiatus** Gahan, p. 159.
– One or three pairs of ocelli present. Ventral front margin of head without small paired tubercles on acetabulum (but a single tubercle present in *Callidium*). Mandible without a protuberant, transverse, apical margin. Spiracles on abdominal segment 8 not larger than those on segment 7. Hypostoma with front margin regular. . . . 27
27. Mandible with a deep, longitudinal impression on outer face. Dorso-external process of palpifer as long or almost as long as segment 3 of maxillary palp. Legs usually 3- or 4-segmented, as long as maxillary palp and with femur and tibiotarsus quadrate to elongate. [Pleural discs distinct (except *Hylotrupes*, but then three pairs of ocelli present).] Callidiini, Callidiopini. 28
– Mandible without a longitudinal impression on outer face. Dorso-external process of palpifer very much shorter than segment 3 of maxillary palp sometimes absent. Legs either absent, vestigial or very small, not more than half length of maxillary palp (except Callichromini (pars) and *Rosalia*, but then spiracles very large, subcircular and set obliquely to longitudinal axis of body (*Nothopeus*) or anal lobes with sclerites (*Quettania* (fig. 108)) or gena with a dentate process immediately above antennal foramen (*Rosalia* (fig. 104)) or abdominal ampullae with moniliform tubercles (*Chelidonium*) . 34
28. Proeusternum finely but distinctly longitudinally striate (as on pronotum). Abdominal ampullae strongly bilobed. Callidiopini (pars I). **Ceresium unicolor** (Fabricius), p. 143.
– Proeusternum not striate. Abdominal ampullae not strongly bilobed. . . 29
29. Three pairs of distinct ocelli present in a row laterad and ventrad of antenna (fig. 97). 30

[4] This character may be seen without dissection merely by pressing back the lateral area of the prothorax with a needle.

– Only one pair of ocelli present. Callidiopini (pars III) and Callidiini (pars II and III). 31

30. Temples broadly sclerotized and ferruginous immediately behind ocelli (fig. 81). Ocelli with pigmented spots black and almost as large as lenses, the latter almost contiguous. Dorsal ampullae with posterior transverse furrow indistinct. Eusternum with two subcircular, glabrous shining areas. Callidiopini (pars II).
Ceresium leucosticticum White, p. 141.

– Temples feebly sclerotized and testaceous immediately behind ocelli (fig. 97). Ocelli with pigmented spots grey and fragmentary, the lenses narrowly but distinctly separated. Dorsal abdominal ampullae with two very distinct transverse furrows (fig. 95). Eusternum of prothorax distinct, triangular. [Usually in dry, seasoned, coniferous timbers, especially rafters, posts, dead branches, etc. Cosmopolitan species.] Callidiini (pars I).
Hylotrupes bajulus (Linnaeus), p. 161.

31. Legs with femur robust, slightly elongate. Gena with ferruginous area enclosing ocellus. Ventral margin of head with a blunt but distinct tubercle (sub-fossal process?) on acetabulum. Mouthframe completely sclerotized beneath antennae. [Ampulla on abdominal tergite 7 in the form of a semi-circular, raised lobe.] Callidiini (pars II).
Callidiellum rufipenne (Motschulsky), p. 173.

– Legs with femur slender, quadrate to transverse. Gena with ferruginous area not enclosing ocellus. Ventral margin of head without a tubercle on acetabulum. Mouthframe interrupted by a pale, narrow line beneath antennae. 32

32. Dorsal and ventral ampullae (figs. 101, 102) granulate, the granules evenly distributed over entire surface. Maxillary palpi with segment 3 at least one and one-half times as long as segment 2. [Labrum about as long as wide.] Callidiini (pars III).
Phymatodes (testaceus (Linnaeus)), p. 175.

– Dorsal abdominal ampullae (figs. 85, 86) sub-tuberculate or finely shagreened around the area bounded by the lateral and transverse impressions; remainder of ampulla more or less smooth and shining. Ventral ampullae (fig. 86) with sub-tuberculate or finely shagreened area mostly confined to postero-lateral areas, the median and anterior areas smooth and shining. Maxillary palpi (fig. 84) with segment 3 not or scarcely longer than segment 2. Callidiopini (pars III). 33

33. Abdominal ampullae sub-tuberculate (figs. 85, 86). Maxillary palpi with segment 1 sub-quadrate (fig. 84). Labrum distinctly transverse. Eusternum rugose, sparsely setose. Polyphagous species. Oriental species recently established in England.
Trinophylum cribratum Bates, p. 145.

– Abdominal ampullae finely shagreened. Maxillary palpi with segment 1 distinctly elongate. Labrum about as wide as long. Eusternum finely shagreened posteriorly. Cosmopolitan species in tropics. . . **Gelonaetha hirta** (Fairmaire), p. 150.

34. Legs moderately long, at least almost as long as entire maxillary palp and with tibiotarsus quadrate to elongate. Maxillary palp with segment 3 seldom as long as, and usually shorter than, segment 2 (except *Quettania* but then anal lobes with sclerites (fig. 108)). Hypostoma bearing numerous setae. Dorsal ampullae with two distinct transverse impressions. Antenna with segment 2 bearing at least six apical setae. Usually only one pair of ocelli present; lens large and oval (sclerotized and ferruginous in *Nothopeus*); but if three pairs present (*Rosalia*) then gena with a thickened dentate tubercle immediately above antennal foramen (fig. 104). Abdomen slightly and gradually tapering posteriorly. Callichromini and Compsocerini. 35

– Legs usually minute or absent, never as long as entire maxillary palp. Maxillary palp with segment 3 at least as long and usually longer than segment 2. Hypostoma glabrous. Dorsal abdominal ampullae with posterior transverse impression incomplete or absent. Antenna with segment 2 bearing only two or three setae. One or three pairs of ocelli present; lens small and round. Abdomen slightly tapering posteriorly and then abruptly enlarged on segments 7–9. Clytini. 42

35. Three pairs of small contiguous ocelli present (fig. 104). Gena with a thickened dentate tubercle immediately above antennal foramen (fig. 104). Hypostoma thickened towards ventral mandibular articulations (fig. 104). Compsocerini.
Rosalia hariola Thomson, p. 176.
– One pair of ocelli present. Gena without a dentate process above antennal foramen. 36
36. Anal lobes with a minute, ferruginous, sclerotized area at each extremity of the Y-shaped cleft (fig. 108). [Spiracles rather broadly oval. Abdominal ampullae micro-granulate, strigose, glabrous.] . . . **Quettania coeruleipennis** Schwarzer, p. 185.
– Anal lobes without sclerotized areas. 37
37. Frons with a pair of deep pits (fig. 105), each with an anterior carina about halfway along frontal sutures. Abdominal ampullae bearing glabrous tubercles. [Mouthframe pale, feebly sclerotized. One pair of ocelli present; lens elongate oval, pigmented spot indiscernible.] . . . . . **Chloridolum** sp., p. 177.
– Frons without pits. Abdominal ampullae non-tuberculate (except *Chelidonium* (pars) but then tubercles dull, micro-spiculate). 38
38. Mouthframe and basal half of mandible feebly sclerotized and testaceous (fig. 109) with only the apical part ferruginous. . . **Aromia moschata** (Linnaeus), p. 186.
– Mouthframe and basal part of mandible strongly sclerotized and ferruginous. . 39
39. Abdomen with segments 2–6 contiguous; dorsal ampullae very strongly protuberant and bilobed (pl. XII, fig. 3). Abdominal spiracles with upper part of peritreme produced outwards (fig. 106). [Ocellus with lens large, oval, strongly sclerotized, opaque and ferruginous; one, or possibly two, minute vestigial ocelli present behind this, the lens in the form of a small ferruginous spot, which is slightly larger than the surrounding scattered setal pores.] . . . . **Nothopeus fasciatipennis** Waterhouse, p. 181.
– Abdomen with segments 2–6 separated by inter-segmental skin; dorsal ampullae only slightly protuberant. Abdominal spiracles with upper part of peritreme not produced outwards. 40
40. Abdominal ampullae tuberculate, the tubercles matt and micro-spiculate. [Abdominal spiracles with peritreme at most broadly oval and not strongly protruding and obliquely set.] . . . . . **Chelidonium cinctum** Guérin-Méneville, p. 180.
– Abdominal ampullae non-tuberculate and glabrous. 41
41. Abdominal spiracles with peritreme sub-circular, strongly protruding and set obliquely to longitudinal axis of body. Pronotum without a median, oval, wrinkled area.. 42
– Abdominal spiracles with peritreme at most broadly oval and not strongly protruding and obliquely set. Pronotum with a median oval, wrinkled area (fig. 107).
Aphrodisium cantori Hope, p. 183.
42. Ocellus with lens strongly sclerotized and ferruginous; one or, possibly, two minute vestigial ocelli present behind this, the lens in the form of a small ferruginous spot (as in *Nothopeus*). . . . . **Chelidonium brevicorne** Franz, p. 178.
– Ocellus with lens transparent and not pigmented; vestigial ocelli absent.
Niraeus tricolor (Newman)[5], p. 184.
43. Head with temple broadly sclerotized and ferruginous behind ocellus and with a very faint vertical impression with three setal pores (fig. 124). Legs at least half as long as maxillary palp. [Abdominal ampullae matt, micro-granulate.]
Aglaophis quadrifasciata Thomson, p. 216.
– Head with temples not broadly sclerotized and ferruginous behind ocellus and without setal pores. Legs absent, vestigial or not longer than apical segment of maxillary palp. 44
44. Mesonotum and metanotum shining, rugulose. Abdominal ampullae shining and rugulose or glabrous (except *Perissus dalbergiae* Gardner, but then pronotum shining

[5] These characters are based on larvae which are probably less than half-grown and may not be applicable to mature larvae.

posteriorly). Ocellus not surrounded posteriorly or ventrally by sclerotization of gena (fig. 117). 45

– Mesonotum and metanotum dull, micro-granulate. Abdominal ampullae dull, micro-granulate. Ocellus either partly or entirely surrounded by sclerotization of gena (figs. 121, 122). [Legs vestigial, shorter than apical segment of maxillary palp, comprising a setose papilla.] . . . . . **Xylotrechus**, p. 21.

45. Front margin of frons feebly sclerotized, pale castaneous. Ocellus with lens very indistinct and scarcely protuberant. . . . **Epipedocera affinis** Chevrolat, p. 199.

– Front margin of frons strongly sclerotized, ferruginous. Ocellus with lens distinct, strongly protuberant. 46

46. Antenna with segment 2 at least twice as long as basal width (fig. 117). Maxillary palpi with segment 3 not longer than segment 2. Prosternum with a large pair of semi-circular or circular, paramedian, glabrous areas (fig. 118). [Ocellus round, strongly convex, testaceous, slightly darker than surrounding cuticle (rather indistinct in *Epipedocera*).] 47

– Antenna with segment 2 not more than one and one-half times as long as basal width. Maxillary palpi with segment 3 distinctly longer than segment 2. Prosternum with a single large, median, glabrous area. [Thoracic spiracle small, subequal in width to labrum. Sixth dorsal and ventral ampullae with the area posterior to anterior transverse impression more strongly protuberant than anterior area (most obvious when larva viewed laterally). Mainly in bamboo.] . . . . . **Chlorophorus**, p. 21.

47. Abdominal ampullae shining, rugulose. Prosternum with paramedian, glabrous areas circular or oval (fig. 118). Legs very small but clearly 3-segmented. Front margin of frons rather strongly sinuate medially (fig. 117). . **Clytus monticolor** Gahan, p. 197.

– Abdominal ampullae dull, micro-granulate. Prosternum with paramedian glabrous areas semi-circular. Legs vestigial, almost indiscernible. Front margin of frons feebly sinuate medially. . . . . **Perissus dalbergiae** Gardner, p. 201.

Rhytidodera

1. Antennal segment 2 distinctly transverse. . . . **R. bowringi** White, p. 112.

– Antennal segment 2 quadrate. . . . . **R. simulans** White, p. 111.

Margites

1. Front margin of hypostoma non-carinate. Temple striate and with ferruginous area about as extensive as in *Derolus* (fig. 54). . . . **M. modicus** Gahan, p. 110.

– Front margin of hypostoma with several longitudinal carinae (fig. 55). Temple non-striate and much more extensively ferruginous. . . **M. exiguus** Gahan, p. 110.

Stromatium

1. Hypostoma with 4–6 widely-spaced, longitudinal carinae on each side of gula. Abdominal ampullae rather coarsely micro-granulate. . . **S. longicorne** Newman, p. 126.

– Hypostoma with front margin distinctly tuberculate, the tubercles oval and often brownish. Abdominal ampullae reticulate and wrinkled. . **S. barbatum** (Fabricius), p. 120.

Phoracantha

1. Ocellar lens elongate-oval, more than twice as long as median breadth (fig. 74). Front margin of hypostoma not or scarcely sinuate medially.
P. semipunctata (Fabricius), p. 132.

– Ocellar lens oval, less than twice as long as median breadth. Front margin of hypostoma strongly sinuate medially (fig. 76). . . . . **P. recurva** Newman[6], p. 136.

[6] Only two larvae of this species are available. It is possible that they may in fact prove to be atypical specimens of *P. semipunctata* (Fabricius).

Xystrocera

1. Abdominal ampullae micro-spiculate. . . . . **X. globosa** (Olivier), p. 83.
– Abdominal ampullae glabrous. . . . . **X. festiva** Thomson, p. 86.

Xylotrechus

1. Posterior area of pronotum shining, glabrous. 2
– Posterior area of pronotum dull, micro-spiculate. [Ocellus entirely surrounded by sclerotization of gena. Tubercle on acetabulum minute.]
X. buqueti Laporte and Gory, p. 207.
2. Ocellus entirely surrounded by sclerotization of gena (fig. 122). Ventral front margin of head with a small but distinct dentate tubercle on acetabulum (fig. 122). Antennal foramen evenly linear and sub-carinate on outer side (fig. 122).
X. incurvatus (Chevrolat), p. 209.
– Ocellus only partly (ventrally) embraced by sclerotization of gena (fig. 121). Ventral front margin of head without a tubercle on acetabulum. Antennal foramen evenly rounded (fig. 121). . . . . **X. quadripes** Chevrolat, p. 202.

Chlorophorus

1. Antenna with segment 2 about one and one-half times as long as wide. Mainly in bamboo.
C. annularis (Fabricius), p. 193.
– Antenna with segment 2 only slightly longer than wide. Only in cones of *Pinus longifolia*.
C. strobilicola Champion, p. 196.

7. LAMIINAE

1. Prothorax with pronotum, eusternum and sternellum for the greater part covered with very coarse asperities (figs. 143, 145). Anus a transverse cleft. Legs vestigial, distinctly visible with a ×15 lens. Abdominal ampullae with rows of asperities or spicules. [Length up to at least 50 mm.] Batocerini. 2
– Without these characters combined. 3
2. Abdominal ampullae bearing micro-spiculate moniliform tubercles. Prothorax with postnotal fold well-developed and bearing rows of semi-cylindric asperities (fig. 140) (except *Batocera lineolata* Chevrolat and *B. tigris* Voet (fig. 144)); prosternum with eusternum, sternellum and sometimes the ferruginous lateral plates coarsely asperate. Antenna 3-segmented. . . . . **Batocera**, p. 28.
– Abdominal ampullae non-tuberculate. Prothorax with postnotal fold absent; prosternum with ferruginous lateral plates glabrous but eusternum and sternellum asperate. Antenna 2-segmented. [Pronotum with two pairs of oblique, glabrous, sublateral furrows (fig. 145).] . . . . . **Apriona**, p. 28.
3. Posterior area of pronotum dull, finely velvety micro-spiculate or micro-pubescent (figs. 126, 127) (finely micro-asperate only in *Monochamus nivosus* White, the asperities entirely covering this area (unlike *Dihammus*) and abdominal ampullae non-tuberculate). Sternellum of prothorax usually micro-spiculate but if glabrous (*Epepeotes*) then anus a transverse cleft (fig. 130). Abdominal ampullae with two transverse furrows and tuberculate and/or micro-spiculate or micro-pubescent. Antennal foramen closed posteriorly (fig. 128). Gular sutures distinct. Monochamini (pars I), Agniini[7], Phrissomini, Morimopsini and Gnomini 4
– Without these characters combined. 17
4. Frons with one or two small blunt tubercles behind each antennal foramen, alongside frontal suture (fig. 128). Abdomen with tubercles fused to form raised transverse bands which are either glabrous or micro-spiculate. 5

[7] Breuning (1943) merges the Monochamini and the Lamiini with the Agniini, whereas Gressitt (1951) has merged the Monochamini and Agniini with the Lamiini. For the purposes of the present study it is considered preferable to treat these tribes separately, at least until more larval material becomes available.

– Frons without tubercles. Abdomen with tubercles (when present) moniliform and not fused into raised transverse bands. 6

5. Frons with one small and one much smaller rounded tubercle behind each antennal foramen, alongside each frontal suture (fig. 128). Prothorax with sternellum shining, glabrous. Abdominal ampullae shining, glabrous. Anus a transverse cleft (fig. 129). **Epepeotes**, p. 29.

– Frons with only a single rounded tubercle. Prothorax with sternellum dull, micro-spiculate. Abdominal ampullae each with four transverse, raised bands which are dull and micro-spiculate. Anus trilobate, although the vertical cleft is extremely short (as in *Pharsalia*). . . . . **Diochares** sp., p. 229.

6. Pronotum with anterior half bearing numerous scattered stiff setae; embossed posterior area entirely micro-spiculate except for a pair of large paramedian, glabrous depressions (fig. 126); a pair of sub-lateral, oblique impressions present. [Abdominal ampullae non-tuberculate and finely micro-spiculate.] **Celosterna**, p. 30 and **Aristobia approximator** Thomson[8], p. 239.

– Pronotum (fig. 127) more or less glabrous between posterior micro-spiculate area and front margin (which is fringed with setae); embossed posterior area without a pair of large, paramedian, glabrous depressions but usually with numerous scattered, small, glabrous, lenticulate spots; sublateral oblique impressions absent (except in *Belpephaeus* in which they are very broad and shallow but then abdominal ampullae tuberculate). 7

7. Anus a transverse cleft (as in *Epepeotes*, fig. 129). Posterior micro-spiculate or micro-pubescent area of pronotum partly divided by a narrow but distinct longitudinal, median, glabrous depression or spiracular peritreme with paired marginal chambers (as in *Dihammus*). 8

– Anus trilobate, although the vertical cleft is very short as in *Macrochenus*. Posterior micro-spiculate area of pronotum uninterrupted medially and spiracular peritreme without paired marginal chambers. 10

8. Prothorax with eusternum shining, glabrous. Abdominal ampullae tuberculate and micro-spiculate. Posterior part of pronotum micro-spiculate. Phrissomini. . 9

– Prothorax with eusternum broadly dull and micro-pubescent posteriorly. Abdominal ampullae non-tuberculate and densely covered with orange-testaceous micro-pubescence. Posterior part of pronotum densely covered with orange-testaceous micro-pubescence. Gnomini. . . . . **Imantocera penicillata** Hope, p. 255.

9. Posterior micro-spiculate area of pronotum partly divided by a narrow but distinct longitudinal, median, glabrous depression. Abdominal ampullae with tubercles at most feebly defined. Pleural tubercles with at least five setae. Spiracular peritreme without paired marginal chambers. . . . . **Morimus inaequalis** Waterhouse, p. 253.

– Posterior micro-spiculate area of pronotum uninterrupted medially. Abdominal ampullae with moniliform tubercles strongly protuberant. Pleural tubercles with only two or three setae. Spiracular peritreme with paired marginal chambers (as in *Dihammus*). [Antenna three-segmented.] . . . . . **Eupromus ruber** (Dalman), p. 254.

10. Posterior micro-spiculate area of pronotum coarsely striate, very short (confined to about posterior third of pronotum (fig. 127)) and only slightly produced medially; sublateral impressions oblique but broad and shallow. Head scarcely depressed, oval in cross-section. [Hypostoma very narrowly ferruginous anteriorly and bearing several scattered setae.] . . . . . **Blepephaeus nigrosparsus** Pic, p. 223.

– Posterior micro-spiculate area of pronotum not striate, longer, extending to about posterior half of pronotum and appreciably produced medially. Sublateral impressions, if present, transverse. Head moderately to very strongly depressed. . . . 11

[8] Only a single very small larva of this species has been examined and until more material becomes available there seem to be no satisfactory characters whereby these two genera may be distinguished.

11. Head longitudinally carinate sublaterally behind antennal foramen and very strongly depressed (fig. 139). Dorsal anal lobe strongly protruding beyond ventral lobes. [Abdominal ampullae non-tuberculate.] Agniini (pars I). . **Myagrus hynesi** Pascoe, p. 251.
– Head non-carinate. Dorsal anal lobe not strongly protuberant. . . . 12
12. Head capsule with a small posterior, semicircular emargination which is visible from above (Gardner, 1928). [Anus with vertical cleft very short.]
Macrochenus guerini White, p. 230.
– Head capsule rounded posteriorly 13
13. Dorsal abdominal ampullae with tubercles flattened and irregular in shape and mostly glabrous and shining. Transverse cleft of anus very long and curved downwards at extremities, the vertical cleft extremely short. Agniini (pars II).
Pharsalia subgemmatus (Thomson), p. 253.
– Dorsal abdominal ampullae with tubercles moniliform and more or less regular in shape, dull and micro-spiculate (except *M. nivosus* White, *Anoplophora* and *Morimopsis* in which the tubercles are absent or indistinct and *M. bimaculatus* Gahan in which the tubercles are glabrous). Transverse cleft of anus moderately long, linear, the vertical cleft longer. [Antenna 3-segmented (except *Morimposis*). Pleural tubercle with a pair of sclerotized pits (except *M. westwoodi* Westwood).] 14
14. Mesothoracic spiracle large, subequal in width to labrum. Abdominal ampullae with moniliform tubercles. Pleural tubercle (fig. 133) elongate, subovate but rather variable, usually with three setae, the third seta short. [Abdominal spiracles broadly oval (fig. 133).]
Sarathrocera lowi, White p. 233.
– Mesothoracic spiracle smaller, much narrower than labrum. Abdominal ampullae with or without moniliform tubercles. Pleural tubercle broader, apparently always subrectangular and with two setae (fig. 132). 15
15. Pleural tubercles without sclerotized pits. Abdominal spiracles small, not more than half as wide as labrum, with peritreme very thick, sub-circular. Antenna 2-segmented. [Abdominal ampullae non-tuberculate but micro-spiculate.] Morimopsini.
Morimopsis lacrymans Thomson, p. 254.
– Pleural tubercles each with a pair of distinct sclerotized pits (except *M. westwoodi* Westwood but then abdominal ampullae tuberculate). Abdominal spiracles larger, more than half as wide as labrum, with peritreme moderately thick and broadly to narrowly oval. Antenna 3-segmented. 16
16. Abdominal ampullae without distinct moniliform tubercles. Eusternum with a pair of lateral, oval, micro-spiculate areas (fig. 135). Spiracles broadly oval (as in *Sarathrocera*, fig. 133). . . . . **Anoplophora,** p. 29.
– Abdominal ampullae tuberculate (except *M. nivosus* White but then posterior part of pronotum micro-asperate. Spiracles narrowly oval (fig. 132). . **Monochamus,** p. 29.
17. Posterior area of prothorax with rather coarse asperities (fig. 136) covering anterior part, posteriorly micro-granulate; eusternum glabrous, sparsely setose. Abdominal ampullae bearing four rows of micro-spiculate moniliform tubercles. Spiracular peritreme sometimes with a pair of rather large subcontiguous marginal chambers. [Antenna 2-segmented.] Monochamini (pars II). . . . . **Dihammus,** p. 29.
– Posterior part of pronotum non-asperate (except Gleneini and Tetraopini but then prosternum with eusternum and/or sternellum also asperate). Abdominal ampullae, if spiculate, then non-tuberculate. Spiracular peritreme with marginal chambers more numerous and smaller or absent. 18
18. Frontal sutures bifurcate posteriorly (fig. 161). Anterior half of pronotum very strongly sclerotized and ferruginous (fig. 162), thus strongly contrasting with posterior half which is yellowish white, embossed and coarsely longitudinally striate. Two pairs of large ocelli present, the second pair placed behind and above the first pair, alongside frontal sutures. Antennal foramen closed posteriorly. [Head capsule almost completely and very strongly sclerotized and ferruginous. Antenna 2-segmented. Abdominal segment 9

rather densely fringed with short coarse setae.] Xylorhizini. 19

– Frontal sutures simple. Anterior half of pronotum without two such contrasting areas. Ocelli absent or only one pair present (two or three pairs of vestigial ocelli as well are present in some Phytoeciini). Antennal foramen open posteriorly (except *Olenecamptus*). 20

19. Front angles of sclerotized ferruginous area of pronotum acutely produced into a dentate process. . . . . **Thylactus (longipennis** Pascoe), p. 292.

– Front angles of sclerotized ferruginous area of pronotum rounded (fig. 162). **Xylorhiza adusta** (Wiedemann), p. 289.

20. Abdominal tergite 9 bearing a pair of paramedian oval tubercles which are bun-shaped, strongly protuberant and not sclerotized or pigmented (fig. 159). Front margin of frons with a transverse row of eight rounded or conical sclerotized tubercles. [Dorsal abdominal ampullae with four rows of rather large, glabrous, moniliform tubercles. Antenna 2-segmented.] Ceroplesini. . . . . **Diastocera wallichi** (Hope), p. 287.

– Abdominal tergite 9 without paramedian oval tubercles. Front margin of frons without a row of sclerotized tubercles. 21

21. Antenna 3-segmented, segment 3 being distinctly sclerotized and bearing a few setae or processes (fig. 149). Dorsal ampullae generally with two conspicuous transverse furrows, but if with only one, then anterior part of hypostoma steeply sloping down to anterior margin (except *Xenolea* but then front margin semicircular); generally with two or four rows of conspicuous moniliform tubercles but if non-tuberculate than pronotum without spicules and tergite 9 without a sclerotized process. Spiracles broadly oval. Hypostomal sutures straight (except *Mispila*). [Hypostoma (viewed laterally) with anterior region steeply (rather feebly in *Pterolophia* but then tergite 9 with a caudal spine) sloping down to anterior margin, the front margin being in a lower plane than that of hind margin (except *Xenolea* and *Mispila*). Segment 3 of antenna strongly elongate, as long as segment 2.] 22

– Antenna apparently 2-segmented, segment 2 bearing a tapering, glabrous, hyaline process (fig. 176). Dorsal ampullae, if with two transverse furrows, seldom tuberculate but if so, then tubercles not arranged in regular rows; if with a single furrow, then hypostoma never with front part steeply sloping; if very feebly or non-tuberculate, then pronotum asperate or tergite 9 bearing a sclerotized process. Spiracles with peritreme variable in form. Hypostomal sutures slightly curved inwards. [Gular region usually with a pale median line.] 33

22. Frons longitudinally striate or with 8–12 setiferous pores longitudinally impressed (figs. 148, 153). Abdominal tergite 9 bearing a small median spine (fig. 151). Hypostoma with a pair of paramedian setiferous pores. [Pleural tubercles each with a very distinct ventral sclerotized pit. Six stout epistomal setae present. Dorsal abdominal ampullae each with two rows of moniliform tubercles.] Mesosini. 23

– Frons non-striate and with setiferous pores simple. Abdominal tergite 9 without a spine (except *Pterolophia* (but then spine minute) and *Sthenias* (but then spine curved and anus ventral (fig. 170)). Hypostoma bearing scattered setae (fig. 163) (except *Mispila*). 26

23. Hypostoma with a transverse curved ridge which is longitudinally carinate and tuberculate (fig. 152). Frons carinate laterally. . . . **Anagelasta apicalis** Pic, p. 278.

– Hypostoma with transverse ridge non-carinate and non-tuberculate (fig. 154). Frons non-carinate but often striate (fig. 153).. 24

24. Frons distinctly longitudinally striate, with 8–12 setiferous pores (fig. 153). Hypostoma with a transverse median ridge. 25

– Frons not longitudinally striate but with setiferous pores feebly longitudinally impressed (fig. 148). Hypostoma with an abrupt, widely curved ridge or a pair of ridges across middle. [Antenna with segment 3 cylindrical, three times as long as broad; supplementary process shorter than segment three (fig. 149). Spiracles with about 24 marginal

chambers.] . . . . . **Coptops**, p. 30.

25. Frons with striae long and very deeply impressed (fig. 153). Frons and hypostoma entirely ferruginous (fig. 154). Antenna with segment 3 dome-shaped, only slightly longer than broad (fig. 155). Caudal spine elongate (fig. 156).
Mesosa indica Breuning, p. 280.
– Frons with striae shorter and shallower. Frons and hypostoma entirely testaceous (except front margin). Antenna with segment 3 cylindrical, at least twice as long as broad. Caudal spine subconical, minute (fig. 158). . . . . **Cacia cretifera** (Hope), p. 284.
26. Hypostoma (fig. 163) with front margin semicircular; posterior margin having attached to it a sclerotized membrane produced posteriorly into a median process (fig. 163). [Ocelli with pigmented spot large and very distinct. Dorsal abdominal ampullae with moniliform tubercles arranged in two transverse rows.] Xenoleini.
Xenolea, p. 30.
– Hypostoma with front margin at most feebly curved; posterior margin without a sclerotized membrane produced into a median process. 27
27. Abdominal tergite 9 bearing a caudal spine (fig. 170). [Dorsal abdominal ampullae each with three irregular rows of moniliform tubercles.] Niphonini (pars I). . . 28
– Abdominal tergite 9 without a caudal spine 29
28. Anus ventral (fig. 169). Hypostoma bearing several setae. [Caudal spine large, strongly curved (fig. 170).] . . . . . **Sthenias**, p. 30.
– Anus caudal. Hypostoma with a pair of deep, paramedian setal pores.
Pterolophia, p. 30.
29. Frons entirely ferruginous, the frontal sutures pale, very distinct and strongly contrasting with the ferruginous frons. [Abdominal tergite 9 rather densely setose posteriorly.]
Zygrita diva Thomson, p. 308.
– Frons at most broadly ferruginous, the frontal sutures thus never strongly conspicuous for entire length. 30
30. Abdominal segment 10 bearing numerous ferruginous spinules. Dorsal abdominal ampullae with moniliform tubercles arranged in three transverse rows. Hypostoma with posterior area much darker than anterior area (fig. 168). Mainly in bamboos. [Ocellus with pigmented spot large, black and very distinct.]
Niphona (pars ?)[9] **N. hookeri** Gahan, p. 303.
– Abdominal segment 10 without spinules. Dorsal abdominal ampullae with moniliform tubercles arranged in two or four transverse rows. Hypostoma unicolorous. . 31
31. Antennal foramen open posteriorly (as in Mesosini (fig. 148)). Pleural tubercle without sclerotized pits or with only a single (lower) pit distinct. Hypostoma with a single pair of very stout setae. Niphonini (pars II). 32
– Antennal foramen closed posteriorly. Pleural tubercle with a pair of sclerotized pits. Hypostoma with at least three pairs of slender setae. Dorcaschematini.
Olenecamptus, p. 31.
32. Dorsal abdominal ampullae with tubercles arranged in three or four irregular rows. Pleural tubercle without sclerotized pits. [Frons almost completely ferruginous. Gular sutures distinctly raised.] . . . . . **Mispila**, p. 30.
– Dorsal abdominal ampullae with tubercles arranged in two irregular rows. Pleural tubercle each with a single (lower) distinct pit.
Prosoplus banki (Fabricius), p. 305.
33. Frons with two distinct, slightly elongate tubercles (and sometimes a third, much smaller tubercle) on each side. Abdominal tergite 9 bearing a pair of paramedian urogomphi (fig. 166). [Maxillary palp 3-segmented. Pleural tubercle without sclerotized pits. Dorsal abdominal ampullae with three rows of moniliform tubercles.] Hecyrini.
Moechohecyra verrucicollis (Gahan), p. 299.

[9] According to Gressitt (1927, 1931), larvae of some Indian species of *Niphona* bear a caudal spine similar to those present in larvae of Mesosini.

– Frons non-tuberculate. Abdominal tergite 9 without urogomphi (except *Sophronica* and *Eupogoniodes* but then urogomphi slender and spine-like (figs. 194, 195) and maxillary palpi 2-segmented). 34

34. Pronotum with posterior area velvety micro-spiculate or micro-pubescent (except *Exocentrus* (pars) but then caudal spine present). 35

– Pronotum with posterior area never micro-spiculate or micro-pubescent but sometimes bearing coarse asperities (fig. 179) which are individually distinguishable with a ×15 lens. 37

35. Pleural tubercle without sclerotized pits. Prosternum with sternellum micro-pubescent. Epipleurum protuberant on all segments. Abdominal tergite 9 unarmed. Head scarcely depressed. [Antennal foramen open posteriorly; frontal sutures very distinct.] Ancylonotini. . . . . **Palimna palimnoides** (Schwarzer), p. 287.

– Pleural tubercle with a pair of distinct sclerotized pits. Prosternum with sternellum glabrous. Epipleurum protuberant on segments 7–9 only. Abdominal tergite 9 usually with a spine or sclerotized process. Head moderately to very strongly depressed. Acanthocinini. 36

36. Pronotum with posterior area always micro-spiculate; this area broadly and completely divided medially. Maxillary palpi 3-segmented. . . . **Acanthocinus**, p. 335.

– Pronotum with posterior area when micro-spiculate not completely divided medially. Maxillary palpi 2-segmented. . . . . **Exocentrus**, p. 31.

37. Pronotum (figs. 179, 182) with sublateral impressions and asperities. Ampullae generally spiculate but if not then strongly protuberant and bilobed; moniliform tubercles absent. Spiracles rather narrowly to extremely narrowly oval. 38

– Pronotum without sublateral impressions; asperities absent except in *Chreonoma* but then spiracular peritreme with a pair of external marginal tubes (fig. 197). Ampullae glabrous, each with two or three transverse rows of tubercles. Spiracles round to broadly oval. 42

38. Pronotum (fig. 179) with sublateral impressions transverse, semi-circular and pale. Abdomen with dorsal ampullae bearing two transverse furrows, asperate (except *Serixia* where they are tuberculate). Abdominal segment 10 strongly protuberant. Eusternum usually asperate. Saperdini, Gleneini. 39

– Pronotum with sublateral impressions linear, oblique and brownish (figs. 182, 183). Abdomen with dorsal ampullae with a single transverse furrow (except *Oberea* (pars) and *Nupserha* (pars)) which is sometimes callose; generally glabrous, but if spiculate or asperate then one or more pairs of vestigial ocelli present[10]. Spiracle with peritreme narrowly oval to slot-like. Head not or scarcely depressed, thick, with sides strongly converging posteriorly. Clypeus glabrous. Abdominal segment 10 not strongly protuberant. Eusternum not asperate. Phytoeciini. 40

39. Dorsal abdominal ampullae shining, glabrous and tuberculate; each with a single transverse impression. Clypeus glabrous. [Ocelli obscured by sclerotization of gena.] Saperdini. . . . . **Serixia andamanica** Gardner, p. 348.

– Dorsal abdominal ampullae matt, micro-asperate or micro-spiculate and non-tuberculate; each with two transverse impressions. Clypeus with 1–6 pairs of minute lateral setae. Gleneini. 40

40. Hypostoma with two widely separated pairs of setae. Form moderately robust. **Thyestilla gebleri** (Faldermann), p. 347.

– Hypostoma with only a single pair of setae, one on each side of gular area. Form slender, attenuated. . . . . **Glenea**, p. 31.

41. Pronotum with asperities gradually decreasing in size towards posterior margin (figs. 182, 183). One to three pairs of vestigial ocelli present. Length up to 27 mm. In living

[10] Larvae of this group besides having the usual ocellus outward and ventrad of antenna, have from one to three vestigial ocelli behind it, each consisting of a greyish pigmented spot without a distinct lens.

stems and twigs of trees. 42

– Pronotum with asperities more or less uniform in size except for posterior fourth (fig. 186). Vestigial ocelli absent. Length up to 20 mm. Ampullae glabrous, micro-reticulate and very strongly protuberant and bilobed. In stems of herbaceous plants, especially Umbelliferae. [Prothorax subquadrate.] . . **Phytoecia rufiventris** Gautier, p. 355.

42. Head with two pairs of vestigial ocelli (one small, rather faint, pigmented spot immediately behind ocellus and one larger more distinct spot behind and beneath ocellus. [Prothorax elongate, with sides converging posteriorly (fig. 182).]
Nupserha, p. 31.

– Head with only one pair of vestigial ocelli. . . **Oberea** (Palaearctic sp.), p. 354.

43. Abdominal sternites without ampullae. Head salient, almost entirely uniformly sclerotized and pigmented (testaceous); occipital foramen postero-ventral. Mesosternum and metasternum strongly protuberant. Abdominal segment 9 swollen, as wide and high as at apex of segment 8, truncate and densely setose posteriorly (fig. 192). Spiracles with about 30 chambers which occupy the entire inner margin of the peritreme. Form slender, cylindrical (fig. 192). [Often with a caudal process or anal tubercles.] Spalacopsini and Hippopsini. 44

– Abdominal sternites with ampullae. Head retracted in prothorax (slightly salient in *Atimura*), not entirely uniformly sclerotized and pigmented; occipital foramen ventral. Mesosternum and metasternum not protuberant. Abdominal segment 9 usually smaller than segment 8 (except *Atimura*), less densely setose. Spiracles with marginal chambers less numerous (not occupying more than half the inner margin of peritreme (except *Atimura*) or with paired tube-like chambers externally (fig. 197). Form more robust, subcylindrical. 45

44. Abdominal segment 9 bearing a small spine-like, median tubercle above the anal segment (fig. 193). Pronotum striate and laterally defined. Gular region with a distinct pale median cleavage line. Spiracular peritreme round. Dorsal ampullae present on abdominal segments 1 and 7 only. Spalacopsini. . . **Tetraglenes insignis** Newman, p. 364.

– Abdominal segment 9 without a median tubercle (fig. 192). Pronotum smooth and not laterally defined. Gular region without a median cleavage line. Spiracular peritreme broadly oval. Dorsal ampullae present on abdominal segments 1–7 or 1, 2 and 7 only (fig. 192). Hippopsini. . . . . **Pothyne**, p. 31.

45. Pronotum (fig. 106) and prosternum (sternellum) uniformly asperate. Spiracular peritreme with a pair of long, contiguous, marginal, tube-like chambers (fig. 197). [Mainly in pseudobulbs of orchids.] Tetraopini. . . . . **Chreonoma**, p. 32.

– Pronotum and prosternum non-asperate. Spiracular peritreme without paired, tube-like, marginal chambers. 46

46. Abdominal tergite 9 with a pair of vertical urogomphi. Maxillary palpi 2-segmented. Apodasyini. . . . . **Eupogoniodes**, p. 32.

– Abdominal tergite 9 without urogomphi. Maxillary palpi 3-segmented. . . 47

47. Disc of pronotum with a conspicuous dark brown, oval area which is finely transversely carinate (fig. 190). Ptericoptini (pars I). . . **Platyzorilispe variegata** Fisher, p. 359.

– Disc of pronotum without a carinate area. 48

48. Abdominal tergite 9 with a sclerotized process. Ptericoptini (pars II). . . 49

– Abdominal tergite 9 without a sclerotized process. 50

49. Abdominal tergite 9 bearing a minute, transversely-oval, sclerotized, ferruginous plate, the centre of which is produced into a very short blunt tubercle (fig. 191). Posterior part of pronotum faintly longitudinally rugose. Hypostoma micro-granulate.
Sybra alternans Wiedemann, p. 360.

– Abdominal tergite 9 bearing a small, median, spine-like process (fig. 189). Posterior part of pronotum strongly longitudinally striate and strongly embossed (fig. 188). Hypostoma smooth. [Legs vestigial but ferruginous.] . . **Atimura combreti** Gardner, p. 358.

50. Proeusternum at most faintly granulate and bearing several setae. . . . 51

– Procusternum finely but distinctly longitudinally striate (as on pronotum (fig. 173)) and glabrous. Hypostoma (except sometimes front margin) entirely testaceous.
Eunidia spp., p. 324.

51. Frons entirely ferruginous. Maxillary palpi with segment 3 slightly longer than segment 2. Abdominal ampullae with moniliform tubercles subcontiguous. . **Apomecyna**, p. 30.
– Frons entirely testaceous. Maxillary palpi with segment 3 slightly shorter than segment 2. Abdominal ampullae with moniliform tubercles widely separated. [Usually in pseudobulbs of orchids.] . . . . . **Diaxenes dendrobii** Gahan, p. 322.

Batocera

1. Prothorax with ferruginous lateral plates of presternum coarsely asperate (as on eusternum and sternellum). Thoracic and abdominal cuticle almost entirely velured (micropubescent). [Length up to 110 mm.] . . . . . **B. una** White, p. 263.
– Prothorax with lateral plates of presternum glabrous. Thoracic and abdominal cuticle with long dense setae only. 2
2. Prothorax with postnotal fold well-developed, bearing rows of semi-cylindric asperities (fig. 140). Epicranium bearing a distinct dentate tubercle behind antennal foreman. 4
– Prothorax with postnotal fold absent (fig. 144). 3
3. Epicranium bearing a distinct dentate tubercle behind antennal foramen.
B. tigris Voet, var. **hector** Thomson, p. 262.
– Epicranium without a dentate tubercle. . . . **B. lineolata** Chevrolat, p. 263.
4. The semi-cylindric asperities on postnotal fold with those of the first (anterior) row very elongate and slender and more than twice the length of those of remaining rows.
B. gigas (Drapiez), p. 267.
– The semi-cylindric asperities on postnotal fold with those of the first (anterior) row shorter and stouter and less than twice the length of those of remaining rows. (figs 140, 143). 5
5. The semi-cylindric asperities on postnotal fold with those of the first (anterior) row not or scarcely longer than those of remaining rows. . . . **B. thomae** Voet, p. 262.
– The semi-cylindric asperities on postnotal fold with those of the first (anterior) row at least one and one-half times the length of those of remaining rows. . . 6
6. Semi-cylindric asperities on postnotal fold very gradually decreasing in size posteriorly (fig. 140). The large sublateral asperities on pronotum flattened, with their posterior margin slightly elevated.
B. rufomaculata (Degeer) and var. **andamana** Thomson, p. 256.
– Semi-cylindric asperities on postnotal fold distinctly smaller than those of the anterior (first) row (fig. 143). The large sublateral asperities on pronotum coarser and not flattened or elevated. . . **B. rubus** (Linnaeus) and var. **albofasciata** Degeer, p. 260.

Apriona

1. Abdominal segment 10 with setae shorter and appreciably thicker than those on abdominal segments 5–8. Front margin of frons pitchy. Sublateral plates of prosternum testaceous. [Asperities of prosternum protuberant, subconical.]
A. cinerea Chevrolat, p. 270.
– Abdominal segment 10 with setae similar to those on preceding segments. Front margin of frons ferruginous. Sublateral plates of prosternum pale ferruginous. . . 2
2. Asperities on eusternum of prothorax (fig. 147) very numerous (65–85), slightly convex and covering at least posterior third of eusternum.
A. swainsoni (Hope), p. 271.
– Asperities on eusternum of prothorax (fig. 146) much less numerous (25–55), protuberant, subconical and not covering more than basal fourth of eusternum.
A. germari (Hope), p. 268.

Epepeotes

1. Pleural tubercles with a pair of sclerotized pits (pale and not very conspicuous).
E. andamanicus Gahan, p. 228.
– Pleural tubercles without sclerotized pits. 2
2. Gena ferruginous and evenly and moderately swollen around antennal foramen, the basal membrane of antenna fully visible from above (fig. 128).
E. spinosus (Thomson), p. 225.
– Gena pitchy and unevenly and strongly swollen around antennal foramen, the basal membrane of antenna almost completely enclosed and not visible from above.
E. luscus (Fabricius), p. 228.

Dihammus

1. Spiracular peritreme with a pair of rather large subcontiguous marginal chambers on posterior half. 2
– Spiracular peritreme without marginal chambers. [Mentum with two pairs of stout setae.] . . . . . **D. defector** Pascoe, p. 250.
2. Prothorax with asperities entirely confined to pronotum. Pleural tubercle with a pair of moderately long setae. . . . . **D. cervinus** Hope, p. 244.
– Prothorax with a small group of fine asperities present on outer side of lateral furrow in addition to those on pronotum (fig. 136). Pleural tubercle with a pair of long stout setae and several much shorter finer setae. 3
3. Pronotum with asperities becoming markedly elongate towards posterior margin (fig. 136). Mentum bearing at least six pairs of stout setae. [Hypostoma and front margin of frons very strongly transversely strigose. Form very robust; maximum breadth (at prothorax) 14 mm.]. . . . . **D. australis** (Boisduval), p. 241.
– Pronotum with asperities becoming smaller but not elongate towards posterior margin. Mentum with two pairs of stout setae. . . . . **D. mixtus** (Hope), p. 242.

Monochamus

1. Posterior area of pronotum almost entirely and finely micro-asperate. Abdominal ampullae non-tuberculate but with micro-spiculate transverse ridges.
M. nivosus White[11], p. 250.
– Posterior area of pronotum micro-spiculate or micro-pubescent. Abdominal ampullae with moniliform tubercles. 2
2. Abdominal ampullae with moniliform tubercles partly confluent and glabrous. [Spiracles narrowly oval. Pleural tubercle with a pair of sclerotized pits (fig. 132).]
M. bimaculatus Gahan, p. 230.
– Abdominal ampullae with moniliform tubercles micro-spiculate or micro-pubescent. 3
3. Pleural tubercles without sclerotized pits. . . **M. westwoodi** Westwood, p. 229.
– Pleural tubercles each with a pair of distinct sclerotized pits.
M. perplexus Gahan[12], p. 251.

Anoplophora

1. Front margin of posterior micro-spiculate area of pronotum very narrowly ferruginous (fig. 134). Abdominal ampullae sub-tuberculate (the tubercles not individually defined) and micro-spiculate. . . . . **A. chinensis** Forster, p. 236.
– Front margin of posterior micro-spiculate area of pronotum without a ferruginous border. Abdominal ampullae non-tuberculate, densely micro-spiculate.
A. beryllina (Hope), p. 238.

[11] This larva could possibly be mistaken for a species of *Dihammus* but in the latter the asperities are coarser and confined more or less to the anterior part of the posterior area (see fig. 136).

[12] It has been suggested that this species should be transferred to the genus *Dihammus*. According to Gardner (1931) the larva is typically monochamine, with the posterior area of the pronotum micro-spiculate. Unfortunately it has not been possible to examine this larva to ascertain whether the spiracles have paired marginal chambers or whether the antenna is 2- or 3-segmented.

Celosterna

1. Anterior part of pronotum with setae ferruginous and those of anterior rows each arising from a ferruginous basal disc, giving the pronotum a spotted appearance (fig. 126). Gular sutures pale, indistinct. Pleural tubercle with a pair of very distinct sclerotized pits. . . . . **C. javana** White, p. 222.
– Anterior part of pronotum with setae testaceous and not arising from ferruginous basal discs. Gular sutures strongly raised and ferruginous. Pleural tubercle with lower sclerotized pit indiscernible or very indistinct.
C. scabrator (Fabricius), p. 219.

Sthenias

1. Caudal spine arising from a sclerotized ferruginous, basal plate (fig. 169). Head with frons non-carinate. . . . . **S. grisator** (Fabricius), p. 317.
– Caudal spine without a sclerotized basal plate. Head with frons finely and longitudinally carinate (striate?) anteriorly (behind mandibles) (Gardner, 1931).
S. albicollis Gahan, p. 318.

Coptops

1. Hypostoma with a pair of extremely strongly swollen and protuberant, curved ridges, one on each side of gula. Ventral front margin of head with a tooth-like tubercle on acetabulum in which the *condylus mandibulae* rotates.
C. annulipes Gahan, p. 276.
– Hypostoma with a single curved ridge which is not protuberant. Ventral front margin of head without a tubercle on acetabulum. 2
2. Caudal spine obliquely set, short, less than twice as long as basal width. Ocellus with lens well defined, strongly convex and strongly contrasting with surrounding ferruginous gena. . . . . **C. aedificator** (Fabricius), p. 272.
– Caudal spine vertical, more than twice as long as basal width (fig. 151). Ocellus with lens somewhat obscured by sclerotization of gena, feebly convex.
C. leucosticta White, p. 276.

Mispila

1. Dorsal abdominal ampullae with moniliform tubercles arranged in four irregular rows.
M. curvilinea Pascoe, p. 301.
– Dorsal abdominal ampullae with moniliform tubercles arranged in three irregular rows.
M. tonkinea Pic, p. 302.

Pterolophia

1. Caudal spine minute, straight.
P. camura Newman, **P. arrowiana** Breuning and **P. albivenosa** Pascoe, p. 309.
– Caudal spine stout, curved upwards. . . . . **P. melanura** Pascoe, p. 310.

Apomecyna

1. Head capsule (including hypostoma) pale testaceous, except mouth-frame which is ferruginous. Pigmented spot of ocellus very distinct and strongly contrasting with surrounding cuticle of gena which is pale testaceous.
A. histrio (Fabricius), p. 320.
– Head capsule (including hypostoma) entirely ferruginous. Pigmented spot of ocellus less strongly contrasting with surrounding cuticle which is ferruginous.
A. alboguttata Megerle and **A. neglecta** Pascoe, p. 319.

Xenolea

1. Maxillary palp with segment 3 less than one and one-half times length of segment 2.
X. tomentosa (Pascoe), s.sp. **asiatica** Pic, p. 294.
– Maxillary palp with segment 3 more than one and one-half times length of segment 2.
X. collaris Thomson, p. 293.

Pothyne

1. Dorsal ampullae present on abdominal segments 1–7.
P. moringae Aurivillius, p. 364.
– Dorsal ampullae present only an abdominal segments 1, 2 and 7 (fig. 192). . 2
2. Anal lobes each produced into a conical tubercle (fig. 192). Form very slender (fig. 192). Mandible not bifurcate apically. . . . . **P. combreti** Gardner, p. 362.
– Anal lobes only slightly protuberant. Form more robust. Mandible bluntly bifurcate apically. . . . . **P. acaciae** Gardner, p. 363.

Olenecamptus

1. Posterior area of pronotum dull, micro-spiculate (fig. 164). Ocellus with pigmented spot indistinct owing to sclerotization of gena. [Hypostoma raised into a transverse ridge posteriorly.] . . . . . **O. bilobus** (Fabricius), p. 294.
– Posterior area of pronotum glabrous, non-spiculate, sometimes striate. Ocellus with pigmented spot black and very distinct. 2
2. Hypostoma raised into a transverse ridge posteriorly. 3
– Hypostoma plane. 4
3. Hypostoma with three or more short longitudinal carinae on transverse ridge.
O. formosanus Pic, p. 297.
– Hypostoma without carinae. . . . . **O. opatus** Pascoe, p. 297.
4. Posterior area of pronotum longitudinally striate.
O. anogeissi Gardner, p. 296.
– Posterior area of pronotum rugulose. . . . **O. indianus** Thomson, p. 297.

Exocentrus

1. Pronotum with posterior area glabrous, coarsely striate. Abdominal tergite 9 bearing a small median spine. Tergite 8 bearing a transverse row of longitudinal sclerites (fig. 174).
E. flemingiae Fisher, p. 330.
– Pronotum with posterior area micro-spiculate, non-striate. Abdominal tergite 9 without a sclerotized process. Tergite 8 without sclerites. . . . **E.** sp. (African)[13].

Nupserha

1. Prothorax quadrate to slightly elongate (fig. 182). Asperities on pronotum irregularly arranged in five to seven rows (fig. 182). Dorsal abdominal ampullae micro-granulate. and with a single transverse furrow. **N. bicolor** Thomson, p. 348.
– Prothorax transverse. Asperities on pronotum irregularly arranged in at least nine rows Dorsal abdominal ampullae glabrous and smooth, with two transverse furrows which join at extremities to enclose an ellipitical area. . . **N. antennata** Gahan, p. 351.

Glenea

1. Abdominal ampullae with asperities coarse, spine-like and individually distinguishable with a ×15 lens. Ocelli distinct, the pigmented spot large and black. Pronotum coarsely asperate (fig. 179). 2
– Abdominal ampullae densely micro-spiculate, the spicules not individually distinguishable with a ×15 lens. Ocelli indistinct (obscured by sclerotization of gena). Pronotum more finely asperate. 6
2. Spine-like aperities of abdominal ampullae very coarse, each arising from a pale conical base. [New Guinea.] . . . . . **G.** (s.g. **Glenea**) **aluensis** Gahan, p. 338.
– Spine-like asperities of abdominal ampullae less coarse, simple basally. . . 3
3. Asperities of dorsal abdominal ampullae smaller, evenly covering surface. [Eusternum and sternellum asperate.] . **G. indiana** Thomson, p. 343 and **G. relicta** Pascoe, p. 342.
– Asperities of dorsal ampullae larger, more or less regularly arranged in four rows along the two transverse impressions and leaving a glabrous area in between. . . 4

[13] See Duffy, 1957, p. 255.

4. Sternellum of prothorax with a transverse band of distinct asperities (fig. 181). . 5
– Sternellum without asperities (or, rarely, with a few laterally). [Eusternum glabrous posteriorly.] . . . . . **G. spilota** Thomson, p. 347.
5. Eusternum of prothorax with a group of asperities near posterior margin (fig. 181). [Eusternum and sternellum coarsely asperate.]
G. quadrinotata Guérin-Méneville, p. 340.
– Eusternum glabrous. . . . . **G. vaga** Thomson, p. 345.
6. Segment 3 of maxillary palp longer than segment 2. Sternellum micro-granulate. [Apical segment of labial palp very elongate, nearly as long as basal segment and more than twice as long as wide.] . . . . **G. quattuordecimmaculata** Thomson, p. 341.
– Segment 3 of maxillary palp shorter than segment 2. Sternellum of prothorax micro-pubescent. 7
7. Apical segment of labial palp moderately long, about twice as long as wide.
G. multiguttata Guérin-Méneville, p. 343.
– Apical segment of labial palp shorter, less than twice as long as wide.
G. beesoni Heller, p. 340.

Eupogoniodes

1. Urogomphi on tergite 9 very small, separated from one another by a distance equal to about five times the length of one of them (fig. 195). Head capsule broadly oval in cross-section, distinctly narrower posteriorly and without a median constriction.
E. carissae Fisher, p. 367.
– Urogomphi on tergite 9 with spines much larger and narrowly separated (fig. 194). Head capsule moderately depressed, posteriorly very widely rounded and not much narrower than anterior margin and slightly constricted near middle.
E. gardneri Fisher, p. 366.

Chreonoma

1. Spiracular peritreme with contiguous tube-like chambers moderately long and slightly curved (fig. 197). . . . . **C. dioica** (Fairmaire), p. 367.
– Spiracular peritreme with contiguous tube-like chambers nearly twice as long and straight (fig. 198). . **C. nigriventris** Thomson and **C. testacea** (Thomson), pp. 368, 369.

ORIENTAL CERAMBYCID PUPAE

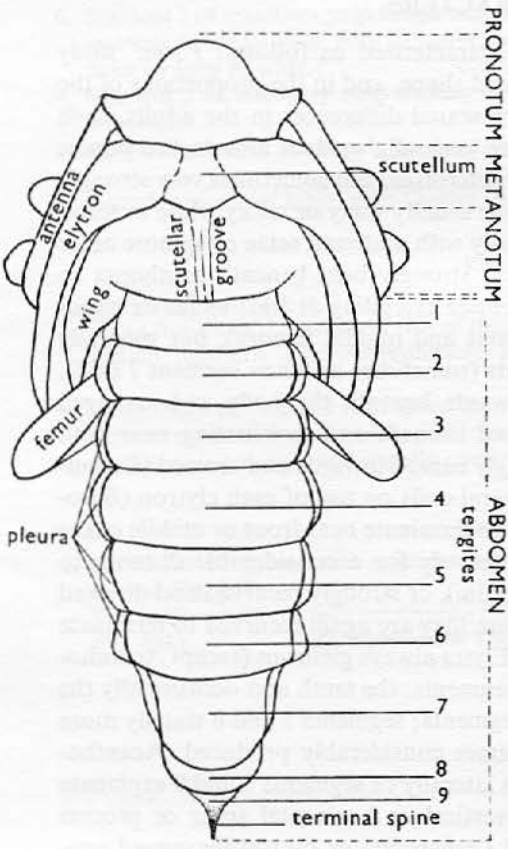
FAMILY CHARACTERS

CERAMBYCID pupae may, in general, be characterized as follows: *Form.* Body closely resembling form of adult both in size and shape, and in the proportions of the cephalic and thoracic appendages. Secondary sexual differences in the adults, such as the proportions of certain appendages, are generally evident also in the pupae. *Cuticle* exarate, weakly to moderately strongly sclerotized but sometimes very strongly in parts (*e.g.* urogomphi, gin-traps, etc.); colour usually waxy or milky white to testaceous, but occasionally orange to brown; usually with scattered setae or spinose areas or combinations of each. *Head* nearly always strongly bent beneath prothorax so that the mouthparts extend posteriorly. Antennae extending at least as far as mesothorax (where they terminate between the front and middle femora), but generally much longer, extending to abdominal segments (sometimes as far as segment 7 or 8), where they are nearly always curved downwards beneath the body and arranged characteristically as follows: (i) slightly curved inwards and terminating near hind femora (*Prionus*, *Phymatodes*); (ii) more strongly curved inwards and crossed (Cerambycini (pars)); (iii) arranged in a single or several coils on top of each elytron (Batocerini, Monochamini); (iv) directed anteriorly to terminate near front or middle coxae (Phoracanthini, Mesosini); or (v) directed anteriorly for a considerable distance to terminate alongside or on top of head (Phytoeciini), or strongly recurved and directed posteriorly to seventh abdominal segment where they are again recurved to terminate near apices of elytra (Acanthocinini (males)). Elytra always glabrous (except Acanthocinini). *Abdomen* usually with nine movable segments, the tenth and occasionally the ninth being telescoped within the preceding segments; segments 7 and 8 usually more elongate than the preceding ones and sometimes considerably produced (Acanthocinini). Segments 7, 8 and 9 either continuous laterally or segments 8 and 9 explanate laterally; segment 9 often terminating in a vertical or horizontal spine or process (Batocerini, Monochamini) or with incurved (*Arhopalus*) or outwardly curved urogomphi. Paired paramedian gin-traps present in some PRIONINAE (Macrotomini and Callipogonini). Functional ampullae absent, although in certain herbaceous plant-feeding lamiids there are cushioned spinose areas which appear to be analogous to larval ampullae. *Legs* often with subapical setae on the femora and sometimes with one or two setae on the tarsi. *Spiracles* of mesothorax functional, large, oval and placed ventro-laterally; spiracles of abdominal segments 1–5 always functional, as are sometimes those on segments 6 or 6 and 7. The spiracular peritreme, as in many larvae, sometimes bears subcontiguous marginal chambers (Acanthocinini (pars)).

Sexual differences. Generally speaking, a transverse rectangular protuberance is present posterior to the eighth sternite in the male, whereas in the female this is represented by a pair of subcontiguous rounded lobes which often bear one or more pairs of setae. A secondary sexual characteristic is the proportion and arrangement of the

antennae, which, in the male, are often considerably longer and more elaborately arranged.

A detailed account of the morphology of the pupa is not considered necessary as all the structures referred to in the keys and descriptions are indicated in the following figures (figs. 9 and 10).



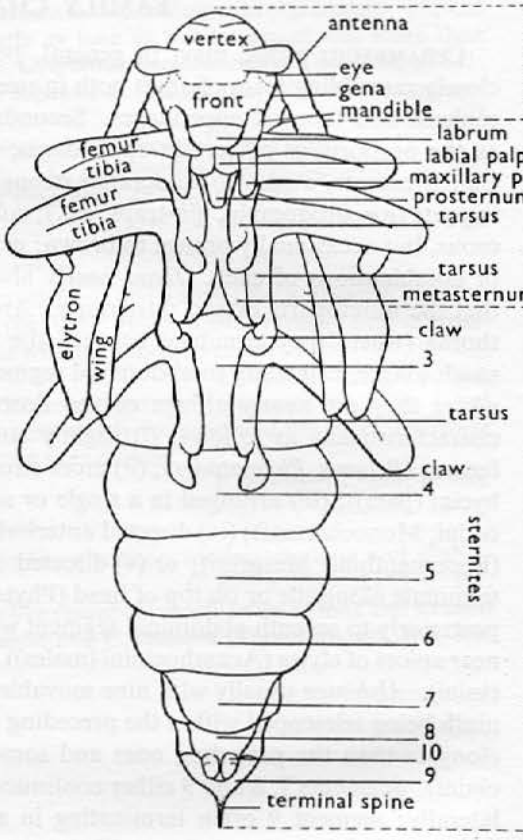


Fig. 9. Diagrammatic figure of a cerambycid pupa. Dorsal aspect. (Duffy, 1953a)
Fig. 10. Diagrammatic figure of a cerambycid pupa. Ventral aspect. (Duffy, 1953a)

KEY TO SUBFAMILIES

In the following keys it has proved necessary, particularly in the case of subfamily diagnosis, to follow an artificial rather than a phylogenetic sequence and to use what are in fact adult characteristics instead of truly pupal ones, as the pupa presents comparatively few characters other than those directly derived from the external structure of the contained imago. Indeed, it is only the various spines and setae, both simple and modified, and the arrangement rather than the form of the antennae which can be regarded as constituting truly independent pupal characters.

1. Head without conspicuous spines or setae (occasionally with a few scattered spinules or papillae) and abdominal spiracles with peritreme narrowly oval. Prothorax either with three pairs of lateral tubercles or none, never one pair only. Prosternum produced beyond coxae into a rounded or truncate process. [Antennae often thick, serrate or pectinate. Femora without spines or setae. Abdominal tergites sometimes with gin-traps. Functional spiracles present on abdominal segments 1–6 or 1–7; peritreme very thick.]
1. PRIONINAE, p. 36.

– Head usually bearing conspicuous spines or setae, but if without then abdominal spiracles broadly oval (fig. 119). Prothorax either with a single pair of lateral tubercles (fig. 177) or none; never three pairs. Prosternum seldom produced beyond coxae, but if so, never simply rounded or truncate but either tapering or confluent with mesosternum (ASEMINAE) or enlarged into a T-shaped process (LAMIINAE (pars)). . . . 2

2. Abdominal segment 9 either with a horizontal spine or with outwardly curved or parallel urogomphi. Tarsi each bearing one or a pair of setae. Hind tibiae with long, tuberculate, apical spurs. Labrum transverse, rectangular. Functional spiracles absent on segments 6 and 7. [Femora with subapical setae. Head triangular and usually rather elongate. Clypeus usually with a deep impression and a row of setae across base.]
2. LEPTURINAE **(Leptura)**, p. 65.

– Abdominal segment 9 usually unarmed, but sometimes with either a vertical spine (figs. 130, 142) or with strongly incurved urogomphi (ASEMINAE). Tarsi nearly always without setae, but if with setae then antennae coiled. Hind tibiae never with long apical, tuberculate spurs. Labrum seldom transverse, but if so, never rectangular; usually triangular or cordate. Functional spiracles usually present on abdominal segments 1–6 or 1–7. 3

3. Antennae with several conspicuous spines at or near apex of basal segment, the remaining segments entirely micro-spiculate (fig. 36). Abdominal segment 9 bearing strongly incurved urogomphi (fig. 36), never with a vertical spine. Abdominal sternites 4–8 with paired sublateral groups of spines. Apices of femora with spines (each with a subapical seta). Functional spiracles present on abdominal segments 1–7.
5. ASEMINAE, p. 36.

– Antennae without spines on basal segment, the remaining segments non-spiculate. Abdominal segment 9 without urogomphi; occasionally either with a vertical spine or carina. Abdominal sternites never with paired groups of numerous spines, but sometimes with two or three very small spines. Apices of femora usually glabrous or with setae only but if spinose, then each spine with a basal seta. Functional spiracles often restricted to segments 1–5 or 1–6. 4

4. Head strongly bent beneath prothorax so that the vertex is totally or for the greater part concealed from above; vertex convex (sometimes dome-shaped); never flat or excavate between bases of antennae (fig. 60). Mandibles without setae (fig. 60). Clypeus without setae (fig. 60). Femora without setae (fig. 60). Pleura strongly protuberant (fig. 60). Abdominal segments 7, 8 and 9 continuous laterally. Eyes moderately convex (fig. 60). Maxillary palpi not tapering apically, often enlarged. Prosternum never produced behind coxae into a T-shaped process. . . . . 6. CERAMBYCINAE, p. 37.

– Head less strongly bent beneath prothorax, so that the vertex is entirely or for the greater part visible from above (fig. 177); vertex between bases of antennae either deeply excavate or flat, never convex. Mandibles each with 1–6 or more setae near middle of outer face (fig. 170). Clypeus with several setae across base (fig. 170). Femora nearly always with subapical spines or setae, but if without them, abdomen either cylindrical or parallel-sided or tergite 9 with a vertical spine. Pleura never strongly protuberant. Abdominal segment 8 or 9 obliquely explanate laterally, the latter often deeply divided beneath. Eyes at most feebly convex, generally flat (fig. 170). Maxillary palpi gradually to strongly tapering; never truncate or enlarged apically (fig. 170). Prosternum often produced beyond coxae into a T-shaped process. . . . . 7. LAMIINAE, p. 39.

KEYS TO GENERA AND SPECIES

1. PRIONINAE

1. Abdominal gin-traps present on tergites 2–3, 3–4, 4–5 and 5–6. [Pronotum without lateral tubercles.] Macrotomini. 2
– Abdominal gin-traps absent. 3
2. Urogomphi present. Pronotum and abdominal sternites glabrous.
Rhaphipodus (s.g. **Rhaphipodus**) **suturalis** Serville, p. 48.
– Urogomphi absent. Pronotum and abdominal sternites spinulose.
Archetypus fulvipennis (Pascoe), p. 47.
3. Urogomphi absent (fig. 20). Pronotum without setose papillae or spinules and with three pairs of lateral tubercles, of which the middle pair is the most strongly produced (fig. 20). Antennae thick (serrate in male) and not curved beneath body. Abdomen very broad at middle. Abdominal tergites bearing only scattered pale papillae. [Usually in an earthen cocoon near roots of mature trees.]
Prionus (**coriarius** (Linnaeus)), p. 59.
– Urogomphi present. Pronotum bearing setose papillae or ferruginous spinules on disc and without lateral tubercles. Antennae slender (never serrate), usually longer and curved or recurved beneath body. Abdomen only slightly broader at middle and strongly tapering posteriorly. Abdominal tergites conspicuously spinose.
Megopis, see below.

Megopis

1. Disc of pronotum bearing a few minute, pale, testaceous setae.
M. nigropunctatus Aurivillius, p. 53.
– Disc of pronotum bearing several rather stout ferruginous spinules, each arising from a papillate base. . . . . **M. costata** Lansberge, p. 52.

5. ASEMINAE

1. Spines on abdominal tergites long, straight, testaceous and never with subapical setae (fig. 36). Pronotum usually with a pair of paramedian, rather large, shallow depressions. Mesosternum broad and flat, with posterior margin at most slightly rounded. Vertex of head with only a few fine pale setae. Maxillary palpi slightly obliquely truncate.
Arhopalus tibetanus (Sharp), p. 78.
– Spines on abdominal tergites either curved or straight and ferruginous or darker; if straight, then each with a long subapical seta. Pronotum without depressions but sometimes with a pair of longitudinal grooves. Mesosternum narrow, with posterior margin either strongly rounded, protuberant or confluent with metasternum. . . 2
2. Pronotum (fig. 37) bearing a few stout curved spines arising from large basal tubercles near lateral margins. Abdomen with subparallel sides. Robust, maximum breadth 10 mm. . . . . **Spondylis buprestoides** (Linnaeus), p. 79.
– Pronotum (fig. 40) with spines slender, straight, and not arising from large basal tubercles. Abdomen (fig. 40) tapering posteriorly. Slender, maximum breadth 5·5 mm. . 3
3. Abdominal tergite 8 with numerous short, stout, ferruginous spines. Clypeus with several short ferruginous spinules extending more or less transversely behind front margin. Vertex of head with numerous spines. Mesosternum parallel-sided and ending in a rounded protuberant process. Abdominal sternites 4–7 with paired sublateral groups of moderately long ferruginous spines (fig. 38). Maxillary palpi cylindrical and rounded apically. Spiracles with peritreme testaceous and completely raised above general level of cuticle. . . . . **Asemum** (**striatum** (Linnaeus)), p. 79.
– Abdominal tergite 8 with at most three or four small spines. Clypeus without spinules. Vertex of head with two to six minute spines. Mesosternum slightly tapering and not protuberant but confluent with metasternum. Abdominal sternites 4–7 with paired sublateral groups of minute spines, each equipped with a long, fine, subapical seta.

Maxillary palpi explanate and obliquely truncate apically. Spiracles with peritreme white and with only anterior half raised above general level of cuticle.

Tetropium oreinum Gahan, p. 80.

6. CERAMBYCINAE

1. Prothorax with a pair of lateral tubercles which are usually long and acutely pointed. Head with vertex dome-shaped (fig. 60), and usually with a deep transverse impression above bases of antennae; base of clypeus with a similar impression. Abdominal tergite 7 with hind margin strongly rounded, sometimes with a single or a pair of oval, spinose, tuberculate protuberances but never with stout recurved spines or scattered spinules. Abdominal spiracles with peritreme narrowly oval. Antennae recurved beneath body. 2

– Prothorax without lateral tubercles. Head never with vertex dome-shaped (except *Dere* but then elytra spiculate) or with a deep transverse impression above antennae; clypeus without a deep impression. Abdominal tergite 7 with hind margin feebly rounded, without spinose protuberances but often with a row of stout curved spines or numerous scattered spinules. Abdominal spiracles with peritreme broadly oval or subcircular. 6

2. Antennae filiform or feebly serrate and sometimes crossed beneath body (fig. 60). Pronotum without papillae on raised tuberculate areas near base. 3

– Antennae strongly pectinate and recurved but not crossed beneath body. Pronotum with a pair of paramedian, raised, tuberculate areas (each bearing numerous setose papillae) near base (fig. 78). [Hind femora strongly clavate. Abdominal tergite 7 either with a pair of oval tuberculate protuberances (each bearing a few spines) or with a single median spinose protuberance.] Phoracanthini. 5

3. Antennae not crossed beneath body. Pronotum with lateral tubercles acutely pointed and strongly protuberant and with front margin strongly produced and conical medially. [Spines on abdominal tergites mostly inclined anteriorly.]

Aromia moschata (Linnaeus), p. 186.

– Antennae crossed beneath body (fig. 60). Pronotum with lateral tubercles blunt, only slightly protuberant; front margin not produced medially. [Abdominal tergite 7 wtihout stout curved spines. Pupal cell with calcareous lining and or operculum.] Cerambycini. 4

4. Tergite 8 with posterior angles rounded and explanate. Tergite 9 strongly bilobed and protuberant; not concealed from above by tergite 8.

Pachydissus (African spp.), p. 104.

– Tergite 8 with posterior angles acutely produced posteriorly. Tergite 9 only slightly bilobed and concealed from above by tergite 8. [Antennae feebly pectinate on outer margin.] . . . . . **Plocaederus (basalis** Gahan), p. 114.

5. Pronotum very elongate, with front margin strongly rounded and bearing groups of fine pale setae (fig. 78). [Vertex of head not visible from above.]

Coleocoptus senio Newman and **Coptocercus biguttatus** (Donovan), pp. 137, 139.

– Pronotum quadrate, with front margin feebly rounded; bearing scattered, short, curved spines near lateral margins. [Apices of elytra produced into a spine-like tubercle.]

Phoracantha semipunctata (Fabricius), p. 132.

6. Head with a conical tubercle alongside base of antenna. Segment 1 of antenna acutely produced apically. [In calcareous cocoon.] . . . . **Xystrocera** spp., p. 83.

– Head without tubercles. Segment 1 of antenna not acutely produced. . . 7

7. Head bearing setae on front near antennal bases. Pronotum with conspicuous groups of pale papillae (each with a basal seta). [Pronotum elongate. Eyes strongly convex. Antennae recurved but not crossed beneath body. Abdominal tergite 7 with three or four anteriorly curved spines arising from tuberculate bases.] Molorchini, Obriini and allied genera. . . . . **Molorchus** (Palaearctic spp.), p. 155.

– Head glabrous. Pronotum without conspicuous groups of setae; either glabrous or sparsely setose or papillate. 8

8. Basal segments of antennae and elytra bearing numerous papillae or spinules (fig. 89). Cleomenini. . . . . **Dere** sp., p. 152.

– Basal segments of antennae and elytra without papillae or spinules. 9

9. Abdominal tergite 7 without a row of anteriorly-curved spines or tubercles (fig. 98). Pronotum never with stout spines or papillae, usually glabrous. Antennae long, extending at least as far as abdominal segment 2, where they are curved beneath body. Eyes feebly convex. Hind femora short, stout and lying rather obliquely to longitudinal axis of body and extending to abdominal segment 4 or 5. Segment 9 very short but visible from above. Callidiini. 10

– Abdominal tergite 7 with a transverse row of four to eight stout spines which are curved anteriorly or inwards (figs. 116, 119). Pronotum bearing some rather stout spines or papillae along front and lateral margins. Antennae short, not extending beyond abdominal segment 3. Eyes strongly convex. Hind femora long and slender, lying more or less parallel to longitudinal axis of body and extending to abdominal segment 5 or 6. Segment 9 retracted in segment 8 and not visible from above. [Pronotum slightly transverse, with sides strongly rounded.] Clytini. 12

10. Abdominal tergite 8 with a longitudinal median groove, on each side of which are numerous spines (fig. 98). Mesonotum with several fine, pale setae on each side of scutellum and metanotum with numerous similar setae. Abdominal tergites 1–6 each with numerous short ferruginous spines which are arranged in a row across anterior and posterior margins and in a broad semi-oval group near each lateral margin (fig. 98). Tergite 7 very elongate, with hind margin narrowly rounded (fig. 98). Segment 9 bilobed, each lobe bearing a fine seta. . . . . **Hylotrupes bajulus** (Linnaeus), p. 161.

– Abdominal tergite 8 without a groove and with at most four short spines near centre. Mesonotum and metanotum usually without setae but sometimes with a few short testaceous spines. Abdominal tergites 1–6 each with only a few spines which are arranged in a row across posterior margin only and never formed into sublateral groups. Tergite 7 less elongate and with hind margin rather sharply angled medially or broadly rounded. Segment 9 not bilobed. 11

11. Pronotum with a few conical papillae above middle of posterior margin. Mesonotum and metanotum bearing a few short testaceous spines. Tergite 7 with hind margin produced and rather sharply angled medially. Tergite 8 slightly elongate and with about four short spines near centre. . . . . **Callidium** (and **Callidiellum**?), p. 174.

– Pronotum simple. Mesonotum and metanotum without spines. Tergite 7 with hind margin simple. Tergite 8 transverse and without spines. [Pronotum bearing a conspicuous conical, tuberculate process just behind middle of front margin.]
Phymatodes (**testaceus** (Linnaeus)), p. 175.

12. Abdominal tergite 7 with a transverse row of at least eight stout, anteriorly curved spines across posterior margin and four pairs of inwardly curved spines along middle (fig. 116). Pronotum with fine pale setae along lateral margins. [Chiefly in bamboo.]
Chlorophorus annularis (Fabricius), p. 193.

– Abdominal tergite 7 with a transverse row of not more than six, stout, anteriorly curved spines across posterior margin and with remaining spines not arranged in four pairs along middle (fig. 119). Pronotum with ferruginous tubercles, spines or spinules. . 13

13. Hind femora stoutly clavate and not extending beyond abdominal segment 5. Pronotum with disc feebly convex and transversely rugose.
Xylotrechus (New World species only?), p. 204.

– Hind femora slender, subparallel-sided and not extending as far as abdominal segment 6 (fig. 119). Pronotum with disc strongly convex and smooth (fig. 119).
Clytus (**arietis** (Linnaeus)), p. 197.

7. LAMIINAE

1. Abdominal tergite 9 produced into a long, vertical, spine-like process which is sclerotized apically. Pronotum with a pair of stout lateral tubercles (fig. 142). . . . 2
- Abdominal tergite 9 seldom with a vertical, spine-like process, but if so (*Eunidia*) then process much shorter and body length not exceeding 15 mm. 4
2. Antennae arranged ventrally in two or more coils. Apical segment of tarsi each with a short seta. Length not exceeding 35 mm. Monochamini. 3
- Antennae arranged in a single complete or almost complete coil. Apical segment of tarsi glabrous. Length usually at least 50 mm. and form extremely robust (Pl. XII, fig. 2 and fig. 142). [Abdominal segments 2–5 each bearing a transverse band of long dense setae.] Batocerini. . . . . **Batocera** spp., p. 256.
3. Caudal process on abdominal segment 9 T-shaped apically (fig. 130); lateral margins of this segment angulate. Mandible bearing four to six stout spines on outer face. Setae numerous and dense on first three abdominal segments, becoming gradually less numerous on posterior segments.
Epepeotes spinosus (Thomson) and **E. luscus** (Fabricius), pp. 225, 228.
- Caudal process on abdominal segment 9 simple, spine-like; lateral margins of this segment straight or slightly curved from ventral lobes to apex of the process.
Dihammus mixtus (Hope), p. 242.
4. Abdominal segment 9 extremely short, densely setose and truncate posteriorly. Pronotum with a pair of very broadly rounded lateral tubercles which are densely setose. Apices of elytra pale ferruginous and slightly thickened into a flange which is embraced by the antenna. Xylorhizini . . . . **Thylactus (longipennis** Pascoe), p. 292.
- Abdominal segment 9 never densely setose and truncate posteriorly. Pronotum never with lateral tubercles which are broadly rounded and densely setose. Elytral apices simple. 5
5. Labrum rather strongly protuberant, with numerous or a dense group of long fine setae across base (fig. 157). Abdominal spiracles with peritreme reniform. Abdominal tergites 1–6 each with two more or less complete transverse rows of long stout, usually curved spines (each with a fine basal seta). Clypeus with a pair of setae at each end of basal margin. Femora with subapical setae. Mesosini, Niphonini. 6
- Labrum not strongly protuberant, generally glabrous. Peritreme of abdominal spiracles never reniform. Abdominal tergites with spines, if present, not arranged in two transverse rows. Clypeus usually with at least six setae across basal margin, but if with only four, then femora without setae or with both spines and setae. . . . 9
6. Antennae long, arranged in a single loop, the apices extending beyond front coxae (fig. 167). [Prothorax without lateral tubercles.] . . . **Mispila tonkinea** Pic, p. 302.
- Antennae shorter, not extending beyond middle coxae. 7
7. Prothorax without lateral tubercles. Elytra placed almost parallel to abdomen.
Pterolophia, p. 40.
- Prothorax with a pair of blunt lateral tubercles (figs. 150, 157). Elytra placed obliquely to abdomen (figs. 150, 157). 8
8. Spines on tergite 9 slightly smaller than those on tergite 7 and pale ferruginous. Pleura each bearing three spines. . . . . **Mesosa (nebulosa** (Fabricius)), p. 280.
- Spines on tergite 9 slightly larger than those on tergite 7 and dark ferruginous. Pleura each bearing five spines. . . . . **Coptops aedificator** (Fabricius), p. 272.
9. Antennae terminating in a single coil beneath body. Abdominal tergite 9 bearing a pair of slender urogomphi and numerous stout spines (each with a subapical seta). Ceroplesini. **Diastocera wallichi** (Hope) and s.sp. **tricincta** (Donovan), p. 287.
- Antennae not coiled beneath body. Abdominal tergite 9 without urogomphi (except *Exocentrus* in which they are minute and accompanied by a vertical spine). . . 10
10. Antennae extending to beyond hind femora, where they are recurved beneath body (fig. 177). Middle and hind femora each with a very long, tapering, tuberculate process

near base (fig. 175). Pronotum spinose and with a pair of sub-basal, lateral tubercles. Abdominal sternites glabrous. Acanthocinini. 11

– Antennae never extending beyond middle femora before being recurved beneath body (fig. 187). Middle and hind femora generally simple but sometimes with a very short tuberculate process which is less than one fourth length of tarsus. . . . 12

11. Abdominal segment 8 about as long as broad. Elytra glabrous.
Exocentrus flemingiae Fisher, p. 330.

– Abdominal segment 8 extremely elongated (fig. 177). Elytra with two or three stout spines opposite mesonotum (fig. 177). . . . **Acanthocinus (aedilis** (Linnaeus)), p. 335.

12. Abdominal tergites 2–6 with bilobed ampullae which bear groups of curved, hook-like spines. Antennae very long, extending ventrally as far as head, where they are curved over onto vertex. Clypeus with about 12 setae across base. Sternites 4–8 with numerous scattered, very fine setae. Pleura bearing several fine setae. [In stems of herbaceous plants and shrubs.] Hippopsini and Spalacopsini (see Duffy, 1957a, 1960).

– Abdominal tergites 2–6 with ampullae, if present, less strongly protuberant and with spines, if present, straight. Tergite 7 simple. Antennae shorter (fig. 171), never recurved over head. Clypeus with at most six setae at base. Vertex of head with only two or three pairs of stout setae or spines. Sternites 4–8 without setae or with a few minute spinules or setae. Pleura either without setae or with two or three short spines. . . 13

13. Vertex of head densely setose, almost pubescent (fig. 171). Segment 9 bearing numerous very long, stout, modified setae which are swollen and truncate apically (fig. 171). Tarsal claws each with at least ten long stout setae (fig. 171). Apomecynini (pars I).
Apomecyna (binubila Pascoe), p. 319.

– Vertex of head either with only a few widely separated setae or glabrous. Abdominal segment 9 without modified setae. Tarsal claws each with a single seta or glabrous. 14

14. Tergite 9 with a long vertical spine-like process which is sclerotized apically. Apomecynini (pars II). . . . . **Eunidia** spp., p. 324.

– Tergite 9 without a vertical process. 15

15. Mandibles with setae arising from conspicuous conical papillae or stunted spines (Frontispiece). Abdominal sternite 9 bilobed, each lobe bearing several short conical spines (each with a very long basal seta). [Usually in pseudobulbs of orchids.] Apomecynini (pars III). . . . . **Diaxenes dendrobii** Gahan, p. 322.

– Mandibles bearing setae only. Abdominal sternite 9 not bilobed. . . . 16

16. Disc of pronotum (fig. 180) bearing numerous short spines (each with a long basal seta). Mandibles with three pairs of setae near middle of outer face. Hind femora extending at least to abdominal segment 5. [Apices of hind tarsi extending posteriorly beyond apices of elytra. Sternites 4–8 glabrous.] Gleneini. . **Glenea** (Ethiopian spp.), p. 338.

– Disc of pronotum bearing setae only. Hind femora extending only as far as abdominal segment 3 or 4. Mandibles with two pairs of setae near middle of outer face. Phytoeciini. 17

17. Antennae long, recurved and extending ventrally at least as far as maxillary palpi. [Disc of pronotum bearing a few fine setae which are simple basally.]
Phytoecia (cylindrica (Linnaeus)), p. 355.

– Antennae shorter, extending ventrally as far as middle tarsi or front tibiae (fig. 185).
Oberea (Palaearctic spp.), p. 354.

Pterolophia

1. Pronotum almost glabrous, bearing only a few widely scattered pale, short, inconspicuous setae. . . . . **P. camura** Newman, p. 309.

– Pronotum rather densely covered with at least 50 long testaceous setae.
P. albivenosa Pascoe, p. 316.

DESCRIPTIONS AND BIONOMICS OF THE IMMATURE STAGES

THE general form of adults of this family is rather elongate, more or less flattened, subcylindrical and often somewhat narrowed posteriorly. Many species are well known for their cryptic coloration and mimicry of other beetles as well as bees, wasps, ants, crickets and so forth. Their characteristic antennae, which have gained them the name of "Longhorns", arise from conspicuous tubercles on the front of the head and are usually capable of being reflexed backwards. Generally they are more or less filiform (occasionally pectinate, tufted or clubbed) and as long as, though often considerably longer than, the body. But this peculiarity by no means applies to them all. Another characteristic is the formation of the tarsi, which although always 5-segmented have, with few exceptions, segment 4 considerably reduced so that they appear to be only 4-segmented. Segment 3 is always strongly bilobed. The tibiae each bear a pair of distinct spurs. In general structure many resemble members of the Chrysomelidae or "Leaf Beetles", from which they may usually be distinguished by the more elongate form, the reflexible antennae and the pubescent elytra; moreover, there is a tendency for the epimera of the metathorax to extend to the sides of the ventral segments, while in the latter family the first abdominal sternite is prolonged forwards at the sides to meet the metathorax.

The family Cerambycidae may conveniently be divided on immature characters into nine subfamilies, namely the ANOPLODERMINAE (larvae of which have recently been studied), PARANDRINAE, PRIONINAE, LEPTURINAE, OXYPELTINAE, DISTENIINAE, ASEMINAE, CERAMBYCINAE and LAMIINAE. Of these, the following are represented in the Oriental region: PRIONINAE, LEPTURINAE, DISTENIINAE, ASEMINAE, PHILINAE, CERAMBYCINAE and LAMIINAE. Larvae of the PHILINAE have so far not been studied but they may well prove to possess clear-cut subfamily characteristics and to provide useful indications concerning the phylogeny of the family as a whole.

Although an attempt has been made to adhere as closely as possible to the sequence of tribal and generic classification as cited in the *Coleopterorum Catalogus* of Junk and Schenkling (1912–1923), a number of exceptions have had to be made. In each case, however, the original position has been indicated, together with a cross-reference to the proposed taxonomic position where reasons for the transference are discussed. In the interests of brevity, full synonomy has not been included except under exceptional circumstances or where it is considered there may be obvious confusion. Vernacular names have been given whenever possible.

The distribution given for each species comprises a list of countries arranged alphabetically under their respective regions, but it should be pointed out that these lists are not necessarily complete, for they are based mainly on collections in the British Museum (Natural History) and on various catalogues. They are, in fact, provided merely to give a general picture of distribution. The localities listed have

been segregated into zoogeographical regions, namely Oriental, Australasian and Palaearctic, these regions being shown on the accompanying outline map (fig. 11) as black, striped and stippled areas respectively. It will be noticed that New Guinea is here regarded as part of the Oriental region for the purposes of this present series of monographs (see also Duffy, 1963, p. 1). Species occurring in the Seychelles have already been discussed in the author's previous monograph (1953a).

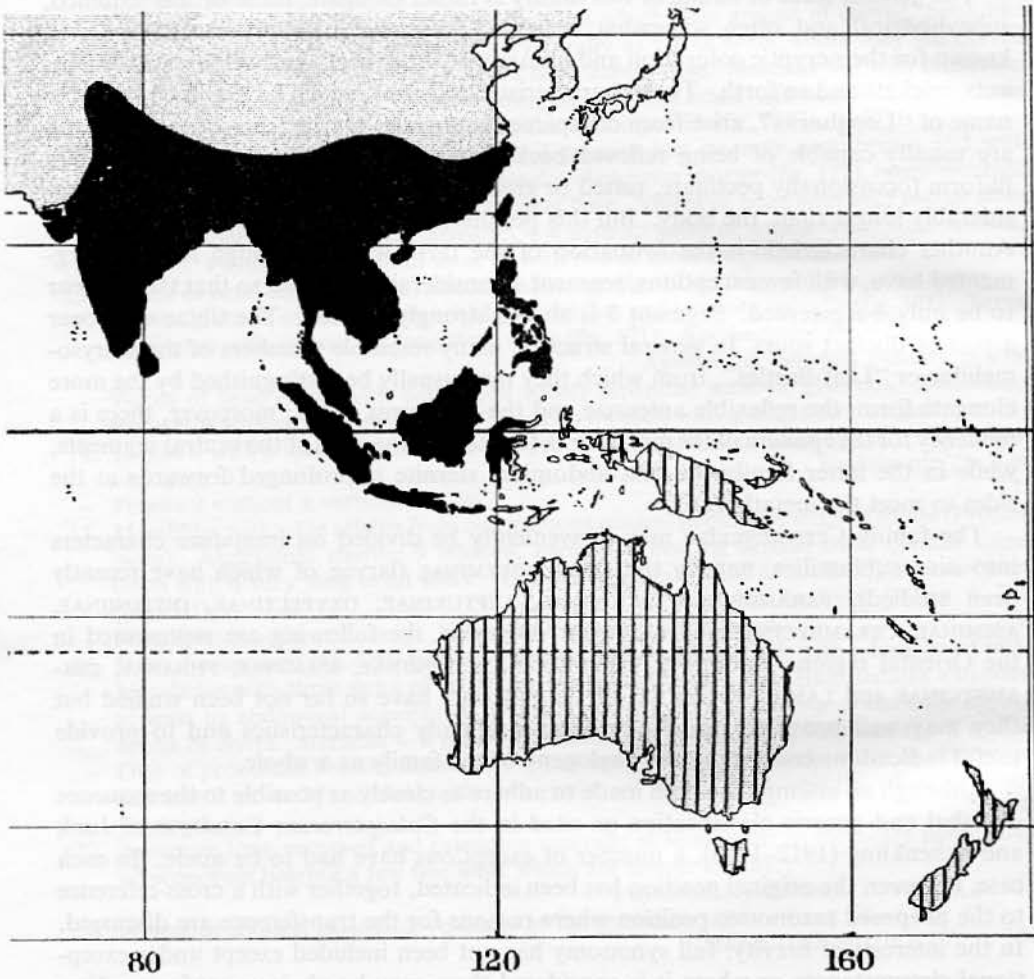


Fig. 11. Outline map of Asia and Australasia showing boundaries of zoo-geographical regions, namely Oriental (black), Australasian (striped) and Palaearctic (stippled).

In listing the references to each species and the material examined, the following abbreviations have been adopted:

In coll. B.M. — In the collection of the British Museum (N.H.), London.

In coll. F.R.I.D.D.	In the collection of the Forest Research Institute and College, Dehra Dun (U.P.), India.
In coll. U.S.N.M.	In the collection of the United States National Museum, Washington, U.S.A.
In coll. D.A.M.	In the collection of the Department of Agriculture, Kuala Lumpur, Malaya.
In coll. U.Z.M.C.	In the collection of the Universitetets Zoologiske Museum, Copenhagen, Denmark.
In coll. F.P.R.L.	In the collection of the Forest Products Research Laboratory, Princes Risborough, Bucks., England.
In coll. D.A.T.	In the collection of the Department of Agriculture, Bangkok, Thailand.
In coll. D.A.N.S.W.	In the collection of the Department of Agriculture, New South Wales, Australia.
In coll. F.C.N.S.W.	In the collection of the Forestry Commission, New South Wales, Australia.
In coll. D.A.S.B.	In the collection of the Department of Agriculture and Stock, Brisbane, Australia.

Leg.=collected by; E.A.J.D. leg.=collected by the author; E=egg, eggs; L=larva, larvae; P=pupa, pupae; I=imago, imagines (adults); Biol.=biology; Physiol.=physiology; Contr.=control; Fig.=figured or photographed; Paras.=parasites and/or predators.

1. PRIONINAE

Larval Characters

Form robust, subcylindrical and tapering posteriorly. *Head* usually quadrate to slightly transverse, seldom slightly elongate; widest behind middle; dorsal margins of epicranial halves fused behind frons, but sometimes separating near the base; tentorial cross-arm in same plane as hypostoma, forming a bridge behind it, which divides the occipital foramen into an anterior and a posterior portion. Front margin of frons strongly sclerotized, often abruptly sloping, with its lower boundary projecting over clypeus and its upper boundary dentate or carinate; six epistomal setae present. Clypeus thick, trapezoidal, as wide at base as front margin of frons. Labrum thick and lanceolate, cordate, transversely elliptical or orbicular. Mandibles wedge-shaped (fig. 19), cutting edge broadly emarginate; apex produced, acute. Ocelli present or absent. Antenna (figs. 16, 17, 19) 2- or 3-segmented, conical, partly retractile; segment 2 barrel-shaped or cylindrical, obliquely truncate, hollowed at tip and often bearing a small third segment. Subfossal process and postcondylar carina present (fig. 12) (except *Sarmydus* and *Anoeme*). Ventral mouthparts attached to hypostoma by slightly more than width of gula. Maxillae movable; cardo distinct; palpifer with outer margin rounded, lobe borne on stipes; maxillary palpi short, conical, robust, 3-segmented, segment 3 relatively short and cylindrical, blunt or conical, the tip being truncate and bearing a sensory impression. Ligula large, fleshy and densely covered with short

stout setae. *Prothorax* with eusternum partially or entirely and lateral zone distinct. *Abdomen* with dorsal ampullae with two transverse impressions, ventral ampullae with one. Epipleura protuberant on last three segments only; segment 9 large, elongate, usually extended. *Legs* distinct, stout, conical; unguiculus imbricately spinose. *Spiracles* of mesothorax protruding into prothorax; abdominal spiracles with small marginal chambers occasionally present.

First-instar larvae of this subfamily are exceptional in that they do not usually possess egg-bursting spines (see Duffy, 1953a, p. 61).

Macrotomini

Macrotoma (Zooblax) crenata (Fabricius)

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Bihar, Calcutta, Maharashtra, Madras, Nepal, Uttar Pradesh, W. Bengal), Jammu and Kashmir, W. Pakistan (Hyderabad, W. Punjab).

Host plants: *Eucalyptus* sp., *Mangifera indica*, *Quercus dilatata*, *Q. incana*, *Shorea robusta*, *Tamarix articulata*, *T. gallica*, *Salmalia malabaricum* (Beeson and Bhatia, 1939); *Prunus amygdalus*, *Ficus religiosa* (Janjua and Samuel, 1941); *Schrebera swietenioides* (Mathur and Balwant Singh, 1961a).

Adult (Pl. I, fig. 1). Length 37–53 mm. Dark brown, except elytra which are light brown, becoming darker towards base. *Head* with antennae reaching to apical third or fourth in male but not beyond middle in female. *Prothorax* with sides converging anteriorly and bearing a series of small spines or teeth; disc (in male) with two triangular, punctate, slightly depressed glabrous areas, two small rugose spots external

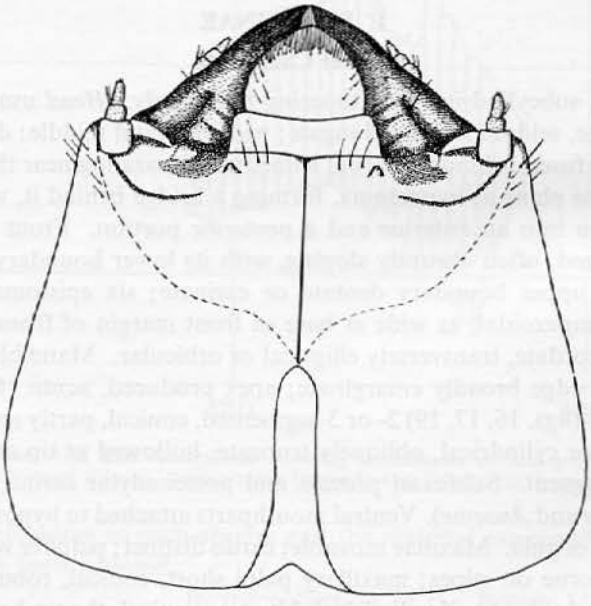


Fig. 12. *Macrotoma crenata* (Fabricius). Mature larva. Head. Dorsal aspect.

to these and a transverse glabrous band at base; disc (in female) strongly and rather closely punctured towards sides, less closely medially, where it is smoother and more shining. *Elytra* densely granulose, broadly rounded apically, often with a minute spine or tooth at sutural angle.

Mature larva (fig. 12). Form subcylindrical, robust. *Head* (fig. 12) moderately depressed, slightly transverse; frons pale testaceous, except middle of front margin and dorsal mandibular articulations which are dark brown; front margin roundly declivous, without a carinate upper boundary and lower boundary not produced over clypeus. A small dentate process present near inner termination of postcondylar carina (fig. 12). Postcondylar carina and subfossal process distinct, the latter bluntly rounded apically. Antenna 2-segmented; segment 2 strongly elongate and obliquely truncate apically; basal membrane strongly produced beyond foramen, the latter smooth, evenly rounded and closely surrounding the membrane but not concealing the inner face. Ocelli indiscernible. Mandible robust, pitchy, shining, with outer face strongly rugose. Labrum subquadrate, cordate, with front margin very densely fringed with long bristly setae. Gula extremely short, with sutures diverging to meet anterior portion of occipital foramen. Maxillary palp with segment 3 acutely conical, slightly shorter than segment 2. Basal segment of labial palpi strongly swollen. *Prothorax* obliquely inclined dorsally, about twice as broad as long; pronotum milky white, sparsely setose anteriorly, vermiculately rugose posteriorly; median cleavage line very shallow and incomplete; eusternum and sternellum sparsely setose and vermiculately rugose; presternum non-tuberculate. *Mesonotum* and *metanotum* smooth, glabrous. *Abdomen* with dorsal and ventral ampullae on segments 1–7 indistinctly defined, slightly wrinkled. Segment 9 large, slightly extended. Anus trilobed, each lobe strongly protuberant. *Legs* shorter than maxillary palpi, testaceous; unguiculus slightly attenuated. *Spiracles* with peritreme broadly oval, moderately thick and slightly raised above general level of cuticle. Length up to 76 mm.; maximum breadth (at prothorax) 16 mm.

Biology. The larval galleries extend irregularly in the wood, penetrating deep into the core; they are about $\frac{3}{4}$ to $1\frac{1}{4}$ in. across, packed with a rather compact mass of fibres. The pupal cell is an irregular excavation about 4 by 2 in., containing loosely aggregated masses of fibres. The exit-tunnel narrows appreciably towards the extremity and extends almost horizontally to the outside. The exit-hole is subrectangular, $\frac{5}{16}$ by $\frac{9}{16}$ of an inch. The life-cycle is annual, with emergence taking place from June to September (Beeson and Bhatia, 1939).

Control. Oviposition in fuel stacks can be prevented by removing the bark of logs felled after March.

References. Beeson, 1919b (L, P fig., Biol.), 1941 (Biol., Contr.); Beeson and Bhatia 1939 (Biol.); Gardner, 1927 (L.), 1942 (L); Janjua and Samuel, 1941 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.), 1961a (Biol.).

Macrotoma (Zooblax) plagiata Waterhouse

Distribution. ORIENTAL REGION: India (Uttar Pradesh, W. Bengal), Jammu and Kashmir.

Host plants: *Eucalyptus robusta, Heritiera minor, Juglans regia, Pyrus malus* (Beeson and Bhatia, 1939); *Prunus persica* (Mathur and Balwant Singh, 1950d).

Mature larva. Very similar to that of *M. crenata* (Fabricius). For differences, see key (p. 11).

Biology. The larval galleries penetrate the heartwood irregularly, running across as well as with the grain and are tightly packed with wood fibres; the diameter is often $\frac{3}{4}$ of an inch. There are no definite subcortical galleries. The pupal cell is an irregular excavation, being simply an enlargement of the larval gallery. The life-cycle is normally annual but in dry wood it may be prolonged to as much as five years. Adults emerge through subrectangular exit-holes between June and August (Beeson and Bhatia, 1939).

References. Beeson, 1919b (L fig., P fig., I fig., Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L), 1942 (L); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960d (Biol.).

Macrotoma (Zooblax) spinosa (Fabricius)

Distribution. ORIENTAL REGION: Ceylon, India (Madhy Pradesh, Madras, Mysore, W. Bengal). PALAEARCTIC REGION: Arabia.

Host plants: *Casuarina equisetifolia, Lannea coromandelica* (Beeson and Bhatia, 1939).

Biology. Adults occur from June to August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Macrotoma (Bandar) fisheri C. O. Waterhouse

Distribution. ORIENTAL REGION: Burma, China, Formosa.

Host plants: *Castanea mollissima, Diospyros kaki, Malus pumila, Pistacia chinensis, Prunus armeniaca, P. persica, Pyrus serotina, Quercus variabilis* (Gressitt, 1951).

Reference. Gressitt, 1951 (Biol.).

Olethrius tyrannus J. Thomson

Distribution. ORIENTAL REGION: New Guinea, New Britain. AUSTRALASIAN REGION: Australia, Fiji, New Caledonia, New Hebrides, Solomon Is., Woodlark.

Host plants: *Cocos nucifera* (Froggatt, 1911); *Theobroma* (Risbec, 1937); *Bruguiera rheedii, Rhizophora mucronata* (Greenwood, 1940); *Leucaena glauca* (G. S. Dun).

Mature larva. Rather similar to that of *Macrotoma crenata* (Fabricius) but differing as follows. *Head* with front margin of frons broadly ferruginous to pitchy; upper boundary transversely carinate; lower boundary irregularly produced over clypeus. Antennal basal membrane not or scarcely produced beyond inner margin of foramen, the latter dentate. Three pairs of distinct ocelli present. *Prothorax* with lateral areas of presternum each with at least 20 rounded or subconical tubercles, the innermost and largest of which being strongly sclerotized, ferruginous and dentate. *Abdomen*

with dorsal and ventral ampullae on segments 1–7 very distinct, with deep furrows. Length up to 100 mm.; maximum breadth (at prothorax) 27 mm.

Biology. Eggs are deposited in batches beneath the bark of dead or dying trees. For this reason this species is not regarded as a serious pest. According to Risbec (1937), mature larvae excise a disc of bark before pupating, a habit which is more characteristic of certain LAMIINAE and which should be verified.

Material studied. 2 L, New Britain, Keravat, i. 1966, from *Theobroma*, G. S. Dun leg. and pres., in coll. B.M.

References. Cohic, 1953 (Biol.); Duffy, 1963 (Biol.); Froggatt, 1911 (L fig., Biol.); Greenwood, 1940 (Biol.); Lepesme, 1947 (Biol.); Risbec, 1937 (E fig., L fig., P fig., I fig., Biol. fig.).

Archetypus fulvipennis (Pascoe)

Distribution. ORIENTAL REGION: Aru Is., New Guinea, Solomon Is.

Mature larva. Rather similar to that of *Rhaphipodus* species from which it differs as follows. *Head* with front margin of frons with upper boundary very feebly, if at all, produced paramedially. One pair of large or two pairs of smaller contiguous ocelli present. *Abdomen* with segments 9 and 10 finely but rather densely setose. Length up to 60 mm.; maximum breadth (at prothorax) 14 mm.

Pupa. Very similar to that of *Rhaphipodus* (s.g. *Rhaphipodus*) *suturalis* Serville but differing as follows. *Pronotum*, *mesonotum* and *metanotum* bearing numerous scattered ferruginous spinules. *Abdomen* with urogomphi absent. Sternites spinulose. Length up to 45 mm.; maximum breadth 14 mm.

Material studied. 2 L, 1 P, 1 I, Solomon Is., Guadalcanal, Tenarn, viii.1965, from log, P. Greenslade leg. and pres., in coll. B.M.

References. None available.

Rhaphipodus (Remphan) hopei Waterhouse

Distribution. ORIENTAL REGION: Andaman Is., Borneo, Burma, Malaya, Penang Is., Singapore, Thailand.

Host plant: *Dipterocarpus turbinatus* (Beeson and Bhatia, 1939).

Mature larva (fig. 13). Rather similar to that of *Acanthophorus serraticornis* Olivier but differing as follows: *Head* (fig. 13) with front margin of frons narrowly pitchy, with upper margin produced into a pair of paramedian, acutely dentate processes, which evidently become more rounded in older larvae. Mandible without a basal tooth. Three pairs of distinct ocelli present, the vertical (postocular) carina absent. Labrum about as long as broad. Length 65–115 mm.

Egg. Yellowish buff. Ellipsoidal, strongly constricted before apices; micropylar end not distinguishable; chorion sculptured with a series of longitudinal and more or less sinuous ridges, which divide at irregular intervals into branches, the branches either ending freely in the inter-space, or rejoining the original ridge, or joining a neighbouring ridge; interspaces deeply pitted with oval pits, which extend transversely between the bordering carinae. Length 4·6 mm.; breadth 2·3 mm. (Beeson, 1919b).

Biology. Larvae of this species infest the heartwood of large logs. The galleries,

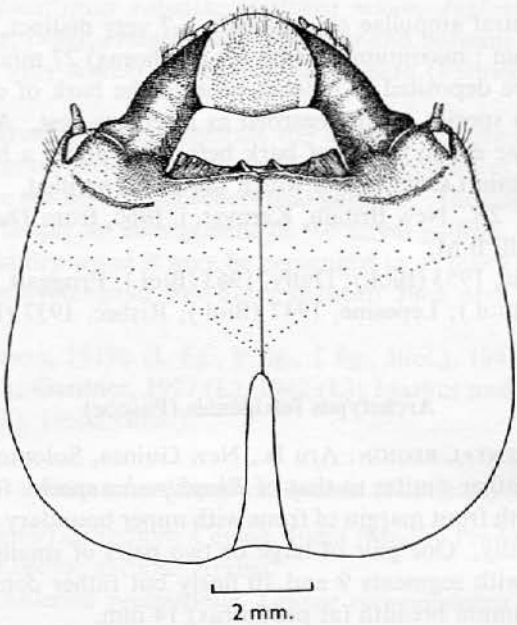


Fig. 13. *Rhaphipodus hopei* Waterhouse. Mature larva. Head. Dorsal aspect.

which are only narrowly separated, are loosely packed with coarse fibres and extend transversely through the heartwood; they are comparatively enormous, being two and three-quarters to four and a quarter inches wide and five-eighths to one inch deep. Adults appear to eclode during any month (Beeson and Bhatia, 1939).

Characteristic damage by this species to *Dipterocarpus* is shown on Pl. II and Pl. III, fig. 2.

Material studied. 1 L, Andaman Is., 20.iv.1918, from *Dipterocarpus turbinatus*, P. Blair leg., in coll. F.R.I.D.D.; 1 L, England (imported from India), 1962, F. Hunter pres., in coll. B.M.

References. Beeson, 1919b (E fig., L fig., P fig., I fig., Biol.), 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Gardner, 1927 (L), 1942 (L); Mathur and Balwant Singh, 1959 (Biol.).

Rhaphipodus (Rhaphipodus) suturalis Serville

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.

Mature larva. Very similar to that of *R. hopei* Waterhouse but differing as follows. *Head* with paramedian processes on front margin of frons feebly rounded and only slightly protuberant. Form more robust. Length up to 100 m.; maximum breadth (at prothorax) 21 mm.

Pupa. Head visible from above, glabrous. Antennae filiform, slightly curved beneath body and terminating about halfway alongside elytra. *Pronotum* glabrous, with sides broadly explanate, very feebly rounded, diverging posteriorly, with posterior angles obtusely dentate and slightly raised. *Mesonotum* and *metanotum* with a few

scattered papillae; scutellum with more numerous papillae. Elytra and wings extending to between abdominal segments 3 and 4. *Abdomen* with gin-traps present on tergites 2–3, 3–4, 4–5 and 5–6. Tergites each with a pair of paramedian elliptical areas which bear scattered pale ferruginous spinules. Segment 9 bearing a pair of short stout subcontiguous urogomphi bearing numerous pale ferruginous papillae. Sternites glabrous. Legs glabrous; hind femora extending as far as abdominal segment 4. *Spiracles* present on segments 1–6, the seventh and eighth pair being closed and probably non-functional; peritreme rather narrowly oval, thick and slightly raised above general level of cuticle. Length up to 55 mm.; maximum breadth 19 mm.

Material studied. 1 L, 1 P, Java, Malang, I.x.1904, Rouyer vend., in coll. U.Z.M.C.

References. None available.

Rhaphipodus (Rhaphipodus) gahani Lameere

Distribution. ORIENTAL REGION: India (Uttar Pradesh, W. Bengal).

Host plants: *Sapium sebiferum* (Beeson and Bhatia, 1939); *Salmalia malabarica* (Mathur and Balwant Singh, 1961).

Biology. Adults occur in August.

References. Beeson, 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Gardner, 1942 (L); Mathur and Balwant Singh, 1961 (Biol.).

Rhaphipodus (Rhaphipodus) subopacus Gahan

Distribution ORIENTAL REGION: India.

Host plants: *Ailanthus malabrica* (Bhasin and Roonwal, 1954); *Vateria indica* (Mathur and Balwant Singh, 1961b).

References. Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Xixuthrus microcerus (White)

Distribution. ORIENTAL REGION: Ceram, Java, Sumatra, New Guinea. AUSTRALASIAN REGION: Australia (Northern Territory), Celebes, Solomon Is., Moluccas (Kei Is.).

References. Duffy, 1963 (Biol.); Heller, 1904 (L, P fig.).

Callipogonini

Megopis (Aegosoma) tibialis White

Distribution. ORIENTAL REGION: India (W. Bengal).

Host plants: *Evodia fraxinifolia, Ilex hookeri, Lindera pulcherrima, Machilus odoratissima, Symplocos theaefolia* (Gardner, 1931); *Quercus dilatata* (Mathur and Balwant Singh, 1960d).

Mature larva (fig. 14). *Head* very slightly transverse, moderately depressed, with posterior median emargination rather shallow. Mouthframe rather strongly sclerotized and ferruginous, with only anterior margin of frons inclined to pitchy. Gena with postocular carina present. Front margin of frons (fig. 14) with upper boundary carinate, feebly protuberant and sinuate on each side of median emargination; lower boundary rather strongly and acutely produced over clypeus at lateral angles. Post-

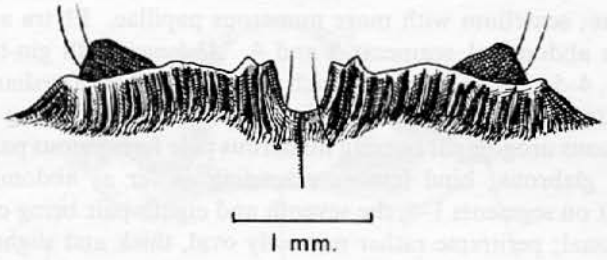


Fig. 14. *Megopis tibialis* White. Mature larva. Front part of head. Dorsal aspect.

condylar carina well defined, ferruginous; subfossal process distinct, bluntly rounded apically. Antenna 3-segmented; segment 3 elongate, nearly twice as long as breadth at base. Mandible with outer face strongly rugose and bearing several setae on basal half. Labrum cordate, ferruginous, fringed anteriorly with bristly setae. Three pairs of distinct ocelli present beneath antennal foramen; ocellar lens convex, pigmented spot indiscernible. *Prothorax* obliquely sloping anteriorly, about twice as broad as long. Pronotum rectangular, rugulose, shining and delimited laterally by a pair of shallow grooves; median cleavage line faint and incomplete. *Abdomen* with dorsal and ventral ampullae present on segments 1–7; each with two transverse furrows. Segments 7 and 8 smooth, the latter slightly extended. Segment 10 trilobed and bearing a few short, pale setae. *Legs* shorter than maxillary palpi and entirely testaceous, except apex of unguiculus. *Spiracles* with peritreme rather broadly oval, moderately thick, pale ferruginous, the posterior half entirely lined with subcontiguous marginal chambers. Length up to 65 mm.; maximum breadth (at prothorax) 14 mm.

Biology. Larvae infest old or decaying wood. The life-cycle is annual. Adults emerge in April and May, mainly May.

Material studied. 3 L, India, Darjeeling, ix.1929, from *Machilus odoratissima*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.), 1942 (L); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.), 1960d (Biol).

Megopis (Aegosoma) sinica sinica (White)

[The Thin-winged Longicorn Beetle]

Distribution. ORIENTAL REGION: Burma, China (Chekiang, Hopeh, Kiangsu, Shansi, Shantung, Szechwan), Formosa, PALAEARCTIC REGION: Japan, Korea, Ryukyu Is.

Host plants: *Abies firma*, *A. sachalinensis*, *Populus*, *Fraxinus*, *Mallotus japonicus*, *Salix babylonica*, *Pinus densiflora* (Kojima, 1931); *Fraxinus mandshurica*, *Robinia pseud-acacia* (Saito, 1932); *Forsythia mandshurica* (Matsushita, 1933); *Citrus* sp.?, *Morus alba*? (Gressitt, 1951); *Paulownia tomentosa* (Yano, 1934); *Pyrus malus* (Chang, 1963).

Biology. The life-cycle is usually two years in duration. The condition of trees susceptible to attack varies according to the host species. *Abies firma* and *Pinus dense-*

flora were found to be dead and highly decayed when infested. Dead stumps of *Mallotus japonicus* were found to contain numerous larvae. But in the case of *Salix babylonica*, living trees are infested, though mainly in the basal portion. Adults emerge mostly during July and August. The larvae bore inwards and upwards, making a flattened gallery. The pupal cell is plugged at the entrance with fibrous shreds, the beetle emerging by gnawing a round hole from the cell (Kojima, 1931).

References. Bates, 1873 (Biol.); Chang, 1963 (Biol.); Cheo, 1935 (Biol.); Gardner, 1942 (L); Gressitt, 1951 (Biol.); Kojima, 1931 (L fig., Biol.), 1959 (L fig.); Matsumura, 1921 (?); Matsushita, 1933 (Biol.); Nijima, 1913 (?); Saito, 1932 (?); Shiraki, 1942 (Biol.); Yano, 1934 (Biol.), 1936 (Biol.).

Megopis (Aegosoma) sinica ornaticollis (White)

Distribution. ORIENTAL REGION: Burma, China, East Indies, Formosa, India (Assam).

Host plants: *Salix* sp., *Morus* sp. (Gressitt, 1951).

Reference. Gressitt, 1951 (Biol.).

Megopis (Aegosoma) buckleyi Gahan

Distribution. ORIENTAL REGION: Formosa, India (Uttar Pradesh).

Host plant: *Quercus dilatata* (Beeson, 1941).

Mature larva (fig. 15). Similar to that of *M. tibialis* White, from which it differs as follows. *Head* with segment 3 of antenna subquadrate. Upper boundary of front margin of frons strongly dentate or bidentate on each side of median emargination (fig. 15).

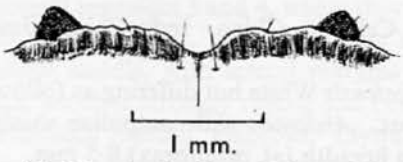


Fig. 15. *Megopis buckleyi* Gahan. Mature larva. Front part of head. Dorsal aspect.

Biology. This species infests rotting wood.

Material studied. 1 L, India, Mundali Chakrata, 14.iv.1933, from *Quercus dilatata*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Gardner, 1942 (L); Mathur and Balwant Singh, 1960d (Biol.).

Megopis (Baralipton) cingalensis White

Distribution. ORIENTAL REGION: Ceylon, India (Madras).

Host plants: *Acacia melanoxylon*, *Eucalyptus globulus*, *Michelia nilagirica*, *Rhododendron arboreum*, *Semecarpus thwaitesii* (Beeson, 1941); *Alseodaphne semecarpifolia* (Bhasin and Roonwal, 1954).

Mature larva (fig. 16). Similar to that of *M. tibialis* White, from which it differs as follows. *Head* with lower boundary of front margin of frons linear, not produced over clypeus (fig. 16).

Biology. Adults emerge in April (Beeson, 1941).

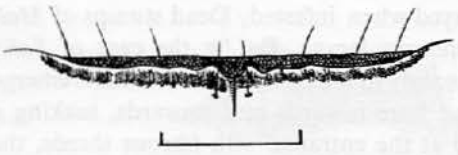


Fig. 16. *Megopis cingalensis* White. Mature larva. Front part of head. Dorsal aspect.

Material studied. 3 L, India, Madras, v.1930, from rotten wood, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L), 1942 (L); Mathur and Balwant Singh, 1959 (Biol.), 1960c (Biol.), 1960d (Biol.).

Megopis (Baralipton) costata Lansberge

Distribution. ORIENTAL REGION: Celebes, Java, Sumatra.

Host plant: *Quercus* (Kalshoven, 1955).

Mature larva. In the key (p. 12) this larva runs down to *Megopis marginalis* (Fabricius). As the latter is no longer accessible to the author it is not yet possible to separate these two species. Length up to 55 mm.; maximum breadth (at prothorax) 10 mm.

Pupa. Very similar to that of *M. nigropunctatus* Aurivillius, from which it may be distinguished by the presence of several rather stout ferruginous spinules on the pronotal disc. Length up to 34 mm.; maximum breadth 13 mm.

Material studied. 1 L (and 3 L of another genus), 2 P, 2 I, Java, Malang, 1.x.1904, Rouyer vend. in coll. U.Z.M.C.

Reference. Kalshoven, 1955 (Biol.).

Megopis (Baralipton) marginalis (Fabricius)

Distribution. ORIENTAL REGION: Borneo, Celebes, China, Indo-China, Java, Singapore, Sumatra, Thailand.

Mature larva. Very similar to that of *M. cingalensis* White but differing as follows. *Prothorax* with pronotum shining and glabrous. *Abdomen* with ampullae shining and glabrous. Length up to 40 mm.; maximum breadth (at prothorax) 8·5 mm.

Material studied. 4 L, Sumatra, Asakan, 8.x.1927, in old wood, W. B. Wood and H. Y. Gouldman leg., in coll. U.S.N.M.

References. None available.

Megopis (Baralipton) sanchezi Schultze

Distribution. ORIENTAL REGION: Malaya.

Host plant: *Pinus insularis* (Dammerman, 1929).

Reference. Dammerman, 1929 (Biol.).

Megopis (Megopis) costipennis White

Distribution. ORIENTAL REGION: East Pakistan, India (Assam, Sikkim).

Host plant: *Tectona grandis* (Maxwell-Lefroy and Howlett, 1909).

References. Cotes, 1896 (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Stebbing, 1914 (I fig., Biol.).

Megopis (Dinoprionus) cephalotes H. W. Bates

Distribution. ORIENTAL REGION: India (W. Bengal).

Mature larva. No material available. Gardner (1931a) gives the following description (see also key, p. 12): "Head capsule slightly wider than long; wider behind middle but without the swollen appearance of *Megopis tibialis*. Epistoma with a pair of teeth above clypeus which are much stronger than those of *M. tibialis*. Ocelli, three on each side. Labrum cordate, slightly wider than long. Ventral mouthparts distinctly more setose than in *M. tibialis*. Length of larva about 60 mm.; width of capsule about 9 mm.; these larvae probably not fully fed. Other characters very much as in *M. tibialis*."

References. Gardner, 1931a (L fig.), 1942 (L).

?Megopis (Dandamis) nigropunctatus Aurivillius

Distribution. ORIENTAL REGION: S. India.

Mature larva. Now that more material representative of this genus has become available, it seems likely that the larva described as that of *M. nigropunctatus* Aurivillius (Duffy, 1953a) has been wrongly associated. It appears in fact to be closely related to *Sarmydus*, as both the postcondylar carina and the subfossal process are absent and the antenna is distinctly 3-segmented. In addition, there are three pairs of ocelli present. As the true identity of this larva remains to be confirmed, it has not been included in the key.

Pupa. Head directed antero-ventrally and not concealed by pronotum; sides rounded, glabrous. Antennae filiform, moderately long, extending to between abdominal segments 3 and 4, where they are slightly curved ventrally to terminate alongside posterior tarsi. Maxillary palpi large and fleshy. *Pronotum* transverse, broadest behind middle, with lateral margins strongly rounded; disc with an oval elevated area, which is strongly rugose and bears several pale setose papillae. *Mesonotum* and *metanotum* smooth, glabrous. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 1–7 bearing numerous scattered, ferruginous spines (each with a basal seta); tergite 8 longer and narrower than tergite 7 and with a pair of conspicuously stouter spines (placed paramedially) as well as numerous smaller spines. Segment 9 bearing a pair of short stout, incurved urogomphi. Sternites glabrous. *Legs* with hind femora extending to abdominal segment 3. *Functional spiracles* present on abdominal segments 1–6, the remaining pair being partly closed and probably non-functional; peritreme narrowly oval, moderately thick, pale testaceous and distinctly raised. Length up to 30 mm; maximum breadth 10 mm.

Material studied. 1 L, 3P, India, Nilgiri Hills, i.1902, H. E. Andrews leg., in coll. B.M.

Reference. Duffy, 1953a (?L fig.).

Eurypoda (Neoprion) batesi Gahan

Distribution. ORIENTAL REGION: China, Indo-China (Viet Nam). PALAEARCTIC REGION: Japan.

Host plant: *Cinnamomum* (Gressitt, 1951); *Shiia cuspidata* (T. Fujimura).

Reference. Gressitt, 1951 (Biol.).

Prionini

Acanthophorus (Acanthophorus) serraticornis (Olivier)

Distribution. ORIENTAL REGION: E. Pakistan (E. Bengal), India (Bihar, Kerala, Madras, Mysore, Punjab, Sikkim, Uttar Pradesh, W. Bengal), W. Pakistan (Rawalpindi).

Host plants: *Salmalia malabarica*, *Mangifera indica*, *Morus alba*, *Shorea robusta* (Beeson and Bhatia, 1939); *Dalbergia sissoo* (Gardner, 1942).

Adult (Pl. I., fig. 3). Length 53–98 mm. Entirely reddish brown, except basal halves of antennae and pronotum which are pitchy. *Head* with antennae shorter than body, 12-segmented; segments 5–11 strongly produced apically on outer margin. Mandibles variable; in large males longer than head, strongly and gradually incurved from base and bearing two or three strong teeth; in small males they are similar to those of female, being short, incurved apically and bearing several teeth. *Prothorax* strongly transverse, bearing three pairs of lateral spines, the middle pair the longest. *Elytra* twice as long as broad, rounded apically.

Mature larva (fig. 17). Form cylindrical, very robust, gradually tapering posteriorly. *Head* moderately depressed, quadrate (maximum head-width 17 mm.). Gena very

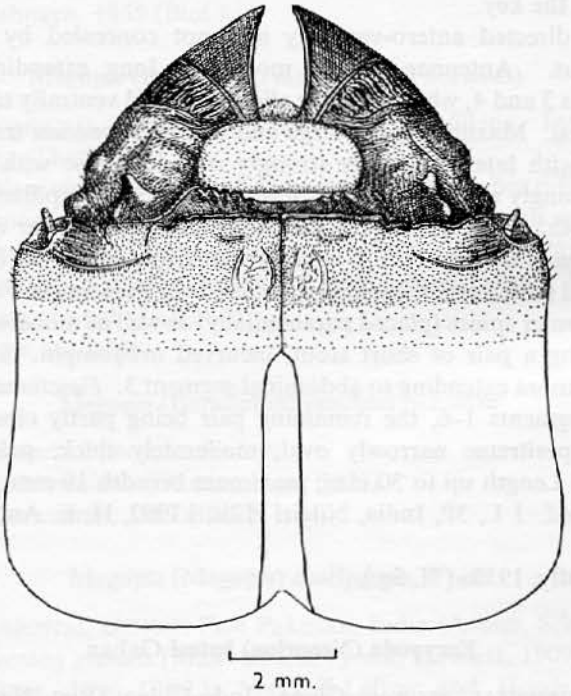


Fig. 17. *Acanthophorus serraticornis* (Olivier). Mature larva. Head. Dorsal aspect.

strongly shouldered, rugose, extremely broadly pitchy to ferruginous and with a strongly raised vertical carina beneath antennal foramen. Mouthframe very strongly sclerotized, broadly pitchy. Front margin of frons (fig. 17) broadly pitchy; upper boundary slightly produced over clypeus, with margin rather irregularly crenate; lower boundary strongly produced over clypeus, more strongly laterally, with margin rather strongly curved and pectinate. Postcondylar carina deep, with upper boundary regularly curved. Subfossal process strongly developed, acutely conical. Antenna salient, 2-segmented, segment 2 elongate, gradually narrowed to apex where it is obliquely truncate. Mandible very robust, pitchy, shining, with outer face very strongly rugose and bearing numerous scattered, short setae on basal half of outer face; a well developed basal tooth present near dorsal condyle (fig. 17). Labrum strongly transversely oval, leathery, ferruginous, with anterior margin very densely fringed with short bristly setae. Ocelli indiscernible, owing to strong sclerotization of gena though probably visible in younger larvae. Ventral mouthparts entirely strongly sclerotized and ferruginous. *Prothorax* slightly obliquely sloping anteriorly, about twice as broad as long. Pronotum rectangular, delimited laterally by a pair of shallow grooves; median cleavage line indistinct, strongly rugose and pitted, sparsely setose; extensively ferruginous, at least anteriorly. *Abdomen* almost entirely moderately strongly sclerotized (pale testaceous to castaneous); ampullae present on segments 1–7, each with two transverse furrows and sometimes corneous or callose, particularly around furrows. Pleural discs distinct on segments 1–6, each radially striate, with a deep pore, pale testaceous, thus contrasting with the surrounding ferruginous cuticle. Segments 8 and 9 smooth, glabrous, the latter slightly extended. Segment 10 trilobed, the cleft very deep and bearing a few pale setae. Legs slightly shorter than maxillary palpi, ferruginous, setose. *Spiracles* with peritreme rather narrowly oval, thick but scarcely raised above general level of cuticle. Length up to 100 mm.; maximum breadth (at prothorax) 24 mm.

This larva possesses several unusual features such as the extensive sclerotization of the mouthframe, ventral mouthparts, and to a lesser degree the thoracic and abdominal cuticle. The pectinate lower boundary of the frons and the presence of a basal tooth on the mandible are also unusual modifications.

Biology. The larva feeds in decaying roots of mature trees and often leaves the wood to travel through the surrounding soil to neighbouring roots. The pupal cell, which is smooth inside, is composed of earth particles and wood fibres.[14] In this the mature larva hibernates throughout the cold months, pupating about April. Adults emerge from April to September and are readily attracted to artificial light (Beeson and Bhatia, 1939).

In India larvae of this species used to be eaten by the native population (Planet, 1889).

Economic importance. Fruit trees are sometimes seriously injured by this species and Gardner (1942) records a report that larvae seriously damaged roots of roadside trees of *Dalbergia sissoo*. Lucas (1854) remarks that mulberry trees in Madras have been destroyed by larvae tunnelling along the roots.

[14] A similar cocoon is prepared by the palaearctic *Prionus coriarius* (Linnaeus) (see Duffy, 1953a).

Control. Larval galleries should be injected with a mixture of two parts chloroform and one part creosote (Fletcher, 1914).

Material studied. 1 L, India, Punjab, Gurdaspur, 19.i 1938, from *Dalbergia sissoo*, in coll. F.R.I.D.D.

References. Beeson, 1919b (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1943a (Biol.); Fletcher, 1914 (I fig., Biol., Contr.); Gardner, 1942 (L); Lucas, 1854 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960 (Biol.), 1961 (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Pierce, 1918 (Biol.); Planet, 1889 (Biol.); Stebbing, 1899 (Biol.), 1914 (I fig., Biol.).

Priotyrannus (Chollides) closteroides J. Thomson

Distribution. ORIENTAL REGION: China (Kwangsi), Formosa, Indo-China (Viet Nam).

Host plant: *Citrus* (Sonan, 1925).

References. Cheo, 1935 (Biol.); Sonan, 1925 (Biol.).

Prionomma (Prionomma) atratum (Gmelin)

Distribution. ORIENTAL REGION: Ceylon, India (Kerala, Madhy Pradesh, Madras, Maharashtra, Mysore.)

Host plant: *Boswellia serrata* (Beeson and Bhatia, 1939).

Biology. Adults occur from June to August and also in October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Fig. 18. *Logaeus subopacus* Waterhouse. Mature larva. Mouthframe, showing the single ocellus and 3-segmented antenna. Lateral aspect.

Logaeus subopacus Waterhouse

Distribution. ORIENTAL REGION: India (Kerala).

Mature larva (fig. 18). Rather similar to that of *Prionus corpulentus* Bates but differing as follows. *Head* (fig. 18) with posterior margin rounded. Mouthframe mainly ferruginous. One pair of rather large, oval ocelli present. Postocular carina absent. Antenna with segment 2 strongly elongate; segment 3 quadrate to transverse and truncate apically. Size smaller. Length up to 62 mm.; maximum breadth (at prothorax) 11 mm.

Material studied. 1 L, India, Madras, S. Mangalore, v.1930, from rotten wood, in coll. F.R.I.D.D.

References. Beeson, 1919b (L, P); Gardner, 1927 (L), 1931b (L), 1942 (L).

Dorysthenes (Lophosternus) hugeli Redtenbacher

[The Apple Root Borer]

Distribution. ORIENTAL REGION: India (Assam, Bihar, Uttar Pradesh), Jammu and Kashmir, W. Pakistan (Peshawar, Rawalpindi).

Host plants: *Cedrus deodara*, *Pyrus malus*, *Quercus ilex*, *Q. incana*, *Rhododendron* sp., *Sapium sebiferum* (Beeson and Bhatia, 1939); *Shorea robusta* (Beeson, 1941); *Dalbergia sissoo* (Mathur and Balwant Singh, 1959); *Quercus dilatata* (Mathur and Balwant Singh, 1960d).

Adult (Pl. XVIII, fig. 3). Length 29–53 mm. Castaneous, the head and prothorax slightly darker than elytra. *Head* elongate behind eyes; mandibles long, curved downwards and backwards, crossing when closed. Antennae 11-segmented, shorter than body. *Prothorax* transverse, with sides oblique or denticulate anteriorly, with two pairs of spines (one pair median, the other antero-median) and sometimes sharply angulate or dentate basally. *Elytra* more than twice as long as broad, rounded apically and often with a small sutural spine.

Mature larva. No material available. Gardner (1927) gives the following characters based on the original description by Beeson (1919b). "Frons with anterior margin raised into a slightly sinuate fairly even carina which has, however, a blunt flattened tooth at each extremity and a slight protuberance on each side of the median notch. Epistoma projecting over clypeus, curving gradually from the median notch to the extremity of the produced lateral angles; surface aciculate. Sub-fossal spine prominent. Pleural tubercles of abdomen radially striate, present on first six abdominal segments."

First-instar larva. Gardner (1942) gives the following description. "Spiracles biforous, each with two small contiguous lobes that project slightly beyond the peritreme; the frontal carina is weak but distinct; the epistoma projects rather irregularly over clypeus; the ampulla with minute skin-points. Length about 6 mm."

Biology. This beetle infests chiefly stumps and living or dead tree roots. Oviposition occurs mainly in July and about 600 eggs are laid by a single individual in about four weeks. Eggs are deposited about one-third of an inch deep in the soil. Stebbing's observations (1909, 1914) that this species oviposits on the bark of oak trees is highly questionable.

The incubation period is from three to six weeks. As the larvae frequently leave the roots in which they have been feeding and travel through the soil, it is seldom that they are successful in finding another root, hence the larval mortality is high. Pupation takes place in the soil in an earthen cocoon which is lined internally with the larval secretion. The life-cycle is probably three or four years in duration, the emergence occurring mainly in June and July. The adults, which may live up to three months, are readily attracted to light.

It has been observed (Anon., 1941a) that 74 per cent of the infested apple trees in the United Provinces were growing on sandy soil, 14 per cent on loamy soil and 12 per cent on clay; a soil moisture content of 20–40 per cent proved more suitable for oviposition and for the hatching and survival of the young larvae. The newly-hatched

larvae feed on all kinds of organic matter, but well rotted manure is toxic to them. If the spring and early summer are fairly dry, the pupae develop normally, and adults emerge after the first rain. But if there is frequent rainfall early in the year, the rate of development of the pupae is presumably slowed down, and emergence is delayed, even though there is normal rainfall in July. Both sexes are positively phototropic, though males are taken more frequently (Anon., 1941b).

The adults, which do not feed, remain in holes under grass during the day and fly by night, pairing soon after emergence. Males live for only a few days and the females for about 16, during which period they deposit about 300 eggs each, usually singly, at a depth of about 8 mm. in the soil but not necessarily near a host plant. Many larvae die owing to their inability to find food. Experiments have shown that they move at the rate of about four inches a month and only by chance in the direction of a root (Singh, 1941).

Economic importance. In the United Provinces this beetle is a pest of apple orchards. The larvae tunnel into the large healthy roots of apple trees which they sometimes completely sever. Roots of seedlings of deodar and other small trees are also attacked (Beeson, 1941). It has been reported that about 2½ per cent of apple trees in Kumaon are killed annually (Fletcher, 1932).

Control. Orchard sites with unsuitable soil should be improved by the removal of undecomposed debris and by manuring with organic matter. Paradichlorobenzene should be applied at a depth of three inches (one oz. per linear foot) around the base of the tree where oviposition takes place (Beeson, 1941).

References. Anon., 1941a (Biol.), 1941b (Biol.); Beeson, 1919b (L), 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1953 (Biol.); Fletcher, 1921 (Biol.), 1932 (Biol.); Gardner, 1927 (L), 1942 (L); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.), 1961 (Biol.); Muhlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Singh, 1941 (E fig., L fig., P fig., I fig., Biol. fig.); Stebbing, 1909 (L fig., I fig., Biol. fig.), 1914 (L fig., I fig., Biol. fig.) (the larva figured is not a prionid. The account of *Paraphus* on p. 275 should refer to *Dorysthenes hugeli* Redtenbacher).

Dorysthenes (Lophosternus) socius Gahan

Distribution. ORIENTAL REGION: India (Assam, W. Bengal).

Host plant: *Cryptomeria japonica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in June (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1942 (Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Dorysthenes (Lophosternus) buqueti Guérin-Méneville

Distribution. ORIENTAL REGION: Burma, India (Assam), Java, Malaya.

Host plant: *Bambusa* (Kalshoven, 1955).

Biology. According to Kalshoven (1955), larvae live in the soil and feed on rhizomes of bamboo clumps. Adults are attracted to artificial light.

Reference. Kalshoven, 1955 (Biol.).

Dorysthenes (Paraphus) granulosus (Thomson)

Distribution. ORIENTAL REGION: Burma, China, Hainan I., India, Indo-China (Viet Nam), Thailand.

Host plant: ?*Quercus ilex* (Stebbing, 1914).

References. Beeson, 1919b (Biol.); Gressitt, 1951 (Biol.); Stebbing, 1914 (see *Dorysthenes hugeli* Redtenbacher).

Dorysthenes (Cyrtognathus) hydropicus Pascoe

Distribution. ORIENTAL REGION: China (Taiwan), Formosa.

Host plant: *Saccharum officinarum* (Box, 1953).

Mature larva. Form subcylindrical, robust, gradually tapering posteriorly to segment 9. *Head* moderately depressed, subquadrate (maximum head-width 9 mm.). Gena strongly shouldered, rugose, broadly ferruginous and bearing a few bristly setae. Mouthframe strongly sclerotized, rugose, broadly ferruginous. Front margin of frons comprising a strongly sclerotized ridge, which is rather abruptly and obliquely sloping; upper boundary very feebly bilobed to almost straight, subcarinate, notched medially; lower boundary produced over clypeus in an evenly curved flange which is broadest laterally and notched medially. Postcondylar carina well defined; subfossal process bluntly rounded apically. Antenna 3-segmented; segment 2 subquadrate, barrel-shaped, obliquely truncate apically and bearing a slightly elongate, distinctly sclerotized apical segment. Mandible very robust, pitchy, shining, with outer face smooth and bearing a few stout setae near base; without a carina on apical third of outer face. Labrum transversely oval, leathery, with front margin rather densely fringed with short bristly setae, basal third ferruginous. Ocelli indiscernible. *Prothorax* moderately depressed, about twice as broad as long, with a very pale, brownish, transverse band near front margin. Pronotum with lateral grooves deep, complete; median cleavage line indiscernible. Posterior area of pronotum feebly vermiculately rugulose and sparsely setose. *Mesonotum* and *metanotum* subrugulose and sparsely setose. *Abdomen* with dorsal and ventral ampullae on segments 1–7; ampullae smooth and very sparsely setose. Pleural discs present on segments 1–6, each radially striate, with a deep pore. Segment 9 smooth, somewhat extended. Segment 10 trilobed, the lobes compact and strongly protuberant. *Legs* slightly shorter than maxillary palpi, ferruginous, densely setose. *Spiracles* with peritreme broadly oval and slightly raised above general level of cuticle. Length up to 75 mm.; maximum breadth (at prothorax) 15 mm.

Material studied. 3 L, 2 I, China, Taiwan, Tainan, Tsungyeh, from sugar estate, C. S. Wang leg., in coll. B.M.

Reference. Box, 1953 (Biol.).

Prionus corpulentus Bates

Distribution. ORIENTAL REGION: India (Punjab), Jammu and Kashmir, W. Pakistan (W. Punjab).

Host plants: *Abies webbiana, A. pindrow, Juglans regia, Pinus excelsa* (Beeson and Bhatia, 1939); *Quercus semecarpifolia*? (Stebbing, 1914).

Mature larva (fig. 19). Form subcylindrical, very robust, gradually tapering posteriorly to segment 9. *Head* (fig. 19) moderately depressed, slightly transverse. Genae very strongly shouldered, rugose, pitchy and bearing a few bristly setae. Mouthframe strongly sclerotized, rugose and very broadly pitchy. Frons with a broad pitchy anterior margin; front margin comprising a pitchy, heavily sclerotized ridge which is abruptly sloping; upper boundary keel-shaped and varying from straight to slightly bilobed on each side of the strong median emargination; lower boundary narrowly produced over clypeus, with lateral angles acutely dentate and very feebly dentate paramedially. Postcondylar carina distinct. Subfossal process acutely conical. Antenna 3-segmented; segments 2 and 3 slightly elongate, the latter dome-shaped.

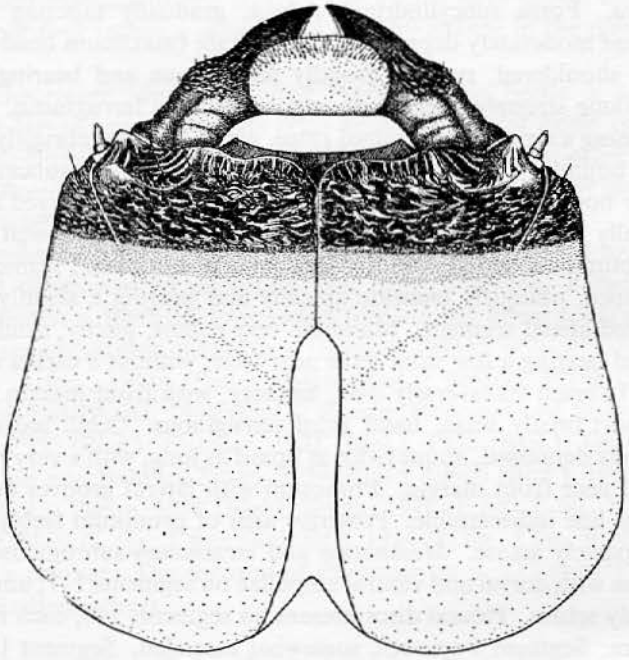


Fig. 19. *Prionus corpulentus* Bates. Mature larva. Head. Dorsal aspect.

Mandible very robust, pitchy, shining, outer face strongly rugose. Labrum transversely oval, leathery, ferruginous and fringed anteriorly with numerous rather short bristly setae. Ocelli indiscernible. Postocular carina well defined. Gular sutures extremely short; sutures diverging to meet anterior portion of occipital foramen. *Prothorax* moderately depressed, about twice as broad as long, with a conspicuous transverse, ferruginous band near front margin. Pronotum rectangular, delimited laterally by a pair of conspicuous grooves; median cleavage line shallow but distinct; anterior area transversely rugose, bearing a few scattered setae; posterior area irregularly vermiculately rugose and very sparsely setose. Eusternum distinctly separated from presternum by a V-shaped suture. Sternum coarsely rugose, with a few scattered short setae. *Mesonotum* and *metanotum* irregularly rugose, almost glabrous. *Abdomen*

with dorsal and ventral ampullae on segments 1–7. Pleural discs present on segments 1–6, each radially striate with a deep pore. Segments 8 and 9 feebly rugose, the latter large, extended and very setose. *Spiracles* with peritreme broadly oval, thick and slightly raised above general level of cuticle. Length up to 85 mm.; maximum breadth (at prothorax) 16 mm.

Pupa (figs. 20, 21). No material available but probably very similar to that of *P. coriarius* (Linnaeus) of which the following is a description. *Head* almost concealed from above by prothorax; glabrous, with four converging series of striae on disc. Antennae thick (serrate in male), extending as far as abdominal segment 1. Labrum

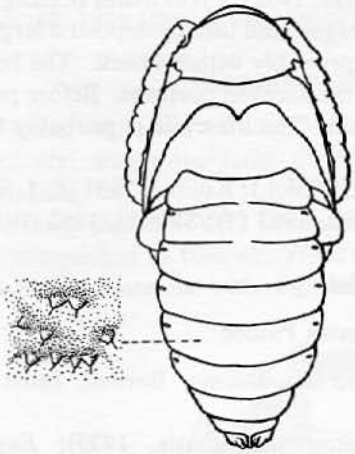


Fig. 20. *Prionus coriarius* (Linnaeus). Male pupa. Dorsal aspect. (Duffy, 1953a)

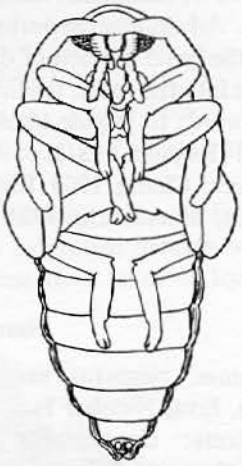


Fig. 21. *Prionus coriarius* (Linnaeus). Male pupa. Ventral aspect. (Duffy, 1953a)

triangular, elongate, glabrous. *Pronotum* strongly transverse, with three pairs of lateral tubercles, the middle pair being the most strongly produced; transversely striate, glabrous. *Mesonotum* similarly striate, glabrous; scutellum prominent, fleshy, glabrous. *Metanotum* almost smooth. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites rugose, the first six bearing scattered minute papillae; sternites smooth (except last two) and glabrous; tergite 9 markedly rugose, with two paramedian, elongate, fleshy protuberances. *Legs* with hind femora extending only as far as abdominal segment 3. *Functional spiracles* present on abdominal segments 1–6, the pair on segment 7 being almost closed and probably non-functional; peritreme narrowly oval and rather thick. (Duffy, 1953a).

Biology. This species infests stumps and decaying logs. Adults emerge in June and July (Beeson and Bhatia, 1939).

Material studied. 2 L, India, Kulu Punjab, vi.1932, from rotten fir sleepers, H. G. Champion leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and

Roonwal, 1954 (Biol.); Gardner, 1927 (L), 1942 (L); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol.).

Prionus insularis Motschulsky

[The Serrate Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, East Three Provinces, Hopeh, Liaoning, Szechwan), Formosa. PALAEARCTIC REGION: Japan, Korea, Manchuria.

Host plants: *Pinus*, *Ulmus*, *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Fagus sieboldi* (Matsumura, 1921); *Abies sachalinensis*, *Picea ajanensis*, *Pinus densiflora* (Kojima, 1931); *Kalopanax ricinifolium* (Shiraki, 1952); *Pyrus malus* (Chang, 1963).

Biology. Adults emerge during July and August and usually deposit a large number of eggs in the basal portion of dead stumps, probably without bark. The larva bores downwards into the roots, feeding mainly on the decayed portions. Before pupation it tunnels upwards to pupate above ground level. The life-cycle is probably two years in duration (Kojima, 1931).

References. Chang, 1963 (Biol.); Cheo, 1935 (Biol.); Kojima, 1931 (E, L fig., Biol.), 1959 (L fig.); Matsumura, 1921 (Biol.); Nijima, 1913 (?); Shiraki, 1952 (Biol.).

Anacolini

Sarmydus antennatus Pascoe

Distribution. ORIENTAL REGION: Andaman Is., Burma, Borneo, India (Assam, W. Bengal), Java, Nicobar Is.

Host plants: *Cryptomeria japonica* (Beeson and Bhatia, 1939); *Engelhardtia spicata* (Mathur and Balwant Singh, 1959).

Mature larva. Form subcylindrical, robust. *Head* moderately depressed, slightly wider behind middle and slightly elongate; frons pale testaceous, except declivity of front margin which is ferruginous and mandibular articulations which are pitchy; front margin roundly declivous, without a complete transverse ridge on upper boundary and lower boundary not produced over clypeus. Antenna 3-segmented; segment 3 very small but distinctly elongate (at least twice as long as basal width); basal membrane strongly produced beyond foramen, the latter smooth, evenly rounded and closely surrounding the membrane but not concealing the inner face. Postcondylar carina and subfossal process absent. One pair of very indistinct ocelli present. Mandible robust, pitchy, shining, smooth, with apices only slightly obliquely truncate. Labrum about twice as wide as long, broadly rounded anteriorly and fringed with rather sparse, very pale, bristly setae. Gula extremely short, with sutures diverging to meet anterior portion of occipital foramen. Maxillary palpi with segment 3 broad, conical, less than two-thirds length of segment 2. *Prothorax* obliquely inclined dorsally about twice as long; pronotum milky white, sparsely and rather regularly covered with very pale brownish setal pores giving a spotted appearance; median cleavage line distinctly bisecting pronotum, eusternum triangular, sparsely setose, presternum without tubercles. *Mesonotum* and *metanotum* smooth, very sparsely setose. *Abdomen* with dorsal and ventral ampullae on segments 1–7 distinctly defined, smooth. Anus

trilobed. *Legs* as long as maxillary palpi, pale testaceous; unguiculus slightly attenuated. *Spiracle* with peritreme broadly oval, moderately thick and slightly raised above general level of cuticle. Length up to 38 mm.; maximum breadth (at prothorax) 12 mm.

The absence of a postcondylar carina and a subfossal process is unique in the PRIONINAE and is perhaps indicative of a closer relationship to the more primitive PARANDRINAE.

Biology. The life-cycle is probably annual. Adults occur from June to September (Beeson and Bhatia, 1939).

Material studied. 1 L, 1 I, Sarawak, 16.i.1911, in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960 (Biol.).

Sarmydus subcoriaceus (Hope)

Distribution. ORIENTAL REGION: India (Uttar Pradesh), Nepal.

Host plants: *Pieris ovalifolia, Quercus incana* (Beeson and Bhatia, 1939); *Alnus nitida* (Gardner, 1942).

Mature larva (fig. 22). Very similar to that of *S. antennatus* Pascoe from which it may be distinguished as follows. *Head* (fig. 22) with sub-fossal process well defined, acutely dentate. Antenna with segment 3 slightly less than twice as long as basal

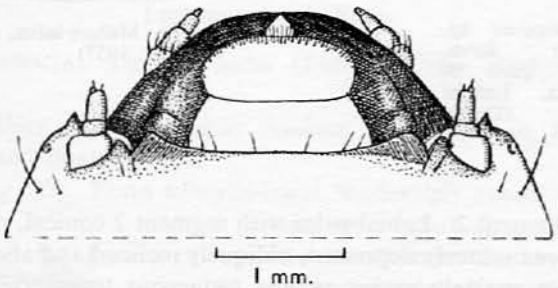


Fig. 22. *Sarmydus subcoriaceus* (Hope). Mature larva. Front of head. Dorsal aspect.

width. Ocelli rather indistinct but rather more clearly defined. Length up to 40 mm.; maximum breadth (at prothorax) 8·5 mm.

Biology. Emergence occurs in June and July (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1942 (L); Mathur and Balwant Singh, 1960d (Biol.).

Anoeme andrewesi Gahan

Distribution. ORIENTAL REGION: S. India.

Mature larva. No larvae of this species are available. The following is a description of an unknown African species. "Form cylindrical, rather slender and slightly tapering posteriorly. *Head* scarcely depressed, slightly transverse. Genae not strongly

shouldered. Mouthframe moderately strongly sclerotized, ferruginous. Front margin of frons roundly declivous, without a sclerotized ridge on upper boundary; lower boundary not projecting over clypeus. Postcondylar carina and sub-fossal process absent. Antennae 3-segmented, segment 3 elongate and strongly sclerotized (fig. 23). Ocelli indiscernible (absent?). Mandible robust, pitchy, with outer face smooth. Labrum strongly transversely oval, ferruginous posteriorly and densely fringed anteriorly with pale setae. Gula extremely short, with sutures diverging to meet anterior portion of occipital foramen. Maxillary palpi with segment 3 stoutly conical,

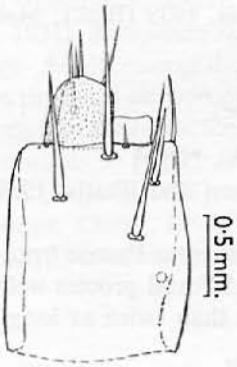


Fig. 23. *Anoeme* sp. Mature larva. Apical part of antenna. Lateral aspect. (Duffy, 1957)

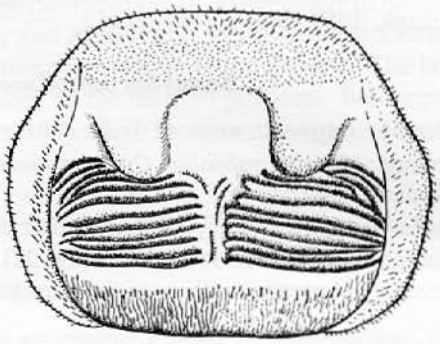


Fig. 24. *Anoeme* sp. Mature larva. Pronotum. (Duffy, 1957)

about as long as segment 2. Labial palpi with segment 2 conical, much shorter than segment 1. *Prothorax* scarcely depressed, obliquely inclined and about twice as broad as long. Pronotum sparsely setose, with a testaceous transverse band near front margin; posterior area coarsely and transversely plicate (fig. 24), the ridges rather strongly sclerotized, testaceous. Eusternum distinct from presternum, the latter transversely striate as in pronotum. *Mesonotum* and *metanotum* densely microspiculate. *Abdomen* with dorsal and ventral ampullae densely microspiculate. Pleural discs indistinct. Segment 9 short, not extended. Anus trilobed, each lobe sparsely setose. *Legs* about as long as maxillary palpi, fleshy, pale; unguiculus attenuated, imbricately spinose. *Abdominal spiracles* with peritreme subcircular, thin, pale testaceous and not raised above general level of cuticle. Length up to 24 mm., maximum breadth (at prothorax) 4·2 mm." (Duffy, 1957.)

The characters relating to the larva of *Anoeme* as given in the key (p. 10) serve to corroborate Crowson's contention (1953) that species of this genus are true prionids. *Anoeme* larvae may perhaps have closer affinities with the PHILINAE than with the PARANDRINAE, but so far larvae of the former subfamily are unknown.

References. None available.

2. LEPTURINAE

Larval Characters.

Form subcylindrical to strongly depressed. *Head* slightly to strongly transverse; epicranial halves entirely separated behind frons (except in a few exotic species); occipital foramen not divided into an anterior and posterior portion, as the tentorial cross-arm is internal; postero-dorsal emargination very strong, extending to frons; front margin of frons never steeply declivous or projecting over clypeus, and with six to ten (occasionally as many as 20) epistomal setae. Clypeus trapezoidal, as wide at base as front margin of frons. Labrum transverse, semicircular or cordate. Mandibles with an oblique cutting edge, apex acutely produced. Ocelli absent or one to six pairs present. Antennae very small, retractile, 2- or 3-segmented. Maxillae movable; palpifer with outer margin straight and bearing lobe. Ligula larger than labial palpi. *Prothorax* with eusternum distinct, triangular. Abdomen with ampullae tuberculate; epipleurum strongly protuberant on all segments but region surrounding spiracle not protuberant; pleural discs absent; segment 9 sometimes with a terminal spine or urogomphi. *Legs* slender and rather long; coxae large, almost touching inwardly between eusternum and sternellum; unguiculus with a long stout seta arising near base. *Spiracles* of mesothorax not protruding into prothorax; all spiracles small, with nearly contiguous marginal chambers.

Leptura rubriola Bates

Distribution. ORIENTAL REGION: India (Punjah, Uttar Pradesh), Jammu and Kashmir.

Host plants: *Abies pindrow*, *Cedrus deodara*, *Picea morinda*, *Pinus excelsa*, *P. longifolia* (Beeson and Bhatia, 1939).

Mature larva (fig. 25). Form subcylindrical, moderately robust and very slightly tapering posteriorly. *Head* appreciably narrower than prothorax, rather thick, robust, moderately transverse, widest behind middle, with rounded sides; posterior margin angulately emarginate; temples ferruginous behind ocellus and genae with a deep vertical furrow immediately in front of ocellus. Six epistomal setae present. Antenna 3-segmented; segment 2 about half as long as broad and bearing segment 3 as well as a conical supplementary process which is nearly as long as segment 3; segment 3 about one-third longer than wide and bearing an elongate digitiform apical process. One pair of ocelli present; lens rather large, oval, pigmented spot indiscernible (fig. 25). Mandible with apex

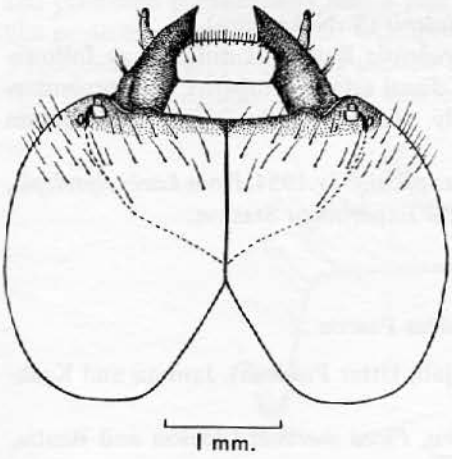


Fig. 25. *Leptura rubriola* Bates. Mature larva. Head. Dorsal aspect.

strongly acutely produced, the dorsal margin just lateral to cutting edge flattened into a striate plate. Labrum transversely oval, bearing numerous marginal and two discal setae. Hypostoma bearing numerous fine setae, anterior margin pitchy to ferruginous. Maxilla with segments 2 and 3 of palp about equal in length, the latter obtuse. Mentum with a short, transverse, castaneous band apically. *Prothorax* scarcely depressed, about twice as wide as long; anterior region pale testaceous, posterior region feebly rugulose. Proeusternum triangular, shining, sparsely setose. *Mesonotum* and *metanotum* non-tuberculate; mesosternum and metasternum each with two rows of moniliform tubercles. *Abdomen* with ampullae present on segments 1–7; each dorsal ampulla bearing four rows of small rounded glabrous tubercles, each ventral ampulla with only two rows of similar tubercles. Epipleurum strongly protuberant on all segments. Segment 9 without a caudal process. Segment 10 trilobed. *Legs* well developed; unguiculus slender, attenuate, castaneous almost to base which bears on the inner side a seta of equal length. *Abdominal spiracles* with peritreme broadly oval and bearing several subcontiguous marginal chambers on posterior half. Length up to 20 mm.; maximum breadth (at prothorax) 5 mm.

Biology. Adults emerge from April to August, mainly in April and May (Beeson and Bhatia, 1939).

Material studied. 4 L, India, Uttar Pradesh, Chakrata, iv.1933, from dead *Pinus excelsa*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1927 (L fig.); Mathur and Balwant Singh, 1960d (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol.).

Leptura succedanea Lewis

Distribution. ORIENTAL REGION: China (Hunan, East Three Provinces, Hopeh, Liaoning). PALAEARCTIC REGION: Japan.

Host plant: *Alnus* (Cheo, 1934); *Larix liptolepis* (S. Nakamura).

Mature larva. Very similar to that of *L. rubriola* Bates but differing as follows. *Head* with labrum bearing four (two pairs) of discal setae. *Prothorax* with proeusternum dull and micro-spiculate posterolaterally. Length up to 25 mm.; maximum breadth (at prothorax) 6 mm.

Material studied. 1 L, Japan, Gunma, Manzaguchi, 5.iv.1954, from *Larix liptolepis*, S. Nakamura leg., in coll. Shimane Agricultural Experiment Station.

Reference. Cheo, 1935 (Biol.).

Teledapus dorcadioides Pascoe

Distribution. ORIENTAL REGION: India (Punjab, Uttar Pradesh), Jammu and Kashmir.

Host plants: *Abies pindrow*, *Cedrus deodara*, *Picea morinda* (Beeson and Bhatia, 1939); *Quercus dilatata*? (J.C.M.G.).

Mature larva (fig. 26). Rather similar to that of *Leptura rubriola* Bates, from which

it differs as follows. *Head* with mouthframe very narrowly ferruginous; temples pale testaceous behind ocellus which is small and rather indistinct. *Abdomen* with segment 9 produced into a large conical caudal process which terminates in a pair of spine-like tubercles (one above the other) which are both bifid and sclerotized apically (fig. 26). Length up to 40 mm.; maximum breadth (at prothorax) 7·75 mm.

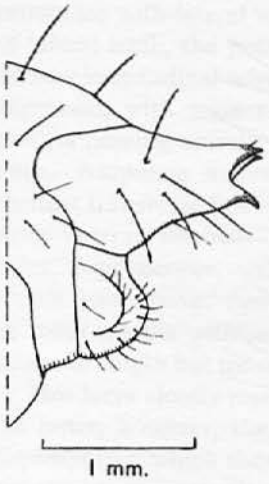


Fig. 26. *Teledapus dorcadioides* Pascoe. Mature larva. Caudal process. Lateral aspect.

Biology. Larvae of this species infest only rotting or decayed wood. The life-cycle is annual, with emergence from April to June (Beeson and Bhatia, 1939).

Material studied. 4 L, India, Uttar Pradesh, Chakrata, iv.1933, from rotten *Picea morinda*, *Cedrus deodara*, *Abies* sp. and ?*Quercus dilatata*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1942 (L, Biol.); Mathur and Balwant Singh, 1960d (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol.).

Apiocephalus licheneus Gahan

Distribution. ORIENTAL REGION: India (Madras, Uttar Pradesh).

Host plants: *Buchanania lanzan* (Beeson and Bhatia, 1939); *Santalum album* (N. C. Chatterjee).

Mature larva (fig. 27). Form rather stout, extremely depressed and parallel-sided. *Head* (fig. 27) strongly and entirely sclerotized, ferruginous, with long lateral setae, sides widely produced and angulate, the antero-lateral margins each with two acute projections, the inner pair bearing the minute antennae. Front margin of frons straight and produced paramedially into a pair of large, conical, strongly sclerotized, tooth-like projections; six epistomal setae present. Antenna minute, 3-segmented; segment 3 subquadrate, supplementary process acutely conical, Mandible very slender, outer face strongly angulate medially and bearing two stout setae. Three pairs of ocelli

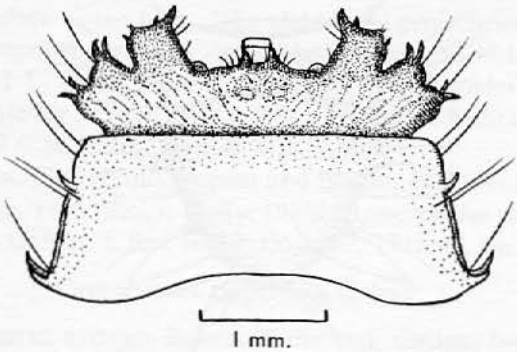


Fig. 27. *Apiocephalus licheneus* Gahan. Mature larva. Head and prothorax. Dorsal aspect.

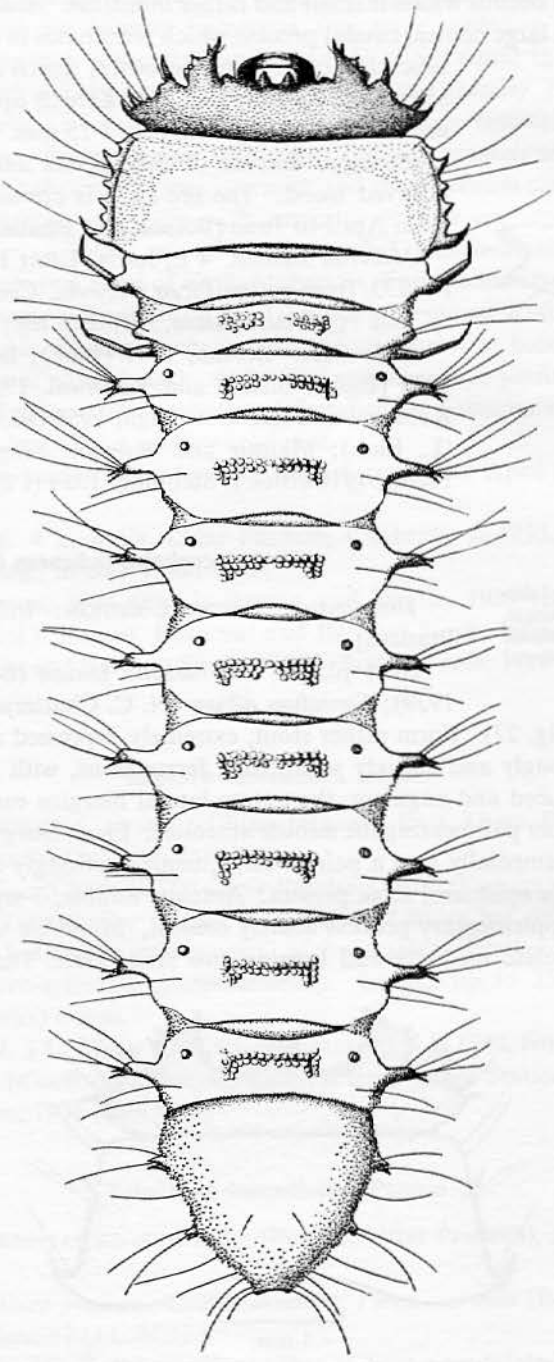


Fig. 28. *Apiocephalus punctipennis* Gahan. Half-grown larva. Dorsal aspect.

present, one near external basal angle of antennal projection, another similarly placed on the outer projection and one pair placed ventrally; lens strongly protuberant, pigmented spot distinct. Hypostoma flat, with sutures ferruginous, straight and divergent. Gular sutures and cleavage line indiscernible. Maxilla with segment 3 of palp longer than segment 2, lobe slender, cylindrical. *Prothorax* (fig. 27) strongly transverse; pronotum with lateral margins sub-parallel, distinctly sclerotized and with two pairs of lateral teeth, the posterior pair bifurcate; with a well defined sternal plate and a narrow longitudinal sclerotized area on each side sublaterally. *Abdomen* very strongly depressed, with segments 1–8 bearing lateral peg-like tuberculate processes, each process bearing apically a pair of slender spines, a pair of blunt teeth and four long setae. Ampullae scarcely protuberant, tuberculate, glabrous, shining and with a shallow transverse furrow. Segment 9 large, extended, with bifurcate marginal teeth. Anus ventral, bilobed. Pleural areas densely covered with corneous dentiform granules. *Legs* slender, strongly sclerotized, extremely long, protruding laterally and visible from above. *Spiracles* placed dorsally, with peritreme round, thick and lined on inner margin with subcontiguous chambers. The largest larva available measures 8 mm. in length but the maximum length is probably nearer 20 mm.

This larva closely resembles that of the African *A. punctipennis* Gahan (fig. 28). In the latter, however, the sides of the head are much more strongly angulate as in *Capnolymma*, which shows that the degree of angulation of the sides of the head will not serve to separate all species of *Apiocephalus* from *Capnolymma;* on the other hand, the presence or absence of lateral teeth on the pronotum appears to be a character by which these two genera may be distinguished satisfactorily.

Biology. As would be expected from its curious form, the larva feeds on the inner surface of the bark which separates from the sapwood. Emergence takes place from September to October and January to February. As already pointed out (Duffy, 1953a), larvae of this group bear striking affinities towards the European lepturid *Acmaeops collaris* (Linnaeus). The extremely depressed form suggests a strict subcortical existence and the fact that locomotion is facilitated by means of the unusual lateral processes (the ampullae being scarcely raised) would suggest that the larval galleries are excavated in trees in which the bark is firm and not decayed. According to Gardner (1931), larvae of this group make a wide, shallow excavation in the bark, surrounded by a barricade of frass; the hardwood surface does not appear to be affected. The normal position for the larva is with the dorsal surface apposed to the wood, the ventral surface to the bark. The abdominal projections may afford some degree of protection against predators such as histerid and clerid larvae.

Material studied. 1 L, India, Madras, N. Salem, x.1930, under bark of *Santalum album*, N. C. Chatterjee leg., in coll. F.R.I.D.D.; 3 L, India, Dehra Dun, 1931, under bark of *Buchanania*, J.C.M.G. leg., in coll. U.S.N.M.

References. Beeson, 1941 (Biol.), Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1953a (*Apiocephalus* group; L fig., Biol.), 1957 (*A. punctipennis* Gahan; L fig., Biol.); Gardner, 1931c (L fig., Biol.).

Capnolymma cingalensis Gahan

Distribution. ORIENTAL REGION: Burma (Rangoon), Ceylon, India (Madras).

Host plants: *Terminalia paniculata, Pterocarpus dalbergioides* (Gardner, 1931c).

Mature larva. Gardner (1931c) gives the following description.

"Antennal projection comparatively short, with two apical points or spines, one dorsal to the other. Outer projection unidentate. Anterior margin between outer projection and lateral extremity fairly even, sometimes a blunt tubercle is visible in dorsal view. Frontal sutures, and a transverse suture between them, very distinct. Epistomal margin rather strongly produced with the epistoma; teeth extending slightly beyond antennal projections. Lateral margins of pronotum more or less even. Length about 10 mm."

References. Gardner, 1931c (L fig. (referred to as "Larva A")), 1942 (L).

[Necydalini]

Necydalis indicola Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Quercus dilatata, Q. incana, Q. semecarpifolia* (Beeson and Bhatia, 1939).

Mature larva. Rather similar to that of *Leptura rubriola* Bates, from which it may be distinguished as follows. Form much more slender, attenuated. *Head* with ocelli and vertical furrows absent. Mandible shorter, the apex not abruptly produced. Gular area appreciably raised, swollen. *Prothorax* with prosternum extensively matt and micro-pubescent, with scattered glabrous lenticulate spots. *Abdomen* with ampullae entirely covered with very much smaller tubercles which are irregularly arranged. Length up to 20 mm.; maximum breadth (at prothorax) 4·25 mm.

Biology. This species infests dry wood and stumps.

Material studied. 2 L, India, Uttar Pradesh, Chakrata, v.i.1934, from *Quercus incana* and *Q. semecarpifolia*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.), Beeson and Bhatia, 1939 (Biol.); Gardner, 1942 (L); Mathur and Balwant Singh, 1960d (Biol.).

3. DISTENIINAE

Larval Characters

In general form larvae of this subfamily, at least in the genus *Distenia*, are strikingly aberrant. Firstly the occipital foramen is postero-dorsad (as in certain LAMIINAE) and, secondly, the prothoracic skin is attached ventrally directly to the submentum, a condition suggesting close affinity to the OXYPELTINAE (see Duffy, 1960, p. 77).

Craighead (1923) characterizes these larvae as follows. "Head transverse, dorsal margins of the epicranial halves behind front entirely separated; occipital foramen postero-dorsad; tentorium very broad, gula and hypostoma not evident. Mandibles rather elongate from side; apex slightly produced, cutting edge obliquely truncate, short. Epistoma not produced over clypeus, three epistomal setae. Clypeus trapezoidal, filling space between dorsal condyles of mandibles. Submentum attached to the collar; maxillae movable, cardo visible; maxillary articulating lobe full; palpifer

small, joint-like; lacinia borne on stipes. Antennae frail, retractile. *Prothorax* with presternum and epipleurum anteriorly fused. Epipleurum large, rectangular; eusternum not sharply defined; coxae small, widely separated and situated at extremities of sternellum. Mesothoracic spiracles not protruding into prothorax. Legs moderate in size, weak. Epipleurum protuberant only on last three abdominal segments; pleural disc never present. Spiracles in a well-defined, elliptical, protruding region."

Distenia dravidiana Gahan

Distribution. ORIENTAL REGION: India (Madras, Maharashtra).

Host plants: *Holigarna arnottiana, Mangifera indica* (Beeson and Bhatia, 1939); *Dipterocarpus indicus* (Mathur and Balwant Singh, 1959).

Mature larva (figs. 29, 30). Form very elongate, slender, anteriorly depressed, posteriorly cylindrical (fig. 30); prothorax proportionately much wider than in other subfamilies of Cerambycidae, suggesting a buprestid; integument thin, shining, sparsely setose. *Head* (fig. 29) depressed, widest about middle, rather deeply retracted

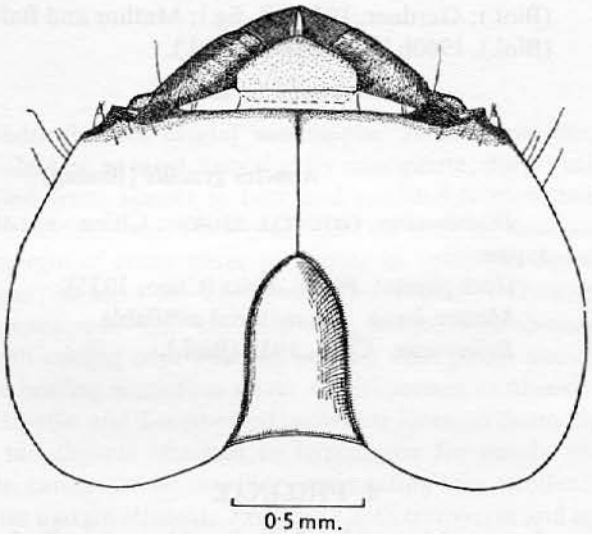


Fig. 29. *Distenia dravidiana* Gahan. Mature larva. Head. Dorsal aspect.

in prothorax. Mouthframe pitchy; front margin of frons straight, rather abruptly raised. Labrum strongly transverse, the anterior margin rather thickly fringed with short setae. Occipital foramen postero-dorsad and not visible from below; anteriorly extending as far as frons; gula and hypostoma not evident, the wide, median, ventral plate being of tentorial origin (according to Craighead, 1923); anterior ventral margin of head capsule strongly emarginate, the ventral mouthparts being strongly retracted. Mandibles with apical cutting-edge oblique, truncate. Antenna 3-segmented. One pair of ocelli present; lens rather large but not very clearly defined; pigmented spot visible as a greyish blotch. Maxillary palp 3-segmented. Submentum continuous with prothoracic skin. *Prothorax* depressed; pronotum trapezoidal, widest at base,

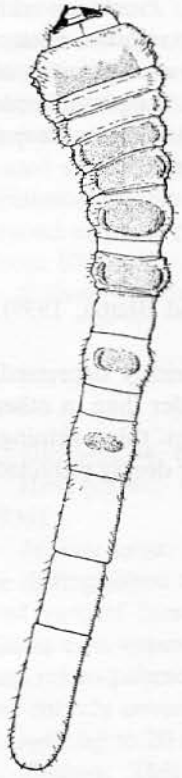


Fig. 30. *Distenia dravidiana* Gahan. Mature larva. Dorsal aspect.

with a narrow band of short setae across anterior margin, posteriorly dull, micro-pubescent; sternellum, mesonotum, metanotum, mesosternum and metasternum transverse, micro-pubescent; scutal and hypopleural areas protuberant. *Legs* small, slender, 3-segmented; tarsus attenuated, claw-like. *Abdomen* with segments very elongate, slender, cylindrical, intersegmental skin very long; ampullae widely separated, flat, transverse, dull, micro-pubescent, present only on segments 1–6; parascutal and coxal lobes protuberant laterally; segment 9 the longest; anus a transverse cleft. *Spiracles* small, peritreme orbicular, each with a series of large subcontiguous marginal chambers. Length up to 35 mm.; maximum breadth (at prothorax) 5·75 mm.

Biology. Adults emerge in May and June.

Material studied. 2 L, India, Madras, Anamali Hills, 7.v.1930, from tree stump, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961 (Biol.).

Apheles gracilis (Blessig)

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Japan.

Host plants: *Pinus*, *Abies* (Cheo, 1935).

Mature larva. No material available.

References. Cheo, 1935 (Biol.).

4. PHILINAE

Unfortunately no larvae of this subfamily have yet been described. Crowson (1953) regards this smallest subfamily of the Cerambycidae as being the most primitive of all and intermediate between the prionid and cerambycid conditions. The larval characteristics, when known, will prove to be of great interest and importance as far as cerambycid phylogeny is concerned.

Philus pallescens Bates

[The Sugar Cane Longhorn]

Distribution. ORIENTAL REGION: China (Fukien, Kwantung, Szechuan), Formosa.
Host plant. *Saccharum officinarum* (Gressitt, 1942).
Biology. Larvae feed in or on the roots and perhaps also the lower part of the stem.

Pupation almost certainly occurs in the soil. The adults, which emerge during April, May and "summer", are nocturnal and may be attracted to artificial light (Gressitt, 1942).

Economic importance. The effect on a single plant by a larva is probably quite severe, but information concerning the prevalence of this species in cane fields and the extent of damage is scanty. This species has been recognized as a pest in Formosa (Gressitt, 1942).

Control. It is suggested that plants be removed and burned. Overcrowding should be avoided and working of the soil and alternation of crops should be practised. Toads feed on adult beetles and should be encouraged (Gressitt, 1942).

References. Box, 1953 (Biol.); Gressitt, 1942 (Biol.).

Philus antennatus (Gyllenhal)

Distribution. ORIENTAL REGION: China (Hong Kong), Hainan Is.

Host plants: *Citrus*, *Morus alba*(?) (Gressitt, 1951).

References. Gressitt, 1951 (Biol.).

5. ASEMINAE

Larval Characters

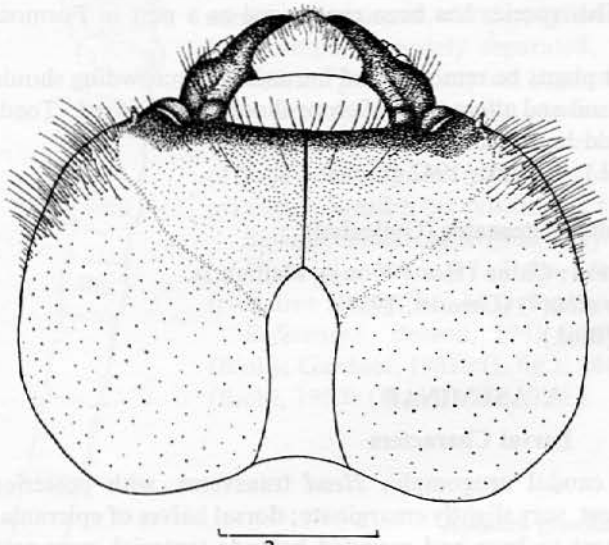
Form subcylindrical, with caudal urogomphi. *Head* transverse, with posterior margin nearly straight or, at most, very slightly emarginate; dorsal halves of epicranial halves fused behind frons almost to base and rounded behind; tentorial cross-arm internal, in a plane at right-angles to hypostoma (the occipital foramen not apparently divided); front margin of frons never projecting or carinate. Epistoma never produced over clypeus; at least ten epistomal setae present. Clypeus trapezoidal, as broad at base as epistoma. Labrum transverse, semicircular to cordate. Mandibles wedge-shaped, with cutting edge oblique, broadly emarginate and apex acutely produced; outer face bearing numerous setae. Ocelli present or absent. Antennae frail, short, strongly retractile and 3-segmented; antennal foramen distinctly open to frontal suture. Ventral mouthparts attached to hypostoma for nearly its entire breadth. Maxillae movable, cardo visible; maxillary articulating area swollen; palpifer bearing lobe and with outer margin straight. *Prothorax* with transverse and sublateral grooves very distinct; posterior region either glabrous or micro-spiculate; eusternum distinct, triangular; presternum and epipleurum fused; coxal lobe small, opposite sternellum. *Abdomen* with ampullae either glabrous or dull, micro-spiculate, never tuberculate and with two lateral impressions on each side; regions bearing spiracles distinctly defined, elliptical; epipleurum protuberant on segments 7, 8 and 9 only; segment 9 with a pair of urogomphi; pleural discs absent. *Legs* moderately long, slender. *Spiracles* of mesothorax not protruding into prothorax; abdominal spiracles with two or more small marginal chambers.

Arhopalus ferus (Mulsant) (=**Criocephalus polonicus** Motschulsky)

Distribution. ORIENTAL REGION: Possibly extending as far east as China but apparently not so far recorded, probably owing to its very close similarity to *A. rusticus*

(Linnaeus) in the adult stage. PALAEARCTIC REGION: British Isles, Europe, Middle East, North Africa, Scandinavia.

Host plants: *Pinus* and *Picea* (Duffy, 1946c). Xambeu (1898–1902) also records *Prunus cerasus*.



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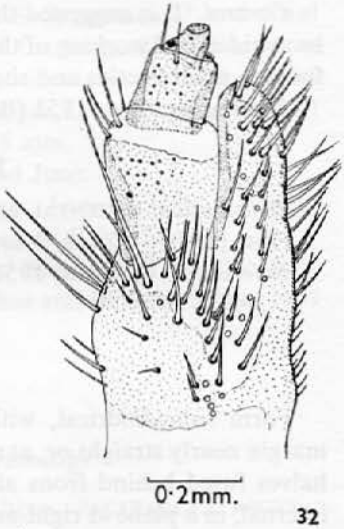

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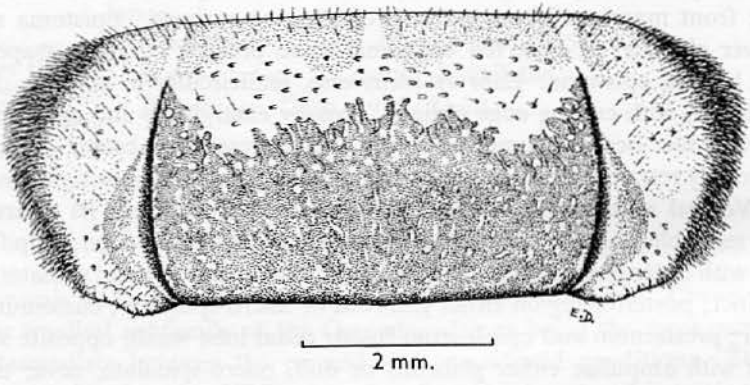

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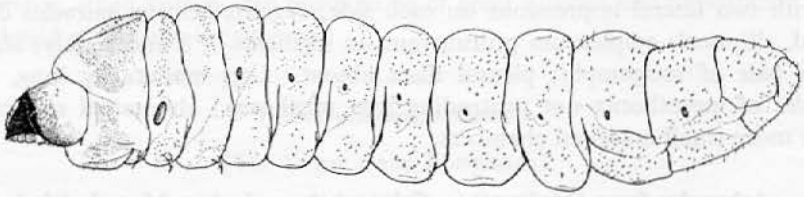

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Fig. 31. *Arhopalus ferus* (Mulsant). Mature larva. Head. Dorsal aspect. Fig. 32. *Arhopalus ferus* (Mulsant). Mature larva. Apical part of right maxilla. Ventral aspect. Fig. 33. *Arhopalus ferus* (Mulsant). Mature larva. Prothorax. Dorsal aspect. Fig. 34. *Arhopalus ferus* (Mulsant). Mature larva. Lateral aspect.

Mature larva (figs. 31–35). Form rather robust, slightly depressed anteriorly. *Head* (fig. 31) depressed, transverse, widest behind middle, with sides moderately strongly rounded; smooth, orange-testaceous, shining, moderately strongly sclerotized. Genae testaceous, with rather dense, long, reddish setae, which are distributed beyond level of posterior end of frontal sutures. Frontal sutures distinct as pale lines, each extending to a gap in antennal ring; median adfrontal suture complete and very distinct. Mouthframe strongly sclerotized, pitchy. Frons with front margin very slightly curved and roundly declivous; at least 16 epistomal setae present. Antenna with segment 2 bearing a conical supplementary process, which is as long as, or slightly longer than, its basal width; segment 3 very elongate. Mandible pitchy, shining, with a transverse group of numerous setae across basal half; inner part of dorsal surface with a large oblique plate. Labrum cordate, about as long as wide; ferruginous, with numerous short setae apically and with a few longer setae medially. Ocelli absent. Gula narrow, testaceous, with sutures not raised. Hypostomal plates large, trapezoidal, ferruginous, with anterior margin thick and pitchy. Ventral mouthparts fleshy; apical segment of maxillary palpi about half as long as second and as long as apical segment of labial palpi; lobe (fig. 32) slender, cylindrical, with setae as figured. *Prothorax* (fig. 33) depressed, trapezoidal, widest in front; lateral setae very dense and ferruginous. Pronotum sparsely setose, pale and shining anteriorly, posteriorly orange-yellow, finely asperate, with numerous interspaced glabrous spots. Eusternum and sternellum finely asperate and setose. *Abdomen* with ampullae on segments 1–7 (fig. 34). Pleural tubercle broadly oval and bearing about five setae. Urogomphi (fig. 35) of ninth segment acutely conical, seldom separated by more than twice their basal diameter, usually less. *Legs* distinct, 3-segmented; unguiculus very long, attenuated and imbricately spinose. *Spiracles* of prothorax large, about twice as broad as those on abdominal segment 1; obsolescent metathoracic spiracle visible; abdominal spiracles with peritreme broadly oval, and with at least six small contiguous chambers on posterior margin. Length up to 34 mm.; breadth (at prothorax) 9 mm.

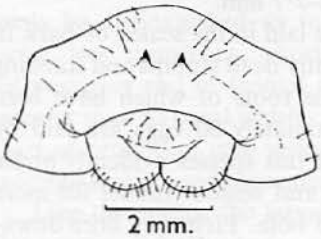

Fig. 35. *Arhopalus ferus* (Mulsant). Mature larva. Urogomphi and anal lobes. Caudal aspect.

Pupa (fig. 36). *Head* bent beneath pronotum which almost conceals it from above; quadrate, with sides strongly rounded, rugose and with at most a few short pale spines and setae. Antennae transversely rugose, densely spiculate and with four to six rather stout, ferruginous spines near apex of basal segment only; extending to just beyond middle of metathorax, where they are curved downward to terminate near the front coxae. Labrum triangular, transversely rugose and glabrous. Maxillary palpi spiculate and with a few fine pale setae. *Pronotum* very slightly transverse, with sides strongly rounded, and disc with two paramedian striated areas (often in the form of depressions); with scattered pale papillae of varying length. *Mesonotum* glabrous or almost so; scutellum rather broad, fleshy and with a few fine setae. *Metanotum* with a papillate area on each side of scutellar groove, each papilla being equipped with a spine-like seta. Elytra and wings extending as far as abdominal segment 4. *Abdomen*

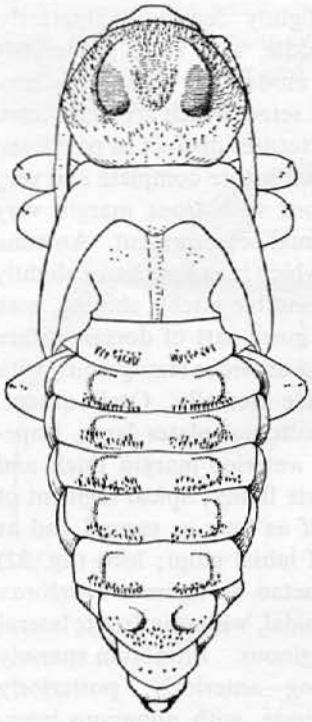

Fig. 36. *Arhopalus ferus* (Mulsant). Male pupa. Dorsal aspect.

with tergites 1–6 each bearing four transverse groups of long straight spines near hind margin. Tergite 7 with a transverse group of scattered spines and tergite 8 with only a few spines. Tergite 9 rather short, glabrous and terminating in a pair of urogomphi, which are widely separated, slender and strongly curved inward. Sternites with lateral groups of spines, except the last three, which are glabrous. *Legs* with several ferruginous spines near apex of each femur; hind femora with a large basal tubercle, almost at right-angles to longitudinal axis of body and extending to between segments 2 and 3. *Functional spiracles* present on abdominal segments 1–7; peritreme broadly oval, moderately thick and slightly raised for anterior half. Length 10–30 mm.; breadth 4·2–7·7 mm.

Biology. The eggs are laid in the scales of bark in slightly decaying or recently dead stumps and standing boles, especially those the roots of which have been scorched by fire. Approximately 60 eggs are laid by a single adult. Larvae of this species evidently prefer the large, exposed roots, and seldom tunnel for more than a foot or so up the bole. First they bore downward, making winding galleries until about two-thirds grown; they then tunnel in an upward direction. Larvae of *Asemum striatum* (Linnaeus), which make similar galleries, are often present. Pupation occurs during June and July in exposed or underground roots or in the base of standing boles. The pupal cell is elongate-ovoid and packed at both ends with coarse wooden shavings. When in a root, it is usually near the surface, parallel to the grain of the wood, but if the bark is very thick, pupation often takes place in the bark itself. Pupae of this species are very active and frequently move up and down the cell while performing gyratory movements. The emergence period is from July to August.

Parasites. Diptera. Many of the pupae obtained by the author were almost fully matured when they suddenly turned dark brown and soft. Dipterous larvae emerged, and by 19th July had pupated around and in the desiccated pupal integument. The results were kindly identified as *Megaselia rufipes* Mg. (Phoridae) by C. N. Colyer (1950).

Natural enemies. Both larvae and pupae have been taken from stumps tenanted by large colonies of the ant *Lasius niger* L. As soon as the roots were split open and the larvae and pupae exposed, the ants would swarm over them and cling on to them with their mandibles.

Economic importance. This species will occasionally attack growing and apparently quite healthy trees.

Material studied. 6 L, Surrey, Mytchett, 5.iii.1945, in stump of *Pinus*, A. W.

McKenny Hughes and D. leg., in coll. B.M.; 8 L, 28 P, Surrey, Pirbright,30.vii. 1945, in stump of *Pinus*, E. W. Classey and D. leg., in coll. B.M.

References. Caillol, 1914 (Biol.); Colyer, 1950 (Paras.); Duffy, 1946c (Biol.), 1953a (L fig., P fig., Biol. fig.), 1957 (L, P); Emden, 1939–1940 (L); Fabre, 1891 (Biol.); Harris, 1952 (Biol. fig.); Smith, 1905 (L fig., Biol.); Villiers, 1946 (I fig., Biol.); Wallace, 1953 (Biol.); Xambeu, 1895 (Biol.), 1898-1902 (L, Biol.).

Arhopalus rusticus (Linnaeus) (=**Criocephalus rusticus** Linnaeus)

[The Rusty Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Liaoning). PALAEARCTIC REGION: British Isles, Europe, North Africa, Japan, Korea, Scandinavia.

Host plants: *Abies*, *Cupressus*, *Cryptomeria*, *Juniperus chinensis*, *Pinus* (Cheo, 1935).

Mature larva. Very similar to that of *A. ferus* (Mulsant), from which it may apparently be distinguished as follows. *Head* with frons faintly obliquely striate; genal setae less numerous, shorter, pale testaceous and not occurring beyond level of posterior end of frontal sutures. Antenna with supplementary process distinctly shorter than its basal width. *Prothorax* with lateral setae pale golden yellow; posterior part of pronotum pale yellow and slightly more finely asperate. *Abdomen* with urogomphi smaller and separated by three or four times their basal diameter.

Like the adults, the larvae of both these species are extremely variable, and until long series of both species are available the above distinguishing characters must be regarded as merely provisional. The size and position of the urogomphi usually provide means of identification, though even here there are exceptions; for instance, a small percentage of *A. ferus* larvae examined had small, widely separated urogomphi. The most reliable difference would appear to be that of the shape of the antennal supplementary process.

Pupa. Extremely similar to that of the preceding species but with sublateral spinose areas of abdominal sternites with long setae and short spines.

Egg. Length 1·5 mm. Form elongate-oval. Chorion smooth and white (Xambeu, 1898–1902).

Biology. According to Xambeu (1898–1902) the incubation period varies from fifteen to twenty days. In other respects the biology is very similar to that of *A. ferus*.

Parasites. Hymenoptera: *Chasmias motatorius* (F.), *Odontocolon appendiculatus* Gr. (Reineck, 1919); *Meteorus neesi* Marsh (Schimitschek, 1929); *Odontomerus pinetorum*. Thoms (Thompson, 1943).

Economic importance. This species has occasionally been found infesting structural timbers in France. According to Houlbert (1912), roof timbers have been seriously damaged, and zinc plating and even solder were bored through by emerging adults.

Material studied. 1 P, Denmark, Tisvilde, 7.vi.1896, in coll. U.Z.M.C.; 1 L, England, in coll. B.M.; 1 L, 3 P, Hannover, from stump of *Pinus*, K. Jordan leg., in coll. B.M.; 1 L, Finland, Karjalohja, Haapajärvi, viii.1929 from stump of *Pinus*, U. Saalas leg., in coll. U.Z.M.C.

References. Caillol, 1914 (Biol.); Cheo, 1935 (Biol.); Collet, 1930 (Biol.); Decaux,

1890 (Biol.); Duffy, 1953a (E, L, P, Biol.), 1957 (L, P); Emden, 1939–1940 (L); Harris, 1952 (Biol.); Henriksen, 1914 (L fig.); Houlbert, 1912 (Biol.); Kojima, 1959 (L fig.); Madel, 1940–1941 (Biol.); Mühlmann, 1954 (Biol.); Perris, 1856 (L fig., P); Reineck, 1919 (Biol.); Röthenberg, 1907 (Biol.); Saalas, 1923 (L fig.); Schimitschek, 1929 (Biol.); Schiödte, 1876 (L fig., P); Sharp, 1905 (Biol.); Shiraki, 1952 (Biol.); Thompson, 1943 (Paras.); Trägårdh, 1939 (Biol. fig.); Trappen, 1908 (Biol.); Villiers, 1946 (Biol.); Xambeu, 1898–1902 (E, L, P, Biol.).

Arhopalus tibetanus (Sharp) (=**Criocephalus tibetanus** Sharp)

Distribution. ORIENTAL REGION: China, India, Jammu and Kashmir, Nepal, West Pakistan (Baluchistan, W. Rawalpindi).

Host plants: *Cedrus deodara*, *Pinus excelsa*, *Pinus gerardiana* (Beeson and Bhatia); *Pinus longifolia*, *Picea morinda* (Gardner, 1942b); *Lannea coromandelica* (Mathur and Balwant Singh, 1961).

Mature larva. Very similar to that of *A. ferus* (Mulsant) but with the abdominal spiracles each with 12 marginal chambers. Length up to 43 mm.

Biology. This species infests dying trees and recently felled stumps. Larvae tunnel right into the heartwood. The life-cycle is annual, with an emergence period in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol., fig.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1927 (L fig., P fig.), 1942a (L), 1942b (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961 (Biol.); Pierce, 1918 (Biol.); Stebbing, 1908 (Biol. (the adult figured is not this genus)).

Arhopalus unicolor (Gahan) (=**Criocephalus unicolor** Gahan)

Distribution. ORIENTAL REGION: Burma, China, India (Assam). PALAEARCTIC REGION: Japan.

Host plant: *Pinus khasya* (Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *A. ferus* (Mulsant) but abdominal spiracles each with only three marginal chambers.

According to Gressitt (1942) this larva differs from that of *A. tibetanus* (Sharp) in not only having fewer marginal chambers to the spiracles but in having mandibles which are even more acutely produced apically and with the genal setae relatively longer. Its body length is less—about 14 mm.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1942 (L); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Arhopalus brunneus (Gardner) (=**Criocephalus brunneus** Gardner)

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Pinus longifolia* (Gardner, 1942b).

References. Gardner, 1942b (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Spondylis buprestoides (Linnaeus)

[The Black Pine Longhorn or the Black Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Fukien, Hopeh). PALAEARCTIC REGION: Europe, Japan, Korea, Northern Asia, Siberia.

Host plants: *Pinus massoniana* (Gressitt, 1942); *Pinus, Abies, Picea, Cryptomeria* (Cheo, 1935).

Mature larva. Very similar to those of *Arhopalus* species, from which it may be distinguished by the characters given in the key, p. 13.

Pupa (fig. 37). Similar to those of *Arhopalus* species, from which it may be distinguished by the characters given in the key, p. 36.

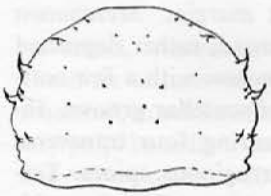

Fig. 37. *Spondylis buprestoides* (Linnaeus). Pupa. Pronotum.

Biology. In China adults emerge during May and June (Gressitt, 1942). Larvae tunnel in the solid wood of dead trunks or fallen branches of pine trees.

Parasites. Hymenoptera. *Ephialtes manifestator* L., *Odontomerus pinetorum* Thoms. (Thompson, 1943).

Economic importance. This species may become a pest where there are large areas of pines and where care is not taken in the disposal of waste wood. It renders wood almost useless for lumber (Gressitt, 1942).

Control. Cutting and disposing of dead branches, the burning of trunks and the prompt removal of cut or dead trees to soaking ponds or mills should reduce danger of infestation (Gressitt, 1942).

Material studied. 1 P, Denmark, Seeland, from *Pinus*, E. Rosenberg leg., in coll. U.S.N.M.; 15 L, Holland, Arnhem, 8.vi.1950, E. T. G. Elton leg., in coll. B.M.

References. Barbey, 1913 (Biol.); Cheo, 1935 (Biol.); Duffy, 1953a (L, P fig., Biol.); Emden, 1939–1940 (L); Gressitt, 1942 (I fig., Biol., Contr.); Kemner, 1922 (Biol.); Kojima, 1959 (L fig.); Mjöberg, 1905 (Biol.); Nördlinger, 1880 (Biol.); Perris, 1856 (L fig., Biol.) 1877 (Biol.); Polozhentzev, 1929 (Biol. fig.); Ratzberg, 1839 (Biol. fig.); Reineck, 1919 (Biol.); Shiraki, 1952 (Biol.); Thompson, 1943 (Paras.); Westwood, 1839 (Biol. fig.); Xambeu, 1898–1902 (Biol.).

Asemum amurense Kraatz

Distribution. ORIENTAL REGION: China (Liaoning). PALAEARCTIC REGION: Japan.

Host plants: Unrecorded, but almost certainly *Pinus* and other coniferae.

Mature larva. No material available but probably very similar to that of *A. striatum* (Linnaeus), of which the following is a description. *Head* less depressed than in *Arhopalus* species, with sides more strongly diverging behind middle; genal setae shorter, finer and testaceous. Labrum slightly wider than long. Gular sutures slightly raised and almost as darkly pigmented as hypostomal sutures. Maxillary palpi with apical segment almost as long as segment 2. *Prothorax* with lateral setae only moderately dense; pronotum with posterior part pale testaceous and much more finely asperate. *Abdomen* with urogomphi longer and stouter, subcontiguous at base and

with apical third (at most) strongly sclerotized. Length up to 20 mm.; breadth (at prothorax) 5·8 mm.

Pupa. No material available but probably very similar to that of *A. striatum* (Linnaeus), of which the following is a description (fig. 38). *Head* with vertex with two groups of short spines intermingled with numerous short pale setae; front with a transverse row of short spines above base of clypeus. Antennae transversely rugose, densely spiculate and with at least three short spines on each segment; extending to just beyond middle of metathorax, where they are strongly curved downward to terminate near bases of elytra. Maxillary palpi spiculate and with a few short pale setae. *Pronotum* strongly transverse, with sides strongly rounded, and with scattered stout, ferruginous spines and long fine setae, especially along front margin. *Mesonotum* with a few fine setae; scutellum broad, rather depressed and glabrous or almost so. *Metanotum* with a few scattered minute spines on each side of scutellar groove. *Abdomen* with tergites 1–6 each bearing four transverse groups of numerous thornlike, ferruginous spines. Tergites 7 and 8 with scattered stout spines. Sternites with lateral groups of spines, except tergite 9, which bears only two stout spines and tergite 10, which is glabrous. *Functional spiracles* with peritreme rather thick and raised above general level of cuticle. Length 10–18 mm.; maximum breadth 7 mm.

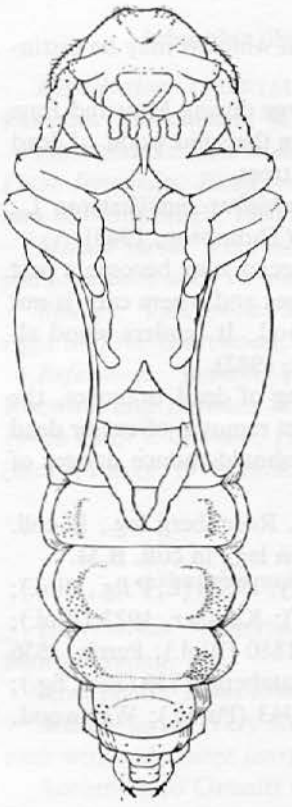

Fig. 38. *Asemum striatum* (Linnaeus). Male pupa. Ventral aspect.

References. Cheo, 1935 (Biol.); Duffy, 1953a (E, L, P fig., Biol. of *A. striatum* (Linnaeus)); Kojima, 1959 (L fig.).

Tetropium oreinum Gahan

Distribution. ORIENTAL REGION: China, India (Punjab, Uttar Pradesh), Jammu and Kashmir.

Host plants. *Cedrus deodara*, *Picea morinda*, *Pinus excelsa* (Beeson and Bhatia, 1939); ?*Ulmus oreinum* (Mathur and Balwant Singh, 1961b).

Mature larva (fig. 39). Rather similar to those of *Arhopalus* species but differing as follows. *Head* transverse, with sides slightly wider behind middle; genal setae mostly arising from ferruginous basal dots, which give the genae a spotted appearance. Frons distinctly darker than epicranial halves. Antenna with segment 3 quadrate to transverse; front margin with declivity deep, almost vertical and feebly but distinctly bilobed paramedially. Mandible without an oblique plate along edge of dorsal surface and bearing fewer setae. Labrum transversely ovate, about twice as wide as long. Gula much shorter, not more than half as long as hypostomal sutures. Maxillary palpi with apical segment almost as long as segment 2. *Prothorax* as in *Asemum*. *Abdomen* with uro-

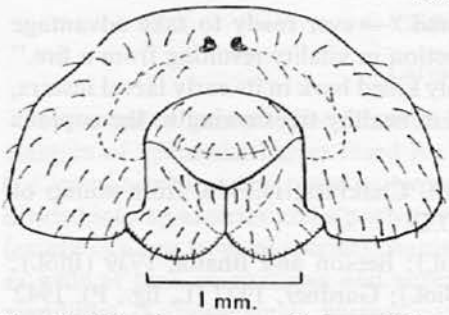

Fig. 39. *Tetropium oreinum* Gahan. Mature larva. Urogomphi and anal lobes. Caudal aspect.

gomphi widely separated basally, broadly rounded apically (fig. 39). *Legs* with femur and tibiotarsus distinct, ferruginous. *Spiracles* with peritreme sub-circular and with two protuberant subcontiguous tubes on posterior margin. Thoracic spiracle about twice as large as those on abdominal segment 1. Length up to 24 mm.; maximum breadth (at prothorax) 5·75 mm.

Pupa. No material available but probably very similar to that of *T. gabrieli* Weise, of which the following is a description (fig. 40). *Head* with two to six short pale spines on vertex. Antennae transversely rugose, densely spiculate, the basal segment with about six testaceous spines near apex of basal segment, and remaining segments with scattered, much smaller spines; extending as far as second abdominal segment. Maxillary palpi broadly truncate at apex. *Pronotum* elongate, with sides moderately rounded, and vertex with a pair of paramedian, longitudinal furrows; vertex and front margin with numerous conical papillae (each with an apical seta). *Mesonotum* glabrous; scutellum with a few minute setae. *Metanotum* sometimes with a few pale setae on each side of scutellar groove. *Abdomen* with tergites 1–6 bearing two oval groups of spines (each with a subapical seta). Tergite 7 with a few scattered spines. Tergite 8 often, and 9 always, glabrous. *Legs* with a row of spines (with apical setae) near apex of each femur. *Functional spiracles* with peritreme slightly raised in anterior half. Length 10–16 mm.; maximum breadth 3·75 mm.

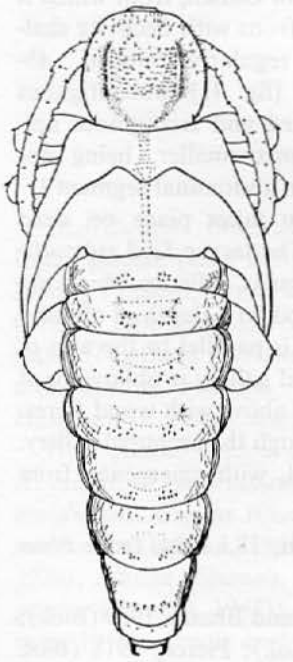

Fig. 40. *Tetropium gabrieli* Weise. Pupa. Dorsal aspect.

Biology. Oviposition takes place on newly felled, green or standing sickly trees, particularly deodar. The eggs are deposited singly in crevices on the sheltered side of the log or trunk. The subcortical larval galleries are long, irregularly curved and shallow and are filled with wood and bark dust. After having rested throughout the winter, the larvae, from about April onwards, tunnel into the sapwood almost horizontally for half to one and a half inches to excavate a pupal cell parallel to the axis of the log and slightly broader than the gallery. In thick barked logs or stumps, however, the pupal cell may lie in the bast or superficially groove the sapwood. The pupal period is probably four to six weeks in duration. The life-cycle is annual, with emergence occurring from May to July, although in the case of logs brought down from high elevations it may be between January and March (Beeson and Bhatia, 1939).

Economic importance. Stebbing (1914) regards this

species as one of the serious pests of deodar and "— ever ready to take advantage of any sickliness or injury to a tree or any reduction in vitality resulting from a fire."

Although this secondary borer requires freshly killed bark in its early larval instars, it is quite unable successfully to establish itself in healthy trees owing to the copious production of resin.

Material studied. 2 L, India, Uttar Pradesh, Chakrata, iv.1933, from stump of *Cedrus deodara*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1915 (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1927 (L, fig., P), 1942 (L); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961b (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (L fig., P fig., I fig., Biol. fig. (besides pp. 284, 285, fig. 195 (*T. oreinum* Gahan), pp. 286 and 287, fig. 196 (*Tetropium* sp.) and pp. 5, 14, 33, 38, 61, 340–344, figs. 229–231, plate 24 (*Trinophylum cribratum* Bates) also refer to this species).

Nothorhina gardneri Plavil'shchikov

Distribution. ORIENTAL REGION: India (Uttar Pradesh), W. Pakistan (W. Punjab).

Host plant: *Pinus longifolia* (Beeson and Bhatia, 1939).

Mature larva (fig. 41). Similar to that of *Tetropium oreinum* Gahan, from which it may be distinguished as follows. *Head* with front margin of frons with declivity shallow and smoothly and regularly rounded. *Abdomen* with urogomphi (fig. 41) subcontiguous basally, acutely produced and ferruginous apically. Spiracle of thorax smaller, being not much larger than that on abdominal segment 1.

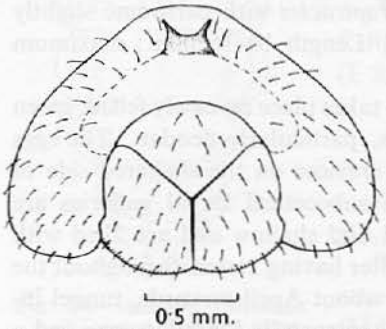

Fig. 41. *Nothorhina gardneri* Plavil'shchikov. Mature larva. Urogomphi and anal lobes. Caudal aspect.

Biology. Oviposition takes place on dead branches and trunks. The larvae feed subcortically, making long irregular galleries which are tunnels into the sapwood to a depth of about ¾ to 1 in. The pupal cell is parallel to the axis of the log and the prepupal gallery is oblique or at right angles to it, closed above with wood fibres. The beetle emerges through the prepupal gallery. The life-cycle is annual, with emergence from March to June (Beeson and Bhatia, 1939).

Material studied. 2 L, India, Uttar Pradesh, Dehra Dun, 18.i.1934, from *Pinus longifolia*, A. K. Sharma leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (L fig., P fig., Biol. fig.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1942 (L); Mathur and Balwant Singh, 1960d (Biol.); Pierce, 1918 (Biol. (under *N. muricata* Dalman)); Stebbing, 1911 (L fig., P fig., I fig., Biol. fig. (under *N. muricata* Dalman)), 1914 (L fig., P fig., I fig., Biol. fig. (under *N. muricata* Dalman)).

6. CERAMBYCINAE

Larval Characters

Form subcylindrical. *Head* transverse to subquadrate, wider behind middle; dorsal margins of epicranial halves fused for some distance behind frons; tentorial bridge (*i.e.* cross-arm) in same plane as hypostoma, the occipital foramen thus apparently divided into an anterior and a posterior portion. Epistoma not produced over clypeus (except in a few tropical species); four epistomal setae present. Clypeus narrow, not as wide at base as epistoma and never filling space between dorsal articulations of mandibles. Labrum small, narrow, usually more or less circular. Antennae salient, rarely entirely retractile, distinctly 3-segmented. Mandible short, trapezoidal, with cutting edge gouge-like, never with apex of dorsal angle produced. Ocelli absent, or one, two or three pairs present. Maxillae movable; cardo distinct; maxillary articulating area swollen. Ventral mouthparts attached to hypostoma by little more than width of gula; maxillae with palpi and lobes curved upwards against ventral part of mandibles; palpifer small, with outer margin strongly rounded; lobe borne on stipes and often setose on inner margin; labial palpi narrowly separated at base. *Prothorax* having presternum and epipleurum often fused but sometimes distinctly separated; eusternum rarely distinctly defined. Postnotal fold usually present. *Abdomen* having elliptical region surrounding spiracle protruding and well defined; epipleurum protuberant only on last three segments; pleural discs present. *Legs* small or absent. *Spiracles* of mesothorax not protruding into prothorax.

Oemini

Xystrocera globosa (Olivier)

[The Two-Lined Albizzia Longhorn[15]]

Distribution. ORIENTAL REGION: Andaman Is., Burma, Celebes, Ceylon, China, East Pakistan (East Bengal), Formosa, India (Assam, Bihar, Madras, Maharasthra, Madhy Pradesh, Mysore, Punjab, Uttar Pradesh, West Bengal), Java, Malaya, New Guinea, Philippine Is., Seychelles, Sumatra, Thailand. AUSTRALASIAN REGION: Australia (Northern Territory). PALAEARCTIC REGION: Arabia, Egypt, Japan, Korea. MADAGASCAN REGION: Madagascar, Rodriguez, Mauritius. HAWAIIAN REGION: Hawaiian Is. NEOTROPICAL REGION: Caribbean (Puerto Rico (introduced)).

Host plants: *Acacia catechu, A. modesta, Acrocarpus fraxinifolius, Albizia lebbek, A. lucida, A. odoratissima, A. procera, A. stipulata, Bauhinia acuminata, Salmalia malabarica, Grewia tiliaefolia, Xylia xylocarpa* (Beeson and Bhatia, 1939); *Albizia moluccana* (Beeson, 1941); *Theobroma* (De Haan, 1933); *Acacia mollissima* (Miwa, 1939); *Albizia chinensis, Adenanthera pavonia, Acacia confusa, Cassia glauca, Prunus persica* (Gressitt, 1942); *Parkia speciosa* (L. G. E. Kalshoven); *Parkia* sp. (Dammerman, 1919); *Acacia arabica, Adina cordifolia* (Bhasin and Roonwal, 1954); *Duabanga*

[15] The original spelling of *Albizia* has been used here as this is a common name.

sonneratioides (Mathur and Balwant Singh, 1959); *Samanea saman* (Boonsom Meksongsee); *Haematoxylon campechianum* (Vinson, 1962).

Adult (fig. 42). Length 15–32 mm. Reddish brown, except elytra which are pale yellowish brown; pronotum with front and hind margins and elytra with external and apical margins and a median longitudinal stripe metallic green. *Head* with antennae about one and two-thirds as long as body in male but only slightly longer than body in female. *Prothorax* subglobose, with rounded sides. *Elytra* gradually narrowed posteriorly, rounded apically.

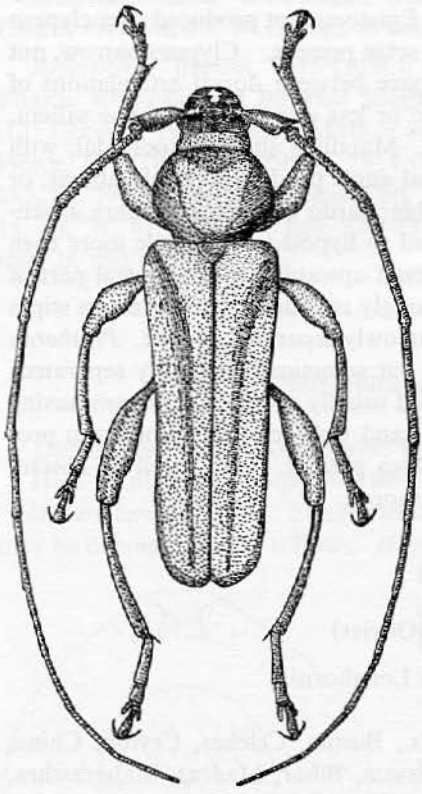

Fig. 42. *Xystrocera globosa* (Olivier). Adult.

Mature larva (fig. 43). *Head* trapezoidal. Genae strongly shouldered. Temples narrowly ferruginous ventrad of antennae and bearing numerous short bristly setae. Sclerotization of mouthframe ferruginous and narrowly interrupted beneath antennae. Antenna with segment 2 about one and one-half times as long as basal width; supplementary process conical, about one-fourth length of segment 3. Mandibles short, broad, entirely pitchy. Labrum transversely oval, with anterior margin very densely fringed with short pale setae. Ocelli indiscernible, probably absent. Hypostoma with front margin broadly and very strongly sclerotized and very faintly transversely striate; sutures distinct, slightly incurved. Gula slightly raised, sutures concave, distinct. Maxillary palpi with segment 3 not longer than segment 2; dorso-external process of palpifer distinctly attenuated. Labial palpi with segment 2 shorter than segment 1. *Prothorax* transverse, slightly wider posteriorly, with numerous short, very pale setae and interspersed glabrous spots on lateral margins; pronotum with median cleavage line distinctly impressed; anteriorly testaceous, shining; median area rather coarsely punctate and bearing short setae; posteriorly finely and closely longitudinally striate. Prosternum with a pair of triangular, shining, slightly rugose areas. *Abdomen* with ampullae dull, reticulate, rugose and micro-spiculate; strongly bilobed, especially those on posterior segments. Pleura micro-pubescent, with a few longer setae. *Legs* distinctly 4-segmented, pale (Duffy, 1953b). The characteristic broadening of abdominal segment 8 and the shortening of segment 9 is shown in fig. 43. Length up to 44 mm.; maximum breadth (at prothorax) 7·1 mm.

Pupa. No pupae of this species are available but Gardner (1927) gives the following description. "Antennae long, recurved near the 7th abdominal segment, the apical

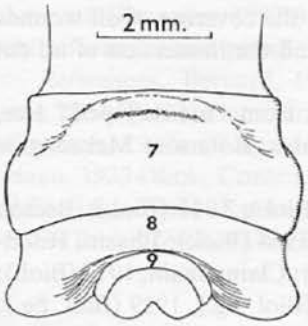

Fig. 43. *Xystrocera globosa* (Olivier). Mature larva. Outline of posterior part of abdomen showing caudal truncature. Dorsal aspect.

joint reaching to near the head in the male. Pronotum with a number of soft, erect papillae, each papilla with a short cephalad seta. Abdominal tergites 1–6 without papillae or setae; 7th tergite with a posterior group of papillae similar to those on the pronotum but smaller; 8th tergite with a slight median posterior projection and a few papillae."

Biology. The following account has been abstracted from that by Beeson (1941). "The larval tunnels run in the inner bark mainly but also groove the sapwood superficially. In trees with thick bark a heavy infestation reduced more than half the thickness of the bark to dust so that the bark readily separated from the wood. The prepupal tunnel is made at a right angle or an obtuse angle to the surface of the sapwood and then turns downwards or upwards to terminate in a pupal chamber parallel to the long axis of the log. The chamber (Pl. XV, fig. 2) is lined throughout with a fine deposit of calcium carbonate, very thin, so that the inequalities and minor projections on its walls are hardly concealed; the lining is white, with some yellowish discoloration, especially at the lower end where the larval exuviae rest. The upper end is closed by a thin, smooth, ellipsoidal dome of calcium carbonate about $\frac{1}{4}$ in. high and $\frac{7}{16}$ in. wide. The calcium carbonate is produced in two of the four Malpighian tubules. The pupal period lasts about three weeks."

"The digestive juice of the larvae contains amylase, saccharase and maltase but does not contain cellulase and consequently it does not digest cellulose. There are no mycetocytes in any part of the body. The principal food supply is from other carbohydrates and soluble sugars in the sapwood. The heartwood of *Albizzia lebbeck* contains only small traces of starch and sugar and this fact explains why the larval tunnels do not penetrate the heartwood."

"Emergence occurs in every month of the year but mainly in May, June and September. The larval life is variable and in some individuals of the same brood may develop in less than a year."

According to Coquerel (1848) larvae of this species are eaten by natives in Madagascar. Gressitt (1942) states that adults are nocturnal and may be attracted to light. In China there are two or three generations a year.

Parasites. Hymenoptera: *Sclerodermus immigrans* Bridw. (Thompson, 1943).

Economic importance. In Egypt this species has been reported to cause severe damage to *Albizia lebbeck*, which is extensively used for ornament and shade. Sometimes felled timber is attacked, but the resulting adults are much smaller in size (Willcocks, 1909).

Control. Gressitt (1942) recommends that infested dead trees or logs should be disposed of promptly or the bark should be removed and the larvae destroyed (the latter method will not necessarily result in exterminating those in the pupal stage). For living trees, infested branches should be trimmed off and destroyed and the bark removed from affected areas of the trunks, the larvae killed and the wood treated with tar. Rau (1939) recommends the injection of a 10 per cent solution of paradi-

chlorobenzene under the bark. Willcocks (1909) suggests the covering of all wounds in the bark with tar, the felling of heavily infested trees and the immersion of all cut logs in water for several months.

Material studied. 1 L, Hawaii, Honolulu, 11.vi.1945, from "monkey-pod" tree, in coll. U.S.N.M.; 1 L, Thailand, from *Enterolobium saman*, Boonsom Meksongsee pres., in coll. B.M.

References. Anderlind, 1888 (Biol.); Beeson, 1919a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (I fig., Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Breuning, 1957 (Biol.); Clainpanain, 1917 (Biol.); Coquerel, 1848 (L fig., P fig., Biol.); Dammerman, 1919 (Biol. fig.), 1929 (Biol. fig.); De Haan, 1933 (Biol.); Duffy, 1952a (Biol.), 1953b (L, P, Biol.), 1957 (L fig., P, I, Biol.), 1960 (L fig., P, Biol., Contr.), 1963 (L fig., P, Biol., Contr.); Fletcher, 1914 (Biol.); 1921 (Biol.); Galeb, 1889 (Biol.); Gardner, 1927 (L, P fig.); Gressitt, 1942 (L fig., P fig., Biol. fig.), 1951 (Biol.); Hammad and Hassan, 1961 (L fig.); Hoffmann, 1934 (I fig., Biol., Contr.); Kalshoven, 1951 (Biol.); Kojima, 1959 (L fig.); Kojima and Nakamura, 1961 (Biol.); McKeown, 1940 (Biol.); Mansour and Mansour Bek, 1934a (L fig., Physiol.), 1934b (Physiol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Miwa, 1939 (Biol.); Moutia, 1955 (Biol.); Mühlmann, 1954 (Biol.); Petroff, 1920 (Biol.); Rau, 1939 (Biol.); Schiödte, 1876 (L fig.); Stebbing, 1914 (I fig., Biol. fig.); Thompson, 1943 (Paras.); Ultée, 1931 (Biol.); Vinson, 1962 (Biol.); Willcocks, 1909 (L fig., P fig., I fig., Biol., Contr.), 1922 (?).

Xystrocera festiva Thomson

[The Albizzia Borer]

Distribution. ORIENTAL REGION: Assam, Borneo, Burma, Java, Malaya, Nias I., Sumatra, Tonkin.

Host plants. *Albizia falcata, A. lebbeck, A. stipulata, A. sumatrana, Pithecolobium lobatum, Theobroma, Coffea* (Beeson, 1941); *Albizia chinensis* (L. G. E. Kalshoven).

Mature larva. No material available but apparently differing from that of *X. globosa* (Olivier) in having glabrous abdominal ampullae.

Biology. Under laboratory conditions eggs were deposited in clusters up to 400 on host plant stems, the incubation period averaging 18 days. Recently infested trees may be recognized by the secretion of gum and sap, causing black stains to appear. Larvae feed subcortically, and if the branches are completely encircled by the larval galleries they die. Pupation occurs deep in the wood, and where there are several pupal cells close together, trunks and branches are weakened. The pupal stage, under laboratory conditions, averaged 18 days, the total life-cycle being about 190 days in duration. The female beetle lives about four days, in which time it deposits about 400 eggs (Franssen, 1937a).

Economic importance. In Java this species is very injurious to shade trees of the genus *Albizia.* Heavily infested trees may die (Franssen, 1937a).

Control. Infested portions of the tree should be completely removed, and fresh infestations, which are conspicuous due to the staining, should be dealt with once

a month (Franssen, 1937a). Haan (1933) suggests the injection of a mixture of paradichlorobenzene and petrol. Other control measures are discussed by Jong (1931).

References. Bernard, 1919 (?); Beeson, 1941 (Biol., Contr.); Bhasin and Roonwal, 1954 (Biol.); Dammerman, 1919 (Biol.), 1929 (I fig., Biol.); Duport, 1913 (Biol.); Franssen, 1937a (E fig., L fig. P fig., I fig., Biol. fig., Contr.); Goot, 1928 (Biol.); Haan, 1933 (Biol., Contr.); Jong, 1931 (Biol., Contr.); Kalshoven, 1951 (E fig., L fig., P fig., I fig., Biol.); Koningsberger, 1898 (Biol.), 1908 (Biol.), 1915 (Biol.); Mühlmann, 1954 (Biol.); Veen, 1879 (Biol.).

Entetraommatus quercicola Fisher

Distribution. ORIENTAL REGION. India.

Host plant: *Quercus incana* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Hypoeschrus indicus Gahan

Distribution. ORIENTAL REGION: Ceylon, India (Maharashtra, Uttar Pradesh, West Bengal).

Host plants: *Acacia catechu, Dichopsis grandis, Shorea robusta* (Beeson and Bhatia, 1939); *Acacia senegal* (Bhasin and Roonwal, 1954); *Gymnosporia montana* (Mathur and Balwant Singh, 1960b).

Biology. The life-cycle is annual, with emergence from May to October, mainly June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961 (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol.).

Oplatocera (=Epioplatocera) oberthuri Gahan

Distribution. ORIENTAL REGION: Bhutan, Formosa, India (Sikkim), West China.

Host plant: *Adinandra formosana* (Mitono, 1938).

Reference. Gressitt, 1951 (Biol.); Mitono, 1938 (Biol.).

Tetraommatus filiformis Perroud

Distribution. ORIENTAL REGION: Ceylon, India (Madras).

Host plant: *Chloroxylon swietenia* (Beeson and Bhatia, 1939).

Biology. Adults have been bred in January and taken on the wing in July and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Tetraommatus insignis Gahan

Distribution. ORIENTAL REGION: Andaman Is., Burma, India (Assam); Malaya, Thailand.

Host plant: *Myristica longifolia* (Beeson and Bhatia, 1939).

Biology. Adults have been bred in May and June (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Tetraommatus ocularis continentalis Heller

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Pinus longifolia* (Beeson and Bhatia, 1939).

Biology. Larvae infest small branches and twigs. The life-cycle is usually annual but may sometimes be carried over to the second year. Adults emerge from July to October (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L); Mathur and Balwant Singh, 1960d (Biol.).

Noserius tibialis Pascoe

Distribution. ORIENTAL REGION: Borneo, Burma, Java, Malaya.

Host plant: *Xylia xylocarpa* (Beeson and Bhatia, 1939).

Biology. Adults occur in May and from October to January.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Braithwaite, 1941 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Noserius indicus Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Xylia xylocarpa* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Cerambycini

Larval Characters

Head rectangular or only slightly narrowed anteriorly; posteriorly straight or only very slightly emarginate. Three pairs of ocelli present. Labrum transverse. Ligula wide. Labial palpi distinctly separated. Palpifer and segment 1 of maxillary palp each with a small rounded process; lobe with several stout setae on inner margin. *Prothorax* with eusternum triangular (the apex often being fused with presternum); hypopleurum distinct, triangular; postnotal fold present; presternal plates indiscernible. *Abdomen* with dorsal ampullae having two distinct transverse furrows. *Legs* distinctly 4-segmented. *Spiracles* sometimes with distinct marginal chambers.

Larvae of many, if not all, species of Cerambycini possess the ability to secrete calcium carbonate from the Malpighian tubules in the form of a milky suspension of amorphous granules. According to Mayet (1896), calcium is present in four of the six Malpighian tubules of *Cerambyx*, but in *Hoplocerambyx* only two of the tubules secrete calcium carbonate (Beeson, 1919). At a time several weeks before pupation, the larva starts to regurgitate through the mouth most of the calcium secreted during

larval development together with a variable proportion of gum-like matter. During this period the calcium carbonate present in the gut is readily visible through the integument. As a result of this performance the larva becomes reduced to at least two-thirds of its original length and bulk. It also loses its former transparency and becomes opaque and yellowish. The secreted calcium carbonate is moulded by the larva into a cocoon or an operculum; in the latter the design is constant and often characteristic of the genus or species. The protection possibly afforded by these deposits has already been discussed (Duffy, 1953a).

Hoplocerambyx spinicornis (Newman)

[The Singhbhum Sal Borer]

Distribution. ORIENTAL REGION: Borneo, Burma, Bhutan, India (Assam, Bihar, Madras, Maharashtra, Orissa, Punjab, Uttar Pradesh, West Bengal), Indo-China, Malaya, Nepal, New Guinea, Pakistan (East Bengal), Philippine Is., Singapore, Sumatra, Thailand. PALAEARCTIC REGION: Afghanistan. AUSTRALASIAN REGION: Palau Is.

Host plants: *Duabanga sonneratioides*, *Hevea brasiliensis*, *Parashorea robusta*, *Pentacme suavis*, *Shorea assamica*, *S. obtusa*, *S. robusta* (Beeson and Bhatia, 1939). *Anisoptera glabra* (Bhasin and Roonwal, 1954); *Parashorea malaanonan*, *P. stellata* (Mathur and Balwant Singh, 1960d). *Hopea odorata* (D. of A., Bangkok).

Adult (Pl. IV, fig. 3). Length 20–65 mm. Brownish black, the elytra varying from reddish brown to piceous. Head, prothorax and appendages covered with fine greyish pubescence, the elytra more densely covered with silky fulvous grey pubescence. *Head* with antennae at least one-fifth longer than body in male, slightly shorter than body in female; segments 3–10 spined apically. *Prothorax* slightly elongate, rounded laterally, with disc transversely crenulate but with a small median smooth area. *Elytra* slightly elevated close to suture, at about basal fourth, truncate apically, spined at suture and dentate at outer angle.

Mature larva (figs. 44, 45). Form elongate, subcylindrical, robust. *Head* (fig. 44)

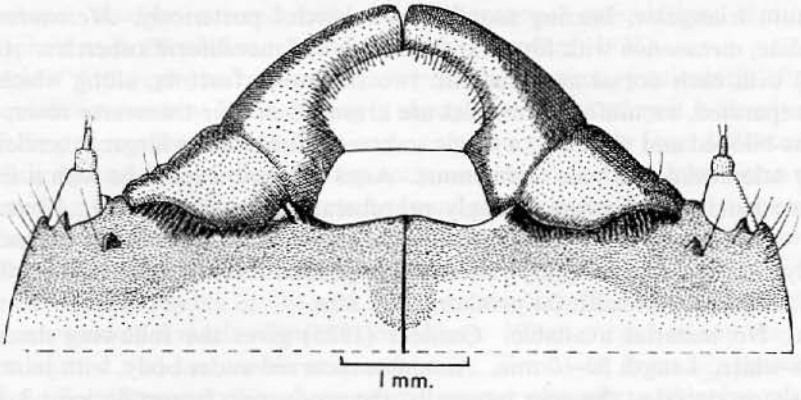

Fig. 44. *Hoplocerambyx spinicornis* (Newman). Mature larva. Anterior part of head. Dorsal aspect. (Duffy, 1963)

with temples smooth, testaceous, glabrous, except for a protuberant ferruginous ridge or carina immediately behind ocelli.

Postcondylar carina present. Frons testaceous, with front margin broadly ferruginous to pitchy and produced sublaterally into a pair of dentate processes; a pair of similar processes present behind each dorsal mandibular condyle. Antennal foramen with upper margin produced into a dentate process. Three pairs of distinct subcontiguous ocelli present, arranged in a vertical row laterad and ventrad of antenna; lens round, convex, strongly protuberant, pigmented spot indistinct. Hypostoma smooth,

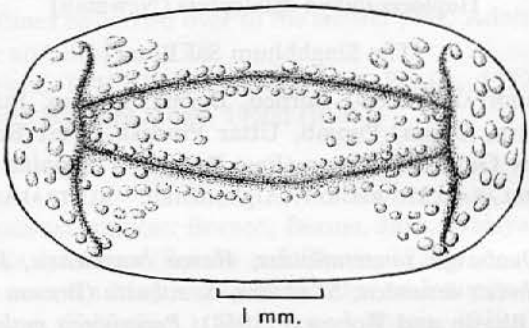

Fig. 45. *Hoplocerambyx spinicornis* (Newman). Mature larva. Abdominal ampulla of tergite 6. (Duffy, 1963)

testaceous, with front margin narrowly ferruginous; gula broad, with sutures subparallel. Antenna with segment 3 about two-thirds length of segment 2; supplementary process about one-fifth length of segment 3. Labrum broadly subcordate, with anterior margin subangulate medially; bearing numerous stout pale setae around margins. Maxilla with segment 3 of palp about half length of segment 2; labial palp with segment 2 about half length of segment 1. *Prothorax* rectangular, lateral margins impressed and distinct posteriorly; posterior area of pronotum vermiculately rugulose. Eusternum triangular, bearing moniliform tubercles posteriorly. *Mesonotum* nontuberculate, *metanotum* with four transverse rows of moniliform tubercles. *Abdomen* (fig. 45) with each dorsal ampulla with two transverse furrows, along which small, widely separated, moniliform tubercles are arranged in four transverse rows; ventral ampullae bilobed and with only a single transverse furrow; the larger tubercles rather strongly sclerotized and pale ferruginous. Anus trilobed, each lobe with a fringe of short fine hairs. Epipleurum strongly protuberant on segments 7–9. Pleural discs present on segments 1–3; small, depressed, subcircular. *Spiracles* with peritreme narrowly oval, pale and slightly raised above general level of cuticle. Length up to 90 mm.; maximum breadth (at prothorax) 18 mm.

Pupa. No material available. Gardner (1925) gives the following description. "Yellow-white. Length 30–60 mm. Antennae recurved under body, with joints 3 to 7 angulately produced at the apex internally, the production largest on joint 3, in male longer than body, in female shorter than body. Labrum about as long as wide, with a

median depressed line; narrowed towards apex. *Pronotum* with a prominent lateral blunt projection on each side; the posterior margin with a short prominent fleshy prominence on each side of the median line; with a few scattered setae. *Mesothorax* with a transverse stridulatory area indicated; with a posterior median fleshy tubercle which is slightly bilobed at the apex. *Abdomen* with tergite 1 with a few asperities; tergites 2 to 7 with fairly dense transverse bands of small castaneous asperities near the posterior margin, each asperity associated with a seta; anterior to this band are a few patches of smaller asperities; tergite 9 with two fleshy rugulose projections; posterior to sternite 8 is, in the male, a transverse rectangular lobe and in the female two contiguous rounded lobes."

First-instar larva. Gardner (1925) figures this and gives the following description. "The two days old larva is about 4 mm. long by 1·2 mm. at the prothorax. General shape and coloration as in the mature larva. Skin covered with minute retrorse asperities. *Head* with the epistoma more or less even with no evident projections over the clypeus. Three ocelli on each side. Mentum and submentum of labium each with two setae. Antennae with an elongate conical accessory joint which is as long as the true terminal joint. *Pronotum* with posterior area smooth and with a few short striae. Dorsal and ventral ampullae of abdomen divided into two lobes by a median longitudinal depression; each dorsal ampulla with two transverse furrows; each ventral ampulla with a single furrow; ampullae with minute asperities except along the transverse furrows where skin is smooth. *Legs* small, four-jointed, with the terminal joint longer than the third. *Spiracles* bifore, with two finger-like contiguous lobes projecting from a common chamber or atrium, the walls of the latter showing irregular polygonal, elongate reticulation; the two terminal lobes with transverse striation except for a narrow longitudinal slit along the middle of each; at the base of the atrium is the closing apparatus and below this the tracheae branch off; the thoracic spiracle is larger than the abdominal spiracles; the two external lobes of the spiracles are nearly perpendicular to the length of the larva, projecting upwards and slightly backwards."

Egg. "Spirit material with a pale reddish tinge; length 3·2 mm., width 1·2 mm. Rounded at each end; one end slightly larger than the other and bearing a slight protuberance. Surface covered with minute hexagonal reticulation; shining. No minute spines as in *Plocaederus* and *Aeolesthes*" (Gardner, 1925).

Biology. "Although the beetles are active in the daytime, particularly afternoon, they avoid direct sunshine by sheltering in shady places; but when it is cloudy or light rain is falling they often take to flight and cover comparatively long distances. They run actively up and down trees and frequently assemble in large numbers on a suitable tree for mating. After sunset they are to be found resting in crevices and other secluded places but if stimulated they soon become active; they have even been attracted to trees felled as late as ten o'clock at night.

"The beetles feed readily on the bark of sal, particularly the inner living bark which has been exposed as a result of mechanical injury. When gorged on sap they appear to be intoxicated and are unable to stand or fly. Fresh sap is readily detected and beetles have been known to fly a distance of a quarter of a mile, within five minutes of flying upwind, to freshly felled trees. Fermented sap a week or more old is not nearly

so attractive. Water appears to be a necessity and without it the adult life is reduced by ten days or more.

"Rival males are ferocious fighters and antennae and other appendages are frequently bitten off. A bite from the powerful mandibles will draw blood from the human finger. In captivity large males have been observed to monopolize several females, driving off smaller males rather as a stag or boar does. Both sexes stridulate when alarmed or molested and, when courting, the male sometimes stands still and rises his body to the full extent of his legs and stridulates by raising and depressing the prothorax.

"Before the act of copulation the male mounts the female, clasping her humeri with the claws of his front tarsi, pressing his mandibles between the bases of the antennae of the female and grasping her hind legs with his middle legs. It is in this position that the male is carried about on the female's back until she halts with exserted ovipositor and accepts the exserted aedeagus of her mate. Although coitus lasts only a few seconds the male usually remains mounted for some time. Copulation is frequently repeated after each period of oviposition" (Beeson, 1941).

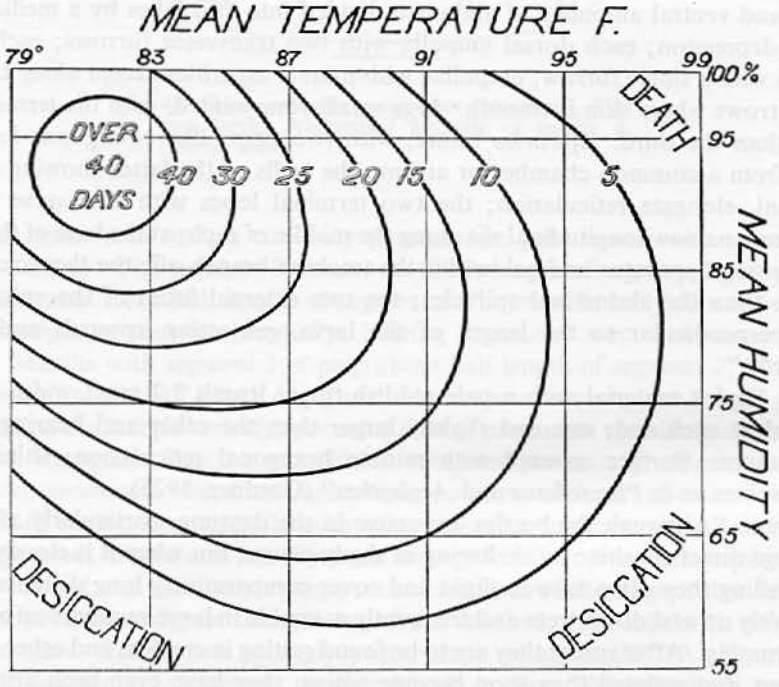

Fig. 46. Graph showing the zones of maximum adult life of *H. spinicornis* (Newman) at different combinations of temperature and relative humidity. Mean temperature during life in degrees Fahrenheit is the mean of the daily maxima and minima; mean relative humidity percentages during life as measured by a continuous recording hygrograph. Note that low humidities are unfavourable to the continued existence of the beetle at both low and high temperatures, and that in dry air the beetle dies through desiccation. High temperatures, by speeding up metabolism, reduce the length of life proportionately. The most favourable atmospheric conditions are at temperatures round about 80°F. [26·7°C.] and at relative humidities of 88 to 99 per cent. (Beeson, 1941)

The maximum duration of adult life in captivity has been recorded as 49 and 38 days for the male and female respectively. Arid conditions and temperatures exceeding 85°F [29·4 °C] considerably shorten the beetle's life, excesses resulting in loss of control of direction, rigidity of appendages and finally death due to desiccation. On the other hand, high atmospheric humidities appreciably increase adult life. The graph facing (fig. 46) shows the zones of maximum life of *H. spinicornis* at different combinations of temperature and humidity. From this it will be seen that low humidities are unfavourable to adult longevity at both low and high temperatures and that high temperatures by speeding up metabolism, reduce the length of life proportionately. Temperatures around 80°F [26·7°C] and relative humidities between 88 and 98 per cent constitute the most favourable atmospheric conditions for this beetle.

Eggs are deposited seven to nine days after the first fertilization. Although numerous eggs may be laid without subsequent fertilizations, copulation sometimes takes place repeatedly during active life. The maximum number of eggs known to have been deposited by an individual is 468 and the maximum oviposition period observed is 30 days. Eggs are deposited singly, deep in cracks and crevices in the bark, particularly on the underside of logs or the shady side of a tree's bole or branches.

Above a humidity of 75 per cent (at the most favourable temperature) over 200 eggs may be laid and the possible maximum increases with increasing humidity but between 90 and 100 per cent there is a slight decrease. The optimum combination of relative humidity and air temperature conducive to fecundity is the same as that already given for longevity. In other words, the humidity-temperature combinations producing a progressive variation in longevity also produce a progressive variation in fecundity in the same direction but not directly ovoportional. Thus the maximum number of eggs possible for a life zone may be laid by an individual whose actual life is less than the maximum possible for a given humidity-temperature combination. The greatest total number of eggs from a female to be recorded is 465 at 91 per cent relative humidity and 82·7°F [28°C].

The normal incubation period varies from three to seven days with a mode of four days. Exposure to dry air for three or four hours is sufficient to inhibit germination. On the other hand very wet conditions make the eggs susceptible to fungoid attack. The percentage of eggs hatching under normal atmospheric conditions varied from 75 to 100 per cent and is generally between 80 and 90 per cent. The success or failure of a brood and the progress of epidemics is governed mainly by the ratio of the population density of the borer to the resin production capacity of the tree. Isolated first-instar larvae when boring into the bark are overwhelmed by the exudation of resinous sap. But if numerous larvae are penetrating the bark at the same time, exudation of resin is not copious enough to overwhelm each larva and thus many are able to survive.

Infested trees are readily recognizable by the patches of resin on the bark. In cases of prolonged attack the exudation may be so copious as to cause the formation of pendent stalactites of solid resin often a foot or more in length, with corresponding stalagmites on the ground beneath. The exudation of resin from a healthy sal tree may cause a mortality of 85 to 100 per cent in first-instar larvae.

Unlike the adult, the larva can withstand considerable loss of body moisture and survive for several weeks before succumbing. In the dry season shortly before pu-

pation the larva is able to withstand exposure to moderately dry conditions for short periods and still complete its metamorphoses. Saturated atmospheric conditions can be tolerated for several months. Atmospheric humidity during the dry season does not affect the rate of development of the immature stages sufficiently to accelerate or retard appreciably the date of eclosion but effective temperature has a decided influence in this respect.

The initial date of emergence and the rate of emergence of the first 60 to 70 per cent of the total annual population of *H. spinicornis* (Newman) is influenced by the initial date of the preliminary showers of the monsoon and by the quantity of monsoon rainfall in June and July; the earlier and more abundant the rains, the earlier and quicker the emergence. Presumably the effect of rainfall is through the moisture-content of the wood containing the pupal cells. At Dehra Dun the earliest recorded emergence is 7th June and the latest 23rd September. The rate of emergence is affected by the rate of precipitation, but is not directly proportional to it. The relationship of the three variables, — emergence percentage, accumulated rainfall and date are shown in fig. 47. The zones of probable emergence apply only to the weather conditions at Dehra Dun. Emergence in Assam and Bengal, for example, occurs earlier because of the earlier rains. As the monsoon precipitation does not fall at a uniform rate, emergence does not occur uniformly, for each shower brings out only a fraction of the

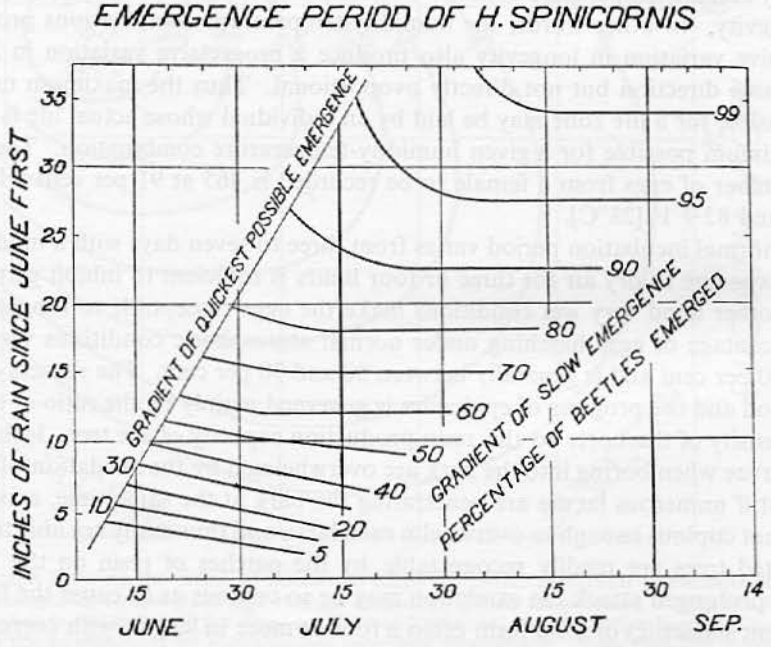

Fig. 47. Correlation of the number of inches of rain falling since June 1st., the date and the percentage of the total annual population of beetles of *H. spinicornis* (Newman) emerged. The zones of emergence—percent reach the quickest possible rate in the gradient on the left, and the slowest recorded rate in the gradient on the right. From this graph one may read off the percentage of the population that may be expected to have emerged on a given date with a given amount of rainfall since June 1st. (Beeson, 1941)

total population and during a short rainless period emergence ceases. A typical graph of emergence is shown in fig. 48. A much more comprehensive and detailed account of the biology of this species has been given by Beeson and Bhatia (1939). Larval galleries are shown on Pl. IV, fig. 1 and Pl. V, fig. 1.

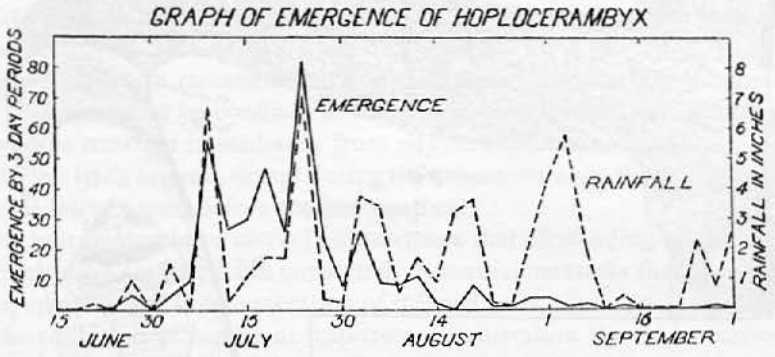

Fig. 48. Graph of the emergence period of *H. spinicornis* (Newman) from *Shorea robusta*, showing percentages of the total annual population of beetles emerging at 3-day intervals correlated with the rainfall for the same period by 3-day intervals. Note that the emergence does not start until the first monsoon showers occur and that the subsequent subsidiary peaks of beetle emergence coincide with peaks of rainfall. (Beeson, 1941)

Beeson (1919a) on examining the Malpighian tubules of this larva, found them to be inserted in two groups of three at the junction of the mid and hind intestines and twice traversing the length of the body. Only one tube of each group secretes calcium carbonate; the remaining four are shorter and contain a colourless fluid which may be the source of the silky matter. This author gives the following account of how the mature larva closes the pupal cell with a calcareous operculum (fig. 49). "After the necessary working surface has been obtained by the deposit of a thin film of lime, the larva proceeds to construct at each end of the long axis of the ellipse a stout peg-like projection about $\frac{1}{12}$ in. wide. These two projections form the bases from which spring the opposite sides of an arch. The larva gradually extends the arch upwards and inwards, and at the same time connects its two segments with a thinner wall built up along the circumference, so that a dome takes shape. The pupal chamber is finally roofed with a sub-ellipsoidal dome having one main rib externally thickened. In miniature it much resembles one pattern of the ancient Hellenic helmet. The long axis of the cap may be one inch in length, and its height half an inch."

Predator. According to Stebbing (1914), larvae of a species of *?Bothrideres* (Colydiidae) have been observed to feed on larvae of *H. spinicornis* (Newman).

Economic importance. Normally the trees which are infested with this cerambycid are dead, dying or felled, and healthy standing trees are not attacked unless there is an epidemic and the beetles are so numerous that there are insufficient dead trees available. A few decades ago, *H. spinicornis* (Newman) was not regarded as being particularly injurious, but now, as a result of a series of severe epidemics in the Uttar Pradesh and Madhy Pradesh, it is considered to be one of the most serious pests of Indian forests. The average loss due to this beetle in Government forests has recently

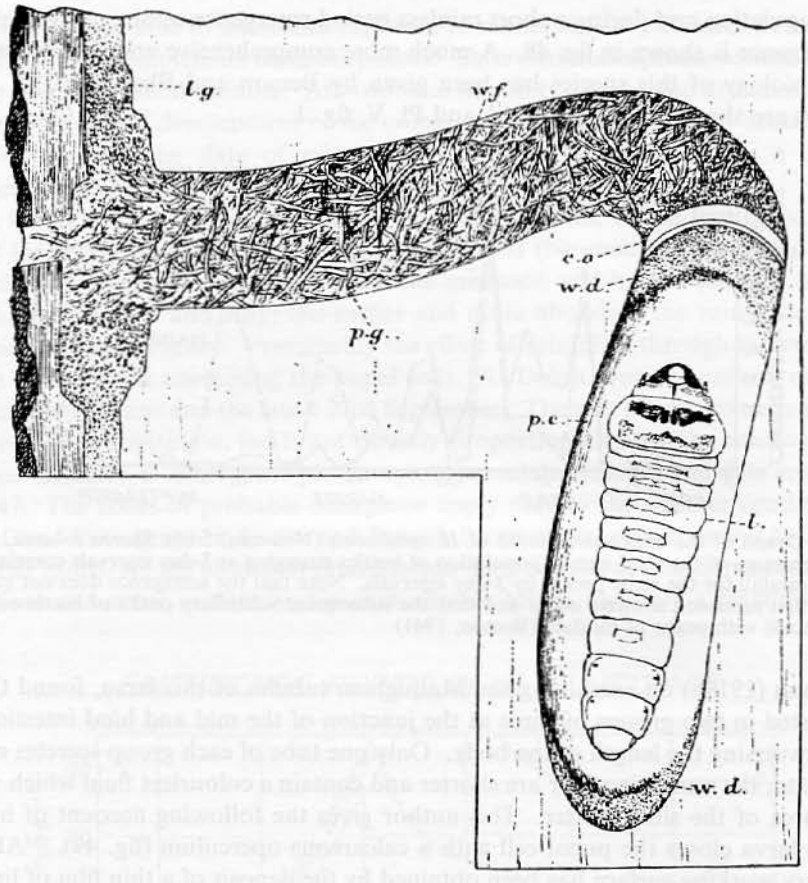

Fig. 49. *Hoplocerambyx spinicornis* (Newman). Pupal cell, showing larva and calcareous operculum (Beeson, 1919a)

been estimated to be about two annas per acre per annum. In a small epidemic affecting eight square miles of forest in Uttar Pradesh, 45,000 trees amounting to nearly a million cubic feet of timber were killed. The most serious epidemic to be recorded affected five forest divisions of Madhy Pradesh, an Indian State and much private land. It was found that on 150,000 acres of sal forest, timber valued at Rs. 7,50,000 had been destroyed. The following year the attack had spread to five and a half million trees. The total number of trees attacked over the whole infested area was estimated at about seven million. Before this epidemic was checked, four years of control operations and an expenditure of Rs. 1,25,800 were required (Beeson, 1941).

Control. According to Beeson (1930a), field work on the biology of this species has shown conclusively that beetles of both sexes react immediately to the smell of a newly felled *Shorea* tree, and in particular to that of the sap freshly liberated by the act of felling. If beetles happen to be nearby they detect the tree within a few minutes. By cutting isolated sal trees in open country, it is possible to attract beetles in less

than half an hour from forest at a distance of at least half a mile. The beetles approach upwind, flying low, and in a remarkably straight course. In the course of a day or two the attraction of the felled tree diminishes considerably and the beetles disperse; but by logging the tree or stripping off the bark or by otherwise exposing fresher sap, the attractiveness of the tree can be renewed. Thus, by means of trap trees felled at appropriate periods and inspected systematically, millions of beetles have been collected and destroyed.

Preventive measures recommended for combating this pest are essentially silvicultural. Felling should be confined to the period between October and March. The bark should be removed immediately from all branches, butts, offcuts, etc., which are likely to be left lying around, except during the monsoons when they should be utilized as traps and later burned before the hot weather.

Regular patrols should be carried out to ensure that all standing sal trees that show signs of infestation are felled and converted. Remedial measures that should be taken during the epidemic are (1) enumeration of infested trees, (2) disposal of infested trees and (3) the collection of beetles at trap-trees. Enumeration should be carried out so that a clear picture of the incidence and extent of the outbreak is obtained during its initial stages. This should be started about December so that the trees which die during the cold weather are not missed. Infested trees should be classified by girth-classes and types of attack. It should then be decided what proportions of these infested trees are to be extracted, converted or burned. Heavily infested trees should receive priority.

Decortication must be carried out before the young larvae have entered the sapwood, which is usually by November. Otherwise the wood must be burned. Stumps should be decorticated at once, irrespective of the date of felling.

Trees selected for trapping purposes should be unsound, injured by fire or wind or infested. Logs about three feet in girth and with a high proportion of sapwood are the most attractive. The felling of trap-trees should be started at the beginning of the emergence period and continued throughout the peak of emergence. Traps should be located where attacked trees and felling refuse are most abundant. Two to four days after felling, the trap-trees should be cross-cut into small logs and billets. Later on they should be cross-cut again and the bark partially stripped or bruised to produce fresh sap. Traps should be inspected daily and the beetles destroyed (Beeson, 1941).

The effectiveness in the use of trap trees as a means of control has recently been demonstrated by Mathur (1962). A severe outbreak on *Shorea robusta* began in 1949 in Himachal Pradesh, moderate damage was caused in the Timli Range, Uttar Pradesh, in 1958–59, and light attack was observed in several parts of Assam in March 1961. Trap trees were felled in the first two areas in 1951–60 and 1959–60, and over 68,000 and 17,000 beetles were caught, respectively. It is maintained that these results have contributed to a decline in infestation.

Material studied. 2 L, Assam, Saro Hills, 15.xi.1903, from *Shorea robusta*, E. Stebbing leg., in coll. B.M.

References. Ahmad, 1935 (Biol., Contr.); Anonymous, 1913a (Biol.); Atkinson, 1927 (L fig., P fig., I fig., Biol. fig.), 1953 (Biol., Contr.); Beeson, 1916 (Biol.), 1919a (E fig., Biol. fig.), 1919c (Biol.), 1921 (Biol.), 1922 (Biol.), 1924a (Biol.), 1924b (Biol.),

1927 (Biol.), 1928a (Contr.), 1928b (Biol.), 1930 (Biol.), 1930b (Biol., Contr.), 1935a (Biol.), 1935b (Biol., Contr.), 1941 (L fig., P fig., Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol., fig.); Beeson and Chatterjee, 1925 (Biol., fig., Contr.); Benskin, 1927 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhatia, 1950 (Biol., Contr.); Chatterjee, 1923 (Biol.); Duffy, 1953a (Biol.), 1963 (L fig., P, I fig., Biol. fig., Contr., Paras.); Gardner, 1925 (E fig., L fig., P fig.); Garthwaite, 1940 (Biol.); Linsley, 1959 (Biol. fig.); Mühlmann, 1954 (Biol.); Mathur, 1962 (Contr.); Mathur and Balwant Singh, 1960d (Biol.), 1961 (Biol.); Muir, 1929 (Biol. fig.); Stebbing, 1899 (L fig., I fig., Biol.), 1906 (L fig., P fig., I fig., Biol. fig.), 1907b (E fig., L fig., Biol. fig., Contr.), 1908 (L fig., P fig., I fig., Biol. fig.), 1914 (E fig., L fig., P fig., I fig., Biol. fig., Paras.); Watts, 1928 (Biol.).

Trachylophus approximator Gahan

Distribution. ORIENTAL REGION: Java.

Host plant: *Schima noronhae* (Kalshoven, 1933).

Mature larva (fig. 50). Similar to that of *Hoplocerambyx spinicornis* (Newman) but distinguishable as follows: *Head* with temples ferruginous behind ocelli and without a postocular carina. Dentate processes on front margin of frons and behind dorsal mandibular condyles absent; postcondylar carina absent. Antennal foramen not produced into a dentate process. Two or three pairs of vestigial ocelli present behind true ocelli[16]. *Prothorax* with distinct orange-testaceous plates. Mesonotum, metanotum and abdominal ampullae sub-tuberculate, the tubercles not moniliform, but separate and well defined or sclerotized. Length up to 80 mm.; maximum breadth (at prothorax) 14·5 mm.

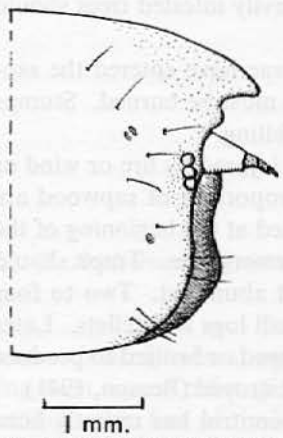

Fig. 50. *Trachylophus approximator* Gahan. Mature larva. Part of head capsule showing position of ocelli and vestigial ocelli. Lateral aspect.

Biology. According to Kalshoven (1933), infestation can readily be detected by the accumulation of frass ejected through holes in the bark at the base of the host tree. Large galleries have been found running horizontally under the bark of the buttresses, one of them as long as 29 centimetres. Infestation has also been seen in the axils of larger crotches near the base of the tree. At first the galleries are formed in the bark, but later they penetrate deep into the heartwood. No emergence holes have been observed but it is possible that adults use the larval galleries as a means of egress. The pupal cells have a calcareous operculum.

Economic importance. As infestation appears to be confined to the extreme base of the tree, the damage done with regard to the production of timber is not considered serious, providing there is no secondary attack by other borers or fungi (Kalshoven, 1934).

[16] This is the first time that vestigial ocelli have been observed in larvae of the CERAMBYCINAE although they are known to be present in larvae of some of the LAMIINAE (*e.g. Nupserha*). See also footnote of key, p. 26.

Material studied. 10 L, West Java, vi.1927, from *Schima noronhae*, L. G. E. Kalshoven leg., in coll. B.M.

References. Kalshoven, 1933 (L fig., I fig., Biol. fig.), 1934 (L fig., I fig., Biol. fig.).

Trachylophus sinensis Gahan

Distribution. ORIENTAL REGION: Burma, China, Hainan I., Formosa.

Host plant: *Camellia sinensis* (Gressitt, 1951).

Reference. Gressitt, 1951 (Biol.).

Aeolesthes holosericea (Fabricius) (=**similis** Gahan)

Distribution. ORIENTAL REGION: Andaman Is., Burma, Ceylon, China, India (Assam, Bihar, Madras, Maharashtra, Mysore, Orissa, Punjab, Uttar Pradesh, West Bengal), Indo-China (Viet Nam), Jammu and Kashmir, Malaya, Nicobar Is., Philippines, Thailand, West Pakistan (Peshawar, Rawalpindi).

Host plants: *Aegele marmelos*, *Alnus nitida*, *Anogeissus latifolia*, *Bauhinia acuminata*, *B. retusa*, *B. variegata*, *Bridelia retusa*, *Butea monosperma*, *Careya arborea*, *Cedrela toona*, *Cynometra ramiflora*, *Duabanga sonneratioides*, *Eucalyptus robusta*, *Excaecaria agallocha*, *Ficus benghalensis*, *Grewia optiva*, *Kydia calycina*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Mallotus philippinensis*, *Miliusa velutina*, *Morus alba*, *Myristica andamanica*, *Ougeinia dalbergioides*, *Pentacme suavis*, *Pinus longifolia*, *Prunus communis*, *Pterocarpus marsupium*, *Pyrus communis*, *Samalia malabarica*, *Sapium sebiferum*, *Shorea assamica*, *Soymida febrifuga*, *Tectona grandis*, *Terminalia belerica*, *T. myriocarpa* (Beeson and Bhatia, 1939); *Shorea robusta*, *Terminalia tomentosa* (Cotes, 1889); *Acacia arabica*, *Chloroxylon swietenia*, *Hardwickia binata*, *Mangifera indica*, *Psidium guajava*, *Tamarix articulata* (Stebbing, 1914); *Juglans regia*, *Prunus avium*, *P. armeniaca*, *P. domestica*, *P. persica*, *Pyrus baccata*, *P. malus* (Rhaman and Khan, 1942a); *Dipterocarpus indicus* (Khan, 1947); *Anacardium occidentale* (Bhasin and Roonwal, 1954); *Boswellia serrata*, *Casearia tomentosa* (Bhasin, Roonwal and Balwant Singh, 1958); *Polyalthia coffeoides*, *Quercus incana* (Mathur and Balwant Singh, 1960d).

Adult (Pl. XV, fig. 4). Length 20–36 mm. Dark or reddish brown, densely covered with greyish or light brown silky pubescence; elytra with a sheen of contrasting dull and bright areas which vary according to incidence of light. *Head* with antennae much longer than body (in male), with segments 5–8 spined apically on inner angle; slightly longer than body in female, with spines more pronounced. *Prothorax* with sides unarmed, rounded medially; disc strongly and irregularly wrinkled. *Elytra* with apices truncate and spined at sutural angle.

Mature larva (fig. 51). Rather similar to that of *Hoplocerambyx spinicornis* (Newman) but differing as follows. *Head* with postcondylar carina absent. Postocular carina curved, subcrenulate and very strongly protuberant (fig. 51). Frons and dorsal mandibular condyles without dentate processes. Hypostoma entirely ferruginous, with front margin darker and subtuberculate. Antennal foramen with upper boundary dentate. Antenna with segment 3 shorter than segment 2. *Prothorax* with posterior area of pronotum rather coarsely longitudinally strigose. *Abdomen* with tubercles on

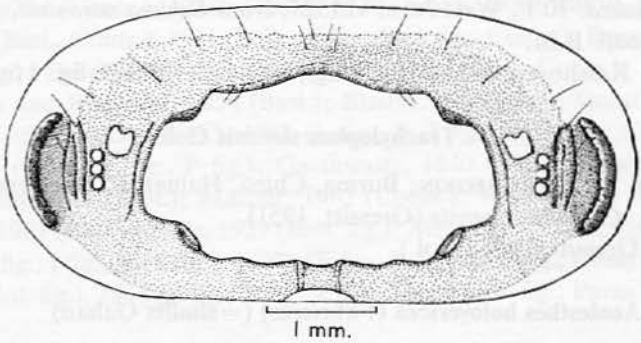

Fig. 51. *Aeolesthes holosericea* (Fabricius). Mature larva. Mouthframe. Frontal aspect.

dorsal ampullae similarly arranged in four rows but not sclerotized. Length up to 45 mm.; maximum breadth (at prothorax) 13 mm.

Egg. White, shining, oval, one end with a short, stout, stalk-like process, the opposite end with a slight blunt thickening. Chorion covered with minute erect asperities. Length about 2·5 mm., breadth about 1·4 mm. (Gardner, 1925.)

Biology. This species, which is very polyphagous, attacks only dead or felled trees, healthy living trees being immune to attack. A female beetle lays about 200 eggs, which are deposited in crevices in the bark. The larva at first bores into the bast and tunnels along the sapwood superficially. Within a few months, broad irregular cavities are made in the bark and to a lesser extent in the sapwood. Much of the frass and wood fibres with which the larval gallery is packed is periodically thrown out through ejection holes. The prepupal tunnel runs in almost horizontally for $2\frac{1}{2}$–3 in. from the sapwood, eventually turning downwards to terminate in a vertical chamber (Pl. VI, fig. 2). Before pupation the larva returns to the bark where an exit hole is made. The outer end of the pupal chamber is blocked by a partition of calcium carbonate[17], which is constructed as follows. Firstly the neck of the prepupal gallery adjoining the pupal chamber is covered by the larva with a thin secretion of calcareous cement forming a band about $\frac{1}{2}$ in. wide. Along the central line of this band the larva deposits a beading of nearly semi-circular section and about $\frac{1}{16}$ in. radius which is finished off smoothly. Just below this beading the larva then gradually builds up the calcareous cement circumferentially in a wall projecting at a slight angle into the lumen of the gallery; this wall is carried upwards and away from the wood surface until its edge impinges on the face of the beading. As this structure considerably reduces the cross-sectional area of the gallery, the larva is able to "roof in" the pupal chamber by filling up the remaining gap with successive concentric deposits, each one in a slightly lower plane. The completed partition is thus slightly convex on the chamber face and concave on the gallery face.

After secretion, the larva, which is now considerably reduced in size, starts to smooth down the rough walls of the pupal cell, the resulting wood dust being

[17] For further details regarding the construction of calcareous cocoons and opercula, see Beeson 1919a) and Duffy (1953a, 1956).

compacted against the calcareous operculum. Pupation occurs about October in North India and adults eclode approximately three weeks later. They remain in their chambers throughout the cold months and emerge the following March to May. Peak-emergence takes place in April. The life-cycle is normally annual (Beeson and Bhatia, 1939).

According to Rhaman and Khan (1942a), eggs are deposited from May to October. Injured areas of the bark and more often previously attacked parts of the stem are selected for oviposition. Incisions on the injured edges of the bark are made in which eggs are inserted singly. One to five eggs are laid daily. In confinement a female laid a maximum of 92 eggs. Eggs hatch out in seven to twelve days. The young larva bites irregular holes in the egg-shell, most of which it usually eats. At first the larva feeds upon the inner layers of the bark, making shallow zig-zag galleries, but soon feeds subcortically, making wider and longer zig-zag galleries. When nearly mature the larva enters the wood through a reniform entrance hole which later serves as an emergence hole for the adult. The larval stage lasts from two years, three months and five days to two years and eight months. If the larva is full-grown by October it pupates after a rest of three to 25 days only, but when full-grown by November, the prepupal period may be prolonged to four and a half to five months. Such larvae pupate in the middle of April. The pupal stage lasts from one month ten days to three months ten days. If pupation occurs in October, the adult eclodes from December to February. The adult remains quiescent in the stem throughout the winter and spring, its resting period varying from three months eleven days to five months two days. But when the larva enters the resting stage in winter and pupates in April, the adult has a shorter resting period of one month ten days to one month seventeen days. The life-cycle is completed in from two years seven and a half months to about three years. Adults appear on the wing towards the end of April and continue to do so up to the middle of July. They live up to the end of October.

Khan (1947) found that attack was heavy in logs of *Terminalia* felled between November and April, both in the open and in the shade, but absent in logs felled between May and October. The minimum time taken by larvae to reach the sapwood was two months, which is therefore the maximum period for which the bark can be retained on logs with safety. In *Dipterocarpus* felled and exposed at a higher altitude, only timber left unbarked for periods over six months showed an occasional attack for felling of August to January, and the felling from February to July remained free from attack in all treatments. This low incidence of attack, however, may possibly be due to scarcity of adult beetles at a higher altitude.

Economic importance. This beetle can quickly ruin logs stored in timber yards and sawmills and will speedily attack freshly felled logs lying in forest clearings. Fortunately attack does not spread from felled trees to healthy living trees, although unhealthy standing trees are sometimes attacked and eventually killed. As the beetle is shade-loving, logs exposed to sunlight are not so heavily infested as those lying in the shade. Oviposition may occur on logs of trees which have been felled in any month of the year and within eleven months of felling, providing the bark has not completely dried out. Young larvae of this species occurring in *Shorea* are often mistaken for

those of the much more serious pest *Hoplocerambyx spinicornis* (Newman) (see key, p. 14).

Control. In northern India, logs from trees felled in winter should be decorticated before March as the adult is on the wing from March to June. Unbarked logs stored in timber-depots are susceptible to attack up to one year from the time of felling. All felling refuse should be removed as it would serve as a breeding site. All standing trees which have been attacked should be felled and converted (Beeson, 1941). Rhaman and Khan (1942a) suggest the application of solignum to injured areas of bark. Also the introduction of cotton wool soaked in kerosene oil into the larval gallery, which has first been cleared with wire or a knife. The plugged gallery should then be plastered with clay mud to retain the fumes which prove fatal to the larvae (see also Chatterjee and Thapa, 1964a).

References. Beeson, 1919c (Biol. fig.), 1919e (Biol.), 1922 (Biol.), 1935a (Biol.), 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Zingh, 1958 (Biol.); Bhatia, 1950 (Biol., Contr.); Chatterjee and Chatterjee, 1951 (Contr.); Chatterjee and Thapa, 1964a (Biol. fig., Contr.); Cotes, 1889 (I fig., Biol.), 1894a (Biol.); Fletcher, 1921 (Biol.); Gardner, 1925 (E fig., L fig., P, Biol.); Gressitt, 1951 (Biol.); Khan, 1947 (Biol.); Mathur and Balwant Singh, 1960c (Biol.), 1960d (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Rhaman and Khan, 1942a (E, L, P, I, Biol., Contr.); Stebbing, 1899 (I fig., Biol.), 1914 (I fig., Biol. fig.).

Aeolesthes sinensis Gahan

Distribution. ORIENTAL REGION: Burma, China, Formosa, India.

Host plants: *Cedrela sinensis*, *Citrus deliciosa*, *Crataegus scabrifolia*, *Diospyros kaki*, *D. lotus* (Gressitt, 1951); *Acer* (H. G. Champion).

Mature larva. Apparently indistinguishable from that of *A. holosericea* (Fabricius) except perhaps for its smaller size (length up to 39 mm.; maximum breadth (at prothorax) 9·75 mm.).

Material studied. 4 L, India, West Almora, 14.iii.1917, from *Acer*, H. G. Champion leg., in coll. B.M.

Reference. Gressitt, 1951 (Biol.).

Aeolesthes basicornis Gahan

Distribution. ORIENTAL REGION: Andaman Is.

Host plant: *Myristica andamanica* (Beeson and Bhatia, 1939).

Biology. Adults normally emerge during April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Aeolesthes indicola (Bates)

Distribution. ORIENTAL REGION: India (Punjab, Uttar Pradesh).

Host plant: *Salix* sp. (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Aeolesthes induta (Newman) (=**Pachydissus frenchi** Blackburn)

[The Silky Gray-brown Longhorn or the Satin-wood Borer]

Distribution. ORIENTAL REGION: Borneo, Burma, Ceylon, China, Formosa, Hong Kong, India (Assam, Bengal), Indo-China, Java, Philippines, Sumatra, Thailand.

Host plants: *Chloroxylon swietenia, Hymenodictyon excelsum* (Beeson and Bhatia, 1939); *Theobroma* (Dammerman, 1929); *Dracontomelon dao, Eugenia operculata, Melia azedarach, Delonix regia* (Gressitt, 1942); *Sapium sebiferum* (Gressitt, 1940); *Pinus, Citrus*?, *Camellia thea, Melia japonica* (Shiraki *et al.*, 1937); *Parashorea malaanonan* (Mathur and Balwant Singh, 1960d).

Biology. Larvae tunnel in the bark, sapwood and heartwood of dead and living branches and probably also of slender trunks or damaged areas of larger trunks. They enter the solid wood when about half grown to excavate a pupal cell, the entrance to which is plugged with a calcareous operculum. In China, pupation probably takes place in December, the adults remaining in their cells until the following spring. Adults are nocturnal (Gressitt, 1942).

Economic importance. According to Dammerman (1929), this species is very destructive to cocoa in the Philippines, and Hadden (1928), states that in Formosa it is injurious to stalks and roots of tea.

Infestation by larvae of this species causes the bark of the trees to fall off in large pieces. Natives frequently wound the bark of *Chloroxylon* to obtain the gum, thereby affording the beetles ideal oviposition sites. The presence of mistletoe (*Viscum orientale*), which often kills the branch it is on, is another condition encouraging oviposition (Stebbing, 1914).

Control. Unwanted branches should be left as traps for two to three months and then burnt (Stebbing, 1914). Dead branches should be trimmed off and destroyed. Larvae may be extracted from trunks by means of a hooked wire (Gressitt, 1942).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Dammerman, 1929 (Biol.); Gressitt, 1940 (Biol.), 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Hadden, 1928 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.); Shiraki *et al.*, 1937 (Biol.); Stebbing, 1914 (Biol.).

Aeolesthes sarta (Solsky)

[The Quetta Borer or Uzbek- or Urban-Cerambycid]

Distribution. ORIENTAL REGION: Jammu and Kashmir, West Pakistan (Baluchistan, Quetta). PALAEARCTIC REGION: Afghanistan, Tibet, Turkestan.

Host plants: *Aesculus indica, Populus alba, P. nigra, P. euphratica, Salix alba, S. aemophylla, S. babylonica, Platanus orientalis, Fraxinus* sp., *Ulmus* sp., *Morus alba, Prunus armeniaca, Robinia pseud-acacia* (Stebbing, 1905); *Acer pictum, Corylus colurna, Juglans regia, Prunus racemosa, Pyrus communis, P. malus, Salix tetrasperma, Ulmus wallichiana* (Beeson and Bhatia, 1939); *Cydonia oblonga, Prunus amygdalus, P. padus, P. persica* (Mathur and Balwant Singh, 1960d.).

Adult. Usually a much larger species than *A. holosericea* (Fabricius), 33–44 mm.

long. Pubescence greyish, the brighter areas on elytra silvery. *Prothorax* subangulate laterally.

Egg. Milky white, elliptical, with pointed ends; 3·2–4·2 mm. in length (Stebbing, 1914).

Biology. Eggs are laid in small groups of about five to ten on living trees, particularly in wounds in the bark, on broken ends of branches and in pits gnawed down to the living bark. About 50 eggs are laid by a female beetle. The incubation period is ten to fourteen days. Young larvae tunnel in the bast and sapwood and the galleries made by older larvae are broad deep excavations packed with wood fibres. When mature, the larva tunnels towards the heartwood and at a depth of a few inches turns downwards in a vertical direction, where a pupal chamber about three inches long is excavated. The entrance is closed by a calcareous operculum as in *A. holosericea* (Fabricius). The life-cycle is normally two years, the first winter being spent in the larval stage and the second in the pupal or pharate adult stage. Emergence takes place in May and June.

The destruction of the bast and sapwood by these larvae causes the bark to die and fall away. If the growth of the tree is vigorous, a callus is formed and the wounds are healed. But if the infestation recurs for several years in succession, then the tree becomes completely girdled and eventually dies (Beeson and Bhatia, 1939).

Economic importance. This beetle is often injurious to various shade trees planted in towns and compounds. Willows and poplars are particularly susceptible. In Quetta, during the years 1904–06, infestation by this species necessitated the felling of about 5,000 trees, and in 1905 over 20,000 beetles were collected and destroyed. Kashmir, too, has lost many trees due to this borer (Beeson and Bhatia, 1939). Janjua and Samuel (1941) maintain that this species is also a serious pest of fruit orchards.

Control. All trees in avenues, orchards, gardens, etc. should be maintained in healthy condition, regular inspections being made to locate instances of attack. Slightly infested trees should be pruned and any wounds repaired. Seriously infested trees should be felled and removed before the month of November. During large outbreaks, adults should be trapped by means of freshly cut logs of host. Stored fuel supplies should be barked or split, if infested (Beeson, 1941).

The use of trap-trees, the bark on some parts of which have been removed to expose the wood, has been suggested as a means of control (Anonymous, 1913b) but this is not recommended under the conditions prevailing in Turkestan.

References. Anonymous, 1913b (Contr.); Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol., Contr.); Bhasin and Roonwal, 1954 (Biol.); Gressitt, 1951 (Biol.); Janjua and Samuel, 1941 (L fig., I fig., Biol. fig.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (E fig., L fig., P fig., I fig., Biol.); Plotnikov, 1913 (Contr.); Stebbing, 1905 (E fig., L fig., P fig., Biol. fig., Contr.), 1908 (E fig., L fig., P fig., I fig., Biol. fig., Contr.), 1914 (E fig., L fig., I fig., Biol. fig., Contr.).

Pachydissus birmanicus Gardner

Distribution. ORIENTAL REGION: Burma.

Host plants: *Xylia xylocarpa* (Beeson and Bhatia, 1939).

Mature larva. No material available. For generic characters, see key, p. 37.

Pupa. No material available. For generic characters, see key, p. 37.

Biology. This species infests living trees of over 2 ft. 6 in. in girth. The larval gallery, which is up to two inches in diameter, penetrates the heartwood radially for three or four inches and then axially for five or six inches. Infestation may occur up to 40 ft. above ground level. The pupal cell is closed by a cap-shaped operculum of calcium carbonate. The life-cycle may be prolonged for two years. Adults emerge in April and May (Beeson and Bhatia, 1939).

Economic importance. Garthwaite (1940a) records an average of 26 galleries per tree in one reserve.

References. Beeson, 1919a (Biol.); 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Braithwaite, 1941 (Biol.); Garthwaite, 1940a (Biol.); Mathur and Balwant Singh, 1961b (Biol.); Mühlmann, 1954 (Biol.).

Pachydissus xyliae Fisher

Distribution. ORIENTAL REGION: Burma.

Host plant: *Xylia xylocarpa* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Braithwaite, 1941 (Biol.); Mathur and Balwant Singh, 1961b (Biol.); Mühlmann, 1954 (Biol.).

Dialeges pauper Pascoe

Distribution. ORIENTAL REGION: Borneo, Burma, East Pakistan (East Bengal), India (Assam, Uttar Pradesh), Penang I., Thailand.

Host plants: *Millettia auriculata, Parashorea stellata, Pentacme suavis, Shorea assamica, S. robusta* (Beeson and Bhatia, 1939); *Hopea odorata* (Beeson, 1941); *Dipterocarpus tuberculatus* (D. of A., Bangkok).

Adult (Pl. XV, fig. 4). Length 15–31 mm. Entirely reddish to dark brown, but densely covered with greyish brown, silky pubescence, which on the elytra forms vague longitudinal bands of lighter and darker shades, according to incidence of light. *Head* with antennae about one-third longer than body in male, about one-sixth in female. *Prothorax* with disc transversely strigose and with four longitudinal, glabrous impressions. *Elytra* gradually narrowed posteriorly, truncate apically, with a short spine at sutural angle and with outer angle dentate.

Mature larva (fig. 52). Rather similar to that of *Hoplocerambyx spinicornis* (Newman) from which it differs as follows. Form rather slender, attenuated. *Head* without postcondylar and postocular carinae. Frons and antennal foramen without dentate processes. Ocelli with pigmented spot distinct. Antenna with segment 2 distinctly elongate. *Prothorax* with posterior area of pronotum evenly covered with small separate tubercles or feebly sclerotized asperities, which are somewhat flattened, with a prominent posterior edge (fig. 52). *Abdomen* with tubercles of ampullae proportionately smaller and not sclerotized. Segments 4–7 with rather long intersegmental skin. Length up to 50 mm.; maximum breadth (at prothorax) 8 mm.

This larva may readily be distinguished from those of other cerambycine genera by the tuberculate pronotum.

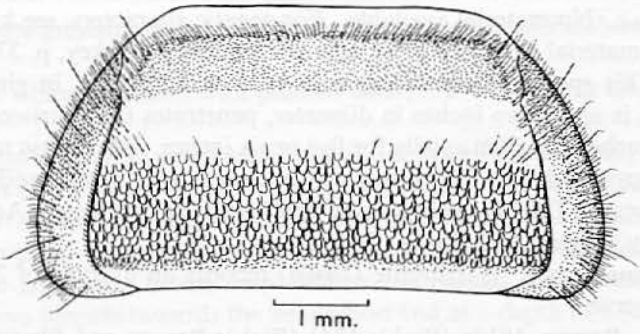

Fig. 52. *Dialeges pauper* Pascoe. Mature larva. Prothorax. Dorsal aspect.

Biology. Eggs are deposited in cracks of the bark of recently felled or dead trees. The irregular galleries enter the sapwood but not very deeply but the prepupal gallery penetrates the heartwood up to half an inch. The pupal cell may be either almost horizontal or slightly curved downwards or vertically downwards; it is completely lined internally with a deposit of calcium carbonate spread on a very thin layer of wood dust and extending in a band $\frac{1}{4}$ to $\frac{3}{8}$ in. beyond the point of attachment of the operculum; the surface is rather roughly smoothed off and matt, there being no internal film of sericinous or other material as in *Diorthus*. The dome-like operculum is marked externally along the middle line by feeble excrescences which sometime expand into a flat-topped projection. The beetle, which emerges via the prepupal gallery, makes a subrectangular hole in the bark.

In Bengal and Assam there are two generations a year; the overwintering generation emerges from April to July, mainly in April, but eggs laid in April or May produce a second generation during August to October, mainly October. In the eastern United Provinces a proportion of the over-wintered generation may not emerge until July or August (Beeson and Bhatia, 1939).

Material studied. 2 L, Burma, Mytkyina, Mohnyin Reserve, from *Pentacme suavis*, D. J. Atkinson leg., in coll. F.R.I.D.D.

References. Beeson, 1916 (Biol.), 1919a (Biol.), 1919e (Biol.), 1935a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1925 (L fig., Biol.); Garthwaite, 1940a (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961a (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Stebbing, 1907b (L fig., I fig., Biol.), 1908 (I fig., Biol.), 1914 (L fig., I fig., Biol., Paras.).

Dialeges undulatus Gahan

Distribution. ORIENTAL REGION: Burma, Ceylon, Hainan I., Thailand.

Host plants: *Berrya cordifolia*, *Prunus puddum*, *Xylia xylocarpa* (Beeson and Bhatia, 1939); *Pyrus communis* (Beeson, 1941); *Actinophora fragrans* (Kalshoven, 1955).

Biology. The life-cycle is mostly annual but a proportion of individuals take two years. Adults emerge between April and June, mainly the former (Beeson and Bhatia, 1939).

According to Kalshoven (1955), larvae of this species are frequently found in trunks of branches of *Actinophora* killed by the buprestid *Agrilus kalshoveni* Obenberger in Java. The period of development from egg to adult in purposely infested logs, which were kept moist, was between 12 and 15 months. The pupal cell is lined with a calcareous deposit. Garthwaite (1938) states that this species normally attacks only felled or moribund trees.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Garthwaite, 1938 (Biol.); Gressitt, 1951 (Biol.); Kalshoven, 1955 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961b (Biol.).

Cyriopalus wallacei Pascoe

Distribution. ORIENTAL REGION: Borneo, Burma, Malaya, Penang I.

Host plant. *Pentacme suavis* (Gardner, 1931b).

Mature larva. Rather similar to that of *Dialeges pauper* Pascoe, from which it may be distinguished by the following characters. *Head* with frons bearing numerous scattered setae behind ferruginous front margin. *Prothorax* with posterior area of pronotum covered with imbricated tubercles resembling asperities; each tubercle strigose; numerous deep setal pores present in between the tubercles. *Abdomen* with tubercles on ampullae large and conical. *Spiracles* with peritreme bearing dorsally a pair of subcontiguous marginal chambers. Length up to 75 mm.; maximum breadth (at prothorax) 11 mm.

Biology. This cerambycid infests green healthy trees, particularly branches between about one foot six inches to three feet in girth. Generally there are not more than two or three individuals to a tree, and, although the galleries cause appreciable damage (one larva can affect two or three feet of timber), attack by this species is seldom fatal to the tree (Beeson and Bhatia, 1939).

Material studied. 1 L, Burma, Mytkyina, 1928, from *Pentacme suavis*, D. J. Atkinson leg., in coll. P.R.I.D.D.

References. Atkinson, 1953 (Biol.); Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (I fig., Biol.); Garthwaite, 1940a (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Diorthus cinereus (Fabricius) (=**simplex** (White))

Distribution. ORIENTAL REGION: Burma, Ceylon, India (West Bengal, Bihar, Madras, Maharashtra, Punjab, Uttar Pradesh), Java, Thailand, West Pakistan (Baluchistan, Hyderabad). ETHIOPIAN REGION: West Africa, Aden, Tanzania. MADAGASCAN REGION: Mauritius.

Host plants. *Acacia leucophloea, Albizia odoratissima, Anogeissus latifolia, Bauhinia vahlii, Butea superba, Cassia fistula, Dalbergia fusca, D.* sp., *Dichopsis grandis, Eugenia* sp., *Hardwickia binata, Heritiera minor, Lannea coromandelica, Mallotus philippinensis, Scutia indica, Shorea robusta* (Beeson and Bhatia, 1939); *Dalbergia sissoo* (Mathur and Balwant Singh, 1959); *Quercus incana* (Mathur and Balwant Singh, 1960d).

Mature larva (fig. 53). Rather similar to that of *Hoplocerambyx spinicornis* (New-

man) but differing as follows. *Head* with postcondylar carina absent. Postocular carina very strongly protuberant (fig. 53). Antennal foramen with upper boundary sinuate but not dentate (fig. 53). Hypostoma with front margin strongly and broadly

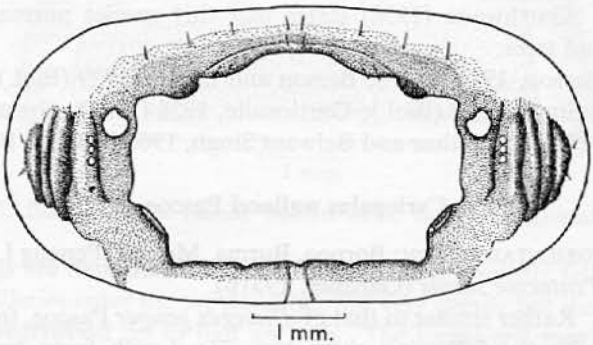

Fig. 53. *Diorthus cinereus* (Fabricius). Mature larva. Mouthframe. Frontal aspect.

ferruginous to pitchy. Antenna with segment 2 transverse; segment 3 slightly longer than segment 2. *Prothorax* with posterior area of pronotum rather coarsely and irregularly strigose. *Abdomen* with tubercles of ampullae not sclerotized. Length up to 50 mm.; maximum breadth (at prothorax) 12 mm.

Biology. Eggs are deposited in crevices in the bark of recently felled or fallen trees and of the liane *Bauhinia vahlii*. In timber the larval galleries groove the sapwood rather deeply; they are packed with rather fine wood particles. The prepupal gallery enters the heartwood in a full curve to terminate in a short vertical pupal cell. The latter is closed at the entrance by a small plug of wood fibres against which has been rammed a wad of finer dust which forms a hemispherical depression. The cell thus formed is entirely lined with a thin deposit of calcium carbonate which is then glazed with a brown film of sericinous or chitinous nature. The operculum is thus a simple hemispherical or hemi-elliptical cap continuous with the lining of the pupal cell. The life-cycle is annual, with adult emergence mainly in June (Beeson and Bhatia, 1939).

Material studied. 2 L, India, Uttar Pradesh, Birpur Gonda, 11.ii.1918, from *Bauhinia vahlii*, C. F. C. Beeson leg., in coll. F.R.I.D.D.

References. Beeson, 1919a (Biol. fig.), 1919b (Biol.), 1935a (Biol.), 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1953a (Biol.); Gardner, 1925 (L fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960d (Biol.), 1961 (Biol.); Mühlmann, 1954 (Biol.).

Diorthus sericeus Gardner

Distribution. ORIENTAL REGION: India (Madras, Mysore).

Host plants: *Acacia* sp., *Pterocarpus marsupium* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Derolus volvulus (Fabricius) (=**demissus** Pascoe)

Distribution. ORIENTAL REGION: China, Hainan Is., India (Assam, Madras, Maharashtra, Orissa, Uttar Pradesh), Java, Philippine Is. ETHIOPIAN REGION: Arabia.

Host plants: *Acacia* sp., *Aegle marmelos*, *Albizia lebbek*, *Bridelia retusa*, *Buchanania lanzon*, *Careya arborea*, *Garuga pinnata*, *Lannea coromandelica*, *Mallotus philippinensis*, *Pterocarpus marsupium*, *Shorea robusta*, *Salmalia malabricum*, *Xylia xylocarpa*, *Zizyphus xylopyra* (Beeson and Bhatia, 1939). *Eugenia cuminii* (Mathur and Balwant Singh, 1959); *Cassia siamea* (Kalshoven, 1955).

Mature larva (fig. 54). Very similar to that of *Diorthus cinereus* (Fabricius) from which it differs as follows. Form less robust. *Head* with postocular areas ferruginous and without distinct impressions and protuberances (fig. 54). Length up to 20 mm.; maximum breadth (at prothorax) 4·5 mm.

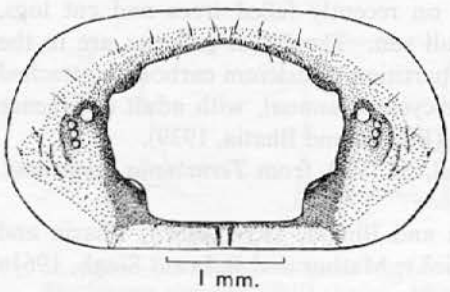

Fig. 54. *Derolus volvulus* (Fabricius). Mature larva. Mouthframe. Frontal aspect.

Biology. The larval gallery for about the first six inches is subcortical, superficially grazing the sapwood; it then penetrates the sapwood more deeply. There is very little or no frass present. The pupal cell is similar to that of *D. discicollis* Gahan. Adults emerge from April to August, mainly in May, after an annual life-cycle (Beeson and Bhatia, 1939).

Adults are attracted to artificial light in teak forests (Kalshoven, 1955).

Material studied. 2 L, India, Madras, S. Mangalore, 22.v.1930, from *Pterocarpus marsupium*, J. C. M. Gardner, leg. in coll. R.F.I.D.D.

References. Beeson, 1919a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, Biol.); Gressitt, 1951 (Biol.); Kalshoven, 1955 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960d (Biol.), 1961b (Biol.).

Derolus discicollis Gahan

Distribution. ORIENTAL REGION: India (West Bengal), West Pakistan (Hyderabad, Rawalpindi).

Host plants: *Acacia modesta*, *Heritiera minor* (Beeson and Bhatia, 1939).

Biology. Pupation takes place in the sapwood, the pupal cell being plugged at its entrance with wood dust that is lined on the inside with a hemi-ellipsoidal deposit of calcium carbonate, the walls of the cell being bare. The life-cycle is annual, with emergence taking place in June and July (Beeson and Bhatia, 1939).

References. Beeson, 1919a (Biol.), 1919b (Biol.), 1941 (Biol.); Beeson and Bhatia,

1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961 (Biol.).

Margites modicus Gahan

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madhy Pradesh, Madras, Orissa, Uttar Pradesh).

Host plants: *Anogeissus acuminata, A. latifolia, Shorea robusta, Terminalia chebula, T. tomentosa* (Beeson and Bhatia, 1939); *Terminalia belerica* (Mathur and Balwant Singh, 1961b); *Boswellia serrata* (Roonwal, Chatterjee and Thapa, 1961).

Mature larva. Very similar to that of *Derolus volvulus* (Fabricius) but differing as follows. *Head* with upper margin of antennal foramen dentate or subconical. Temple finely but distinctly striate, even posterior to ferruginous area which is about as extensive as in *Derolus* (fig. 54). Length up to 25 mm.; maximum breadth (at prothorax) 4·5 mm.

Biology. Oviposition takes place mainly on recently felled trees and cut logs, particularly when they are exposed to the full sun. The larval galleries are in the sapwood. The pupal chamber is closed by a partition of calcium carbonate attached to a narrow thin band on the wall. The life-cycle is annual, with adult emergence occurring between May and July, mainly June (Beeson and Bhatia, 1939).

Material studied. 1 L, India, Orissa, Angul, 5.i.1939, from *Terminalia tomentosa*, S. N. Chatterjee leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Margites exiguus Gahan

Distribution. ORIENTAL REGION: Burma.

Host plants: *Anogeissus acuminata* (Gardner, 1931b); *Aporosa villosula, Terminalia pyrifolia* (Beeson, 1941).

Mature larva (fig. 55). Very similar to that of *M. modicus* Gahan but differing as follows. *Head* with ferruginous area of temple smooth, darker and much more extensive. Hypostoma with front margin with several longitudinal carinae (fig. 55). Length up to 30 mm.; maximum breadth (at prothorax) 6 mm.

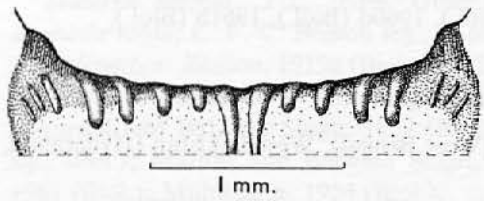

Fig. 55. *Margites exiguus* Gahan. Mature larva. Front margin of hypostoma.

Biology. Similar to that of *M. modicus* Gahan. Emergence occurs in May.

Material studied. 1 L, Burma, Yanaungmyin, 25.viii.1928, from *Anogeissus acuminata*, D. J. Atkinson leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner 1931b (appendix) (L, Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Rhytidodera simulans White

[The Mango Branch Borer]

Distribution. ORIENTAL REGION: Borneo, Celebes, Ceram, Java, Malacca, Malaya, Sumatra, Thailand.

Host plants: *Mangifera odorata, M. foetida, Elaeocarpus grandiflorus* (Kalshoven, 1951); *Canarium commune, Couroupita guianensis, Mangifera indica* (Miller, 1932).

Mature larva (figs. 56, 57). Rather similar to that of *Hoplocerambyx spinicornis* (Newman) from which it differs as follows. *Head* with temples rather coarsely strigose; postocular carina absent. Frons without dentate processes and postcondylar carinae.

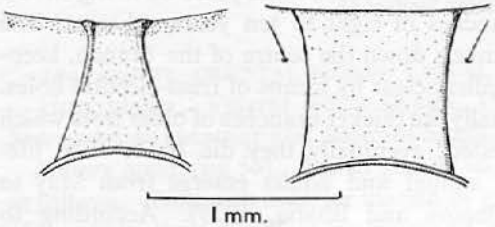

Fig. 56. *Massicus venustus* Pascoe (*left*) and *Rhytidodera simulans* White (*right*). Mature larva. Gula.

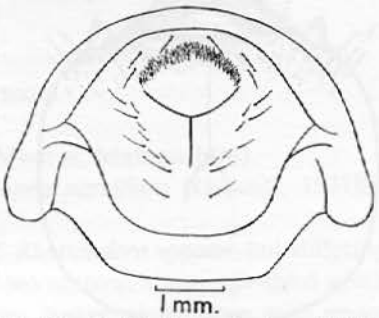

Fig. 57. *Rhytidodera simulans* White. Mature larva. Abdominal segment 10. Caudal aspect.

Antennal foramen not produced. Ocelli with pigmented spot very distinct. Gula broad, front margin almost as broad as mentum and sides not diverging posteriorly (fig. 56). *Prothorax* with posterior area of pronotum rather coarsely longitudinally strigose. *Abdomen* with moniliform tubercles rather more strongly protuberant and distinctly separated. Anus with dorsal lobe fringed with only fine decumbent setae, behind which are six to eight very coarse bristly setae (fig. 57). *Spiracles* with peritreme rather broadly oval and very thick. Length up to 55 mm.; maximum breadth (at prothorax) 11 mm.

Biology. The eggs are laid on the branches and the larvae bore into them and pupate. Severely infested branches die. The eggs and larval stages last nine to twelve days and four to six months respectively. The pupal stage, together with the resting period of the adult, lasts one to three months (Kalshoven, 1951).

Material studied. 2 L, Java, Bogor, 1930, from *Mangifera*, L. G. E. Kalshoven leg., in coll. L.G.E.K. 2 L, Malaya, Kedah, Sungei Petani Estate, 2.xii.1925, from *Mangifera indica* in coll. D.A.M.

References. Corbett and Gater, 1926 (Biol.); Dammerman, 1919 (Biol.), 1929 (Biol.); Franssen, 1938 (Biol., fig., Contr.); Kalshoven, 1951 (E, Biol. fig.); Miller, 1932 (Biol.); Mühlmann, 1954 (Biol.).

Rhytidodera bowringi White

[The Yellow-spotted Ridge-necked Longhorn]

Distribution. ORIENTAL REGION: Burma, China, Hainan Is., India (Assam, Bihar), Java.

Host plants: *Mangifera indica* (Fletcher, 1930); *Dracontomelon dao, Celtis sinensis* (Gressitt, 1942).

Mature larva (fig. 58). Very similar to that of *R. simulans* White from which it may be distinguished by the distinctly transverse second antennal segment. Length up to 50 mm.; maximum breadth (at prothorax) 10 mm.

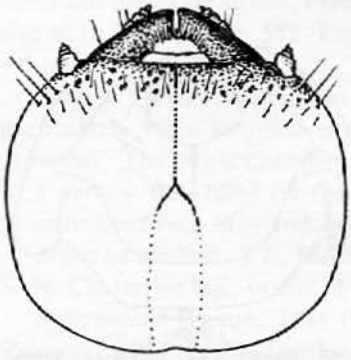

Fig. 58. *Rhytidodera bowringi* White. Mature larva. Head. Dorsal aspect. (J. L. Gressitt)

Only a single larva in very poor condition is available for study but other distinguishing characters may be apparent when more material becomes available.

Biology. Oviposition takes place on living shoots and branches of eight to ten years-old trees. The larva tunnels down the centre of the branch, keeping its gallery clear by means of frass-ejection holes. It is usually the thicker branches of older trees which are infested; eventually they die back. The life-cycle is annual and adults emerge from May to June (Beeson and Bhatia, 1939). According to Gressitt (1942) the pupal cell is sealed with a calcareous operculum. Adults are nocturnal and are frequently attracted to artificial light.

Economic importance. According to Gressitt (1942) this species may prove to be of considerable economic importance since it attacks living fruit trees and weakens them, perhaps occasionally killing entire branches.

Control. Owing to the inconspicuous nature of the larval damage, the most effective measure appears to be the attraction of adults to light traps (Gressitt, 1942).

Material studied. 1 L, India, Bihar, Barsoi, 26.v.1929, from *Mangifera indica*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Fletcher, 1930 (L fig., P fig., I fig., Biol. fig.); Gardner, 1931b (L fig., Biol.); Gressitt, 1942 (L fig., P fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Mathur and Balwant Singh, 1961 (Biol.); Mühlmann, 1954 (Biol.).

Rhytidodera robusta Gahan

Distribution. ORIENTAL REGION: India (Maharashtra, Mysore, Uttar Pradesh).

Host plants: *Shorea robusta* (Beeson and Bhatia, 1939); *Ficus carica* (Mathur and Balwant Singh, 1959); *Mangifera indica* (Mathur and Balwant Singh, 1961).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Fletcher, 1921 (?Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Rhytidodera integra Kolbe

[The Gray-spotted Rough-necked Longhorn]

Distribution. ORIENTAL REGION: Burma, China, Thailand. PALAEARCTIC REGION: Japan, Korea.

Host plant: *Ficus retusa* (Gressitt, 1942).

Egg. Short, stout, oblong-oval, abruptly narrow at ends; brown: about 3 mm. by 1·7 mm. (Gressitt, 1942).

Biology. This species probably only attacks weakened branches of *Ficus*. Pupation probably takes place in the spring instead of late autumn as is the case with *R. bowringi* White (Gressitt, 1942).

References. Gressitt, 1942 (E, L fig., I fig., Biol., Contr.), 1951 (Biol.).

Massicus venustus (Pascoe)

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Maharashtra).

Host plants: *Vateria indica* (Kahn, 1947); *Hopea parviflora* (Gressitt, 1931b); *Shorea talura* (Mathur and Balwant Singh, 1961).

Mature larva. (fig 56). Rather similar to those of *Rhytidodera* species but differing as follows. *Head* with anterior margin of gula (fig. 56) narrow, about one-third width of mentum, the sides strongly diverging posteriorly. Antennal foramen with upper margin thickened and slightly protuberant. *Prothorax* with posterior striate area of pronotum not distinctly embossed. *Abdomen* with tubercles of ampullae confluent or indistinct or flattened. Length up to 65 mm.; maximum breadth (at prothorax) 14 mm.

Biology. This species is a heartwood borer of stumps, fire-scorched poles and trees. Although primarily a borer of dead wood it does infest living trees which are not really healthy; trees in this condition are sometimes killed by the girdling effect of numerous larvae. The pupal cell is plugged with a calcareous helmet-shaped operculum. The life-cycle is apparently annual but may be delayed up to a year thereafter. In the south of India emergence occurs in both monsoon seasons (Beeson and Bhatia, 1939).

Kahn (1947) has found that logs of *Vateria* are susceptible to attack soon after felling. Monthly decortication has revealed that the larvae, on hatching, bore through the bark to the bast and continue feeding for about two months on the phloem tissue and then tunnel into the wood, making wide, oblique galleries up to 4 ins. in depth.

Control. For attacks on standing living trees the same measures should be applied as for *Hoplocerambyx* (p. 96). Before the utilization of trap-trees the local flight-period of the beetle must first be ascertained (Beeson, 1941).

Material studied. 2 L, India, Madras, S. Mangalore, 24.v.1930, from *Hopea parviflora*, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Gardner, 1931b (L fig., Biol.); Khan, 1947 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961a (Biol.), 1961b (Biol.).

Massicus unicolor Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam).

Host plants: *Quercus griffithi, Q. mespilifolia* (Beeson and Bhatia, 1939).

Biology. The larval galleries of this species are in the heartwood. A calcareous operculum is secreted at the entrance to the pupal cell. Adults occur in August and are often to be found in old larval galleries (Stebbing, 1914).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1925 (L, Biol.); Mathur and Balwant Singh, 1960d (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (L fig., P fig., I fig., Biol. fig.).

Plocaederus obesus Gahan (Pl. XVII, fig. 1)

[The Red Cocoon-making Longhorn]

Distribution. ORIENTAL REGION: Andaman Is., Burma, China, Ceylon, East Pakistan (East Bengal), Formosa, Hainan Is., Hong Kong, India (Assam, Bihar, Madras, Maharashtra, Orissa, Sikkim, Uttar Pradesh, West Bengal), Indo-China, Thailand.

Host plants: *Buchanania lanzan, Butea monosperma, Caryota urens, Cordia dichotoma, Eriodendron anfractuosum, Garuga pinnata, Gmelina arborea, Salmalia malabarica, Kydia calycina, Lannea coromandelica, Mangifera indica, Shorea robusta, Spondias mangifera, Sterculia colorata, S. urens, S. villosa, Terminalia tomentosa* (Beeson and Bhatia, 1939); *Cedrela toona, Protium serratum* (Beeson, 1941); *Odina* (Stebbing, 1914); *Dracontomelon dao* (Gressitt, 1942); *Boswellia serrata, Pterocarpus marsupium* (Roonwal, Chatterjee and Thapa, 1961); *Ceiba pentandra* (Beller and Bhenchitr, 1936).

Adult (Pl. XVII, fig. 1). Length 25–46 mm. Reddish brown or testaceous, clothed with short, dense, tawny grey or buff pubescence; apices of antennal segments, parts of legs and margins of prothorax and elytra pitchy. *Head* with antennae one and three-quarters as long as body in male but only slightly longer than body in female. *Prothorax* slightly transverse, with sides stoutly tuberculate; disc vermiculate-rugulose. Elytra truncate apically, with marginal and sutural angles slightly toothed or spined.

Mature larva (fig. 59 and Pl. X, figs. 1 and 2). Form elongate, subcylindrical, rather slender (but short and robust after calcium has been secreted). *Head* (fig. 59) with genae ferruginous, rugose; temples smooth, without carinae or weals; dorsal boundary of antennal foramen not raised, scarcely produced, ferruginous; front margin of frons with upper boundary rounded, straight and smooth. Antenna with segment 3 about four times as long as basal width and nearly half as long as segment 2 which is elongate; supplementary process short, less than one-fourth length of segment 3. Mandible pitchy, rugose, with three to six stout setae on basal half of outer face. Labrum transversely oval and fringed with coarse golden setae. Three pairs of subcontiguous ocelli present, being arranged in a straight vertical row laterad and ventrad of antenna; ocellar lens round, convex, strongly protuberant; pigmented spot indistinct owing to sclerotization of lens. Hypostoma feebly strigose, ferruginous, with front margin more darkly so, and abruptly swollen at extremities; sutures dark, in-

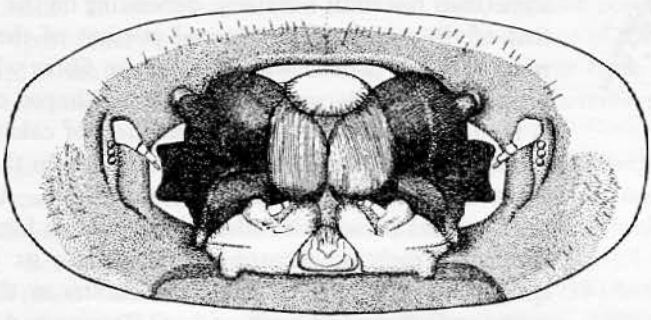

Fig. 59. *Plocaederus obesus* Gahan. Mature larva. Head. Frontal aspect.

curved; gular sutures distinctly raised. Maxilla with segment 3 of palp tapering, about two-thirds length of segment 2. Labial palpi with segment 2 about one-third length of segment 1 which is elongate. *Prothorax* rather sparsely setose laterally, front margin rather densely fringed with reddish setae; posterior part of pronotum dull, microspiculate, longitudinally rugose and sparsely setose. *Abdomen* with dorsal ampullae each with two transverse furrows and a broad shallow median furrow; non-tuberculate but densely spiculate. Tergite 9 without a sclerotized process. Anal lobes rugose and glabrous but surrounded by very dense, pale, silky setae. Pleural discs rather indistinct. *Legs* with unguiculus long, slender, pale and imbricately spinose. *Spiracles* with peritreme broadly oval, thick, pale and without marginal chambers. Length up to 58 mm.; maximum breadth (at prothorax) 15 mm.

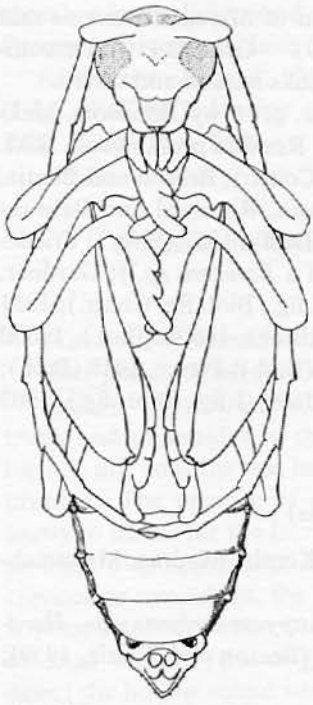

Fig. 60. *Plocaederus basalis* Gahan. Female pupa. Ventral aspect.

Pupa. No material available but Gardner (1925) gives the following description (the figure given (fig. 60) is that of the African *P. basalis* Gahan, which should be very similar). "Antennal joints 3 and 4 swollen at apex, 5–10 angulately produced externally at apex; antennae curved reaching 2nd abdominal sternite. Thoracic lateral spines prominent; two blunt prominences on posterior margin of prothorax rather strong. Chitinous asperities on abdominal tergite sparse, not forming a complete transverse band near posterior margin. Two large spherical rounded lobes below projections of 9th tergite. Length 35 mm."

Egg (fig. 61). Elongate, rounded, curved at each end, stouter towards one end, with no distinct terminal prominences; surface dull, covered with minute spines. Length 4·1 mm.; breadth 1·4 mm.

Biology. Adults first appear during March in north India. The young larvae soon penetrate into the deeper layers of the wood in which they excavate irregular tunnels. Some larvae mature as early as August, others

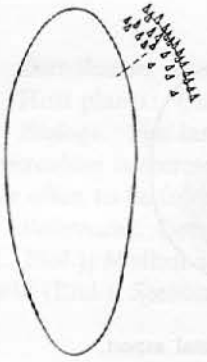

Fig. 61. *Plocaederus obesus* Gahan. Egg.

sometimes not until February, depending on the moisture content of the wood. The terminal portion of the pupal cell is rather loosely packed with long coarse fibres which are compressed and interwoven to form an egg-shaped cocoon, which is then lined internally with a secretion of calcium carbonate nearly $\frac{1}{16}$ in. thick; it is easily loosened from the surrounding fibres and will withstand strong compression. After secretion, the larva has become considerably reduced in length. Pupation occurs as early as September or as late as the following spring. The majority of beetles overwinter in their pupal cocoons and emerge in March or April (Beeson and Bhatia, 1939).

On Hainan Island, adults have been found during April, May, June, July and October (perhaps only in cocoons in the latter month). Adults are nocturnal. African species of this genus construct similar cocoons (see Duffy, 1957).

Economic importance. This is a heartwood borer, chiefly of softwoods, and according to Friederichs (1919) in Indo-China it attacks *Eriodendron anfractuosum* which it ultimately kills. Gressitt (1942) states that it seriously injures living *Dracontomelon*, and in India living trees of *Sterculia urens* (which is blazed and tapped for gum) are attacked (Beeson, 1941).

Control. Effective control measures against this species have not yet been formulated. It should be possible to modify the tapping system of *Sterculia urens* so that the wounds heal more rapidly (Beeson and Bhatia, 1939). Gressitt (1942) recommends that infested branches should be destroyed and trunks barked and tarred.

Material studied. 1 L, Thailand, from *Ceiba pentandra*, pres. by Boonsom Meksongsee, in coll. B.M. 1 L, 2 I, Laos, Vientiane, 1964, J.A. Rondon pres., in coll. B.M.

References. Beeson, 1919a (Biol. fig.), 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Beller and Bhenchitr, 1936 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cotes, 1889 (Biol.), 1894a (Biol. fig.); Duffy, 1957 (E fig.); Friederichs, 1919 (L fig., P fig., I fig., Biol. fig. (larval figs. are of a *Batocera* sp.)); Gardner, 1925 (E fig., L fig., P, Biol.); Gressitt, 1942 (L fig., P fig., I fig., Biol. fig. Contr.); 1951 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960d (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Pierce, 1918 (Biol.); Roonwal, Chatterjee and Thapa, 1961 (Biol.); Stebbing, 1899 (I fig., Biol. fig.), 1902 (I fig., Biol. fig.), 1914 (I fig., Biol. fig.).

Plocaederus ferrugineus (Linnaeus)

Distribution. ORIENTAL REGION: Ceylon, India (Bihar, Kerala, Madras, Maharashtra, Uttar Pradesh).

Host plants: *Boswellia serrata, Buchanania lanzan, Diospyros melanoxylon, Hardwickia binata, Lannea coromandelica, Salmalia malabarica* (Beeson and Bhatia, 1939); *Anacardium occidentale* (Bhasin and Roonwal, 1954).

Biology. The larval galleries in the sapwood are broad and meandering and are packed with fibrous dust. Pupation takes place in the heartwood where a large

excavation is made. In this excavation a flattened oval, egg-like cocoon of calcium carbonate is prepared; its distal end may be level with the surface of the sapwood and become exposed if the bark and dust fall away. Adults emerge from April to July, mainly May, eclosion often having taken place as early as November (Beeson and Bhatia, 1939).

Economic importance. In the case of *Boswellia* (according to Chatterjee *et al.*, 1950), attack by this species is of no consequence as the pupal cells never occur more than 1 in. deep in the sapwood, all of which is removed during conversion of the logs.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Chatterjee, Bhasin and Bhatia, 1950 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.).

Plocaederus pedestris (White)

Distribution. ORIENTAL REGION: Andaman Is., Burma, Ceylon, East Pakistan (East Bengal), India (Bihar, Madhy Pradesh, Maharashtra), Thailand.

Host plants: *Mangifera indica* (Beeson and Bhatia, 1939); *Shorea robusta, Lannea coromandelica* (Cotes, 1889); *Salmalia hepataphyllum, Butea monosperma* (Thomson, 1868).

Biology. The larva at first feeds subcortically but later excavates a wide oblique chamber in the heartwood in which it prepares a yellowish white calcareous cocoon. Emergence occurs in June (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Cotes, 1889 (I fig., Biol. fig.); Mathur and Balwant Singh, 1961 (Biol.); Thompson, 1868 (L fig., P fig., I fig., Biol. fig.).

Plocaederus fulvicornis Guérin-Méneville (=**ruficornis** Newman)

[Barbero]

Distribution. ORIENTAL REGION: Philippines, Thailand.

Host plant: *Mangifera indica* (Jones, 1913).

Biology. This cerambycid prefers the larger trees (at least over ten years old), the trunk and undersides of the larger branches being the parts most usually attacked, for it is not until the tree has become severely weakened that the tops of the limbs are invaded. The practice of slashing the trunk in order to force the tree into fruit is partly to blame for the increased infestation, as the scar in the bark so formed affords an ideal oviposition site. Eggs are deposited singly on the bark of, or inserted into crevices or wounds in, the base and lower part of the trunk. The entire larval stage is passed subcortically. As no frass is ejected, the presence of larvae is not easily detected without removing the bark, although by careful tapping, an acute ear can detect the hollow sound which indicates their excavations. Before pupating, the larva forms a calcareous cocoon in the frass (Jones, 1913). Duport (1920) states that the life-cycle is annual.

Economic importance. In Manila many trees have been killed off by this longicorn and it has been regarded as the most serious menace to the mango industry in the Philippines (Jones, 1913).

Control. Jones (1913) suggests the removal of bark, frass, larvae and pupal cells from infested parts of the trees, the exposed surface then being sprayed with resin wash. Uichanco (1931) discusses the efficacy of the application of a coal tar-kerosene emulsion to the trunks of mango trees. There were indications that this treatment, when applied once a year, would afford the trees protection against re-infestation.

References. Beller and Bhenchitr, 1936 (Biol.); Dammerman, 1929 (Biol.); Duport, 1920 (Biol.); Jones, 1913 (L fig., P fig., I fig., Biol. fig., Contr.); Mathur and Balwant Singh, 1961 (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (L fig., P fig., I fig., Biol. fig.); Uichanco, 1931 (Contr.).

Xoanodera regularis Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam).

Host plant: *Ficus elastica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April (Beeson and Bhatia, 1939). The adult is remarkable for its close resemblance in colour to that of the bark of *Ficus* (Stebbing, 1914).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol.).

Trirachys atkinsoni Gardner

Distribution. ORIENTAL REGION: Burma.

Host plant: *Pentacme suavis* (Beeson and Bhatia, 1939).

Biology. Adults have been taken in January and April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Mallambyx raddei (Blessig)

Distribution. ORIENTAL REGION: China (Chekiang, Fukien, Kiangsu, Liaoning), Manchuria. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Quercus acutissima, Q. serrata* (Matsumura, 1921); *Morus, Castanea sativa, Pasania cuspidata* (Chen, 1933); *Quercus glandulifera* (Cheo, 1935).

Egg. Yellow in spirit, elongate-ovoid, 4·2–4·4 mm. long, 1·5–2·1 mm. broad, rounded at one end, prolonged into a thick stalk at the other end, smooth except for the produced stalk-like end which is strongly marked with hexagonal reticulation, protected with a thick opaque cap which is also strongly reticulated (Kojima, 1931).

Biology. Adults emerge in July and August, depositing their eggs abundantly, mostly in the basal portion of the trunk. Larvae after feeding at first on the cambial region, burrow into the heartwood making a spacious longitudinal gallery; the frass is entirely ejected through the bark. The pupal cell is plugged with a calcareous operculum. The life-cycle is at least two years in duration (Kojima, 1931).

Economic importance. The damage caused by larvae of this species is severe, as

living trees are attacked and often hollowed out by the large larval galleries (Kojima, 1931).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Kojima, 1931 (E fig., L fig., P fig., Biol. fig.), 1959 (L fig.); Köppen, 1880 (?); Matsumura, 1921 (?); Mühlmann, 1954 (Biol.); Nakamura, 1959b (Biol.); Nijima, 1913 (?); Sasaki, 1911 (?).

Nadezhdiella cantori (Hope)

[The Gray-black Citrus Longhorn]

Distribution. ORIENTAL REGION: China (Fukien, Hong Kong), Formosa, Thailand.

Host plants: *Citrus aurantifolia, C. limonia, C. maxima* (Gressitt, 1942); *Citrus tangerina, C. limon, C. sinensis* (Lieu, 1947).

Adult (Pl. XVII, fig. 2). Length 41–52 mm. Greyish brown to brownish black, thinly covered with greyish buff or golden pubescence, particularly on head and prothorax. *Head* with antennae one and one-half times as long as body in male but only about as long as body in female. *Prothorax* slightly transverse, deeply vermiculately strigose and sides with a pair of stout median tubercles. Elytra with a minute tooth at sutural angle.

Egg. Creamy white, later becoming brownish grey, covered with minute conical projections. Length about 4 mm. (Lieu, 1947).

Biology. Lieu (1947) has observed that the egg, larval, pupal and pre-emergence stages usually lasted about 2–12 days, 20–23 months, 21–33 days and 12–23 days, respectively, the adults lived for about one month after emergence and the life-cycle was normally about two years in duration, though in some instances it was a three-year period, the third winter being passed in the pre-emergence stage. Chang, Shen and Si (1963), however, have found that the duration of a generation depends on the date of hatching. Larvae that hatch before mid-July pupate between the beginning of August and the beginning of October of the following year and give rise to adults that emerge at the beginning of November but may remain in the pupal chambers until the end of the following April. Larvae that hatch after August pupate in August-September of the following year but one, and the adults do not leave the pupal chamber until the fourth year.

Eggs are deposited between late May and late July, usually singly, in crevices in the bark of the trunk and main branches. The larvae feed on the inner bark for about six weeks before entering the sapwood; they are active for about four and a half to five months before overwintering for four and a half months and for about four and a half to seven months of the second year, before overwintering again for five to nine months.

Although the maximum length of the larval gallery does not exceed two feet, it seriously impairs the health of the tree. Both the fecundity and the percentage hatch are very high and when several larvae are present in a single tree, as often happens, the tree ultimately dies. Pupation takes place in a short lateral gallery leading off from the main gallery. Most adults emerge during June or July, although a few appear in May or August; they often spend some time in the larval gallery and have been observed pairing in large excavations made for emergence. Flight takes place at dusk.

Captured females deposited a maximum of 57 eggs each, but field-collected females contained 100–150 mature eggs.

Economic importance. *N. cantori* (Hope) is one of the most abundant and most destructive of the *Citrus* cerambycids in China. It is widely distributed in the *Citrus*-growing districts of all the Chinese provinces and in Formosa. Galleries made by the larvae greatly weaken the trees and render them highly subject to breakage and insect attack, as well as reducing the yield of fruit (Gressitt, 1942). According to Chen (1943) this species is responsible for a loss of about ten per cent of *Citrus* trees annually in Szechwan.

Control. Adults should be collected between late May and early August (before the dew disappears), especially from large excavations in the lower portion of the *Citrus* trunks. The latter should be examined up to a height of about eight feet for the presence of eggs and for frass-ejection five times throughout June and July, and the eggs removed with a hard brush or by hand and the young larvae killed by hammering the bark at points where powdery frass is visible. The trunks should be brushed clean and then whitewashed with a freshly made mixture of quick-lime and water (1:6) during hot sunshine in early June in order to discourage oviposition. Badly infested trees should be felled, sawn into short lengths and split so that the larvae may be removed and killed (Lieu, 1947). The use of light-traps in late spring and the collection of mating pairs on trees in daytime has been suggested by Gressitt (1942). Chen (1943) suggests the covering of the lower portion of the trunk with straw ropes to prevent oviposition.

References. Chang, Shen and Si, 1963 (Biol., Contr); Chen, 1943 (E fig., L fig., I fig., Biol., Contr.); Cheo, 1935 (Biol.); Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Lieu, 1947 (E fig., L fig., P fig., I fig., Biol. fig., Contr. fig.); Sonan, 1925 (Biol.).

Neocerambyx paris (Wiedeman)

Distribution. ORIENTAL REGION: Burma, India (West Bengal, Maharashtra, Mysore), Malaya, Thailand.

Host plants: *Quercus* sp. (Beeson and Bhatia, 1939); *Hevea brasiliensis* (Corbett and Gater, 1926).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Corbett and Gater, 1926 (Biol.).

Hesperophanini

Stromatium barbatum (Fabricius)

[The Kulsi Teak Borer]

Distribution. ORIENTAL REGION: Andaman Is., Burma, Ceylon, East Pakistan (East Bengal), India (Assam, Bihar, Madras, Maharashtra, Mysore, Orissa, Punjab, Uttar Pradesh), West Pakistan (Rawalpindi), Seychelles. MADAGASCAN REGION: Madagascar, Mauritius, Réunion, Rodriguez.

Adult. Length 12–29 mm. Colour varying from reddish brown to brownish black;

sparsely covered with tawny pubescence. *Head* with antennae about one-third longer than body in male, scarcely longer than body in female; ciliate beneath. Eyes coarsely faceted. *Prothorax* densely covered with coarse punctures; disc bearing five feebly defined tubercles. Middle coxal cavities open externally. *Elytra* coarsely and densely punctured; each with two pairs of costae and with a sutural tooth at apex.

Host plants: INDIA: *Abies webbiana, Acacia arabica* (sapwood), *A. caesia, A. catechu* (sapwood), *A. dealbata, A. eburnea, A. farnesiana, A. jacquemontii, A. latronum, A. leucophloea* (sapwood), *A. modesta, A. pennata, A. senegal, Acer campbellii, A. caudatum, A. pictum, A. villosum, Acrocarpus fraxinifolius, Aegle marmelos, Adina cordifolia, Aesculus hippocastanum, A. indica, Alangium salvifolium, Albizia chinensis, A. distachya, A. julibrissin, A. lebbekoides, A. lophantha, A. procera, A. stipulata, Alnus nepalensis, A. nitida, Anogeissus latifolia, A. pendula, A. sericea, Annona squamosa, Anthocephalus cadamba, Ardisia humilis, A. solanacea, Artocarpus calophylla, A. lakoocha, Averrhoa carambola, Balanites rox-burghii, Bambusa, Bauhinia foveolata, B. purpurea, B. racemosa, B. retusa, B. vahlii, B. variegata, Beaumontia grandiflora, Betula alnoides, B. utilis, Bischofia javanica, Boswellia serrata, Bridelia tomentosa, Broussonetia papyrifera, Butea monosperma, B. parviflora, Canarium strictum, Carallia brachiata, Carapa granatum, Carpinus viminea, Cassia auriculata, C. fistula, C. nodosa, C. siamea, Casuarina equisetifolia, Cedrela toona, Cedrus deodara, Celtis australis, Chloroxylon swietenia, Cinnamomum glanduliferum, C. tamala, Citrus aurantium, C. maxima, C. medica, Clausena lansium, Clerodendrum colebrookianum, Coffea arabica, Cordia dichotoma, Cordyline australis, Cornus macrophylla, Corylus colurna, C. ferox, Cotoneaster bacillaris, C. microphylla, Crateagus crenulata, C. oxyacantha, Cryptomeria japonica, Cudrania javanensis, Cupressus torulosa, Dalbergia hircina, D. kurzii, D. lanceolaria, D. latifolia* (sapwood only), *D. ovata, D. paniculata, D. rimosa, D. sericea, D. sissoo, D. stipulacea, D. volubis, Debregeasia hypoleuca, Dendrocalamus strictus, Desmodium tiliaefolium, Deutzia corymbosa, D. staminea, Diospyros chloroxylon, D. embryopteris, D. humilis, D. kaki, D. melanoxylon* (sapwood), *D. microphylla, D. montana, D. tomentosa, Dipterocarpus macrocarpus, Docynia indica, Elaeagnus conferta, E. latifolia, Elaeocarpus lanceaefolius, Eriobotrya dubia, E. japonica, E. petiolata, Eriolobus indica, Erythrina suberosa, Eucalyptus calophylla, E. globulus, E. teretricornis, Eugenia bracteata, E. laeta, Euonymus frigidus, E. hamiltonianus, E. lacerus, Eurya symplocina, Excoecaria agallocha, Fagus sylvatica, Feronia elephantum, Ficus carica, F. glaberrima, F. hispida, F. nemoralis, F. retusa, F. scandens, Fraxinus floribunda, Gamblea ciliata, Garcinia indica, G. wightii, Gardenia obtusifolia, G. turgida, Garuga pinnata, Gaya lyallii, Glochidion lanceolarium, Gmelina arborea, Gouania leptostachya, Grevillea robusta, Grewia asiatica, G. disperma, G. elastica, G. hainesiana, G. laevigata, G. optiva, G. subinaequalis, G. tiliaefolia, Gynocardia odorata, Hedera helix, Helicia robusta, Helicteres isora, Heritiera minor, Heteropanax fragrans, Hiptage benghalensis, Holigarna arnottiana, H. helferi, Holmskioldia sanguinea, Holoptelea integrifolia, Hopea wightiana, Hypericum mysorense, Ilex dipyrenia, I. sikkimensis, I. wightiana, Indigofera heterantha, I. pulchella, Juglans regia, Kydia calycina, Lagerstroemia lanceolata, L. villosa, Lannea coromandelica, Larix griffithii, Lasiosiphon eriocephalus, Leucomeris spectabilis, Litsea wightiana, Machilus bombycina, M. duthiei, M. odoratissima, Malus baccata, Madhuca butyracea, Magnolia campbellii,*

Mallotus nepalensis, M. philippinensis, Mangifera indica, Mappia foetida, Meliosma dilleniifolia, M. pungens, M. thomsoni, Michelia excelsa, M. champaca, M. nilagirica, Millettia brandisiana, M. pulchra, M. racemosa, Mimusops elengi, Morus alba, M. acidosa, Murraya exotica, Myrica nagi, Myrsine semiserrata, Olearia avicenniifolia, Ougeinia dalbergioides, Oxyspora paniculata, Parkinsonia aculeata, Parrotira jacquemontiana, Pentacme suavis, Phlogacanthus thyrsiflorus, Photinia notoniana, Picea smithiana, Pinus wallichiana, Piptadenia oudhensis, Piptanthus nepalensis, Pistacia integerrima, Pithecellobium bigeminum, Pittosporum eriocarpum, P. eugenioides, P. floribundum, Plecospermum spinosum, Poinciana elata, P. regia, Polygala arillata, Pongamia pinnata, Populus ciliata, P. tremula, Premna serratifolia, P. integrifolia, Prinsepia utilis, Prosopis juliflora, P. spicigera, Prunus communis, P. eburnea, P. microcarpa, P. padus, P. persica, P. racemosa, Pterocarpus marsupium, Pterygota alata, Pyrus communis, P. lanata, P. pashia, P. ursina, P. variolosa, Quercus dealbata, Q. dilatata, Q. ilex, Q. incana, Q. lanuginosa, Q. pubescens, Q. semecarpifolia, Q. semiserrata, Q. serrata, Randia spinosa, R. uliginosa, Rhamnus persicus, Rhododendron grande, R. campanulatum, R. falconeri, Rhus insignis, R. punjabensis, R. wallichii, Ribes rubrum, Rosa macrophylla, R. moschata, R. sericea, Rubus lasiocarpus, Salix babylonica, S. daphnoides, S. elegans, Salmalia malabarica, Salvadora persica, Sapium sebiferum, Sauraula napaulensis, Semecarpus anacardium, Sesbania aegyptiaca, Shorea obtusa, S. robusta, Siphonodon celastrineus, Sonneratia apetala, Sorbus foliolosa, Spiraea canescens, Spondias axillaris, S. mangifera, S. pinnata, Staphylea emodi, Styrax serrulatum, Sterculia alata, Syzygium cumini, S. hemisphericum, Tectona grandis (sapwood), *Terminalia belerica, T. tomentosa, Tilia parvifolia, Toddalia aculeata, T. asiatica, Torricellia tiliaefolia, Trewia nudiflora, Turpinia nepalensis, Ulmus wallichiana, Viburnum cylindricum, V. coriaceum, V. cotinifolium, V. erubuscens, V. foetens, V. grandiflorum, V. nervosum, Woodfordia floribunda, Wrightia tinctoria, Xylosoma longifolium, Ziziphus nummularia, Z. xylopyrus.*

EUROPE: *Acer pseudoplatanus, Aesculus hippocastanum, Alnus glutinosa, Betula verrucosa, Carpinus betulus, Fagus sylvatica, Populus tremula, Tilia cordata, Ulmus* sp.

NEW ZEALAND: *Cordyline australis, Hoheria lyallii, Olearia avicenniifolia, Pittosporum eugenioides, Rapanea urvillei* (Beeson and Bhatia, 1939; Bhasin and Roonwal, 1954; Bhasin, Roonwal and Balwant Singh, 1958; Mathur and Balwant Singh, 1959, 1960a, 1960b, 1960c, 1960d, 1961a, 1961b).

Mature larva (figs. 62–65). *Head* (figs. 63–64) subquadrate, somewhat wider behind middle, the posterior margin with a very slight median emargination; shouldered behind each antenna. Genae with setae short and sparse. Front margin of frons weakly concave and not strongly pigmented. Hypostoma (fig. 64). with front margin distinctly tuberculate, the tubercles oval and often brownish. Gula narrow, not raised. One pair of ocelli present; lens oval, indistinct; pigmented spot usually indiscernible. Antenna strongly protuberant, with a long basal membrane; segment 2 cylindrical, more than one and a half times as long as segment 3; segment 3 wider in basal half, tapering apically; supplementary process elongate, conical. Labrum moderately transverse, with anterior margin straight medially and with numerous setae. Maxilla and labium with brownish sclerotization basally to the segment: lobe of maxilla broad,

Fig. 62. *Stromatium barbatum* (Fabricius). Mature larva. Anterior part of body. Oblique aspect. (Gardner, 1927)

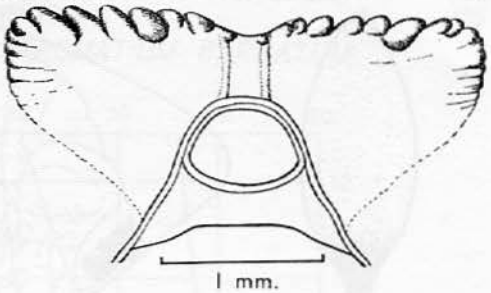

Fig. 64. *Stromatium barbatum* (Fabricius). Mature larva. Hypostoma. (Duffy, 1953a)

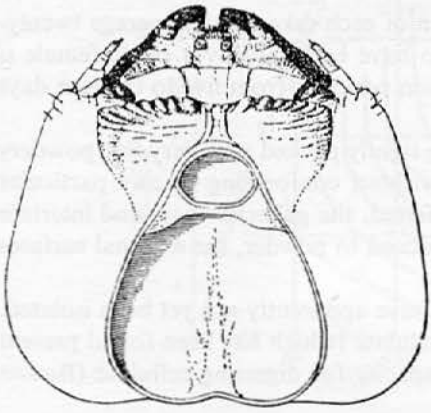

Fig. 63. *Stromatium barbatum* (Fabricius). Head. Ventral aspect. (Gardner, 1927)

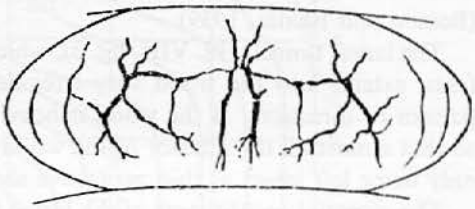

Fig. 65. *Stromatium barbatum* (Fabricius). Mature larva. Abdominal ampulla. Dorsal aspect. (Gardner, 1927)

fleshy. *Prothorax* (fig. 62) with pronotum subrectangular, with anterior area narrowly yellowish, shining; posterior area elevated, soft, striate, except for a posterior, finely reticulate area. Postnotal fold present. Eusternum not distinctly limited; shining rugulose, with a weak, oblique depression on each side. *Abdomen* with ampullae non-tuberculate and with surface reticulate and wrinkled; transverse furrows indistinct (fig. 65). *Legs* well developed. *Spiracles* with peritreme oval and pale. Length up to 38 mm.; maximum breadth (at prothorax) 9·5 mm.

Egg (figs. 66, 67). Gardner (1927) gives the following description. "Average length 2·1 mm.; width about 0·8 mm. Elongate ovoid, one end with a slight blunt thickening, the opposite end with a more distinct blunt prominence. White, the surface minutely granulate, except towards the more prominent end where the granules are much coarser and more closely placed."

Biology. The eggs are deposited in small holes and cracks in wood (with or without bark) and in thin battens, planks and plywood; other sites are fissures formed by imperfect carpentry joints and rough, splintery surfaces. They may be laid singly or

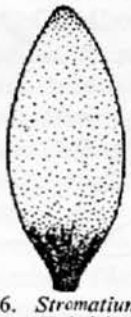

Fig. 66. *Stromatium barbatum* (Fabricius). Egg. (Gardner, 1927)

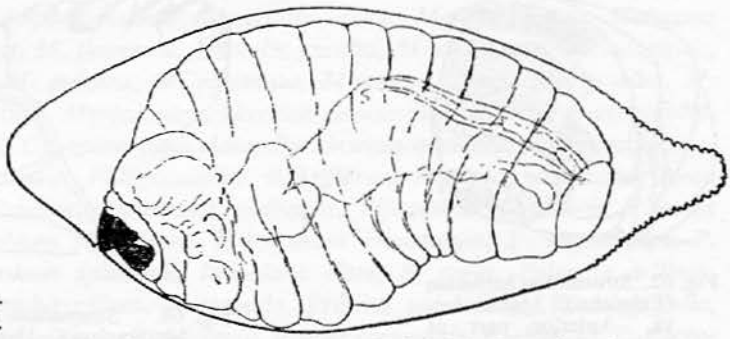

Fig. 67. *Stromatium barbatum* (Fabricius). Larva just about to emerge from egg. (Beeson and Bhatia, 1939)

in batches of about half a dozen. The extrusion of each takes on an average twenty-five seconds. The maximum number known to have been laid by a single female is 246, the average being about 100. The incubation period is from five to thirteen days (Beeson and Bhatia, 1939).

The larval tunnels (Pl. VIII, fig. 3), which are tightly packed with very fine powdery frass, extend into the wood very irregularly without conforming to any particular pattern or direction. If the wood is heavily infested, the galleries cross and interlace so that almost all the interior of the wood is reduced to powder, the external surfaces only being left intact as thin protective sheets.

The essential constituents of the larval food have apparently not yet been isolated. The larval gut probably contains the enzyme cellulase (which has been found present in *S. fulvum* Villers), and this may have the capacity for digesting cellulose (Beeson and Bhatia, 1939).

No special cell appears to be constructed for pupation, which occurs at various depths in the wood (Pl. III, fig. 1). Adults excavate separate tunnels to the surface (Pl. VII, fig. 3). Pupation takes place during May and June and adults emerge during June and July. The life-cycle is completed in from one to several years, the maximum period recorded being ten years.

The following chart (fig. 68) shows a typical sequence of emergence from a single brood. The chart opposite (fig. 69) shows the correlation of the rainfall and the percentage of the total annual population of adults which emerged (after Beeson and

Emergence of Stromatium barbatum ex Albizzia stipulata, Dehra Dun.

1st year.	2nd year.	3rd year.	4th year.	5th year.	6th year.	7th year.
1	28	42	23	4	1·5	0·5 per cent.

Fig. 68. Chart showing emergence of *Stromatium barbatum* (Fabricius) at Dehra Dun. (Beeson and Bhatia, 1939)

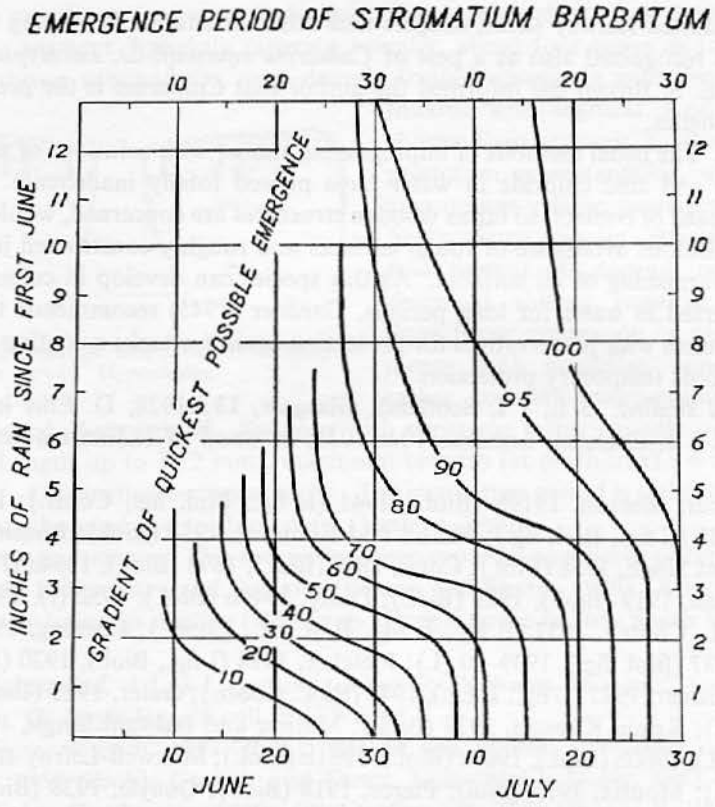

Fig. 69. Chart showing the emergence period of *Stromatium barbatum* (Fabricius). The zones of emergence per cent reach the quickest possible rate in the gradient on the right. Thus on June 30th, if only 10 inches of rain has fallen about 90 per cent of the beetles will have emerged; if only one inch of rain has fallen about 30 per cent of the beetles will have emerged. (Beeson and Bhatia, 1939)

Bhatia, 1939). This shows, for example, that if only one inch of rain has fallen, about 30 per cent of the beetles will have emerged.

Economic importance. This species is of considerable economic importance, not only on account of its extremely polyphagous nature, but also because of its preference for seasoned timbers. It is perhaps most notorious as a pest of plywood packing-cases and is also known readily to attack furniture, wooden structures, rafters, door- and window-frames, shelves, panels, wooden tent-pins, museum wood specimens, etc. Sometimes several years elapse before the concealed depredations are noticed.

In woodland areas this species will usually oviposit only on dry wood, such as the dead crowns of trees. There are apparently no authentic records of this species attacking living, healthy trees, except by Khare (1916), who reports that living trees of *Citrus aurantium* have been attacked by this species.

No records or observations are available to the author indicating that this species is established in Africa, although it is frequently imported in packing-cases. In Mauritius, however, it has become widely established, particularly in coastal areas, and has

seriously infested railway sheds, sleepers and other structures. According to A. J. E. Orian, it is recognized also as a pest of *Casuarina equisetifolia*, *Eucalyptus* spp. and *Bambusa*. E. S. Brown has informed the author that *Casuarina* is the preferred host in the Seychelles.

Control. The usual methods of impregnating timber with solutions of naphthalene in benzene and zinc chloride in water have proved totally inadequate. The most effective means of control, so far as wooden structures are concerned, would appear to be the meticulous avoidance of rough surfaces and roughly constructed joints and a thorough varnishing of all surfaces. As this species can develop in culms that have been immersed in water for long periods, Gardner (1945) recommends the impregnation of culms with preservatives for protection against attack; a coating of creosote and oil affords temporary protection.

Material studied. 3 L, 1 I, Scotland, Glasgow, 13.x.1928, D. Ellis leg., in coll. B.M.; 5 L, 1 I, England, London, 10.xi.1936, in wood of Indian tea-cases, in coll. B.M.

References. Beeson, 1919b (Biol.), 1941 (L fig., Biol. fig., Contr.); Beeson and Bhatia, 1939 (E fig., Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cotes, 1889 (Biol.), 1893 (Biol.), 1894a (I fig., Biol.); Dammerman, 1919 (Biol.), 1929 (Biol.); Duffy, 1949b (Biol.), 1952 (I), 1953a (E fig., L fig., Biol., Contr.), 1957 (E fig., L fig., Biol. fig., Contr.); Ebening, 1950 (Biol.); Emden, 1937 (Biol. fig.), 1939–40 (L); Fletcher, 1914 (I fig., Biol.), 1920 (Biol.), 1921 (Biol.); Gardner, 1927 (E fig., L fig.), 1945 (Biol., Contr.); Gater, 1925 (Biol.); Khare, 1916 (Biol.); Kunhi Kannan, 1928 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960c (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Moutia, 1955 (Biol); Pierce, 1918 (Biol.); Quayle, 1938 (Biol.); Ramakrishna Ayyar, 1940 (I fig., Biol.); Roonwal, Chatterjee and Thapa, 1961 (Biol.); Saalas, 1939 (L fig., Biol.); Stebbing, 1889 (L fig., I fig., Biol. fig.), 1902 (Biol.), 1908 (Biol.), 1914 (I fig., Biol.); Vinson, 1962 (Biol.).

Stromatium longicorne (Newman) (=**asperulum** White)

Distribution. ORIENTAL REGION: Bonin Is., Borneo, Burma, Celebes, China, Formosa, Hainan Is., East Pakistan (East Bengal), India (Assam, West Bengal), Indo-China, Java, Loochoo Is., Malaya, New Guinea, Philippine Is., Ryukyu Is., Sumatra, Thailand. AUSTRALASIAN REGION: Australia (imported).

Host plants: *Cassia fistula;* Stebbing's record of this species from living *Tectona* is erroneous (Beeson and Bhatia, 1939); *Shorea* (K. M. Moore). *Cupressus* (Middlekauff, 1962); *Anogeissus acuminata* (Beeson, 1941.)

Mature larva (fig. 70). *Head* subquadrate, somewhat wider behind middle, the posterior margin with a very slight median emargination, behind antennae. Genae with setae fine and sparse. Front margin of frons rounded, feebly emarginate medially, faintly transversely strigose and pale ferruginous. Hypostoma (fig. 70) with front margin pale ferruginous and with four to six widely spaced longitudinal carinae on each side of gula; gula very broad, with sutures raised. One pair of ocelli present; lens large, oval, pigmented spot indiscernible. Antennae strongly protuberant, with a

long basal membrane; segment 2 elongate, about one and one-half times as long as segment 3; segment 3 slightly tapering apically, about four times as long as basal width. Labrum subquadrate, very densely fringed anteriorly with very fine setae. Maxilla with segment 3 of palp much shorter than segment 2. *Prothorax* with pronotum subrectangular, with anterior area orange-yellow; posterior area rather finely longitudinally striate. Postnotal fold present. Eusternum not distinctly delimited, shining, rugulose, with an oblique linear impression on each side. *Abdomen* with ampullae non-tuberculate, rather coarsely micro-granulate. *Legs* well developed, 4-segmented. *Spiracles* with peritreme rather broadly oval, pale testaceous. Length up to 31·2 mm.; maximum breadth (at prothorax) 9·6 mm.

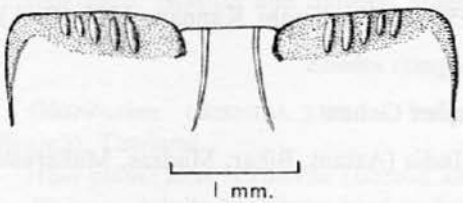

Fig. 70. *Stromatium longicorne* (Newman). Mature larva. Hypostoma.

Biology. Oviposition occurs at night. The incubation period is eight to twelve days and the larval period two to three years (Yashiro, 1940).

Economic importance. This species has been reported as a borer of furniture in the Netherlands Indies, Java and Sumatra (Beeson and Bhatia, 1939). A larva and adult were recently found in skirting (*Shorea* sp.) from a house in New South Wales (K. M. Moore).

Material studied. 1 L, 1 I, Australia, New South Wales, 16.v.1956, from imported *Shorea* sp., G. Boyle leg., in coll. F.C.N.S.W.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Corbett and Gater, 1926 (Biol.); Duffy, 1953 (Biol.), 1963 (L fig., Biol.); Garthwaite, 1940a (Biol.); Gressitt, 1951 (Biol.); Kalshoven, 1939b (L, Biol. fig.); Mathur and Balwant Singh 1960d (Biol.); Middlekauff, 1962 (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Sonan, 1925 (Biol.); Stebbing, 1914 (L fig., I fig., Biol.), Yashiro, 1940 (Biol. fig.).

Gnatholea eburifera Thomson

Distribution. ORIENTAL REGION: Borneo, China, Hainan Is., India (Assam), Indo-China (Tonkin), Malacca, Thailand.

Host plants: *Citrus grandis* (Gressitt, 1951); *Citrus aurantium* (Bhasin, Roonwal and Balwant Singh, 1958); *Ficus elastica* (B. S. Rao, Rubber Research Institute of Malaya).

Mature larva. No material available, but that of *G. liturifer* (Walker) (fig. 71) resembles that of *Stromatium barbatum* (Fabricius) but is separable as follows. *Head* with genal setae long and fine. Hypostoma (fig. 71) with only two pairs of tubercles which are longitudinally sub-carinate and ferruginous. Antenna with segment 2 not or scarcely longer than segment 3. *Abdomen* with

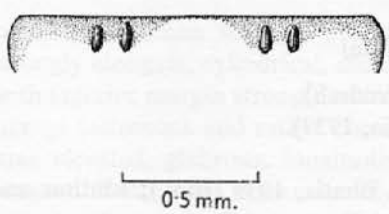

Fig. 71. *Gnatholea liturifer* (Walker). Mature larva. Hypostoma.

dorsal ampullae micro-granulate.

Material studied. 1 L, Kenya, Athi River, Clayton's Estate, 3,500 ft., 5.iv.1937, from dead branch of *Acacia*, H. Wilkinson leg., in coll. B.M.

References. Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Ebeling, 1950 (Biol.); Fletcher, 1921 (Biol.); Gressitt, 1951 (Biol.); Kunhi Kannan, 1928 (Biol.); Quayle, 1938 (Biol.).

Gnatholea simplex Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Bihar, Madras, Maharashtra, West Bengal).

Host plants: *Albizia odoratissima, Hardwickia binata, Millettia pendula, Pongamia pinnata, Shorea robusta* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual but may be prolonged up to three years in dry conditions. Adults emerge from May to August, mainly in May (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1927 (L); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961 (Biol.).

Hesperophanes javanus Schwarzer

Distribution. ORIENTAL REGION: Java.

Host plant: *Actinophora fragrans* (Kalshoven, 1955).

Biology. This species has frequently been bred from *Agrilus*-killed trunks and branches of the host. Most adults emerged between January and August (Kalshoven, 1955).

Reference. Kalshoven, 1955 (Biol.).

Jebusea hammerschmidti (Reiche) (=**Pseudophilus testaceus** Gahan)

Distribution. ORIENTAL REGION: West Pakistan (imported). PALEARCTIC REGION: Iraq.

Host plant: *Phoenix dactylifera* (Beeson and Bhatia, 1939).

Economic importance. This species was introduced to West Pakistan from Iraq in imported date palm suckers about 1927. Apparently it has not become established.

References. Anonymous, 1928 (Biol.); Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Zoodes basalis (White)

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Quercus incana* (Beeson and Bhatia, 1939).

Biology. Adults have been taken in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Zoodes quadridentatus Gahan

Distribution. ORIENTAL REGION: South India.

Host plant. *Vateria indica* (Mathur and Balwant Singh, 1961b).

Reference. Mathur and Balwant Singh, 1961b (Biol.).

Zoodes compressus (Fabricius)

Distribution. ORIENTAL REGION: India (Madras, Madhy Pradesh, Maharashtra, Punjab), Thailand.

Host plant: *Acacia catechu* (Beeson and Bhatia, 1939).

Biology. Adults have been bred in June and July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Stenaspini

Euryclelia cardinalis (Thomson)

Distribution. ORIENTAL REGION: Borneo, Malaya. AUSTRALASIAN REGION: New Zealand (imported).

Host plant: *Eusideroxylon zwageri* (R. Zondag).

Mature larva (fig. 72). *Head* subquadrate, slightly wider posteriorly; very strongly shouldered behind each antenna. Gena with setae short and sparse. Temples broadly sclerotized and ferruginous behind ocellus. Hypostoma with front margin (including gula) entirely broadly sclerotized and ferruginous and bearing eight to twelve oval tubercles (fig. 72). One pair of ocelli present; lens large, round, pigmented spot indis-

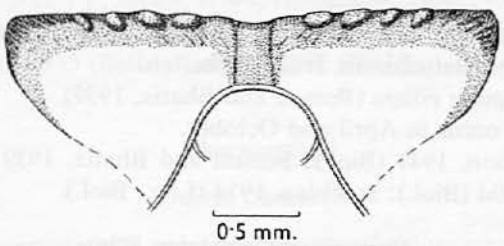

Fig. 72. *Euryclelia cardinalis* (Thomson). Mature larva. Hypostoma.

cernible. Antenna strongly protuberant, with a long basal membrane; segment 3 strongly elongate, cylindrical, almost as long as segment 2. Labrum subcircular and with anterior margin strongly rounded. *Prothorax* with presternal plates of pronotum orange testaceous and rather densely covered with long ferruginous setae; posterior area elevated, glabrous, longitudinally and rather coarsely striate. Postnotal fold present. Eusternum rather densely covered with fine ferruginous setae, except posteriorly where it is glabrous. *Abdomen* with ampullae slightly dull, unevenly microgranulate, with transverse impressions very distinct. *Legs* well developed. *Spiracles*

with peritreme oval and pale. Length up to 45 mm.; maximum breadth (at prothorax) 11·5 mm.

The examination of this larva has shown it to possess all the major characteristics of the Hesperophanini, such as the uneven and tuberculate hypostoma, the large ocellus and the protuberant and irregularly swollen gena. In the adult classification, however, the Stenaspini has been placed (provisionally?) at the end of the CERAMBYCINAE. In view of the larval morphology, it is suggested that the position of this tribe in the adult classification be reviewed.

Economic importance. Larvae and adults of this species have been obtained from a consignment of posts of *Eusideroxylon* imported into New Zealand. The sapwood showed severe infestation (R. Zondag, N.Z. Forest Service).

Material studied. 1 L, Borneo, in coll. B.M.

References. None available.

Euryphagus lundi (Fabricius)

Distribution. ORIENTAL REGION: Borneo, Burma, India (Assam, Sikkim, West Bengal), Indo-China, Java, Malaya, Thailand.

Host plants: *Dipterocarpus alatus*, *Shorea robusta* (Beeson and Bhatia, 1939); *Hopea*, *Sonneratia* (Kalshoven, 1955); *Dipterocarpus tuberculatus* (Beller and Blenchitr, 1936).

Biology. Adults occur from April to June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Beller and Bhenchitr, 1936 (Biol.); Kalshoven, 1955 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Purpuricenus indus Semenov (=**haussknechti** Witte)

Distribution. ORIENTAL REGION: India (Punjab), Jammu and Kashmir, Pakistan. PALAEARCTIC REGION: Baluchistan, Iraq, Turkestan.

Host plants: *Populus ciliata* (Beeson and Bhatia, 1939).

Biology. Adults occur in April and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.); Stebbing, 1914 (I fig., Biol.).

Purpuricenus montanus White

Distribution. ORIENTAL REGION: India (Uttar Pradesh), Jammu and Kashmir, West Pakistan (Peshawar). PALAEARCTIC REGION: Tibet.

Host plants: *Pinus excelsa*, *Quercus dilatata* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual. Adults occur in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.); Stebbing, 1914 (Biol.).

Purpuricenus sanguinolentus (Olivier)

Distribution. Ceylon, India (Keralia, Madhy Pradesh, Madras, Maharashtra, Uttar Pradesh, West Bengal).

Host plants: *Acacia arabica*, *Dendrocalamus strictus*, *Bambusa* (Beeson and Bhatia, 1939).

Biology. The adult, which has been observed gnawing living shoots of *Santalum album*, occurs from April to July and in December (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Purpuricenus lituratus (Ganglbauer) (=**ritsemai** Villard)

Distribution. ORIENTAL REGION: China (Liaoning). PALAEARCTIC REGION: Japan, Korea.

Host plant: *Pyrus malus* (Cheo, 1935).

Reference. Cheo, 1935 (Biol.).

Sternoplistes temmincki Guérin-Méneville

[The Red Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Fukien, Kiangsu). PALAEARCTIC REGION: Japan, Korea.

Host plant: *Bambusa* (Cheo, 1935).

Mature larva. Very similar to that of *Euryclelia cardinalis* (Thomson) but differing as follows. *Head* with temples rather narrowly sclerotized and dark testaceous behind ocellus. *Abdomen* with dorsal ampullae evenly micro-granulate. Form more slender. Length up to 28 mm.; maximum breadth (at prothorax) 7 mm.

Material studied. 3 L, 1 P, Japan, Hiwa, Hiroshima, 28.vi.1954, S. Nakamura leg., in coll. Shimane Agricultural Experiment Station.

References. Cheo, 1935 (Biol.); Shiraki, 1952 (Biol.).

Phoracanthini

Larval Characters

Head rather depressed, with sides rather strongly diverging posteriorly. Genae shouldered; temples without postocular carinae. Front margin of frons evenly rounded, upper boundary distinct. Antennal foramen with upper boundary not raised or produced. Mouthframe entirely sclerotized beneath antennae. Antennae salient. Labrum cordate. Ocelli absent, or one or two pairs present. Hypostoma with front margin transversely striate; sutures very short. Gular sutures well defined, raised. Process of palpifer indistinct. *Prothorax* depressed, moderately setose, lateral regions with scattered glabrous spots; postnotal fold present; presternal plates absent. *Abdomen* with ampullae microscopically alutaceous, glabrous. Pleural discs indistinct. Anal lobes sparsely setose. *Legs* short, but clearly 4-segmented; femur and tibiotarsus strongly sclerotized; unguiculus flagelliform, usually feebly sclerotized and imbricately tuberculate or spinose.

Phoracantha semipunctata (Fabricius)

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia (New South Wales, North West Australia, Queensland, South Australia, Victoria), New Zealand. ETHIOPIAN REGION: South Africa (Cape Province, Orange Free State, Pretoria), East Africa. MADAGASCAN REGION: Mauritius, Rodriguez. PALAEARCTIC REGION: Cyprus, Egypt, Israel, Palestine, Turkey. NEOTROPICAL REGION: South America (Argentina, Chile, Uruguay).

Although of Australian origin, this species has now become widely distributed through commerce and is now established in South Africa, New Zealand, South America and the Middle East.

Host plants: *Eucalyptus* spp., especially *E. globulus* and *E. viminalis;* it has also been recorded from *E. longifolia*, *E. robusta*, *E. saligna*, *E. diversicolor*, *E. sideroxylon*, *E. leucoxylon*, *E. salubris*, *E. tereticornis*, *E. triantha* and *E. crebra* (Tooke, 1935a). In Israel it attacks *E. camaldulensis* (Bytinski-Salz and Neumark, 1953), and in South America *E. viminalis* (Bosq, 1940) and *E. globulus* (Molinari, 1923). In Australia it has been recorded from *E. oleosa* and *E. gracilis* (Tepper, 1887), and Moore (personal communication) has cited the following: *Syncarpia laurifolia*, *Angophora intermedia*, *Eucalyptus microcorys*, *E. saligna*, *E. longifolia*, *E. grandis*, *E. maculata*, *E. acmenioides*, *E. resinifera*, *E. piperita*, *E. pilularis* and *E. camaldulensis*. Brimblecombe has recently obtained larvae from *E. phaeotricha*.

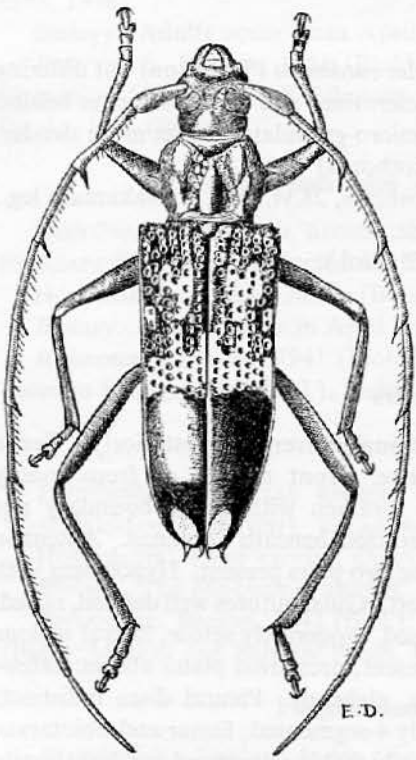

Fig. 73. *Phoracantha semipunctata* (Fabricius). Adult.

Adult (fig. 73). Entirely reddish brown, except elytra, which have a straw-coloured, transverse median band and an apical spot. *Head* with antennal segments 3–7 strongly spined apically on inner angle; extending to at least as far as elytral apices in female, and well beyond apices in male. Eyes coarsely faceted. *Prothorax* slightly elongate, with sides bearing a pair of median spine-like tubercles. Middle coxal cavities closed externally. *Elytra* very coarsely punctured for basal half; apical half smooth; apices with outer and sutural angles strongly spined. Length 16–30 mm.

Mature larva (fig. 74). Form robust and rather strongly depressed. *Head* slightly transverse (maximum head-width 6·5 mm.). Temples (fig. 74) with the broad ferruginous band behind antenna rather protuberant and bisected by a well defined vertical impression on each side of which are one or two shallower impressions. Mouthframe broadly pitchy. Labrum semicircular. One pair of ocelli pre-

sent laterad and ventrad of antenna; lens large, elongate-oval, pigmented spot indistinct. Hypostoma ferruginous, with front margin more darkly so, and very feebly transversely striate; gular sutures strongly raised. Maxilla with segment 3 of palp cylindrical, as long as segment 2. Labial palpi with segment 2 cylindrical, as long as segment 1. *Prothorax* with conspicuous scattered dark, glabrous spots on lateral

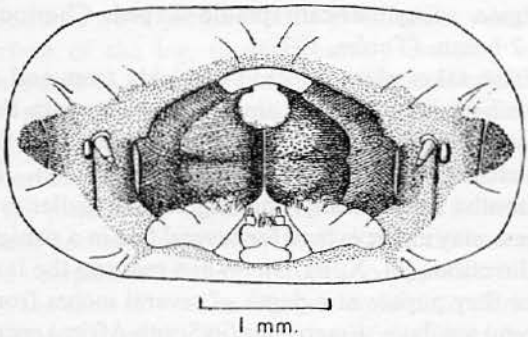

Fig. 74. *Phoracantha semipunctata* (Fabricius). Mature larva. Head. Frontal aspect.

regions; posterior part of pronotum very finely longitudinally striate. *Abdomen* with ampullae micro-reticulate, glabrous, non-tuberculate. *Legs* with unguiculus slender, flagelliform and imbricately tuberculate. *Spiracles* with peritreme oval, thin, pale, testaceous, without marginal chambers and not raised above general level of cuticle. Length up to 32 mm.; maximum breadth (at prothorax) 10·5 mm.

Pupa (fig. 75). *Head* with vertex dome-shaped, smooth, glabrous and partly visible from above; front feebly rugose, glabrous. Antennae with segments 3–6 (at least) strongly pectinate at apex of inner margin, extending to between abdominal segments 3 and 4, where they are strongly recurved to terminate between the middle and front coxae. Eyes feebly convex, glabrous. *Pronotum* (fig. 74) quadrate, with front margin feebly rounded; bearing scattered, short, curved testaceous spines, especially around front angles; lateral tubercles acute and strongly produced. Mesonotum transversely striate, glabrous; scutellum slightly protuberant and glabrous. *Metanotum* smooth and bearing a few minute spines on each side of scutellar groove, which is distinct. Elytra and wings extending as far as abdominal segment 4, the former with an apical spine-like tubercle. *Abdomen* with tergites 1-6 each with paired oval areas bearing about six to eight short, stout spines. Tergite 7 elongate, with a pair of oval tubercles each bearing four to six stouter spines which are inclined anteriorly. Tergite 8

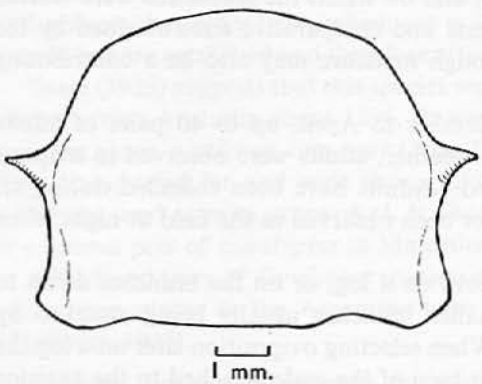

Fig. 75. *Phoracantha semipunctata* (Fabricius). Pupa. Pronotum.

elongate, with two groups of about four or more slender spines which are inclined posteriorly. Tergite 9 extremely short, bearing a few short, stout spines. Sternites glabrous. *Legs* with femora clavate; hind femora with a tuberculate process near base; extending to abdominal segment 5. *Functional spiracles* present on abdominal segments 1–5; peritreme broadly oval, moderately thick and slightly raised above general level of cuticle. Length up to 25 mm.; maximum breadth 6 mm.

Egg. Form elongate, subcylindrical, spindle-shaped. Chorion pale yellow, soft, gelatinous. Length 2·6 mm. (Tooke, 1935a).

Biology. Oviposition takes place on dead or sickly trees and cut logs, especially felled timber with the bark on. The eggs are deposited beneath the thin strips of dry bark which are loosely attached to the smooth green bark of the boles and main branches. The incubation period is from ten to fourteen days, The larvae feed for about four to six months subcortically, making regular galleries which are packed tightly with frass; these may either extend for several feet in a straight line or twist and turn radially in all directions (Pl. X, fig. 3). When mature, the larvae bore obliquely into the wood, where they pupate at a depth of several inches from the surface. The pupal period lasts about ten days. Emergence (in South Africa) occurs from September to April (Tooke, 1935a). According to Lepesme (1950) many first-instar larvae are killed by the copious flow of "gum".

The habits of this species in Palestine, as recorded by Bytinski-Salz and Neumark (1953), have been summarized as follows. The beetles are chiefly active during the night, hiding in daytime under the bark or in crevices. Longevity of the adult is about 40 days in summer and up to 180 days during the colder season. Oviposition occurs practically uninterruptedly from March to November and eggs are deposited in batches of 10 to 110 (average 43·5). The maximum number of eggs laid by a single captive female was about 300.

The following observations have been recently made by K. M. Moore. *Angophora intermedia*, with its thick, rough bark which remains attached for many months after the tree is felled, is particularly susceptible to attack by this species. Desiccation of the log is resisted by the thick bark, which also protects the eggs and young larvae during very hot weather. The amount of starch contained in the sapwood of billets sawn from different trees of *A. intermedia*, and on which the specimens were reared, was a considerable factor in the growth-rate and comparative sizes attained by the larvae, and consequently the adults; although moisture may also be a contributing factor in their development.

After dusk during the months of September to April, up to 40 pairs of adults occurred together on one log. In warmer weather, adults were observed to oviposit less than four hours after a tree was felled. Adults have been collected during all months of the year. Active adults have not been observed in the field at night when the temperature was below 60°F.

Oviposition may continue for some weeks on a log, or on the branches down to approximately 6 in. in diameter, the smaller branches usually being attacked by smaller species such as *Coptocercus* spp. When selecting oviposition sites on a log the paired adults move about with the anterior tarsi of the male attached to the anterior half of the female's elytra, and they pause at irregular intervals to copulate and for the

female to oviposit. Females were seldom found without the males during these observations. Oviposition occurs on all parts of a log, but the portion in contact with the ground, or the shady side, are preferred in the field. A total of 62 developed eggs were dissected from one female.

More than 50 larval galleries have been found to radiate from the one centre of oviposition, although adults sometimes lay eggs singly. Many larvae at an early stage penetrate the sapwood and work parallel to the grain of the wood, usually as deep as $\frac{1}{2}$ in. below the surface of the log, thus apparently escaping attack by parasites, although predators are able to attain some degree of control of larvae in the timber by displacing the firmly packed excreta and working along the galleries.

When about to pupate, the larvae feeding in the cambium area cut oval holes into the sapwood and heartwood for varying depths, often to 3 in. below the surface. In the bark, opposite the pupal cell, larvae also cut an oval hole for varying distances toward the outer bark surface, apparently to facilitate the emergence of the adult. The period from the completion of the pupal cell to pupation is variable, and apparently dependant on the time of year or weather conditions during that time. Many larvae overwinter during that stage. The duration of the life-cycle is variable and may be as short as 117 days during December to March. Under optimum conditions it is possible for three generations of this species to be reared in one year, although this is unlikely to occur in the field. Adults may be found in the field during all months of the year, and generations of this species overlap considerably. Eleven adults collected in the field were used in rearing experiments and fed on partly-candied honey. One lived for nine days, and one for 53 days, the average life being 36·75 days.

Predators. Coleoptera: *Pelonium amoenum* Guér. and *Temnochilia steinheili* Reitter (De Santis, 1945).

Economic importance. P. semipunctata (Fabricius) often causes considerable damage to sickly trees, irrespective of age, and felled timber; but dry wood, even with the bark intact, is not attacked (Duffy, 1953a).

It is interesting to note that, according to Bytinski-Salz and Neumark (l.c.), standing living trees are attacked and often completely girdled in Palestine. Trees up to twelve years old usually succumb to attack owing to the complete destruction of the cambium and phloem, but older trees, which are not entirely girdled, may survive the primary attack, but are weakened and therefore attacked with preference by later generations.

Brain (1929) suggests that this species was probably introduced in Africa in wooden sleepers from Australia about 1896. It was first found about 1900 in blue gum trees growing along a railway line near Cape Town. Lounsbury (1918) states that it has been transported far and wide throughout the Union by traffic of *Eucalyptus* logs which are used as mine props. A. J. E. Orion has informed the author that this insect is a serious pest of *Eucalyptus* in Mauritius.

Introduced trees of *Eucalyptus* species, especially *E. globulus*, growing in parks and other open places in the Argentine have been infested by this species in the past (Molinari, 1923).

Control. Tooke (l.c.) suggests the placing of trap trees (trees of little economic value) in clearings during the emergence period; these should subsequently be burned.

Stripping the bark off trees as soon as they are felled and allowing the timber to dry out as soon as possible discourages oviposition.

An effective method of protecting *Eucalyptus* poles against attack by this species has been described by Neumark (1953). It consists of the impregnation, immediately after felling, by injecting an aqueous solution of zinc chloride into the sapwood under a pressure of five atmospheres by capping one end of the cut pole. At this pressure the speed of flow averages 1 litre per 102 seconds in poles 6·5–20·3 feet long and containing 0·4–4·3 cubic feet of sapwood. *Phoracantha* larvae were found not to enter the bark or wood of poles containing 0·4 lb. zinc chloride per cubic foot sapwood, and it has been shown that poles containing 1 lb. per cubic foot should have an average life of at least twenty-two years.

Material studied. 12 L, Australia, New South Wales, Lisarow, 29.iii–4.viii.1957, from *Angophora intermedia*, K. M. Moore leg., in coll. F.C.N.S.W. 3 L, 1 P, 1 I, Orange River Colony, from *Eucalyptus*, in coll. B.M.

References. Acatay, 1959 (Biol. fig.), Anon, 1958 (Biol., Contr.); Brain, 1929 (Biol.); Bosq, 1934 (Biol.), 1940 (Biol.); Bruch, 1918 (L fig., Biol.); Bytinski-Salz, 1952 (Biol., Contr.); Bytinski-Salz and Neumark, 1953 (Biol., Contr.); Demelt, 1964 (Biol., fig.); De Santis, 1945 (L fig., P fig., Biol. fig., Contr); Duffy, 1953a (E, L, P, Biol., Contr.), 1957 (E, L fig., P, I fig., Biol., Contr), 1960 (E, L fig., P, I fig., Biol., Contr.) 1963 (E, L fig., P fig., I fig., Biol. fig., Contr.); Lepesme, 1950 (Biol.); Lounsbury, 1918 (L fig., I fig., Biol. fig.); Molinari, 1923 (Biol.); Moutia, 1955 (Biol.); Mühlmann, 1954 (Biol.); Neumark, 1953 (Biol., Contr.); Schiödte, 1876 (L); Tepper, 1887 (Biol.); Tooke, 1928 (Biol., Contr.), 1935a (L fig., Biol., Contr.), 1943 (Biol.), 1949 (Biol.); Vinson, 1962 (Biol.).

Phoracantha recurva Newman

[The Yellow Longicorn; the Yellow Phoracantha]

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia (widely distributed, including Central Australia, New South Wales, North West Australia, Queensland, South Australia, Victoria); New Zealand. ETHIOPIAN REGION: South Africa (introduced).

Host plants: *Eucalyptus* spp., including *E. nova-anglica* and *E. camaldulensis* (Froggatt, 1923); *Eucalyptus maculata* and *E. intermedia* (A. R. Brimblecombe).

Mature larva (fig. 76). Extremely similar to that of *P. semipunctata* (Fabricius) from which it may be distinguished by the broadly oval or subcircular ocellar lens

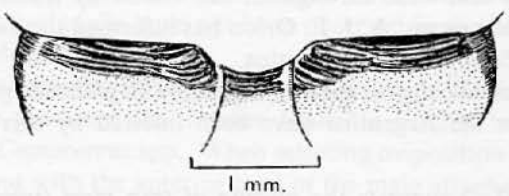

Fig. 76. *Phoracantha recurva* Newman. Mature larva. Front margin of hypostoma.

and the strongly sinuate front margin of the hypostoma (fig. 76). Length up to 44 mm., maximum breadth (at prothorax) 9·5 mm.

Egg. Froggatt (1923) gives the following description: "... pale yellow, elongate, spindle-shaped in form but flattened on the upper and lower surface when deposited (as is usually the case) in a shallow depression between the dry scaly and green bark. They are composed of a soft gelatinous matter without any definite structure or skin and a very large percentage appear to be infertile or shrivelled up by the heat without any larvae emerging. The average length of each egg is about one-tenth of an inch. Before the emergence of the larvae the eggs swell out and are almost cylindrical in form."

Biology. The larval habitat is in the trunk and main branches. The young larvae feed for about six months under the bark, where they make irregular galleries which are tightly packed with frass; a single gallery may be several feet in length. When nearly mature the larva tunnels into the sapwood and then, usually, into the heartwood, where it pupates several inches from the surface (Froggatt, 1923).

There is apparently one generation of this species each year, but considerable overlap of emergences of adults occurs. Adults have been taken in the field during July, October, November and March (K. M. Moore).

Parasites. Hymenoptera: *Iphiaulax rubriceps* Frogg., *I. phoracanthae* Frogg. and *I. morleyi* Frogg. (Froggatt, 1923).

Predators. Coleoptera: *Trogodendron fasciculatum* Schreiber.

Economic importance. Similar to preceeding species.

Material studied. 2 L, Australia, Stapleton, 26.i.1937, from *Eucalyptus maculata*, A. R. Brimblecombe leg., in coll. D.A.S.B.

References. Brimblecombe, 1956 (I fig., Biol.); Clark, 1938 (Biol.); Duffy, 1953a (E, Biol.), 1957 (E, Biol.), 1963 (E, L fig., Biol.); French, 1911 (Biol.); Froggatt, 1916 (I fig., Biol. fig., Paras. fig.), 1923 (E, I fig., Biol.); McKeown, 1944 (Biol.); Miller, 1925 (I fig., Biol. fig.); Pierce, 1917 (Biol.); Schiödte, 1876 (L fig.); Tepper, 1887 (Biol.); Tillyard, 1926 (Biol.); Tooke, 1949 (Biol.); Wakefield, 1874a (Biol.).

Coleocoptus senio (Newman)

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia (New South Wales, Northern Territory, Queensland, South Australia, Victoria, Western Australia); New Zealand, Fiji (introduced).

Host plant: *Syncarpia laurifolia* (Duffy, 1953a).

Mature larva (fig. 77). Form rather slender and depressed. *Head* slightly transverse. Temples with the broad ferruginous area behind antenna rather protuberant and with two or three vertical impressions which connect paired setal pores (fig. 77). Front margin of frons narrowly ferruginous. Antenna with segment 3 rather stout, cylindrical, about twice as long as basal width and less than half the length of segment 2; supplementary process very small and conical. Labrum slightly transverse. Ocelli indiscernible. Hypostoma with front margin ferruginous; sutures ferruginous, very short. Maxilla with segment 3 of palp slightly shorter than segment 2. *Prothorax* with lateral regions micro-pubescent and with rather inconspicuous, scattered, gla-

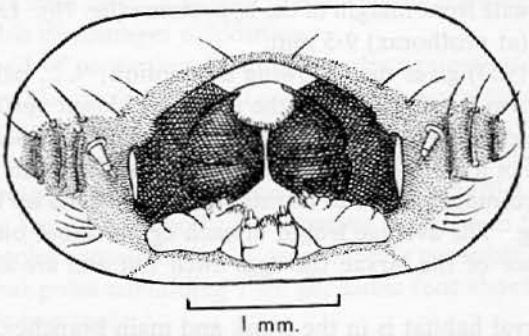

Fig. 77. *Coleocoptus senio* (Newman). Mature larva. Head. Frontal aspect.

brous spots. Posterior part of pronotum very finely longitudinally striate. *Abdomen* with ampullae microscopically alutaceous or reticulate and glabrous. *Legs* with unguiculus scarcely sclerotized, slender, flagelliform, imbricately tuberculate. Length up to 25 mm.; maximum breadth (at prothorax) 6·5 mm.

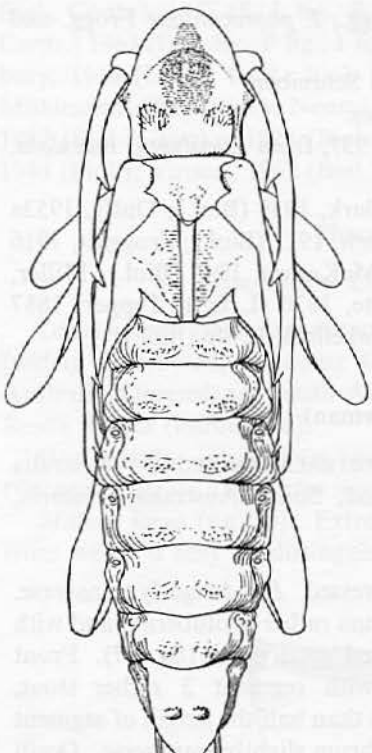

Fig. 78. *Coleocoptus senio* (Newman). Female pupa. Dorsal aspect.

Pupa (fig. 78). *Head* strongly elongate; vertex not visible from above, dome-shaped, smooth and glabrous; front feebly rugose and glabrous; clypeus with a transverse impression at base. Antennae with segments 1–4 (at least) pectinate at apex of inner margin only, extending as far as abdominal segment 3 or 4, where they are strongly recurved to terminate between the front and middle coxae. Eyes feebly convex, glabrous. Labrum trapezoidal, front margin not angled and sometimes with a few minute setae. Maxillary palpi slightly broadened and rounded apically. *Pronotum* very strongly elongate, with front margin strongly rounded and sides bearing a pair of acutely pointed tubercles; disc transversely striate and with two groups of minute setae near middle; basal half with a pair of paramedian, raised, oval areas bearing numerous slightly longer setae. *Mesonotum* almost smooth, with two groups of minute setae; scutellum moderately protuberant and glabrous. *Metanotum* transversely striate on each side of scutellar groove and bearing a few minute scattered setae; scutellar groove very distinct. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 1–6 each with paired, slightly raised, oval areas bearing about six short stout spines. Tergite 7 elongate, with a pair of tuberculate protuberances

each bearing about four to six stouter spines which are inclined forward. Tergite 8 elongate, with two groups of about four more slender spines inclined posteriorly. Tergite 9 extremely short and bearing a few short, stout spines. Sternites glabrous. Pleura rather strongly protuberant, rugose, glabrous. *Legs* with femora clavate; hind femora each with a tuberculate process near base; extending to between abdominal segments 5 and 6. *Functional spiracles* present on abdominal segments 1–5 but vestigial pairs present on segments 6–8; peritreme broadly oval, moderately thick and rather strongly raised above general level of cuticle. Length 16–20 mm.; maximum breadth 3·75 mm.

Material studied. 3 L, 3 P, 1 I, Fiji, Lautoka, 10.xii.1945, in *Syncarpia* from New South Wales, R. A. Lever leg., in coll. B.M.

References. Duffy, 1953a (L, P fig., Biol.), 1963 (L fig., P fig., Biol.); Lever, 1946 (Biol.); Mühlmann, 1954 (Biol.).

Coptocercus biguttatus (Donovan)

Distribution. ORIENTAL REGION: Indonesia (Celebes, Moluccas), New Guinea. AUSTRALASIAN REGION: Australia (New South Wales).

Host plants: *Angophora intermedia* (K. M. Moore); ?*Eugenia aromatica* (Kalshoven, 1936b).

Mature larva (fig. 79). Markedly different from other species of this genus. *Head* (fig. 79) with temples pale testaceous, smooth, without impressions. One pair of ocelli present well behind antennal foramen; pigmented spot visible through cuticle (there

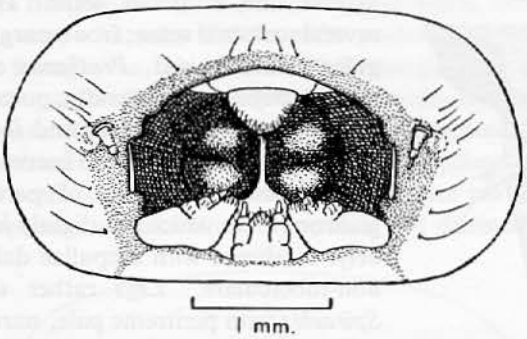

Fig. 79. *Coptocercus biguttatus* (Donovan). Mature larva. Head. Frontal aspect.

being no distinct lens) as a minute greyish blotch (fig. 79). Length up to 21·8 mm.; maximum breadth (at prothorax) 5·6 mm.

Pupa. No constant chaetotaxic differences are evident between the supposed pupa of this species and that of *Coleocoptus senio* Newman.

Biology. Larvae work either in the bark, between the bark and the sapwood or in the sapwood. At 98 days after infestation of some billets, larvae were found to be pinkish cream in colour, and some had attained a length of 17 mm. Attack was plentiful and oviposition occurred principally around branch-stubs or forks of branches. Pupae were taken during October from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. below the surface of the sapwood

or in the bark. There is apparently only one generation of this species each year, and the time taken from oviposition to pupation was 280 days. Adults have been collected from November to May (K. M. Moore).

Material studied. 25 L, Australia, New South Wales, Lisarow, 29.iii–4.viii.1957, from *Angophora intermedia* billets, K. M. Moore leg., in coll. F.C.N.S.W.; 12 P, same locality, 2.x.1957, from *Angophora intermedia*, K. M. Moore leg., in coll. F.C.N.S.W.

References. Duffy, 1963 (L fig., P, Biol.); Kalshoven, 1936b (Biol.); Mühlmann, 1954 (Biol.).

Nyphasia apicalis Gahan

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madras, Orissa, Uttar Pradesh).

Host plants: *Anogeissus acuminata*, *Shorea robusta*, *Terminalia tomentosa* (Beeson and Bhatia, 1939).

Mature larva (fig. 80). *Head* moderately depressed, with sides widest behind middle. Mouthframe rather broadly ferruginous. Gena with the short dark ferruginous area between the antennal ring and the ocellus, which is delimited by the pale frontal suture, bearing a small but fairly distinct oval tubercle (fig. 80). Labrum semicircular. One pair of ocelli present; lens large, oval and pale ferruginous, the pigmented spot being discernible as a greyish linear blotch (fig. 80). Temples with several fine scattered setae. Hypostoma bearing several scattered setae; front margin pale ferruginous; gular sutures raised. *Prothorax* covered with short reddish pubescence laterally; posterior part of pronotum dull, micro-granulate and feebly strigose owing to punctures which tend to become linear posteriorly. Prosternum with a pair of paramedian, rounded, glabrous areas which are slightly less shining posteriorly. *Abdomen* with ampullae dull, micro-granulate, non-tuberculate. *Legs* rather short but distinct. *Spiracles* with peritreme pale, narrowly oval. Length up to 19·75 mm.; maximum breadth (at prothorax) 5 mm.

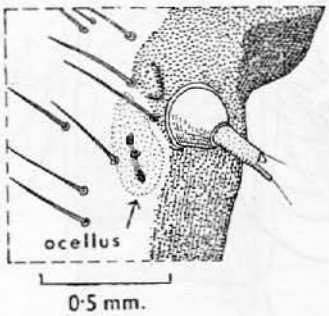

Fig. 80. *Nyphasia apicalis* Gahan. Mature larva. Part of head showing ocellus and tubercle on gena. Lateral aspect.

Biology. Eggs are laid usually on freshly felled timber. Logs felled over seven months before the adult emergence period are not attacked. As the beetle is sunloving, logs piled in the shade are much less susceptible to attack. The life-cycle is usually annual but may be prolonged to the second year under adverse conditions. Emergence occurs in May and June.

Material studied. 2 L, India, Madras, Sappal Palghat, 16.v.1930, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1935a (Biol.), 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol.

fig.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1927 (L fig.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Nyphasia pascoei Lacordaire

Distribution. ORIENTAL REGION: Burma, India (Assam), Thailand.

Host plants: *Terminalia pyrifolia* (Beeson and Bhatia, 1939); *Anogeissus acuminata, Terminalia tomentosa* (Beeson, 1941).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Callidiopini

Ceresium leucostictum White

Distribution. ORIENTAL REGION: Burma, Hainan Is., India (Assam, Bihar, Madras, Maharashtra, Uttar Pradesh), Indo-China (Laos), Sumatra, Thailand.

Host plants: *Acacia pennata, Albizia lucida, Anogeissus latifolia, Cassia fistula, C. siamea, Castanopsis argyrophylla, Grewia tiliaefolia, Lagerstroemia parviflora, Lannea coromandelica, Mallotus philippinensis, Scutia indica, Tectona grandis, Xylia xylocarpa* (Beeson and Bhatia, 1939); *Acacia catechu, Albizia odoratissima, Careya arborea, Dalbergia fusca, Dolichandrone stipulata* (Beeson, 1941); *Acacia intsia* (Bhasin and Roonwal, 1954); *Kiriya* (G. Dutt).

Mature larva (fig. 81). Very unlike that of *C. unicolor* (F.) and for this reason it has been eliminated from the generic key. Form strongly elongate, slender, subcylindrical. *Head* (fig. 81) transverse, with sides slightly wider posteriorly. Mouthframe strongly and rather broadly ferruginous. Frons with front margin very strongly emarginate medially; a pair of paramedian setae present immediately behind mouthframe. Temples sparsely setose. The three pairs of ocelli with pigmented spots almost as large as lenses, the latter almost contiguous. Temples broadly sclerotized and ferruginous immediately behind ocelli (fig. 81). *Prothorax* with posterior part of pronotum striate, with a distinctly impressed median line. Eusternum not distinctly defined, with two

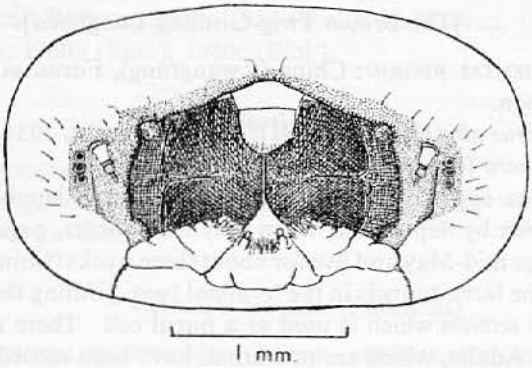

Fig. 81. *Ceresium leucostictum* White. Head. Frontal aspect.

subcircular, glabrous, shining areas. *Abdomen* with ampullae non-tuberculate, shining and wrinkled. *Legs* well developed but small. *Spiracles* with peritreme broadly oval to sub-circular and rather thick. Length up to 20 mm.; maximum breadth (at prothorax) 4·5 mm.

Biology. Eggs are deposited singly or in groups of two or three on bark. The larval galleries vary according to the host plant. In *Grewia*, for example, they are formed in the bark and bast, whereas in *Anogeissus* they penetrate the sapwood at once. They are shallow and irregularly broadened. The pupal cell is about 1 in. long and lies longitudinally about ½ in. below the surface of the sapwood; at the entrance there is a plug of coarse wood fibres. Adults emerge from June to August, mainly in June, and oviposit on logs at the beginning of the rainy season following felling. The life-cycle is usually annual but in dry logs it may be prolonged up to three years, (Beeson and Bhatia, 1939).

Garthwaite (1938) states that this species usually attacks only felled or moribund trees.

Material studied. 2 L, Ceylon, Anuradhapura, Palugama, from *Kiriya*, 8.iv.1935, G. Dutt leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1927 (E fig., L fig.); Garthwaite, 1938 (Biol.); Mathur, 1960 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961b (Biol.).

Ceresium rufum Lameere

Distribution. ORIENTAL REGION: Burma, India.

Host plants: *Acrocarpus fraxinifolius*, *Castanopsis argyrophylla*, *Cassia fistula*, *Lagerstroemia speciosa*, *Pinus khasya*, *Pyrus communis*, *Quercus serrata* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960c (Biol.), 1960d (Biol.). (See also p. 145.)

Ceresium sinicum White

[The Brown Twig-Girdling Longhorn]

Distribution. ORIENTAL REGION: China (Kwangtung), Formosa, Thailand. PALAEARCTIC REGION: Japan.

Host plants: *Morus alba* (Kojima, 1931); *Citrus* (Gressitt, 1951); *Melia azedarach*, *Cinnamomum camphora* (Gressitt, 1942).

Biology. In China eggs are deposited in late May and hatch in about 11 days. Larvae are full grown by September, when they over-winter, pupating the following April. Adults emerge mid-May and live for about three weeks (Chin, 1935). According to Gressitt (1942), the larva tunnels in the terminal twig, girdling the inside of the stem below the hollowed section which is used as a pupal cell. There may be one or two generations a year. Adults, which are nocturnal, have been recorded for April, May, June and November.

In China, twigs of mulberry infested with larvae of this species are sold as food for cage birds (Kojima, 1931).

References. Chin, 1935 (E fig., L fig., P fig., I fig., Biol. fig.); Duffy, 1953a (Biol.); Gressitt, 1951 (Biol.); Kojima, 1931 (L fig., P, Biol.); Mühlmann, 1954 (Biol.).

Ceresium nilgiriense Gahan

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Uttar Pradesh).

Host plants: *Albizia lebbek*, *Shorea robusta* (Beeson and Bhatia, 1939).

Biology. Adults emerge during April and May but mainly in the latter. The life-cycle is usually annual but in dry wood it may be prolonged up to five years (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Ceresium rotundicolle Pascoe

Distribution. ORIENTAL REGION: Ceylon, India.

Host plants: *Berrya cordifolia*, *Cassia fistula*, *Dichopsis grandis* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual and emergence occurs between April and June, mainly in May (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Ceresium zeylanicum White

Distribution. ORIENTAL REGION: Borneo, Burma, Ceylon, India (Assam, Maharashtra, West Bengal), Java, Sumatra.

Host plants: *Careya arborea*, *Heritiera minor*, *Shorea robusta* (Beeson and Bhatia, 1939); *Lagerstroemia parviflora* (Beeson, 1941); *Bauhinia malabarica*, *Artidesma tetrandrum* (Kalshoven, 1955).

Biology. The life-cycle is annual, with an emergence period in May.

References. Beeson, 1919b (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Kalshoven, 1955 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960c (Biol.).

Ceresium furtivum Pascoe

Distribution. ORIENTAL REGION: Sarawak, Thailand.

Host plant: *Mangifera indica* (D. of A., Bangkok)

References. None available.

Ceresium unicolor (Fabricius)

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Solomon Is., New Hebrides, Fiji, Tonga, Samoa, Marquesas, Henderson Is., Bonin Is., N. Mariana

Is., S. Mariana Is., Palau, Truk, Ponape, Kusaie, Gilbert Is., Seychelles, Tahiti. ETHIOPIAN REGION: Kenya (imported). MADAGASCAN REGION: Madagascar, Mauritius (introduced) Réunion. HAWAIIAN REGION: Hawaii (introduced?).

Host plants: ?*Hibiscus tiliaceus* (Fairmaire, 1850); *Artocarpus*, *Sapindus*, *Cordia*, *Casuarina* (Gressitt, 1956); *Pipturus*, *Acacia* (Duffy, 1953b). *Heritiera littoralis* (Duffy, 1957).

Mature larva (fig. 82). Very unlike that of *C. leucostictum* White and for this reason the two species have been eliminated in the generic key. *Head* with frons almost glabrous. One pair of ocelli present. *Prothorax* with proeusternum (fig. 82) longitudinally striate as on posterior part of pronotum. *Abdomen* with dorsal and ventral ampullae very strongly protuberant on segments 1–6; segments 4–7 strongly elongate. Length up to 25 mm.; maximum breadth (at prothorax) 4·1 mm.

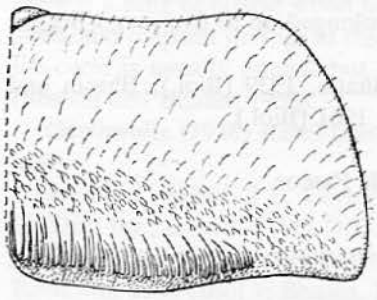

Fig. 82. *Ceresium unicolor* (Fabricius). Mature larva. Left half of prosternum.

Material studied. 1 L, Africa, Kenya, 1954, under bark of *Heritiera littoralis* (imported), J. C. M. Gardner leg., in coll. B.M.

References. Duffy, 1953b (L fig., Biol.), 1957 (L, Biol.), 1963 (L fig., Biol.); Fairmaire, 1850 (Biol.); Gressitt, 1956 (Biol.); Vinson, 1962 (Biol.).

Ceresium flavipes (Fabricius) (=**simplex** Gyllenhal)

Distribution. ORIENTAL REGION: Andaman Is., Burma, Ceylon, China, Formosa, India (Madras), Java, Malaya, New Guinea, Nicobar Is., Philippine Is., Sumatra, Thailand. PALAEARCTIC REGION: Japan. AUSTRALASIAN REGION: Australia, New Zealand, Norfolk Is., Lord Howe Is., Solomon Is., Cocos or Keeling Is. MADAGASCAN REGION: Madagascar, Mauritius, Rodriguez. NEOTROPICAL REGION: Mexico, Manila, Tahiti.

Host plants: India: *Casuarina equisetifolia* (Beeson and Bhatia, 1939); Formosa: *Citrus* (Shiraki *et al.*, 1933); Tahiti: *Artocarpus* (Fairmaire, 1850) Indonesia: *Cassia fistula*, *Streblus asper* (Kalshoven 1955); Indo-China: *Hevea* (Commun, 1930).

Biology. Larvae excavate long galleries which groove both bast and sapwood, and, when numerous, completely ring the tree causing its death. Adults emerge in June, the life-cycle probably being eight to nine months (Stebbing, 1914).

Economic importance. Serious damage has been caused to plantations of *Casuarina* trees in parts of India (Stebbing, 1914).

Control. Badly infested trees should be cut out and burnt. Trap trees should be felled about three weeks before emergence period (Stebbing, 1914).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Commun, 1930 (Biol.); Duffy, 1963 (Biol.); Fairmaire, 1850 (Biol.); Gressitt, 1951 (Biol.); Kalshoven, 1955 (Biol.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (?); Shiraki *et al.*, 1933 (Biol.); Stebbing, 1914 (Biol. fig., Contr.).

Ceresium raripilum Newman

Distribution. ORIENTAL REGION: Java, Philippine Is., Singapore.

Host plants: *Homalium tomentosum*, *Erioglossum rubiginosum*, *?Salacia*, *?Ventilago*, *Phyllanthus emblica*, *Barringtonia* sp., *Cinnamomum burmanni* (Kalshoven, 1955).

Reference. Kalshoven, 1955 (Biol.).

Ceresium rufum Lameere

Distribution. ORIENTAL REGION: East Indies, Java.

Host plants: *Canarium* (Kalshoven, 1955); *Cassia fistula* (Bhasin, Roonwal and Balwant Singh, 1958); *Lagerstroemia speciosa* (Mathur and Balwant Singh, 1961); *Acrocarpus fraxinifolius* (Bhasin and Roonwal, 1954).

References. Bhasin and Roonwal, 1954 (Biol.); Kalshoven, 1955 (Biol.); Mathur and Balwant Singh, 1961 (Biol.). (See also p. 142.)

Megaceresium horni Heller

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Solomon Is.

Host plant: *Theobroma* (F. R. McKillop).

Mature larva. Rather similar to that of *Ceresium australe* Carter but differing as follows. Form more strongly elongate. *Head* with setae much coarser and bristly. Antenna with segment 2 elongate. Ventral pair of ocelli absent. Meso- and metasternum coarsely tuberculate. *Abdomen* with ampullae strongly tuberculate, bilobed, dull and micro-spiculate. Segments 5 and 6 much longer than segments 3 and 4; segments 8 and 9 subequal in length. *Spiracles* with posterior half of peritreme lined with numerous marginal chambers. Length up to 53·9 mm.; maximum breadth (at prothorax) 7·1 mm.

Pupa. Similar to that of *Ceresium illidgei* Blackburn but pronotum with lateral tubercles conical and strongly protuberant; disc strongly transversely striate. Length up to 40 mm.; maximum breadth 13 mm.

Material studied. 2 L, 1 P, New Guinea, Bougainville Is., Arawa Plantation, ix.1956, from *Theobroma* branches, F. R. McKillop leg., in coll. B.M.

Reference. Duffy, 1963 (L, Biol.).

Examnes frontalis Pascoe

Distribution. ORIENTAL REGION: Sarawak, Thailand.

Host plant: *Dipterocarpus tuberculatus* (D. of A., Bangkok).

References. None available.

Trinophylum cribratum Bates (=**Callidium impressipenne** Pic)

Distribution. ORIENTAL REGION: India (Assam, Punjab, Uttar Pradesh), Jammu and Kashmir. PALAEARCTIC REGION: England (introduced and established locally).

Host plants: India: *Quercus dilatata*, *Q. incana* (Beeson and Bhatia, 1939); *Cedrus*

deodara (Pierce, 1918). England: *Quercus robur*, *Fagus*, *Carpinus*, *Juglans*, *Larix*, *Pinus*, *Betula*, *Platanus*, *Fraxinus* (Duffy, 1953c).

In view of the unusually wide range of British hosts, it is suspected that in India there may be other hosts in addition to those listed by Beeson and Bhatia (1939).

Adult (Pl. XIV, fig. 3). Length 10·5–17 mm., breadth 2·9–5·3 mm. Castaneous, more or less nitid, sparsely furnished dorsally with short, suberect, fulvous, brown setae. *Head* strongly rugulose-punctate; vertex with a deep, longitudinal, shining impression. Antennae slender, about as long as body in male, slightly shorter in female. *Pronotum* quadrate, globose, coarsely punctured and regularly rounded laterally; rather sparsely covered with short, decumbent, fulvous setae, except disc which is slightly depressed medially. *Elytra* rather closely and very strongly punctured (excepting near apices), each puncture bearing a short, fulvous, decumbent seta. Each elytron with a pair of feebly defined longitudinal carinae; suture elevated. *Abdomen* with sternites reddish brown, the punctures less dense and setae longer, finer and silky. *Legs* rather sparsely punctate, the femora very strongly and abruptly clavate near apices.

Adults of *T. cribratum* and *Phymatodes testaceus* (Linnaeus) are both known to attack oak, and as their identity may have been confused in the past they may readily be distinguished as follows.

Trinophylum cribratum Bates.

Eyes coarsely faceted. Anterior coxal cavities rounded externally. Pronotum coarsely punctate, bearing short decumbent setae. Elytra castaneous, coarsely punctate.

Phymatodes testaceus (Linnaeus).

Eyes finely faceted. Anterior coxal cavities angulate externally. Pronotum finely and sparsely punctate, strongly shining and bearing very long, fine, suberect setae. Elytra testaceous or violaceous, very finely punctate.

T. cribratum Bates might conceivably be mistaken at first sight for a species of *Asemum* or *Arhopalus* (=*Criocephalus*), particularly as they are all attracted to light. It can, however, at once be distinguished from these by the much longer antennae, the strongly and abruptly clubbed femora, and the shining elytra.

Mature larva (figs. 83–86). Form rather robust, slightly depressed. *Head* subtrapezoidal, widest behind middle (maximum head-width 4·05 mm.). Gena somewhat shouldered, pale, smooth and with numerous short reddish setae. Front margin of frons slightly concave, smooth, ferruginous. Mouthframe completely and strongly sclerotized beneath antennae. Antenna (fig. 83) testaceous, with segment 2 about one and one-half times as long as segment 3; segment 3 cylindrical, nearly four times as long as broad; supplementary process conical, nearly one-third as long as segment 3. Mandible broad, smooth, with basal part ferruginous; spical part pitchy, shining, with a deep longitudinal median impression. Labrum fleshy, transversely oval and fringed with numerous pale setae. One pair of ocelli present laterad and ventrad of antennae; lens oval, strongly protuberant, pigmented spot distinct. Hypostoma smooth, pale testaceous, except front margin, which is transversely strigose and ferruginous; sutures feebly incurved. Gula rather broad, slightly raised, with concave sutures. Maxilla (fig. 84) with lobe glabrous on inner margin; setae as figured;

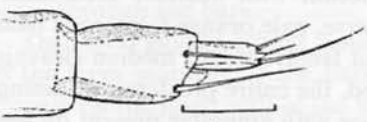

Fig. 83. *Trinophylum cribratum* Bates. Mature larva. Antenna. Lateral aspect. (Duffy, 1953c)

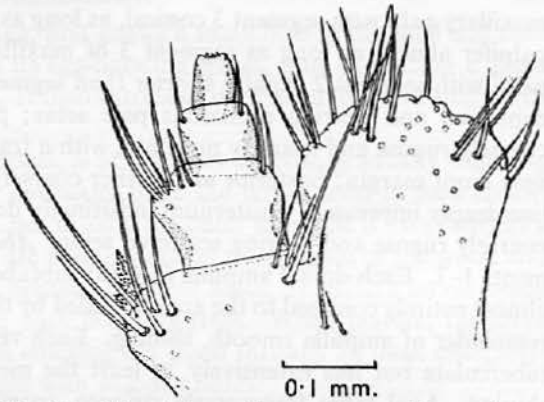

Fig. 84. *Trinophylum cribratum* Bates. Mature larva. Apical part of maxilla. (Duffy, 1953c)

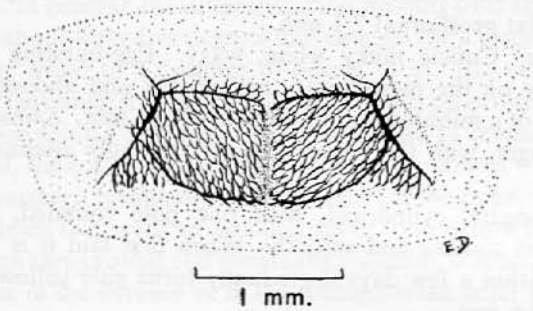

Fig. 85. *Trinophylum cribratum* Bates. Mature larva. Dorsal ampulla of segment 4. (Duffy, 1953c)

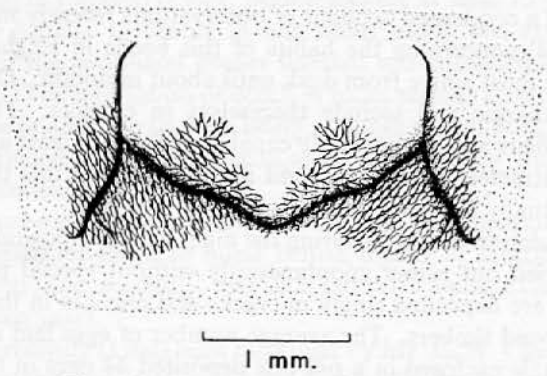

Fig. 86. *Trinophylum cribratum* Bates. Mature larva. Ventral ampulla of segment 4. (Duffy, 1953c)

maxillary palp with segment 3 conical, as long as segment 2; dorso-external process of palpifer almost as long as segment 3 of maxillary palp and densely setose. Labial palpi with segment 2 slightly shorter than segment 1. *Prothorax* rectangular, slightly depressed and bearing numerous pale setae; pronotum with anterior area rather coarsely rugose and sparsely punctate, with a transverse, pale orange testaceous band near front margin; posterior area rather coarsely but feebly striate; median cleavage line deeply impressed. Eusternum indistinctly defined, the entire prosternum shining, coarsely rugose and bearing scattered setae. *Abdomen* with ampullae present on segments 1–7. Each dorsal ampulla (fig. 85) subtuberculate, the feebly defined tubercles almost entirely confined to the area bounded by the lateral and transverse impressions; remainder of ampulla smooth, shining. Each ventral ampulla (fig. 86) similarly subtuberculate but less extensively, at least the median and anterior area smooth and shining. Anal lobes transversely strigose, sparsely setose. Pleural discs distinct at least on segments 1–4, each in the form of an oval smooth depression. *Legs* entirely testaceous; femur transverse; unguiculus strongly attenuated and imbricately spinose. *Spiracles* with peritreme broadly oval, very thin and pale. Length up to 2·6 mm.; maximum breadth (at prothorax) 7·1 mm.

First-instar larva. Cuticle milky white, waxy. Egg-bursting spines situated in pairs dorso-laterally on the mesothorax, metathorax and abdominal segments 1–6. Each spine consists of a minute blunt tooth alongside a seta. *Spiracles* biforous. *Legs* proportionately longer, with the unguiculus very strongly attenuated. Length up to 2·2 mm.

Egg. Form elongate, cylindrical, with one pole rounded, the other slightly attenuated. Chorion shining and smooth. When first laid it is white with a faint greenish tint but within a few days it gradually turns pale yellowish white. Length 1·6 mm.; breadth 0·6 mm.

Biology. Before its discovery in England in 1946 scarcely anything was known of the biology of this longicorn. The original account by Stebbing (1914), who also described the supposed larva and pupa, is erroneous and actually applies to *Tetropium oreinum* Gahan. Beeson and Bhatia (1939) merely state that this species is a sapwood borer of logs of oaks with an annual life-cycle, emerging in May and June.

The following is a condensed account of observations recently made by the author (1953a, 1953c, 1954) concerning the habits of this beetle in England. Adults of *T. cribratum* Bates are most active from dusk until about midnight. During the daytime they are rather lethargic and seclude themselves in crevices. They appear to be moderately strong fliers and are probably capable of flying at least a quarter of a mile. They are readily attracted to artificial light and it is due to this that their breeding grounds were eventually discovered.

In captivity copulation occurred during the night when oviposition also took place. Oviposition is carried out rather spontaneously without special preparation of the substrate and eggs are deposited singly in cracks and crevices in the bark of recently felled or even seasoned timbers. The average number of eggs laid is not known. On one occasion a female enclosed in a pill box deposited 44 eggs in two batches at the bottom of the box but it is probable that some eggs had been laid previously. The incubation period was six days.

The larva, on emerging from the egg, first gnaws a small hole in the shell and then proceeds to rupture the chorion with its egg-bursting spines, thus producing a short longitudinal tear in one or both sides. It then extricates itself head first and afterwards bores through the bark.

The larval gallery, which is subcortical, is at first very narrow, gradually widening as the larva matures. If the bark is unusually thick the larvae tend to feed almost entirely on the inner wall of the bark but usually the outer sapwood is excavated to a depth of about $\frac{1}{8}$ in. Larval galleries are mainly parallel to the grain of the wood and are moderately straight, the average breadth of those made by mature larvae being about $\frac{3}{4}$ in. They are tightly packed with powdery frass. When mature, the larva starts to prepare its pupal cell by first entering the wood through an oval, obliquely-set orifice which is later tightly plugged with wooden fibres.

According to Beeson (1941) the pupal cell is a relatively long, narrow tunnel (two inches) taken vertically down $\frac{1}{2}$ in. to $\frac{3}{4}$ in. within the sapwood. The examination of numerous cells in British timber, however, has shown that the shape and length are somewhat variable. In general, the tunnel, which is broadly oval and gradually curved, enters the wood at about forty-five degrees and extends for a distance of at least 2 in., thus penetrating the wood to a distance of nearly $1\frac{1}{2}$ in. But very often the gallery enters the wood at right-angles, in which case the wood is penetrated to a distance of at least 2 in. On one occasion a gallery in beech was found to extend for $1\frac{1}{2}$ in. and was then broadly angled, the total length of the gallery being almost 4 in. These galleries, which are slightly enlarged terminally to accommodate the pupa, are usually plugged with one or sometimes two wads of wooden fibres, one before and one behind the larva. The larva then turns round and eventually pupates. It is not yet known whether pupation takes place in the autumn or in the spring but the latter is more probable.

After eclosion the adults gnaw their way through the bark, making small but conspicuous flight-holes which are broadly oval and measure 5–8 mm. by 2·8–3·8 mm. (Pl. VI, fig. 3). The emergence period in England extends from mid-July to early September. The life-cycle appears to be annual.

Economic importance. It is now clear that *T. cribratum* Bates has been established in several timber yards in England (Essex, Middlesex) for at least 15 years and probably much longer. The damage to timber in one wharf alone was extremely heavy and the total volume of the peripheral timber infested was estimated to amount to thousands of cubic feet. The infestation of beech is more serious economically than in the case of oak because in addition to there being a higher population, the larval galleries penetrate the heartwood up to a distance of at least two inches (the sapwood in beech being practically non-existent).

Two most disturbing facts have arisen from this investigation: firstly that it is possible for an Indian longhorn to infest British timber of several kinds, both coniferous and deciduous; and, secondly, that such extensive damage can be effected within a period of only two years.

The author has recently (1962) been informed by Mr. E. W. Classey that this insect has now become established in standing dead or partly dead oak trees in Middlesex. The following year adults were taken at light in South London.

Control. As a control measure, which, it is maintained, should be rigidly and

promptly applied if the spread of this beetle in timber yards is to be checked, the decortication of all felled timber is recommended. Owing to the difficulty in carrying out this operation in freshly felled timber, this procedure may safely be postponed for a period of up to five months, during which time the logs, even if infested immediately on arrival, would be safe from attack, since the grubs remain under the bark and do not penetrate the wood until they are about six months old.

If, on the other hand, it is decided to resort to insecticidal sprays, the time of spraying should preferably precede the average emergence period by as short a time as possible, say late April in India and late June in England. As, however, all larvae of a particular brood seldom mature the same year, it would be advisable to spray for at least two and preferably three years in succession if this pest is to be eradicated (Duffy, 1953c, 1954).

References. Beeson, 1915 (Biol. (see *Tetropium orenium* (Gahan))), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1953a (L, Biol.), 1953c (fig., I fig., Biol. fig., Contr.), 1954 (Biol. fig., Contr.); Fisher, 1954 (Biol.); Fraser, 1948 (Biol.); Gilmour, 1948 (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.); Pierce, 1918 (Biol.); Stebbing, 1914 (I fig., Biol. fig. (see *Tetropium oreinum* (Gahan)).

Gelonaetha hirta (Fairmaire)

Distribution. ORIENTAL REGION: Burma, Ceylon, East Indies, India (Kerala, West Bengal), Philippine Is., Thailand. AUSTRALASIAN REGION: Mariana Is., Society Is., Tahiti. HAWAIIAN REGION: Hawaiian Is. NEOTROPICAL REGION: Sandwich Is.

Host plants: *Anogeissus latifolia, Berrya cordifolia, Dipterocarpus* sp., *Grewia* sp., *Heritiera minor, Tectona grandis* (Beeson and Bhatia, 1939); *Grewia tiliaefolia* (Mathur and Balwant Singh, 1960b).

Mature larva. Rather similar to that of *Trinophylum cribratum* Bates but differing as follows. *Head* with segment 1 of maxillary palp distinctly elongate, as long as segments 2 and 3 combined. Labrum about as wide as long. *Prothorax* with eusternum shagreened posteriorly. *Abdomen* with ampullae finely shagreened. Length up to 25 mm.; maximum breadth (at prothorax) 5 mm.

Biology. This cerambycid is a sapwood borer, making shallow, meandering and interlacing galleries in girdled teak. These galleries are closely packed with fine wood and bark dust. The life-cycle is biannual, the first emergence period being in spring and early hot weather and the second post-monsoon and early cold weather (Mathur, 1960). According to Atkinson (1931) only felled or girdled or otherwise dead timber is attacked.

Material studied. 2 L, Ceylon, Kurenegala, Badagamuwa, 500 ft., from *Berrya cordifolia*, G. Dutt leg., in coll. F.R.I.D.D.

References. Atkinson, 1931 (I fig., Biol. fig.); Beeson, 1916 (Biol.), 1919b (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1963 (L, Biol.); Gardner, 1927 (L fig., Biol.); Mathur, 1960 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Stebbing, 1914 (I fig., Biol.).

Stenygrinum quadrinotatum Bates

[Four-spotted Longicorn Beetle]

Distribution. ORIENTAL REGION: Burma, China (Chekiang, Hopeh, Kiangsu, Liaoning), Formosa, India (Assam). PALAEARCTIC REGION: Japan, Korea.

Host plants: *Quercus acutissima, Q. glandulifera, Castanea pubinervis* (Saito, 1932); *Castanea crenata, Quercus serrata* (Nakamura, 1959); *Morus* (Shiraki, 1952).

Biology. Kojima, Watanabe and Nakamura (1959) have estimated (on the basis of the Gaines and Campbell formula) that there are five instars in the larval stage and later (1960) these authors estimated the duration of the life-cycle as being one to two years.

References. Cheo, 1935 (Biol.); Gressitt, 1951 (Biol.); Kojima, Watanabe and Nakamura, 1959 (Biol.), 1960 (Biol.); Mühlmann, 1954 (Biol.); Nakamura, 1959a (L fig., Biol. fig.), 1959b (Biol.); Plavilstshikov, 1940 (Biol.); Saito, 1932 (?); Shiraki, 1952 (Biol.).

Cleomenini

Artimpaza obscura Gardner

Distribution. ORIENTAL REGION: India (Assam, West Bengal).

Host plants: *Bombax malabaricum, Duabanga sonneratioides* (Beeson and Bhatia, 1939).

Mature larva (fig. 87). Form very elongate, slender, cylindrical. *Head* transverse, with sides rather strongly rounded, widest near middle. Mouthframe narrowly brownish. Two pairs of contiguous ocelli present; lens small, slightly protuberant, pigmented spot indiscernible. Antenna with segment 2 slightly elongate; segment 3

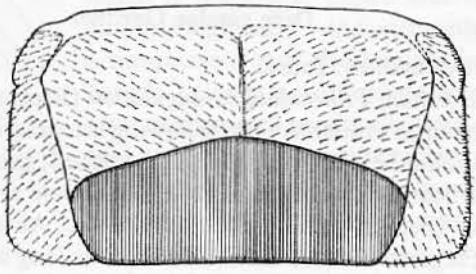

Fig. 87. *Artimpaza obscura* Gardner. Mature larva. Prothorax. Dorsal aspect.

about half the length of segment 2. Maxillary palp with segment 3 about twice as long as segment 2. *Prothorax* (fig. 87) with lateral furrows strongly diverging anteriorly; posterior area of pronotum strongly embossed and extremely finely and regularly striate (fig. 87). Eusternum glabrous, striate. *Abdomen* with segments 3–7 with rather long intersegmental skin. Ampullae non-tuberculate, glabrous, finely wrinkled.

Legs small but distinctly 3-segmented. *Spiracles* with peritreme broadly oval to subcircular, pale. Length up to 19 mm.; maximum breadth (at prothorax) 2·5 mm.

If larvae of *Artimpaza* can be regarded as fairly representative of the Cleomenini, then there would seem to be justifiable grounds for placing this tribe nearer to the Molorchini than to the Clytini where it has been placed according to the adult classification. The characters which more closely approximate to the Mollorchini than to the Clytini are as follows: *Head* transverse, with sides rounded and widest at about middle. Genal setae numerous. Legs small but distinct. Two pairs of ocelli present. Abdominal segments 3–7 with rather long intersegmental skin.

Biology. The life-cycle is annual and adults emerge in April and May.

Material studied. 3 L, India, Darjeeling, Tista Valley, ix.1929, from *Duabanga sonneratioides*, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Artimpaza bicolor Pascoe

Distribution. ORIENTAL REGION: Andaman Is., Burma.

Host plant: *Cassia fistula* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal, and Balwant Singh, 1958 (Biol.).

Artimpaza dehra Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Phoebe lanceolata* (Beeson, 1941).

References. Beeson, 1941 (Biol.), Mathur and Balwant Singh, 1960d (Biol.).

Dere cassiae Gardner

Distribution. ORIENTAL REGION: India.

Host plants: *Cassia fistula*, *Pithecolobium angulatum* (Beeson, 1941).

Mature larva. No material available. The following is a description of an unknown African species which should be similar. *Head* not depressed; genae narrowly rounded up to mouthframe and bearing several rather long, fine, pale setae; maximum head-width 2·1 mm; temples (behind ocellus) pale testaceous. Antenna with segment 2 twice as long as broad; segment 3 more than three times as long as broad and just over half the length of segment 2; supplementary process conical, short, about one-fourth the length of segment 3. Mandible with basal part ferruginous, apical part pitchy; longitudinal impression absent. Labrum transversely oval, fringed with pale setae. One pair of ocelli present; lens round, convex, pigmented spot rather indistinct. Hypostoma slightly rounded, smooth, glabrous, testaceous, with front margin ferruginous; sutures strongly incurved, ferruginous; gular sutures concave, distinct. Maxilla with segment 3 of palp cylindrical, almost as long as segment 2; dorso-external process of palpifer much shorter than segment 3 of palp. Labial palpi with segment

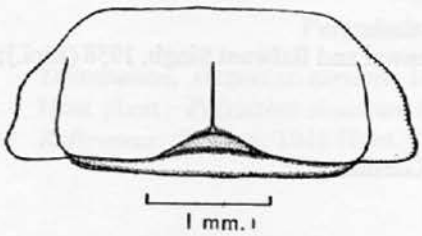

Fig. 88. *Dere* sp. Mature larva. Pronotum, showing pre-postnotal and post-notal fold. (Duffy, 1957)

rather stout and almost as long as segment 1. *Prothorax* (fig. 88) with anterior area of pronotum darkly testaceous, feebly rugose, with a transverse row of fine, pale setae across front margin; posterior area dull, micro-granulate; posterior margin strongly retracted medially, revealing a triangular skinfold ("prepostnotal fold"); median cleavage line exceptionally strongly impressed. Prosternum shining, coarsely rugose, except eusternum which is dull and micro-granulate. *Abdomen* with ampullae bearing two transverse furrows, the posterior one less distinct; median longitudinal furrow narrow, distinct; entire surface glabrous, dull and densely micro-granulate. Pleural discs indistinct. *Legs* 2-segmented, pale, distinct but much shorter than maxillary palpi. *Spiracles* with peritreme rather broadly oval, thin, pale and without marginal chambers. Length up to 14 mm.; maximum breadth (at prothorax) 3·6 mm.

Pupa. No material available. The following description is that of an unknown African species which should be similar (fig. 89): *Head* with vertex visible from above, dome-shaped, smooth, glabrous; front smooth, glabrous. Antennae feebly clubbed, with all segments sparsely but conspicuously spiculate, straight, extending as far as abdominal segment 3, where they terminate between middle and hind femora. Eyes strongly convex, glabrous. Labrum triangular, glabrous. *Pronotum* elongate, with sides strongly rounded, disc with groups of short ferruginous spines (each with a basal seta) as figured. *Mesonotum* with a pair of minute lateral spines. *Metanotum* with about three small spines on each side of scutellar groove which is indistinct. Elytra and wings extending to abdominal segment 4. *Abdomen* with tergites 1–6 each with a transverse row of short spines (each with a basal seta). Tergite 7 elongate, with sides strongly converging posteriorly; median area produced into a pair of subcontiguous, oval, tuberculate protuberances each bearing four to six stout spines. Tergite 8 bearing two to four stouter spines and with antero-median area very deeply excavate. Tergite 9 retracted in tergite 8. Sternites glabrous. Pleura moderately protuberant, longitudinally rugose and glabrous. *Legs* with femora and tibiae sparsely but conspicuously spiculate; hind femora extending nearly as far as abdominal segment 5 and lying parallel to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6; peritreme rather narrowly oval, reniform, thin, pale, and slightly raised above general level of cuticle Length 10–11·5 mm.; maximum breadth 3·2 mm.

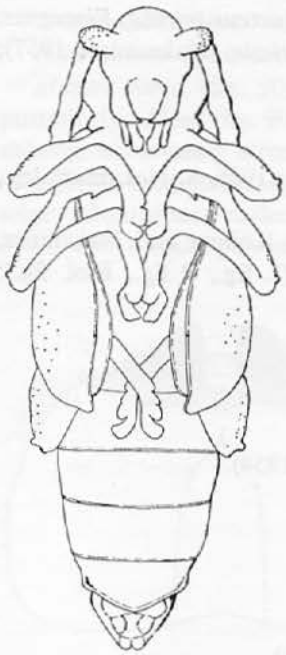

Fig. 89. *Dere* sp. Pupa. Ventral aspect. (Duffy, 1957)

Biology. Adults emerge from April to June.

References. Beeson, 1941 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Bulwant Singh, 1960d (Biol.).

Dere acaciae Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Acacia catechu* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Dere affinis Gahan

Distribution. ORIENTAL REGION: India.

Host plant: *Pithecolobium angulatum* (Mathur and Balwant Singh, 1960d).

Reference. Mathur and Balwant Singh, 1960d (Biol.).

Dere thoracica White

[The Firefly-shaped Longicorn]

Distribution. ORIENTAL REGION: China (Chekiang, Kiangsu). PALAEARCTIC REGION: Japan, Korea.

Host plants: *Quercus* (Shiraki, 1952); *Fagus japonica, Quercus serrata, Elaeagnus, Photinia glabra, Prunus mume, Vitis vinifera, Albizia julibrissin* (Nakamura, 1957); *Acacia* (Kojima and Nakamura, 1961).

Mature larva. For generic characters, see key, p. 16.

Pupa. For generic characters, see key, p. 38.

Material studied. 3 L, 2 P, Japan, Hiroshima, Hiwa, 4.ix.1956, S. Nakamura leg., in coll. Shimane Agricultural Experiment Station.

References. Cheo, 1935 (Biol.); Kojima, 1959 (L fig.); Kojima and Nakamura, 1961 (Biol.); Mühlmann, 1954 (Biol.); Nakamura, 1957 (L fig., P fig., Biol. fig.); Shiraki, 1952 (Biol.).

Dere posticata Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Acacia leucophloea* (Bhasin and Roonwal, 1954).

Reference. Bhasin and Roonwal, 1954 (Biol.).

Nida kala Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant. *Phoebe lanceolata* (Beeson and Bhatia, 1939).

Biology. Adults emerge from May to July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Paramimistena polyalthiae Fisher

Distribution. ORIENTAL REGION: India (West Bengal).
Host plant: *Polyalthia simiarum* (Beeson, 1941).
References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Molorchini

Larval Characters

Form small, slender, seldom exceeding 17 mm. in length. *Head* depressed, strongly transverse, widest at just behind middle. Gena not shouldered but gradually narrowed up to base of mandible and bearing numerous long slightly curved setae. Mouthframe interrupted beneath antennae. Ocelli usually absent but sometimes one pair present. Antenna with segments 1 and 2 very short, about half as long as segment 3. Maxillary palp with segment 3 much longer than segment 2; process of palpifer rather large. Labial palp with segment 2 much longer than segment 1. *Prothorax* with pronotum striate posteriorly, median suture inconspicuous. Postnotal fold present. Eusternum usually distinct. *Abdomen* with ampullae granulate, often bilobed. Pleural discs indistinct. *Legs* extremely small or absent. *Spiracles* very small, with peritreme below general level of cuticle.

Molorchus darjeelingensis Gardner

Distribution. ORIENTAL REGION: India (West Bengal).
Host plant: *Symplocos theaefolia* (Beeson and Bhatia, 1939).

Mature larva (fig. 90). Form subcylindrical, moderately slender and tapering posteriorly. *Head* (fig. 90) strongly transverse, widest just behind middle, testaceous, shining, moderately strongly sclerotized. Posterior margin almost straight, with a very feeble median emargination. Genae with numerous rather long, slightly curved setae. Mouthframe rather broadly ferruginous dorsally and bearing a few stout setae. Frons with a small pair of paramedian, oval depressions near front margin, each with a short seta. Antenna with segment 2 strongly transverse, segment 3 longer than segment 2; supplementary process about as long as segment 3. Labrum transverse, suboval, with sparse setae. One pair of ocelli present. Lens large, round, convex; pigmented spot very distinct. Maxillary palpi with segment 3 longer than segment 2 and longer than apical segment of labial palp. *Prothorax* with pronotum feebly striate posteriorly. *Abdomen* with ampullae finely wrinkled and with a single transverse impression. Lateral regions of body micro-asperate. *Legs* absent. *Spiracles* small, subcircular; peritreme with a series of sub-

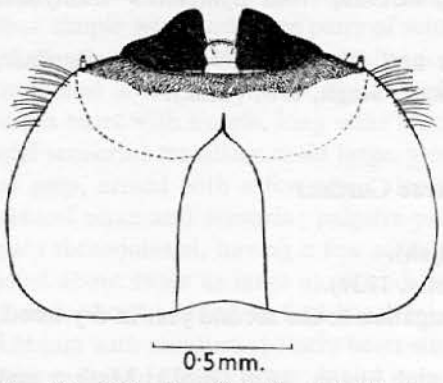

Fig. 90. *Molorchus darjeelingensis* Gardner. Mature larva. Head. Dorsal aspect.

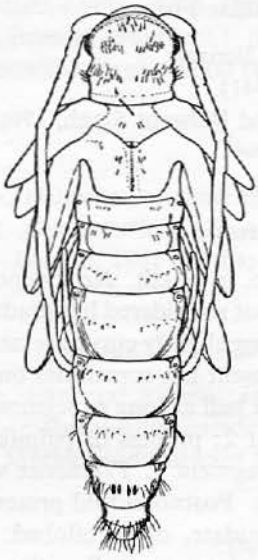

Fig. 91. *Molorchus umbellatarum* (von Schreber). Male pupa. Dorsal aspect.

Fig. 92. *Molorchus umbellatarum* (von Schreber). Male pupa. Ventral aspect.

contiguous marginal chambers. Length up to 10 mm.; maximum breadth (at prothorax) 3 mm.

Pupa. No material available. For generic characters, see key, p. 38. The accompanying figures (figs. 91, 92) are of the Palaearctic *M. umbellatarum* (von Schreber) which should be essentially similar.

Biology. The life-cycle is apparently usually annual but sometimes with prolongation to the second year. Adults occur in April, May and November.

Material studied. 2 L, India, Darjeeling, ix.1929, from *Symplocos theaefolia*, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931 (L fig. (as *Epania* sp.)); Mathur and Balwant Singh, 1961 (Biol.).

Molorchus hederae Gardner

Distribution. ORIENTAL REGION: India (Punjab).

Host plant: *Hedera helix* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with prolongation to the second year in dry wood. Adults emerge in March and April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Merionoeda nigriceps (White)

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh).

Host plant: *Dendrocalamus strictus* (Beeson and Bhatia, 1939).

Biology. This species infests dry bamboo. Adults occur in May and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Merionoeda phoebe Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Phoebe lanceolata* (Beeson and Bhatia, 1939).

Mature larva. No material available. The following is a description by Mathur (1958). "Length about 13 mm., greatest width across thorax, about 3 mm.; size variable. Body sparsely hairy, tapering gradually backward, slightly wider across seventh abdominal segment, and again becoming narrower posteriorly. Legs minute, papilla-like. Spiracles lateral, oval, thoracic spiracle largest, first abdominal spiracle larger than the rest, which are of equal size. Head partly retracted into prothorax, sparsely hairy anteriorly, coarsely hairy antero-laterally with long hairs, transverse, broader than long, broadest posteriorly, posterior corners rounded with a prominent median suture; epistoma smooth, anterior margin with two pairs of setae; gula distinct, with sides slightly divergent posteriorly; occipital foramen with anterior and posterior portions having a thin tentorium in between. Gena with long, slender setae. Ocelli not visible. Antennae prominent, retractile, three-segmented, basal two segments transverse, first segment with two dorsal and two ventral tactile pits, second segment with a few apical setae, third segment cylindrical, about as long as two basal segments, bearing terminal setae. Mandibles piceous, strong, distal piece gouge-shaped, with a round cutting edge, basal piece reddish brown, with two dorsal setae and a ventral row of six papilla-like structures. Clypeus small, transverse. Labrum transverse, anterior margin rounded, irregular, having a few setae along the anterior and lateral borders, two pairs of submedian setae and a few sensoria in the posterior region. Epipharynx with short, thick setae along the anterior border, with long, simple setae laterally and one thick seta antero-medianally; postero-median region with three or four simple setae and three pairs of sensory pores, and on either side, there is a patch of minute points. Maxillae membranous; cardo nearly as broad as long, with a few setae and sensoria in the posterior region, and one anterior seta at the outer angle; stipes beset with simple, long setae along the outer border and also with ventral setae and sensoria; maxillary mala large, stout, slightly longer than broad, nearly as long as palp, armed with a few setae along the anterior margin and also provided with ventral setae and sensoria; palpifer prominent, with a few anterior setae; maxillary palp three-jointed, having a few setae and sensoria, two basal joints transverse, first joint about twice as large as second, apical joint subcylindrical, slightly longer than broad, about as long as first basal joint, with one seta and a few terminal papillae. Labium with mentum sparsely beset with simple setae and a few sensoria, submentum with a pair of simple setae; labial palp two-segmented, basal segment broadly transverse, broader than long, with two small setae and one sensorium, apical joint

subcylindrical, about as long as broad and as long as basal joint, bearing one sensorium and a few terminal papillae. Ligula much shorter than labium, thickly and finely setose. Prothorax large, broader than mesothorax, depressed, with a prominent median suture; pronotum somewhat rectangular, about twice as broad as long, coarsely hairy anteriorly, shining and regularly striate posteriorly, also sparsely pitted and finely reticulate. Prosternum beset anteriorly and laterally with long hairs, posteriorly with two somewhat circular, separated, glabrous, shining areas. Abdomen slender, having wide intersegmental skin, first and second dorsal and ventral ampullae dull; third, fourth, fifth and sixth deeply bilobed, teat-like, projecting; anal slit terminal, trilobed."

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur, 1958 (L fig., Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Epania amoorae Gardner[18]

Distribution. ORIENTAL REGION: Burma.

Host plant: *Mimusops elengi* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with emergence occurring in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Epania calophylli Gardner

Distribution. ORIENTAL REGION: India (Mysore).

Host plant: *Calophyllum apetalum* (Beeson and Bhatia, 1939).

Biology. Larvae of this species feed subcortically, superficially grazing the sapwood. The pupal cell is long with wood-dust filled expansions at each end and traces of a shining white film. The life-cycle is annual with emergence occurring in March (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Epania cingalensis Gardner

Distribution. ORIENTAL REGION: Ceylon.

Host plant: *Diospyros ovalifolia* (Beeson and Bhatia, 1939).

Biology. The life-cycle is presumably annual. Adults emerge between February and June, mainly the latter.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Epania paulla Pascoe

Distribution. ORIENTAL REGION: Java, Sarawak.

Host plant: *Platymitra macrocarpa* (Kalshoven, 1955).

Reference. Kalshoven, 1955 (Biol.).

[18] There is a description of an unknown species of *Epania* by Gardner (1931b).

Kunbir telephoroides Lameere

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madras, Uttar, Pradesh).

Host plants: *Bauhinia vahlii*, *Mallotus philippinensis*, *Ventilago calyculata* (Beeson and Bhatia, 1939); *Acacia leucophloea* (Bhasin and Roonwal, 1954); *Shorea robusta* (Mathur and Balwant Singh, 1961).

Biology. Adults emerge from May to July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Leptepania indica Gardner

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Albizia lebbeck* (Beeson and Bhatia, 1939).

Biology. Adults emerge during most months of the year but mainly in June, July, October and November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Obriini

Obrium randiae Gardner

Distribution. ORIENTAL REGION: India (Mysore, Uttar Pradesh).

Host plant: *Randia spinosa* (Beeson and Bhatia, 1939).

Mature larva. For generic characters, see key, p. 17.

Biology. Adults emerge in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Anaesthetobrium luteipenne Pic

Distribution. ORIENTAL REGION: China (Chekiang, Kiangsu).

Host plant: *Morus* (Chen, 1933).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.).

Thraniini

Thranius triplagiatus Gahan

Distribution. ORIENTAL REGION: India (Assam, West Bengal).

Host plants: *Litsaea citrata*, *Machilus edulis* (Gardner, 1931b).

Mature larva (fig. 93). *Head* (fig. 93) subquadrate, the sides sloping near anterior margin. Front margin of frons rather strongly emarginate. Mouthframe rather broadly sclerotized and ferruginous; sclerotization narrowly enclosing antennal foramen. Ocelli absent. Ventral front margin with a pair of small round tubercles on acetabulum (fig. 93). Hypostoma with front margin ferruginous and irregular (sub-

tuberculate to slightly subcarinate). Antennal membrane well developed; segment 2 of antenna slightly longer than wide, segment 3 less than half as long as segment 2. Maxillary palpi with segment 3 longer than segment 2. Labial palpi with segment 2 longer than segment 1. Mandible with basal part with a protuberant, transverse, rim-like apical margin (fig. 93). *Prothorax* with posterior part of pronotum milky white and finely micro-granulate; eusternum indistinctly defined. *Abdomen* with ampullae dull, micro-granulate. *Legs* long, well developed. *Spiracles* with peritreme rather broadly oval, large, the pair on segment 8 distinctly larger than those on segment 7. Length up to 40 mm.; maximum breadth (at prothorax) 6·5 mm.

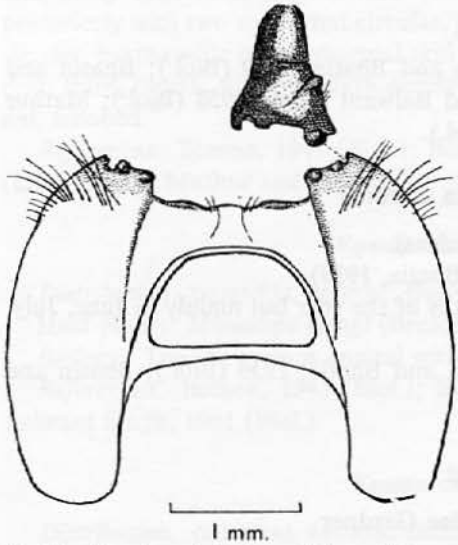

Fig. 93. *Thranius triplagiatus* Gahan. Mature larva. Head with ventral mouthparts and mandible removed. Ventral aspect.

Biology. The life-cycle apparently varies from a half to one and a half years. Adults emerge from April to May (mainly April) and from August to January (mainly August).

Material studied. 2 L, India, Bengal, Darjeeling, 16.ix.1929, from *Litsaea citrata*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Callidiini

Larval Characters

Form robust and of a contracted appearance. *Head* subtrapezoidal, widest well behind middle, with three pairs, one pair or no ocelli. Mandible with a deep longitudinal impression on outer face. Maxilla with lobe glabrous on entire inner margin; process of palpifer nearly as long as or longer than segment 3 of maxillary palp. Antenna with segments 1 and 2 quadrate to strongly elongate. Gula distinct, raised. *Prothorax* densely setose laterally, the setae being more or less equal in length; pronotum not more than twice as wide as long; median cleavage line incomplete (except *Hylotrupes bajulus*) though often deep; posterior half lightly reticulate (except *H. bajulus*) and with some rather coarse longitudinal striae. Postnotal fold present. Sternum with two paramedian or one median oval, glabrous area, the eusternum not clearly defined (except *H. bajulus*). *Abdomen* with ampullae broad, often finely reticulate, with a distinct but shallow, longitudinal, median impression; posterior transverse impression incomplete (except *H. bajulus*). Pleural discs distinct on segments 3–6 (except *H. bajulus*); each disc a deep pore surrounded by a reticulate area. *Legs* 2- or 3-segmented, at least as long as maxillary palp; segments more or less globular, unguiculus imbricately spinose.

Hylotrupes bajulus (Linnaeus)

[The House Longhorn; the European House Borer; the Old House Borer; the Camberly Beetle; the Porter Hylotrupes; the Italian Beetle; der Hausbock; der Hausbockkäfer; der Balkenbock; der Grosser Holzwurm; le Capricorne domestique; le Capricorne des Maisons.]

Distribution. ORIENTAL REGION: China. AUSTRALASIAN REGION: Australia (Queensland), New Zealand. ETHIOPIAN REGION: South Africa (Cape Province). PALAEARCTIC REGION: British Isles, Europe, Scandinavia, Iceland, Italy, Middle East, North Africa (Algeria, Egypt, Morocco, Tunisia), Asia Minor, Siberia. NEARCTIC REGION: U.S.A. NEOTROPICAL REGION: South America (Argentina).

Host plants: *Pinus*, *Picea*, *Abies* and, occasionally, *Pseudotsuga taxifolia*. Feytaud (1939) states that this species is not entirely confined to conifers, since *Populus*, *Alnus*, *Corylus*, and even *Quercus* have been infested by it. Chobaut (1904) records it from *Genista scorpius*, Riley (1880) from *Conium maculatum* and Cailiol (1914) from *Tamarix*. Petroff (1920) found specimens in branches of *Acacia nilotica* in Egypt. Conifers, however, are undoubtedly its preferred hosts and in South Africa, at least, it has never been found in any others. The following coniferae have been found to be infested in South Africa: *Pinus canariensis*, *P. caribaea*, *P. halepensis*, *P. palustris*, *P. maritima*, *P. pinea*, *P. ponderosa*, *P. radiata*, *P. sylvestris*, *P. taeda* and possibly *Pseudotsuga taxifolia* (Tooke, 1949).

Milligan (1961) has recently shown experimentally that the sapwood of rimu (*Dacrydium cupressinum*) is susceptible to infestation by this longhorn.

It should also be mentioned that there have been several reports, mainly from France, of this species infesting *Quercus* (Benoit and Jacquoit, 1953), and it would appear possible that some strains of *H. bajulus* (Linnaeus) have become resistant to oak sapwood. As, however, the present author (1954) has recently found oak to be infested by other species hitherto associated exclusively with Coniferae, this is perhaps not so surprising as it first seemed.

Mature larvae have recently been extracted by the author from a seasoned walnut candelabra imported from Italy at least six years ago. This appears to be the first time that infestation with this species has been observed in *Juglans* and is the only case of hardwood infestation actually seen by the author.[19]

The larval galleries are totally different from those in softwood, being shallow, broad, slot-like in cross-section and more characteristic of those made by buprestids. The frass is finer, more granular and less abundant. The larva, although possessing all the characteristics of *H. bajulus* larvae from softwood, are atypical and upon superficial examination could easily be regarded as being of a different genus. The mouthframe is considerably more strongly sclerotized and more darkly pigmented, and the pronotal "spots" are orange-testaceous instead of pale testaceous. There were two adult emergence holes as well as two mature larvae in the candelabra, so it seems quite evident that this species can successfully mature in hardwood.

Adult (fig. 94). Colour varying from testaceous to castaneous, sometimes almost

[19] A larva has since been examined from a beech table leg in which it had been feeding for at least even years. It possessed the same atypical characteristics as the one found in walnut.

pitchy, particularly the pronotum. *Head* with antennae short, not extending beyond basal third of elytra. *Prothorax* transverse, with sides strongly rounded and bearing dense, outstanding pubescence; disc with a pair of paramedian, shining, glabrous

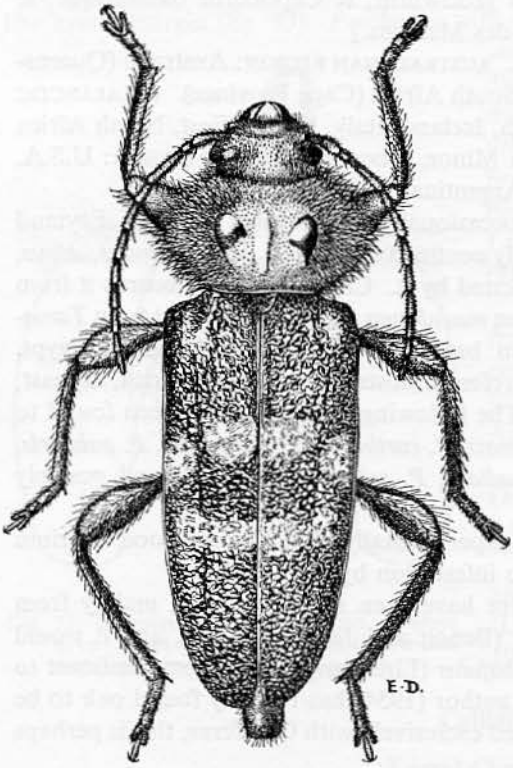

Fig. 94

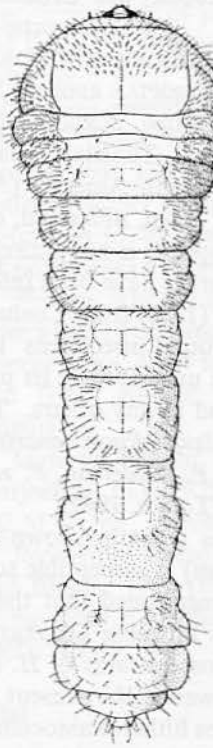

Fig. 95

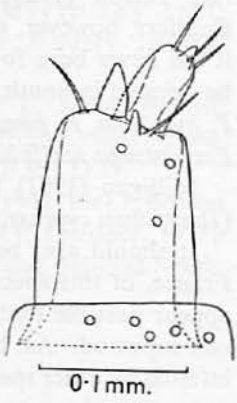

Fig. 96

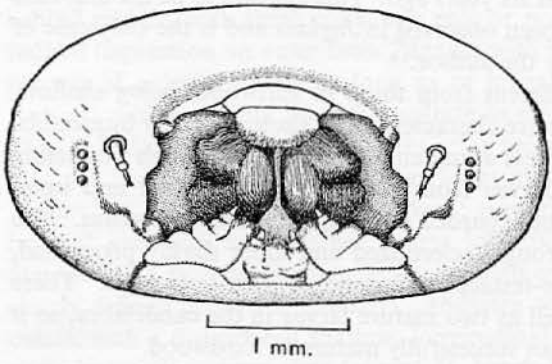

Fig. 97

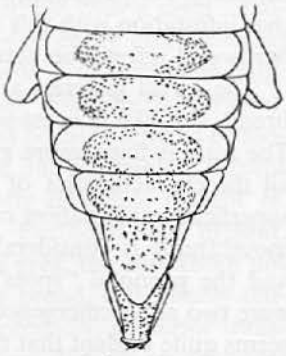

Fig. 98

Figs. 94-98. *Hylotrupes bajulus* (Linnaeus). Fig. 94. Adult. Fig. 95. Mature larva. Dorsal aspect. Fig. 96. Mature larva. Apical part of antenna. Lateral aspect. Fig. 97. Mature larva. Head. Frontal aspect. Fig. 98. Pupa. Posterior part of abdomen. Dorsal aspect. (Duffy, 1957)

tubercles. Anterior coxal cavities rounded and open posteriorly. *Elytra* depressed, rugose, with an interrupted band of pale pubescence before middle, often forming four distinct patches. Length 14–20 mm.

Mature larva (figs. 95–97). Form rather robust, slightly depressed. *Head* (fig. 97). subtrapezoidal, widest well behind middle (maximum head-width 4·25 mm.). Gena somewhat shouldered, pale, smooth and with a few short pale setae. Front margin of head pale ferruginous, rugose; front margin of frons rather swollen. Mouthframe completely though rather weakly sclerotized beneath antennae. Antenna (fig. 96) testaceous, with segment 2 three times as long as segment 3 which is cylindrical and twice as long as broad; supplementary process rather attenuated, at least two-thirds as long as segment 3. Mandible broad, with basal part ferruginous; apical part pitchy,

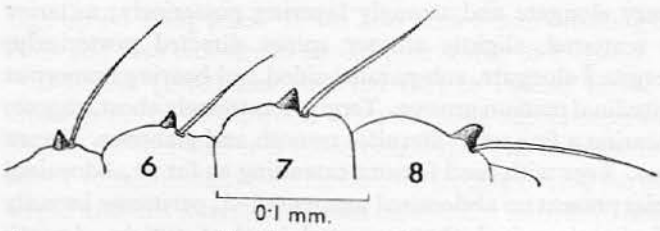

Fig. 99. *Hylotrupes bajulus* (Linnaeus). First-instar larva. Egg bursting spines of abdominal segments 5–8. Dorsal aspect. (Duffy, 1957)

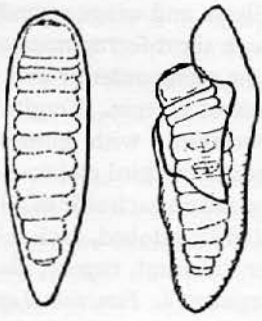

Fig. 100. *Hylotrupes bajulus* (Linnaeus). Eggs, showing emerging larvae.

shining and with a deep longitudinal median impression. Labrum fleshy, transversely oval and with numerous long, fine setae. Epipharynx setose only on sides. Three distinct ocelli present close together in a straight row laterad and ventrad of antenna (fig. 97);[20] ocellar lens strongly protuberant, pigmented spot distinct. Hypostoma rugose, with front margin not or scarcely darker than remainder. Gula rather broad, slightly raised, with concave sutures. Maxilla with lobe entirely glabrous on inner margin; maxillary palp with segment 3 shorter than segment 2 and shorter than segment 2 of labial palpi; dorso-external process of palpifer slightly shorter than segment 3 of maxillary palp. Labial palpi with segments 1 and 2 equal in length. *Prothorax* rectangular, depressed, with numerous long, fine setae; posterior half smooth, shining, with a few irregular coarse striae; median cleavage line deeply impressed. Eusternum distinct, triangular, shining, rugose and almost glabrous. *Abdomen* (fig. 95) with dorsal ampullae shining, coarsely rugose (even subtuberculate), with posterior transverse impression distinct; median furrow rather shallow. Anal lobes sparsely setose. Pleural discs indistinct or absent. *Legs* with femur wider than long; femur and tibiotarsus testaceous; unguiculus ferruginous for at least apical two-thirds and strongly imbricately spinose. *Spiracles* with peritreme broadly oval, very thin and pale. Length up to 24 mm.; maximum breadth (at prothorax) 7·5 mm.

[20] Behind these, three widely separated, vestigial ocelli are usually visible.

Although there seems no doubt that this species has been correctly placed in the Callidiini according to adult and pupal characters, the larva does not conform at all satisfactorily to what would appear to be the true larval characteristics of this tribe. On the other hand, larvae of certain other species of *Hylotrupes* approximate much more closely to the tribal characters.

First-instar larva (fig. 99). Cuticle milky white, waxy. Egg-bursting spines situated in pairs dorso-laterally on abdominal segments 1–8; spines short, stout, blunt and becoming larger posteriorly. Spiracles biforous. Length up to 1·2 mm.; maximum breadth 0·65 mm.

Pupa (fig. 98). *Head* quadrate, glabrous. *Mesonotum* with several long, fine, pale setae directed backward on each side of scutellum which is depressed. *Metanotum* with numerous similar setae on each side of scutellar groove which is slightly depressed. Elytra and wings extending to abdominal segment 4. *Abdomen* with tergites 1–6 each with short ferruginous spines (each bearing a fine basal seta) arranged in a transverse row along anterior and posterior margins and in a broad semi-oval group near each lateral margin. Tergite 7 very elongate and strongly tapering posteriorly; anterior two-thirds with numerous scattered, slightly stouter spines directed posteriorly; posterior third glabrous. Tergite 8 elongate, sub-parallel-sided and bearing numerous spines on each side of a longitudinal median groove. Tergite 9 extremely short, rugose, slightly bilobed, each lobe bearing a fine seta. Sternites smooth and glabrous. Pleura protuberant, rugose, glabrous. *Legs* with hind femora extending as far as abdominal segment 4. *Functional spiracles* present on abdominal segments 1–5; peritreme broadly oval, moderately thick and slightly raised above general level of cuticle. Length 14–25 mm.; maximum breadth 7 mm.

Egg (fig. 100). Form elongate, spindle-shaped, very variable in outline but one pole usually more attenuated than the other. Chorion white, dull, smooth. Length 1·2–2 mm.; breadth 0·5 mm.

According to Weidner (1936b), eggs laid at the beginning of the oviposition period are much more slender than those laid later on.

Biology. The eggs are deposited in batches in cracks and crevices about 0·2–9·6 mm. wide; rough surfaces are preferred. Estimates of the maximum number of eggs laid by a single female are extremely variable; Eckstein (1935a) records 200, Kaufmann (1936) 300 and Becker (1942a) 400, although estimates by most other authors lie between 30 and 100. The incubation period is usually from one to three weeks. Steiner (1937) found that the shorter period was 5·9 days at 31·5°C [89°F] and 90–95 per cent humidity, and that the longest period was 48 days at 16·6°C [62°F] and 18 per cent humidity. The upper temperature limit for incubation was 101·66°F at which all eggs were killed, irrespective of humidity. Increased humidity accelerated development but with 100 per cent humidity many eggs were killed by moulds. The most favourable humidity was 90–95 per cent, which is understandable when it is remembered that this species flourishes in maritime regions. High temperatures (31·5°C [89°F] and 26·3°C [79°F]) reduced mortality by accelerating development and retarding the growth of moulds. Vasić (1962) regards *H. bajulus* (Linnaeus) as being thermophilic and has found that the optimum temperature for its development is 26–28°C [78·8–82·4°F]. Tooke (1949) maintains that *H. bajulus* (Linnaeus) can

exist and breed under a wide range of humidities and that the effect of low humidity is to lengthen the incubation period of the eggs and to shorten the life of both sexes. Becker (1942a) found that oviposition could be induced experimentally by treating wooden blocks with the terpines α-pinene and β-pinene or an oil (turpentine) containing them.

The larval habitat is generally in the sapwood and, to a lesser extent, the heartwood of dry, seasoned, coniferous timber such as telegraph posts, fencing and structural timbers in buildings, especially those of roofs and attics. Infestation usually starts in the attic (particularly around a chimney) and gradually spreads downward. In an infestation recently seen by the author, however, the entire first floor of a 25-year-old council house had become infested and yet the attic above was perfectly sound. Although in recent years this insect has become adapted to a truly domestic environment, there is no doubt that the original habitat was, and probably still is in many areas, confined to woodland and forest. In South Africa, according to Tooke and Scott (1944), this species breeds in old logs and stumps and even in dead branches high up on living trees. It has also been found breeding in a dead standing tree near Paris and also recently in an old pine stump in England.

Dominik (1963) has observed that in Poland larvae of *Hylotrupes* are seldom found in the outer sapwood when infesting timber exposed to the outside atmosphere, despite the fact that it is more nutritious. The increase in temperature caused by the winter sunshine stimulates larvae into feeding during the day, but at night they become torpid and this alternation, with insufficient nutrition, causes them to die. Moreover, low temperatures are responsible for killing off some of the larvae which are feeding in the outer layer.

After emerging from the egg, the first-instar larva usually crawls about for a short period before starting to enter the wood. The larval galleries, which extend parallel to the grain of the wood, are tightly packed with fine powdery particles of wood and frass; the frass is characteristic, being in the form of short cylinders, which, according to Eckstein (1936a), later break up into approximately two spherical portions (probably due to desiccation). In heavy infestations the wood is almost entirely reduced to tightly packed powder, only a thin "veneer" of sound wood and sometimes a central core of heartwood being left untouched. Often the skin-like "veneer", which is about 0·5 mm. thick, splits or bursts under the pressure of the frass, and it is only under these circumstances or through the emergence of adults that frass is ejected. It is due to the unusual absence of tell-tale "boring dust" that infestations are so difficult to detect, although blister-like swellings on the surface of the wood indicate that it is or has been infested. The larvae feed mainly in the sapwood and infestation decreases as soon as the heartwood is reached. There are several instances recorded in literature of both larvae and adults of this species boring through metal sheeting covering wooden structures and even lead cables (Horn, 1933, 1934; Laing, 1919, 1920; Westwood, 1839). After tunnelling for several years and causing considerable damage, the larva usually bores to just beneath the surface of the wood and then turns back to excavate a pupal cell often at some depth and usually parallel to the grain of the wood.

Although intracellular micro-organisms are known to occur in the gut of many species of cerambycid larvae, they are apparently absent in that of *H. bajulus* (Lin-

naeus). According to Mansour (1934), *Hylotrupes* larvae are able only to digest seasoned wood through their ability to secrete cellulase, a cellulose-splitting enzyme. Falck (1930) has found through a comparative analysis of the frass and sound timber that larvae remove about 21 per cent of the total cellulose and hemicellulose content of seasoned coniferous wood. Parkin (1940) suggests that although *Hylotrupes* appears to be confined to coniferous woods, the enzymes present in the larval gut would apparently enable it to digest deciduous wood with equal facility. Kaltwasser (1941a) discovered that larvae were able to develop satisfactorily in deciduous wood and in coniferous heartwood, providing such substances as resin, which are harmful to them, were first removed. This was corroborated by Becker (1944), who found that larvae could survive in deciduous wood providing the latter was first soaked for 24 to 48 hours in 1 or 5 per cent sodium hydroxide, and then for 17 days in distilled water. The larvae increased somewhat in weight—probably due to the removal of pentosans.

Numerous experiments have been made in an attempt to accelerate larval growth. Schuch (1937a) has shown that some constituent of the cell contents of the wood is necessary to rapid growth, since larvae increase in weight more rapidly when feeding in the outer sapwood than in the inner zone or in the heartwood. The same author (1937c) has shown experimentally that larval growth at a given temperature increases with a rise in humidity, and at a given humidity with a rise in temperature. Becker (1938a) observed considerable acceleration of growth in larvae which had been inserted in wood impregnated with peptone solution. The same author maintains that albumin, which is present in dead wood in minute quantities, is essential for larval growth, and that increased amounts of it greatly accelerate their development, thereby reducing the amount of wood destroyed. Gösswald (1939) accelerated larval development through increasing the nutritive value of pine by impregnating blocks under pressure with a 5 per cent suspension of diastase; this was more satisfactory than with peptone or other ferments[21]. Later, Kaltwasser (1941), by adopting a similar technique, succeeded in reducing the total larval period to fourteen months.

Becker (1949b) has shown that young larvae with initial weights of up to about 25 mg. increased their weight more quickly at higher temperatures and older ones at lower and that young larvae responded less to fluctuating temperatures, as might be encountered in a building, than older ones. In experiments conducted over a ten-month period, a reduction in temperature and humidity for one week each month favoured larval development and reduced mortality. Measurement of individuals showed that there was no correlation between the length of females and the size of their eggs or the weight of the larvae from them after feeding for six months. Mortality was high among eggs incubated at 28°C [82·4°F] and 35 per cent relative humidity, but after the larvae that hatched had fed for four months under favourable conditions, all were as heavy as the heaviest larvae from eggs kept at optimum humidity (97 per cent). When first-instar larvae were placed between blocks of pine sapwood and pine heartwood or wood of deciduous trees, the pine sapwood was definitely preferred.

Results are also given by Becker (1949b) of experiments carried out at 28°C and 97 per cent relative humidity to test the nutritional value of diastase and various proprietary preparations of peptone. The degree to which they promoted growth

[21] See also White (1962b).

varied according to the age of the larvae, but the addition to the wood of 1·7 per cent of its weight of peptones resulted in average increases in weight, after 70 days feeding, up to about 25 times as great as that in the controls. Glucose, brewers' yeast and vitamins B_1 and B_2 added to the peptone increased its effect in the order given, glucose being neutral or negative and vitamin B_2 doubling the rate of growth.

Becker (1963) has also investigated the relation between the development of larvae of *Hylotrupes* and the protein content of *Pinus*, *Picea* and *Abies* as measured by their nitrogen content. Pine wood was found to be generally more suitable than spruce for larval feeding, and wood infected by wood-destroying fungi in the early stage of decay proved to be more favourable to larval development than healthy wood; moreover, it possesses an increased amount of protein.

Further nutritional experiments were later carried out by Rasmussen (1956a, 1956b). Results showed that the nutritional value of the media (*i.e.* pine veneer or filter paper impregnated with different concentrations of peptone, with or without yeast extract) increased with the concentration of peptone and was improved by the addition of yeast; both effects were much less apparent in the case of filter paper and mortality was higher. There was a tendency for the larvae to prefer the highest concentration of peptone. In further tests, only filter paper impregnated with peptone and yeast was used, and cholesterol was added for comparison. When it was absent, the larvae did not increase their growth rate with increasing concentrations of peptone and showed signs of nutritional deficiency, but these symptoms did not appear when cholesterol was present, and a later test showed it to be an essential growth factor for first-instar larvae. Becker and Loebe (1961) in a series of experiments found that when subjected to a temperature of 55°C [131°F], a period of 75 minutes was required to kill larvae of *H. bajulus* (Linnaeus) contained in pine sapwood.

The differing rates of oxygen consumption in larvae of this species have recently been studied by Becker and Damaschke (1963).

The mature larvae tunnel to a point just beneath the surface and then turn back and pupate at some depth, although sometimes the larva itself penetrates to the exterior and plugs the orifice with frass before turning back to pupate. The time of pupation is extremely variable in this species as its environment is subject to considerable changes in atmospheric conditions. Usually it takes place in the spring, although sometimes it occurs in the autumn or even in the winter. The pupal period is of two to three weeks' duration. Eckstein (1928) states that adults remain in their pupal cells for five to seven months after eclosion before attempting to emerge, whereas certain other authors contend that adults do not always attempt to emerge, and have been known to copulate and oviposit in excavated portions often deep in the wood. According to Tooke (1949) the emergence period in South Africa begins in November, the peak of emergence being from December to January. Males tend to live considerably longer than females. In European countries adults usually eclode during June and July. The duration of the life-cycle varies considerably but would seem usually to be between three and four years, although Tooke (1949) has shown in South Africa development is usually considerably accelerated. Dürr (1956) has recently found the duration of the larval and pupal stages to be 182 days shorter in *Pinus radiata* than in *P. pinaster*, and 537 days shorter in very recently felled wood than in seasoned timber.

Records of from six to eleven years are not uncommon and there are several accounts of prolonged larval life, notably by Bayford (1938), who discusses a larva estimated to be at least seventeen years old.

Parasites. Hymenoptera. *Cryptus minator* Grav., *C. seticornis* Ratz., *Ephialtes manifestator* L. (Reineck, 1919); *Doryctes leucogaster* Nees (Xambeu, 1898–1902); *Ephialtes tuberculatus* Frc. (Rudow, 1912); *Rhoptrocentrus* sp. (Thompson, 1943).

Predators. Coleoptera. *Opilo domesticus* L. (Steiner, 1938).

Economic importance. Although originally a forest insect, this beetle has now become one of the few truly domestic species, and the material damage it causes in many countries to structural timbers, especially roofs and rafters, is enormous. Linnaeus (1758) who first described this longhorn, must have been aware of its destructive nature, since he gave it the specific name "*bajulus*", which means "nuisance" or "trouble causer". Although first recorded from Algiers, it has since spread to many parts of the world and caused severe damage. According to Ekbom (1967), this beetle has been present in the Åland Islands (off Finland) for about 200 years.

During the past twenty years damage has increased considerably, and many costly measures have been adopted in combating this species on the Continent. In 1935 over a million marks were spent on control measures in Hamburg alone. In Sweden hundreds of houses have been severely infested, while in Denmark buildings have been insured against attack. In certain districts in Germany before the war, assurance companies levied an increase in premium to cover the risk of infestation (Fisher, 1938). The final statistics of a survey of buildings in Germany discussed at a meeting in 1938 of the Association for the Scientific Advancement of Measures against *H. bajulus*, showed that infestation had been recorded in 41·46 per cent of the 132,377 buildings examined and that the percentage in some districts was 70 to 80. Another survey of the same year revealed that the attics of about 40 per cent of all German houses were infested. Although the establishment of this species in South Africa is comparatively recent (probably not more than 50 years), large-scale infestation has already taken place. According to Tooke (loc. cit.), infestation of buildings in South Cape Town may prove to be nearly 90 per cent.[22] It has been calculated that an infested house would collapse within 25 to 30 years providing the insect could spread undisturbed. In England the possibility of this species spreading and causing extensive and serious damage cannot be lightly disregarded. Already breeding has increased in a number of buildings, and infestations have recently been recorded from Surrey, Essex and Sussex (Duffy, 1949b). Hickin (1947a) gives an account of the infestation of a 40-year-old house in Camberley (Surrey), and points out that if infested timber has been used in its construction, the insect must have maintained itself for at least four, or more probably, eight generations.

This recent increase is apparently due to forms of construction which promote exceptionally warm conditions in roof spaces during the summer months. This not only accelerates larval development but causes the wood to crack, thus providing additional oviposition sites. But by far the greatest cause is the widespread use of fast-grown, imperfectly seasoned softwoods as roof timbers. Although the rafters

[22] For further details of the severity of infestation in South Africa, see the comprehensive accounts by the National Building Research Institute (1950) and Dürr (1954).

become air-dried, they still contain an appreciable quantity of water, and where the humidity is highest, the damage, owing to the accelerated growth of the larvae, is greatest. Another contributing factor to the recent increase of this insect is the selection of timbers more closely related to the strain involved than was previously the case, with the result that they break up more readily (Larsson, 1945). The recent succession of hot summers, at least on the Continent, may also have caused an increase in the population of this insect. Dominik (1959) maintains that the recent spread of infestation in central Poland is due to the re-use of timber obtained from old buildings without prior disinfestation.

According to Schuch (1939) and Dürr (1954), recently built houses are most liable to attack, there being comparatively little damage to timber over fifty years old, but Topp and Jensen-Storch (1927) have estimated that structural timbers are not usually damaged until they are about twenty or thirty years old. Trägårdh (1927) is of the same opinion and later (1940) states that liability to infestation appears to increase with the age of roofs up to forty or seventy years, after which it remains constant, and that no houses less than twenty-five years of age are infested in Stockholm, Sweden. The considerable amount of damage that can be caused by only a few larvae is explained by the long larval period. When this insect is well established, it appears that infestation is more likely to spread through adults flying to fresh sites than by the importation of infested timber. In England, adults have recently been observed to be extremely active in hot sunny weather and to engage frequently in short, rapid, wheeling flights around infested houses; this clearly demonstrates the ease with which this longhorn is able to spread of its own accord (Duffy, 1954). In certain districts on the Continent telegraph posts have been heavily attacked (Blair, 1947), and Donisthorpe (1947) records the emergence of this beetle from telegraph posts and fences in Surrey, England. In South Africa (Tooke, 1949), attack is by no means confined to roof timbers, for the beetle readily attacks flooring, doors, window frames, picture rails and even "deal" furniture. There is a recent record (Özer, 1963) of damage to wooden furniture in Turkey. Imported packing cases, too, have recently been found to be infested and the danger of *Hylotrupes* spreading by this means should not be overlooked.

Recently a large quantity of *Pinus maritima* was imported from Europe for building purposes in Australia: this timber has since proved to be infested and *Hylotrupes* is now established in yet another country (Brimblecombe, 1953; Duffy, 1954). Recently the Queensland Government have undertaken the fumigation with methylbromide of some 2,300 houses in efforts to exterminate this insect, and in one suburb of Brisbane it is already established in pre-fabricated houses which were imported from France in 1950. It is conceivable that a similar situation may arise in Victoria, because several thousand precut houses have been imported since the war. The possibility of this pest infesting standing *Pinus* trees now being grown in Queensland and even the native pines (*i.e. Araucaria* spp.) should be given serious consideration.

Although this species would appear to flourish mainly in maritime climates, recent experiments in South Africa (Tooke, 1949) have proved that eggs will hatch at a constant humidity of 10 per cent, and that larvae are capable of completing their development under Pretoria conditions where the moisture content of the wood drops

as low as 6 per cent and does not rise above 9 per cent. Hence the spread of *Hylotrupes* into inland countries is by no means improbable.

So far as South America is concerned, infestation until now appears to be confined to the Argentine. Gemignani and Rodríguez (1940) record damage to floor boards of a house in Buenos Aires and state that *H. bajulus* (Linnaeus) was originally introduced into Argentina in pine battens and that damage by this species is now of common occurrence. Hayward's statement (1941) that various buildings in Argentina (Concordia) have been heavily infested corroborates this.

Control. In cases where structural timbers have become very heavily infested they should be removed and burned, as even if it were possible to kill off the larvae they would be a source of danger, having become weakened through the larval damage. As a treatment for floors which are only moderately infested, Feytaud (1939) suggests the removal of the most heavily attacked boards and either the introduction of a volatile fluid into holes drilled at intervals in the remaining boards or the application of a solution of paradichlorobenzene in carbon tetrachloride[23] by means of a stiff brush. For major infestations Jensen-Storch and Henriksen (1932) found that the application of carbon bisulphide[24] at the rate of 25 fluid ounces per 1,000 cubic feet completely killed off the larvae and that hydrocyanic acid gas[24] produced by Zyklon B at the rate of 30 ounces per 1,000 cubic feet proved quite effective in summer though less so in winter owing to the reduction in larval respiration. Hahmann (1932) experimented with the application of dry heat produced by a generator of the type commonly used for drying out newly built houses. After one hour an air-temperature of 80°–87°C [176°–188°F] was attained, which later rose from 88°–100°C [190·4°–212°F], at which it was maintained for seven hours. All larvae and adults were killed inside the beams in which temperatures of 63°–74°C [145·4°–165·2°F] were recorded. Vasić (1962) maintains that structural timbers in centrally heated buildings are less susceptible to attack.

According to Eckstein (1936b) a proprietary liquid known as "Imprägnier Lasolineum H" killed larvae in telegraph posts to a depth of 4 in.; it acts as both a contact and a respiratory poison. Kaltwasser (1941b), however, maintains that larvae are not harmed by boring short distances through heavily impregnated wood. Vasić (1962) has found that effective protection to structural timbers is afforded by spraying or coating with λBHC (lindane) and also with chlordane, aldrin or dieldrin. Other wood preservatives are discussed by Körting (1958, 1961, 1962) (see also British Standard 3651:1963). A comprehensive account of chemical preventive and eradication measures for combating *Hylotrupes* in South Africa is given by Tooke (loc. cit.) to which the reader is referred.

Sieke (1936) described an electrical sound detector designed to amplify the rhythmic sound produced by larvae scraping off thin wooden shavings with their mandibles. This apparatus has proved useful in the examination of treated timber to ascertain the efficiency of insecticides. It is sometimes necessary to warm the timber to induce feeding.

Trägårdh (1937) maintains that infestation is commonest through adults flying

[23] It is now thought inadvisable to use carbon tetrachloride as the health hazard is too great.
[24] Both these methods are now considered too dangerous to adopt.

from place to place on sunny days and recommends the placing of gauze over open windows in attics.

As a result of experiments with certain essential oils, Becker (1942a) suggests that they could be used to induce oviposition in a given place to prevent extensive oviposition on other timber.

Experiments have recently been carried out by Krough and Tooke (1946) in which the efficacy of pentachlorophenol as a timber preservative against borers has been tested. In Australia, it has been recommended (Brimblecombe, 1953) that infested timbers either be removed and destroyed or given a liberal application of 5 per cent pentachlorophenol in dieseline oil.

An account has recently been published (Tristram, 1964) of how over 2,000 houses in Queensland were fumigated with methyl bromide in an apparently successful attempt to exterminate this pest.

Dürr (1954), after very thorough investigations concerning the relative toxicity of wood preservatives and insecticides to *H. bajulus* (Linnaeus), recommends either 5 per cent zinc naphthenate in power paraffin or 3 per cent zinc naphthenate + 2 per cent pentachlorophenol in power paraffin. It was later found, however, that white spirit or a 50:50 mixture of white spirit and power paraffin was more effective as a solvent for metallic naphthenates, especially if the wood is to be painted after treatment. Both these solutions can be applied by immersing the seasoned timber in the solution for 10–15 minutes. The toxicity of the α, β, γ- and δ-isomers of hexachlorocyclohexane towards eggs and larvae of *H. bajulus* (L.) has recently been determined by Becker (1962b). The γ-isomer proved to be by far the most effective, although rather surprisingly the α-isomer follows, inferior by the factor 10 to 2000, according to the β-isomer proved to be considerably less efficient.

Later, Jacquiot (1949) described the technique for using a high-frequency "pistol" for the destruction of *Hylotrupes* larvae in structural timbers. The destruction of larvae in small sections of timber by means of a very high-frequency electric field has recently been discussed by Bruel, Pietermaat, Bollaerts and Stefens (1960).

Bletchly and Baldwin (1962) have shown that it is possible to obtain clear photographs of larvae of *H. bajulus* (Linnaeus) in infested blocks of softwood by using x-rays. Larvae in samples up to 4 in. thick have been successfully photographed. It is, however, considered improbable that x-rays could ever be used economically in routine examinations for quarantine purposes.

There appears to have been no serious attempt at biological control measures, although Deckert (1929b) states that the large-scale breeding of the predaceous clerid *Opilo domesticus* L. has been considered. Despite earlier assumption, blue-stained timber (*i.e.* timber attacked by the fungus *Ceratostomella*) is not protected against attack by *Hylotrupes* (Steiner, 1939).

According to Tooke (loc. cit.), the possibilities of complete and effective control in South Africa (especially the Western Cape) are even less hopeful than in European countries. It is due to the fact that this insect breeds as readily in dead timbers out of doors as in structural timbers indoors. Hence, whatever efforts are made in eradicating this pest from buildings, there will always remain a high population breeding "wild" in and around forested areas and constituting a constant threat to housing. The task of

clearing such large areas of stumps and dead branches *in situ* is humanly impossible. In view of this constant threat to houses and property in South Africa, the Department of Agriculture has issued certain regulations, which enforce the treatment of all coniferous timbers in those areas where the beetle is known to exist at the owner's own expense, unless special exemption be granted by the Minister. Any person failing to comply with the requirements imposed by these regulations may be liable to a fine not exceeding £20 or to imprisonment with or without hard labour for a period not exceeding two months.

Material studied. 7 L, Germany, nr. Berlin, K. Eckstein leg., in coll. B.M.; L,14 1 P, England, Essex, nr. Grays, vii.1949, in infested floorboards, E.A.J.D. leg., in coll. B.M.; 1 L, London, Balham, vi.1955, from infested crate, E.A.J.D. leg., in coll. B.M.

References. Altum, 1881 (Biol.), 1886 (Biol.), 1923 (Biol.); Bakke, 1960 (Biol. fig.); Barbey, 1913 (Biol. fig.); Bayford, 1938 (Biol.); Becker, 1938a (Biol.), 1938b (Contr.), 1941 (Biol., Contr.), 1942a (Biol.), 1942b (Physiol.), 1942c (Biol.), 1944a (L, Biol., Physiol.), 1944b (not seen), 1947 (Physiol.), 1949a (L, Biol., Physiol), 1949b (L, Biol., Physiol.), 1950a (Contr.), 1950b (Physiol.), 1950c (Physiol.), 1953 (E, Biol.), 1954 (Biol.), 1959 (Contr. fig.), 1961a (Contr. fig.), 1961b (Contr.), 1962a (?), 1962b (?); 1963 (Physiol.); Becker and Buro, 1959 (Contr. fig.); Becker and Damaschke, 1963 (Physiol.); Becker and Loebe, 1961 (Physiol.); Blair, 1947 (Biol.); Blanc, 1907 (Biol.); Bletchly and Baldwin, 1962 (Contr. fig.); Boas, 1923 (Biol. fig.); Bosq, 1934 (Biol.), 1942a (Biol.); Bouthery, 1879 (Biol.); Brammanis, 1944 (Biol., Contr.); Brèthes, 1922a (Biol.), 1922b (Biol.); Brimblecombe, 1953 (L fig., I fig., Biol. fig., Contr.), 1956 (I fig., Biol. fig.); British Museum (Natural History), 1954 (L fig., I fig., Biol.); British Standard 3651:1963 (Contr. fig.); Bruel, Pietermaat, Bollaerts and Stefens, 1960 (Contr. fig.); Buchner, 1953 (Physiol.); Burmeister, 1865 (Biol.); Butovitsch, 1939 (Biol.); Caillol, 1914 (Biol.); Chobaut, 1894 (Biol.); Craighead, 1923 (L, Biol.), 1950 (Biol. fig., Contr.); Davies and Canovan, 1953 (Biol.); Deckert 1928a (Biol.), 1928b (Biol.), 1929a (Biol.), 1929b (Biol.), 1930 (Biol.), 1933 (Biol.); Della Beffa, 1931 (Biol. fig.); Department of Scientific and Industrial Research, 1938 (L fig., Biol. fig., Contr.); Dominik, 1959 (Biol., Contr.), 1962 (Distr.), 1964 (Biol., Physiol.); Donisthorpe, 1947 (Biol.); Duffy, 1949 (Biol. fig.), 1953a (E fig., L fig., P fig., Biol. fig., Contr.), 1954 (Biol.), 1957 (E fig., L fig., P fig., I fig., Biol. fig., Contr.), 1960 (E fig., L fig., P fig., I fig., Biol. fig., Contr.), 1963 (E fig., L fig., P fig., I fig., Biol. fig., Contr.); Dürr, 1951 (L, Physiol., Contr.), 1956 (E fig., L fig., P fig., I fig., Biol.); Eckstein, 1920a (Biol.), 1920b (Biol.), 1921 (Biol.), 1926 (Biol.), 1928 (Biol.), 1929 (Biol.), 1932a (Biol.), 1932b (Biol.), 1934 (Biol.), 1935 (Biol.), 1936a (L, Biol. fig.), 1936b (Contr.), 1936c (Biol.); Eckstein and Butovitsch, 1931 (Biol.); Ekbom, 1957 (Biol.); Emden, 1939–1940 (L fig.); Escherich, 1923 (Biol. fig.); Falck, 1930 (Biol.), 1933 (Biol.); Feytaud, 1939 (Biol., Contr.); Finkenbrink, 1940 (Biol.); Fisher, 1939 (insurance), 1945 (Biol.), 1949 (L fig., Biol. fig., Contr.); Fisher and Harris, 1949 (Biol.); Forest Products Research Laboratory, 1952 (Biol); Franzke, 1936 (Biol.); Gemignani and Rodríguez, 1940 (I fig., Biol. fig., Contr.); Girard, 1881 (Biol.); Grösswald, 1939 (Biol.); Guse, 1893 (Biol.); Hahmann, 1932 (Contr.); Hayward, 1941 (Biol.); Heeger, 1857 (E fig., L fig., P fig., Biol.); Heidenreich, 1939a (Biol. fig., Contr.), 1939b (Biol.,

Contr.); Heitz, 1927 (Biol.); Henriksen, 1914 (L fig.); Henry, 1907 (Biol., Contr.), 1909 (Biol.); Herzig, 1941 (Contr.); Hespeler, 1934 (Biol.), 1939 (Contr.); Hickin, 1947 (Biol.), 1957 (Biol.); Horn, 1933 (Biol.), 1934 (Biol.); Houlbert and Monnot, 1908 (L fig., Biol.); Jacquiot, 1949 (Contr.), 1950 (Biol.); Jarvis, 1947 (Biol.); Jensen, 1931 (Biol.), 1933 (Biol.); Jensen-Haarup and Henriksen, 1914 (L fig.); Jensen-Storch, 1932 (Biol. fig.); Jenson-Storch and Henriksen, 1932 (Contr.); Judeich and Nitsche, 1889 (Biol.); Kaltwasser, 1941a (Biol.), 1941b (Biol., Contr.); Kaufmann, 1936 (Biol.), 1938 (Contr.); Kaufmann and Schuch, 1938 (Biol.); Körting, 1957 (Contr.), 1958 (Contr.), 1960 (Biol., Contr.), 1961 (Biol., Contr.), 1962 (Biol., Contr.); Körting and Methmann, 1963 (Contr.); Krough and Tooke, 1946 (Contr.); Kunike, 1936 (L fig., Biol. fig.); Laing, 1919 (Biol.), 1920 (Biol.); Lakowitz, 1937 (Biol. fig.); Larsson, 1945 (Biol. fig.); Larsson and Gigja, 1959 (Biol.); Lepesme, 1944 (L fig., I fig., Biol.); Määr, 1933a (Biol.), 1933b (Biol.), 1933c (Biol.), 1935 (Biol.); Mansour, 1934 (Biol.); Mansour and Mansour-Bek, 1934a (Biol.), 1937 (Biol.); Mateus, 1952 (Contr.); Miller, 1925 (Biol.); Milligan, 1961 (L fig., I fig., Biol. fig.); Moll, 1926 (Biol.); Morris Thomas, A., and White, M. G., 1959 (Contr.); Nordlinger, 1848 (Biol.); Nüsslin, 1905 (Biol.); Özer, 1963 (Biol. fig.); Parkin, 1934 (Biol.), 1940, (Biol.); Pavel, 1886 (Biol.); Perris, 1856 (L fig.), 1877 (L); Petroff, 1920 (Biol.); Peyerimhoff, 1919 (Biol.); Pierce, 1918 (Biol.); Rasmussen, 1956a (L, Physiol. fig.), 1956b (L, Physiol. fig.), 1957a (Biol.), 1957b (Biol.), 1958 (Biol., Physiol. figs.); Reineck, 1919 (Biol.); Riley, 1880 (Biol.); Rudow, 1912 (Biol.); Ruiz Castro, 1943 (Biol.); Saalas, 1923 (Biol.); Saraiva, 1954 (not seen), 1957a (E fig., L fig., Biol., Contr.), 1957b (Contr.); Schedl, 1935 (Biol.); Scheel, 1930 (Biol.); Schiödte, 1876 (L fig.); Schlottke and Becker, 1942 (Physiol.); Schmidt, 1951 (L fig., I fig., Biol. fig.), 1958 (L fig., Biol.); Schmitz, 1926 (Biol.); Schomann, 1936 (Biol.); Schuch, 1937a (Biol., Contr.), 1937b (Biol., Contr.), 1937c (Biol., Contr.), 1938 (Physiol.), 1939 (Biol.); Schultze-Dewitz, 1957 (Physiol.); Schulze and Becker, 1942 (Contr.); Schwarz, 1935 (Biol.); Schwerdtfeger, 1932 (Biol.); Sieke, 1936 (Contr. fig.); Snyder, 1927 (Biol. fig.); Steiner, 1937 (Biol., fig.), 1938 (Biol.), 1939a (Contr.), 1939b (Contr.); Steyer, 1928a (Biol.), 1928b (Biol.); Tame and Snelling, 1954 (Biol.); Technau and Behrenz, 1958 (Biol.); Thompson, 1943 (Paras.); Tooke, 1949 (Biol., Contr.); Tooke and Scott, 1944 (Biol.); Topp and Jensen-Storch, 1927 (Biol.); Trägårdh, 1927 (Biol.), 1937 (Contr.), 1939 (Biol. fig.), 1940 (Biol.), 1947 (Biol.); Tristram, 1964 (Contr. fig.); Vasić, 1962, (Biol., Contr. fig.); Villiers, 1946 (I fig., Biol.); Vitè, 1953 (L fig., I fig., Biol.); Weidner 1936a (Biol. fig.), 1936b (E fig., L fig., P fig., Biol.); Westwood, 1839 (Biol.); White,, 1954 (Biol.), 1958 (Biol.), 1959 (Biol., Contr.), 1962a (Biol., Physiol.), 1962b (Biol., Physiol.); Wichmaud, 1931 (Biol. fig.); Xambeu, 1898–1902 (L, P, Biol.); Zillig, 1925a (Biol.), 1925b (Biol.); Zumpt, 1947 (Biol., Contr.).

Callidiellum rufipenne (Motschulsky) (=**Callidium rufipenne** Motschulsky)

[Smaller Japanese Cedar Longicorn]

Distribution. ORIENTAL REGION: China, Formosa. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Abies* (Gressitt, 1951); *Cupressus*, *Pinus* (Shiraki, 1952).

Mature larva. Rather similar to that of *H. bajulus* (Linnaeus) from which it differs as follows. *Head* with genae rather broadly ferruginous (partly enclosing ocellus) and with numerous long, fine, slightly curved setae. One pair of ocelli present; lens round, convex, pigmented spot rather indistinct. Mouthframe completely and strongly sclerotized and pigmented. Ventral front margin of head with a small blunt, rounded tubercle on acetabulum in which the *condylus mandibulae* rotates (analogous to the subfossal process of prionine larvae?). Front margin of hypostoma broadly ferruginous. Antenna ferruginous, with segment 2 less than twice as long as segment 3; segment 3 about two and one-half times as long as broad; supplementary process conical, less than half as long as segment 3. Maxilla with segment 3 of palp slightly longer than segment 2. *Prothorax* with posterior area of pronotum micro-granulate and faintly longitudinally striate. *Abdomen* with ampullae on segments 1 to 2 or 3 indistinctly defined; ampulla on tergite 7 in the form of a semicircular, raised lobe which should serve to distinguish this larva from all other known cerambycid larvae. *Legs* stout, femur slightly elongate. Length up to 22 mm.; maximum breadth (at prothorax) 4·5 mm.

Pupa. No material available. For generic characters of *Callidium*, which are probably applicable to *Callidiellum*, see key, p. 38.

Economic importance. This species infests several coniferae of commercial value in Japan and is already established in Formosa. Timber infested with this species has recently been imported into New Zealand and it is conceivable that this beetle could become established, particularly in *Pinus radiata*, if imported in sufficient numbers.

Material studied. 2 L, Japan, Tokyo, Hino, 1938, K. Nakamura leg., in coll. B.M.

References. Duffy, 1963 (Biol.); Gressitt, 1951 (Biol.); Kojima, 1959 (L fig.); Minakawa, 1938 (?); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Semanotus bifasciatus Motschulsky

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Japan.

Host plants: *Thujopsis delabrata*, *Chamaecyparis obtusa* (Mühlmann, 1954); *Juniperus* (T. Fujimura).

Mature larva. No material available. In the larva of *S. undatus* (Linnaeus) the ocelli are indiscernible (see Duffy, 1953a).

References. Mühlmann, 1954 (Biol.); Plavilstshikov, 1940 (Biol.).

Semanotus semenovi Okunev

Distribution. ORIENTAL REGION: West Pakistan, China (W. Sinkiang). PALAEARCTIC REGION: Central Asia (Turkistan).

Host plants: *Juniperus semiglobosa*, *J. polycarpa* (Plavilstshikov, 1940).

References. Gressitt, 1951 (Biol.); Plavilstshikov, 1940 (Biol.).

Phymatodes maaki Kraatz

Distribution. ORIENTAL REGION: China (Amur). PALAEARCTIC REGION: Japan.

Host plant: *Vitis coignetiae* (Nakamura, 1959a).

Mature larva. No material available. It should, however, be essentially similar to that of *P. testaceus* (Linnaeus) of which the following is a description. *Head* with ferruginous area of gena not enclosing ocellus. Ocellus with lens indistinct or absent; pigmented spot large, distinct beneath cuticle. Mouthframe smooth and interrupted by a pale narrow gap at inner side of ocellus, just beneath antenna. Acetabulum without a conical tubercle. Maxilla with segment 3 of palpi one and one-half times as long as segment 2. *Prothorax* with pronotum rather coarsely striate, the interstices reticulate only near base; median cleavage line deeply impressed. *Abdomen* with

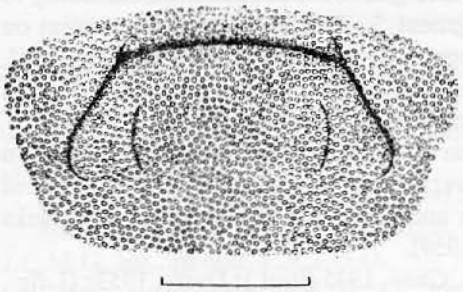

Fig. 101. *Phymatodes testaceus* (Linnaeus). Mature larva. Dorsal ampulla of abdominal segment 4. (Duffy, 1953c)

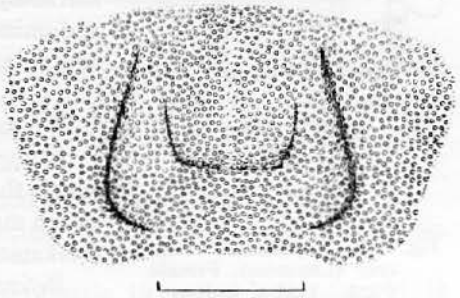

Fig. 102. *Phymatodes testaceus* (Linnaeus). Mature larva. Ventral ampulla of abdominal segment 4. (Duffy, 1953c)

ampullae rather coarsely granulate (figs. 101, 102), slightly shining. *Legs* with femur wider than long; femur and tibiotarsus testaceous. Length up to 26 mm.; maximum breadth (at prothorax) 7·2 mm.

From Nakamura's (1959) illustration of this larva, it would seem to be distinguishable from that of *P. testaceus* (Linnaeus) by the head capsule which has the sides diverging posteriorly.

Pupa. No material available. The following is a description of that of *P. testaceus* (Linnaeus). *Head* (fig. 103) finely rugose, transversely striate in part, glabrous, with vertex visible from above. Antennae transversely striate, especially near base; extending as far as abdominal segment 1, where they are recurved downwards alongside mid-femora to terminate near mid-coxae. Eyes scarcely protuberant, glabrous. Labrum triangular, with front margin rounded, glabrous. Maxillary palpi enlarged apically. *Pronotum* very slightly transverse, with sides moderately rounded and front margin slightly wider than hind margin; a conspicuous, conical, tuberculate process present just behind middle of front margin; disc transversely striate, glabrous. Mesonotum usually transversely striate medially, glabrous. *Metanotum* for the most part transversely striate, glabrous. Elytra and wings extending to between abdominal segments 3 and 4, the former appreciably shorter than the latter. *Abdomen* with tergites 1–6 each with a transverse group of small pale spines across posterior half,

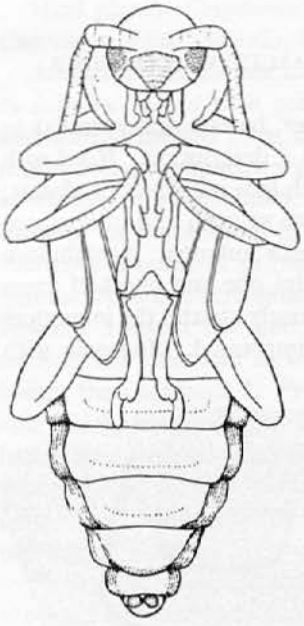

Fig. 103. *Phymatodes testaceus* (Linnaeus). Female pupa. Ventral aspect.

and with an incomplete row of smaller spines across anterior half (which are often curved laterally to form an ellipse). Tergite 7 slightly transverse, parallel-sided for anterior half, with sides converging posteriorly, but hind margin not angled medially; bearing scattered stouter spines which are stoutest near posterior margin. Tergite 8 transverse and explanate laterally, glabrous. Tergite 9 extremely short with hind margin almost straight, glabrous. Sternites smooth and glabrous; sternite 10 protruding beyond sternite 9, thus partly visible from above. Pleura strongly protuberant, longitudinally rugose and glabrous. *Legs* with femora markedly clavate, glabrous; hind femora extending to abdominal segment 5. *Functional spiracles* present on abdominal segments 1–7; peritreme broadly oval, thin and raised above general level of cuticle. Length 7–16·6 mm.; maximum breadth 3·5 mm.

Biology. Larvae infest dead stems of the hosts in which they overwinter. The larval period lasts about eleven months and the pupal period about five weeks (Nakamura, 1959).

References. Cheo, 1935 (Biol.); Duffy, 1953c (L fig., Biol. fig. of *P. testaceus* (Linnaeus)); Kojima, 1959 (L fig.); Nakamura, 1959a (L fig., Biol.); Shimoyama, 1957 (L fig., P fig., Biol.).

Compsocerini

Rosalia (=Eurybatus) hariola Thomson

Distribution. ORIENTAL REGION: India (Sikkim, West Bengal).

Host plants: *Evodia fraxinifolia*, *Mallotus roxburghianus* (Beeson and Bhatia, 1939).

Mature larva (fig. 104). *Head* subquadrate, with sides distinctly diverging posteriorly. Frontal sutures indistinct; genae bearing a few long ferruginous setae and with a thickened dentate tubercle immediately above each antennal foramen (fig. 104). Mouthframe rather broadly ferruginous. Mandible without a longitudinal impression on outer face. Three[25] pairs of small, rather indistinct contiguous ocelli present behind which the temple is rather broadly ferruginous (fig. 104). Antenna with segment 2 about twice as long as basal width; segment 3 slightly more than half as long as segment 2. Labrum subcircular, slightly transverse, with numerous setae arising from dark testaceous discs which give it a spotted appearance. Maxilla with segment 3 of palp shorter than segment 2. *Prothorax* with two distinct brownish plates across anterior margin, each plate partially subdivided into two; posterior area of pronotum rather finely striate, glabrous. Eusternum subtriangular, glabrous. *Abdomen* with

[25] Neotropical species of this tribe have only one pair of ocelli (see Duffy, 1960).

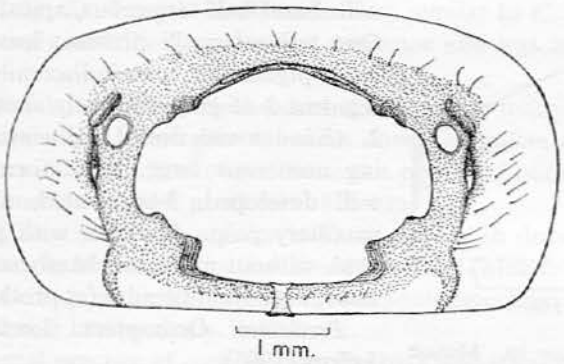

Fig. 104. *Rosalia hariola* Thomson. Mature larva. Mouthframe. Frontal aspect.

ampullae glabrous, non-tuberculate, with posterior transverse impression indistinct. Anus trilobed, sparsely setose. *Legs* long, 4-segmented. Spiracles with peritreme broadly oval and without marginal chambers. Length up to 60 mm.; maximum breadth (at prothorax) 9 mm.

Biology. All stages have been found in wood during September.

Material studied. 1 L, India, Bengal, Darjeeling, ix.1929, from *Evodia fraxinifolia*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Rosalia (=**Eurybatus**) **lateritia** (Hope)

Distribution. ORIENTAL REGION: Burma, India (Keralia, Uttar Pradesh, West Bengal), Indo-China.

Host plants: *Quercus dilatata, Q. semicarpifolia* (Beeson and Bhatia, 1939).

Biology. Adults occur from May to September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Callichromini

Chloridolum alcmene Thomson

Distribution. ORIENTAL REGION: Andaman Is., Burma, India (Assam, Madras, Mysore), Thailand.

Host plants: *Citrus aurantium, C. medica* (Beeson, 1941). *Citrus reticulata* (Bessom Meksomssee).

Mature larva (fig. 105). The only larva of this genus available is in very poor condition, consequently the following description is incomplete. *Head* (fig. 105) with frons strongly sinuate medially; a pair of pits (pores?), each with an anterior carina, situated alongside frontal sutures. Mouthframe pale, feebly sclerotized. Mandible

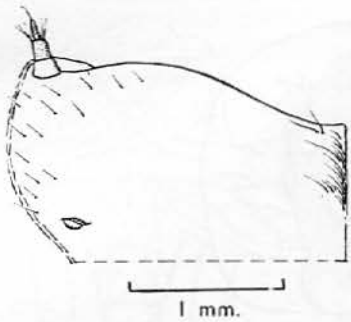

Fig. 105. *Chloridolum* sp. Mature larva. Left half of anterior part of frons showing position of pit in relation to frontal suture.

with basal half testaceous, apical half ferruginous. One pair of ocelli present; lens large, elongate-oval, pigmented spot indiscernible. Maxilla with segment 3 of palp distinctly shorter than segment 2. *Abdomen* with dorsal and ventral ampullae bearing numerous large, moniliform tubercles. *Legs* well developed, 3-segmented, about as long as maxillary palp. *Spiracles* with peritreme broadly oval, without marginal chambers. Length up to 50 mm.; maximum breadth (at prothorax) 9 mm.

Predators. Orthoptera. Locustidae (Maxwell-Lefroy, 1906).

Control. Orange trees should be heavily manured to maintain in good condition. Old infested trees should be cut down and burnt. Other methods suggested are the extraction of larvae with a bent wire, the injection of larval galleries with kerosene and the hand collection of adults (Maxwell-Lefroy, 1906).

Material studied. 1 L, Thailand, from *Citrus nobilis*, Bessom Meksomssee pres., in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Ebening, 1950 (Biol.); Fletcher, 1914 (I fig., Biol.), 1919 (?), 1921 (Biol.); Kunhi Kannan, 1928 (Biol.); Maxwell-Lefroy, 1906 (I fig., Biol. Contr.); Maxwell-Lefroy and Howlett, 1909 (I fig., Biol.); Quayle, 1938 (Biol.); Ramakrishna Ayyar, 1940 (L fig., P fig., I fig., Biol., Contr.); Stebbing, 1914 (I fig., Biol.); Subramania, 1921 (Biol.).

Chloridolum cyanipes Thomson

Distribution. ORIENTAL REGION: Borneo, Java.

Host plant: *Buchanania florida* (Kalshoven, 1955).

Biology. Shelford (1916) recorded that *Chloridolum* beetles in Borneo "emit a strong, but to human nostrils, by no means unpleasant odour, proceeding from glands in the thorax, which open to the exterior by two pores".

References. Kalshoven, 1955 (Biol.); Shelford, 1916 (Biol.).

Chloridolum thaliodes Bates

[The Larger Green Longicorn Beetle]

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Populus*, *Salix* (Shiraki, 1952).

Reference. Shiraki, 1952 (Biol.).

Chelidonium brevicorne Franz

Distribution. ORIENTAL REGION: Malaya.

Host plants: *Eugenia jambos* (Department of Agriculture, Malaya); *Eugenia caryophyllata* (Miller, 1931).

Adult (Pl. VIII, fig. 2). Length 18–30 mm. Very similar to *C. cinctum* (Guérin-Méneville) but entirely metallic green, except antennae and legs which are metallic blue.

Mature larva. Similar to that of *Nothopeus* but differing as follows. *Abdomen* with segments 2–6 separated by intersegmental skin; dorsal ampullae only slightly protuberant. *Spiracle* with upper part of peritreme not produced outwards. Length up to 50 mm.; maximum breadth (at prothorax) 8·5 mm.

Biology. The life-cycle of this species is about a year in duration, oviposition probably taking place in May and pupation about February (Miller, 1931).

The pupal cell (with pupa *in situ*) and prepared adult emergence holes are shown on Plate VII, figs. 2 and 1 respectively.

Control. The usual practice of cutting away the bark and spearing the larvae with a wire is considered to cause irreparable damage to the tree. The following measures are recommended. Careful pruning of smaller infested branches; treating the cut surfaces with tar; the application to trunks and lower branches of washes of which one consisting of fish-oil and crude carbolic acid would probably prevent oviposition (Miller, 1931).

Material studied. 2 L, Malaya, Penang, Balik Pulau, 5.ii.1948, from *Eugenia jambos*, in coll. D.A.M.

References. Evans, 1952 (Biol.); Miller, 1931 (L fig., Biol., Contr.), 1932 (Biol.); Mühlmann, 1954 (Biol.).

Chelidonium argentatum (Dalman)

[The Greenish Lemon Longhorn]

Distribution. ORIENTAL REGION: Burma, China, Hainan Is., India (Assam), Indo-China (Viet Nam).

Host plants: *Citrus limonia* (Gressitt, 1939); *Citrus aurantium, C. aurantifolia, C. microcarpa, C. reticulata, Fortunella margarita* (Gressitt, 1942).

Biology. Eggs are deposited in young terminal stems and the resulting larvae bore down into the branches, causing some degree of withering. The pupal cell is plugged with an operculum of calcium carbonate.[26] The adults, which are diurnal, emerge during May and June, and may be found resting on leaves and green shoots or in flight (Gressitt, 1942).

Economic importance. This species is only of moderate importance as a *Citrus* pest, though sometimes young plants are hollowed to the root and killed (Gressitt, 1942).

Control. Careful pruning and the extraction of larvae from branches should effectively control this species (Gressitt, 1942).

References. Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gressitt, 1939 (Biol.), 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Ramachandran, 1953 (Biol.).

[26] The habit of secreting calcium carbonate occurs in a number of genera of Callichromini (see Duffy, 1960), as well, of course, as in the Cerambycini and Oemini.

Chelidonium sinicum (White)

Distribution. ORIENTAL REGION: Burma, China.

Host plant: *Quercus lindleyana* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Chelidonium gibbicolle (White)

Distribution. ORIENTAL REGION: China.

Host plant: *Citrus* (Mühlmann, 1954).

References. Hoffmann, 1934 (Biol.); Mühlmann, 1954 (Biol.).

Chelidonium cinctum (Guérin-Méneville)[27]

[The Large Citrus Borer or the Lime Tree Borer]

Distribution. ORIENTAL REGION: Burma, India (Kerala, Madras, Maharashtra, Mysore).

Host plants: *Citrus aurantium, C. medica* (Beeson and Bhatia, 1939); *Citrus maxima* (Bhasin, Roonwal and Balwant Singh, 1958).

Adult (Pl. XVI, fig. 2). Length 21-32 mm. Entirely dark metallic green or blue, except for a submedian, irregular, yellow band across elytra. *Head* with antennae filiform, rather thick, slightly longer than body in male, about as long as body in female. *Prothorax* transverse, with a pair of stout lateromedian tubercles. Elytra gradually narrowed posteriorly and separately rounded apically.

Mature larva. Similar to that of *C. brevicorne* Franz although markedly differing in certain respects. *Head* with ocellar lens round, strongly convex and transparent; pigmented spot large, very distinct; vestigial ocelli (ferruginous spots) larger. *Abdomen* with ampullae tuberculate, the tubercles matt and microspiculate. *Spiracles* with peritreme at most broadly oval and not strongly protruding or obliquely set. Length up to 62 mm.; maximum breadth (at prothorax) 10 mm.

First-instar larva. According to Kunhi Kannan (1928), this instar is equipped dorso-laterally with three pairs of conical spines (egg-bursters) on abdominal segments 5–7.

Egg. Diaphanous green, broadly oval, with a rim all round and a delicate honeycomb pattern on the upper surface (Kunhi Kannan, 1923).

Biology. Eggs are deposited in the axils of young living shoots. The larva bores into the centre of the shoot, turns upwards for about an inch and eventually cuts a complete spiral round it. It then bores downwards and enters the larger branches. Here the tunnel is about a $\frac{1}{4}$ in. in diameter, with frass-ejection holes at intervals. The pupal cell is closed at both ends with a partition of calcium carbonate and wood fibres. The life-cycle is annual with emergence occurring in May and June (Beeson and Bhatia, 1939).

[27] There has been considerable confusion in literature concerning *Chelidonium cinctum* (Guérin-Méneville) and *Chloridolum alcmene* Thomson but it has clearly been established (Kunhi Kannan, 1928) that the large cerambycid borer of *Citrus* in South India is *C. cinctum* (Guérin-Méneville).

Frass-ejection holes may be anything from an inch to as much as a foot (in larger branches) apart. It is the younger branches which are most seriously affected as too great a proportion of the sapwood is destroyed. When trees are only three or four years old, a single larva could produce fatal results but in older trees several generations are necessary to destroy them, although the quality and quantity of the fruit is adversely effected. For oviposition the female usually selects the fork of a twig smaller than a lead pencil; eggs are also often deposited at the base of a thorn arising from the twig. The egg is covered with a secretion which secures it to the twig and affords protection from the rain. The incubation period is 11 or 12 days in duration. Eggs are to be found late in June, the adults emerging at the end of April or early in May. They emit a scent reminiscent of lemon grass oil. The pupal cell contains a calcareous operculum (Kunhi Kannan, 1923, 1928).

Economic importance. In South India this beetle is a pest of orange and lime trees.

Control. In the orchards of southern India infested twigs are broken off by means of a forked stick and burnt. The girdled infested twigs turn black and are consequently easily recognizable (Beeson, 1941). This operation should be performed about the end of November and repeated at the end of January (Kunhi Kannan, 1928).

Material studied. 2 L, India, Mysore, 1942, from *Citrus aurantium*, R. N. Mathur leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cherian, 1942 (Biol.); Ebening, 1950 (Biol.); Fletcher, 1919 (Biol.), 1921 (Biol.); Gardner, 1927 (L fig.); Kunhi Kannan, 1923 (E, L fig., I fig., Biol. fig., Contr.), 1928 (L fig., I fig., Biol. fig.); Mühlmann, 1954 (Biol.); Murthi, 1922 (Biol.); Quayle, 1938 (Biol.); Ramachandran, 1953 (Biol.); Ramakrishna Ayyar, 1940 (I fig., Biol., Contr.); Subramania, 1921 (L fig., I fig., Biol., Contr.).

Nothopeus (=Coloborhombus) fasciatipennis Waterhouse

Distribution. ORIENTAL REGION: Borneo, Celebes, Sumatra.

Host plant: *Eugenia aromatica* (Kalshoven, 1935).

Mature larva (Pl. XII, fig. 3 and fig. 106). *Head* testaceous, with rounded divergent sides; frontal sutures indiscernible; front margin of frons broadly ferruginous to pitchy; six epistomal setae present. Genae, temples and frons bearing rather dense, short, ferruginous setae. Labrum small, semicircular, fringed with pale setae. Mandible entirely pitchy and bearing at least two bristly setae on outer face. Ocellus with lens large, oval, strongly sclerotized, opaque and ferruginous; one, or possibly two, minute vestigial ocelli present behind true ocellus, the lens in the form of a small ferruginous spot which is slightly larger than the surrounding scattered setal pores. Antenna with segment 3 elongate, about twice as long as basal width and about one-quarter length of segment 2. Maxilla with segment 3 of palp about half length of segment 2; dorso-external process of palpifer minute. Hypostoma testaceous, bearing a few scattered coarse setae, smooth. Gula broad and strongly raised. *Prothorax* with front margin broadly pale ferruginous and rather densely covered with short ferruginous setae; posterior part rather strongly longitudinally striate. Eusternum and

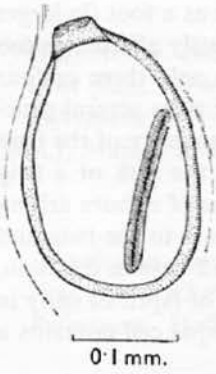

Fig. 106. *Nothopeus fasciatipennis* Waterhouse. Mature larva. Spiracle of abdominal segment 7.

sternellum smooth, extensively glabrous. *Abdomen* (Pl. XII, fig. 3) with dorsal ampullae very strongly protuberant and bilobed, feebly and irregularly tuberculate and glabrous. Anal lobes bearing numerous fine ferruginous setae. Pleural discs indistinct. *Legs* well developed, 3-segmented, at least as long as maxillary palp. *Spiracles* with peritreme set obliquely to longitudinal axis of body and with upper part produced outwards (fig. 106); large, broadly oval to subcircular, with marginal chambers absent. Length up to 50 mm.; maximum breadth (at prothorax) 9 mm.

Biology. Larvae tunnel in the trunks of living trees which are killed by being ringed by subcortical galleries. Some galleries attain a length of five to eight feet (Kalshoven, 1936b).

Material studied. 3 L, Sumatra, Benkulen, 1955, from *Eugenia aromatica*, L.G.E. Kalshoven leg., in coll. L.G.E.K.

References. Kalshoven, 1935 (I fig., Biol.), 1936b (Biol.), 1951 (Biol. fig.); Mathur and Balwant Singh, 1959 (Biol.); Mühlmann, 1954 (Biol.).

Nothopeus (=Coloborhombus) hemipterus (Olivier)

Distribution. ORIENTAL REGION: Borneo, Burma, Java, India (Bihar, Uttar Pradesh), Malaya, Sumatra, Thailand.

Host plants: *Eugenia malaccensis*, *E. aquea* (Kalshoven, 1935); *Psidium guajava* (Fletcher, 1932); *Eugenia aromatica*, *E. polyantha*, *E. cumini*, *Lagerstroemia speciosa*, *Tristania* sp. (*conferta*?) (Franssen, 1937b).

Biology. In India this species attacks living guava trees and, in Java, living clove trees. The movements of the adult are very like those of a psammocharid wasp (Beeson, 1941). The eggs are deposited separately on the lower part of the trunk, usually not more than two metres above ground-level. The incubation period averages 15 days. Larvae are usually confined to the basal part of the tree where they tunnel deep into the wood: only occasionally are galleries to be found to be entirely subcortical. A heavy infestation may result in killing the tree. The larval stage averages 248 days. Before pupating the larva closes the gallery with a plug of wood fragments. The life-cycle averages 328 days in duration. Under laboratory conditions female beetles survived for about 16 days and laid, on an average, 40 eggs (Franssen, 1937b).

Control. The injection of carbon bisulphide into the galleries has proved successful according to Fletcher (1932).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Fletcher, 1932 (Biol., Contr.); Franssen, 1937b (E fig., L fig., P fig., I fig, Biol fig., Contr.); Kalshoven, 1935 (Biol.), 1951 (L fig., Biol. fig); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.); Mühlmann, 1954 (Biol.).

Nothopeus (=Coloborhombus) fulvus Bates

Distribution. ORIENTAL REGION: Burma, India (Assam, Sikkim, Uttar Pradesh).

Host plants: *Zizyphus rugosa* (Gardner, 1931b); *Lagerstroemia speciosa* (Mathur and Balwant Singh, 1960c).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1961b (Biol.), 1961c (Biol.).

Aphrodisium cantori (Hope)

Distribution. ORIENTAL REGION: India (Assam, Uttar Pradesh).

Host plants: *Buchanania latifolia, Mallotus philippinensis, Salix tetrasperma* (Beeson and Bhatia, 1939).

Mature larva (fig. 107). *Head* with genae, temples and frons bearing rather sparse long setae. Ocellus with pigmented spot at least partly discernible beneath; vestigial ocelli absent or indiscernible. Antenna with segment 3 three to four times as long as basal width and bearing an apical seta which is longer than segment 3. Hypostoma with front margin broadly ferruginous. *Prothorax* with a rather distinct median,

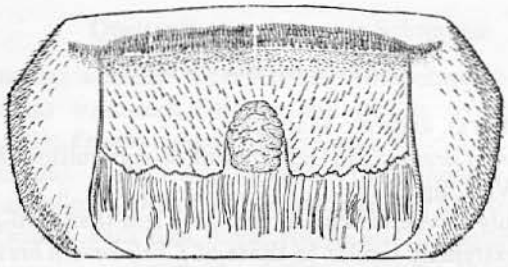

Fig. 107. *Aphrodisium cantori* (Hope). Mature larva. Prothorax. Dorsal aspect.

oval, wrinkled area (fig. 107). *Abdomen* with ampullae non-tuberculate, feebly protuberant and finely wrinkled. *Spiracles* with peritreme at most broadly oval and not strongly protruding and obliquely set. Length up to 70 mm.; maximum breadth (at prothorax) 14 mm.

Biology. This species attacks in particular living trees of *Mallotus philippinensis*, especially those not exceeding 1½ ft in girth. The irregular larval galleries extend in the heartwood from ground level to about 10 ft. above. Ejection holes are made at intervals along the gallery which is kept clear of frass. Piles of fine brown wood-dust at the base of the tree indicate that it has become infested. Attack is apparently not fatal to the tree. Adults emerge from July to October (Beeson and Bhatia, 1939).

Material studied. 1 L, India, Uttar Pradesh, Fatehpur, 15.ii.1925, from *Mallotus phillippinensis*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L fig.); Mathur and Balwant Singh, 1961 (Biol.).

Aphrodisium hardwickianum (White)

Distribution. ORIENTAL REGION: India (Uttar Pradesh), Nepal.

Host plant: *Quercus incana* (Beeson and Bhatia, 1939).

Biology. Oviposition takes place on the crown, side branches and the upper portions of stems of living trees. The young larva starts to tunnel along the branch towards the stem into which it enters and continues to tunnel downwards. Continuous re-infestation throughout several years results in extensive excavations. Thus the tree is eventually killed and the value of the wood for fuel is appreciably reduced. The life-cycle is probably annual. Recent attack is evident by the piles of ejected frass and the crescent-shaped emergence holes in the stem (Beeson and Bhatia, 1939).

Control. Before stacking for fuel, logs should be split into pieces small enough to ensure that all the larvae present are killed; alternatively they should be removed from the forest as soon as possible. In young stands of *Quercus* in which the incidence of attack is comparatively light, annual inspections are recommended in order to fell and remove recently killed trees. This should be accomplished before May (Beeson, 1941).

References. Beeson, 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Mathur and Balwant Singh, 1960d (Biol.).

Niraeus tricolor Newman

Distribution. ORIENTAL REGION: Malaya.

Host plant: *Eugenia aromatica* (Department of Agriculture, Malaya).

Adult. See Plate VIII, fig. 1.

Mature larva. Only larvae which are probably less than half-grown are available. They appear to be extremely similar to those of *Chelidonium brevicorne* Franz, differing only in having a transparent and non-pigmented ocellar lens and with the vestigial ocelli absent. Form extremely slender. Length up to 30 mm.?; maximum breadth (at prothorax) 4·75 mm.?

Biology. Before pupating, the larva prepares a calcium plug to block the exit from the pupal chamber (see Pl. VI, fig. 1).

Predators. Both larvae and pupae are known to be devoured by rhysodid larvae (see photographs by H. T. Pagden on Pl. V, figs. 2 and 3).

Material studied. 2 L, Malaya, Penang, Balik Pulau, Bukit Batu Hitam, 19.xi.1947, from *Eugenia aromatica*, in coll. D.A.M.

References. None available.

Zonopterus corbetti Gahan

Distribution. ORIENTAL REGION: Burma, India.

Host plant: *Lettsomia strigosa* (Mathur and Balwant Singh, 1960c).

Reference. Mathur and Balwant Singh, 1960c (Biol.).

Polyzonus tetraspilotus (Hope)

Distribution. ORIENTAL REGION: Burma, India (Assam).
Host plant: *Acacia caesia* (Bhasin and Roonwal, 1954).
Reference. Bhasin and Roonwal, 1954 (Biol.).

Pachyteria bicolor Parry

Distribution. ORIENTAL REGION: Java.
Host plant: "tjongtjoran" (Kalshoven, 1955).
Biology. According to Kalshoven (1955), this beetle moves in a jerky manner and is somewhat wasp-like in behaviour. Like some *Xystrocera* species, it emits an aromatic odour and readily feeds on honey in captivity.
Reference. Kalshoven, 1955 (Biol.).

Pachyteria virescens Pascoe

Distribution. ORIENTAL REGION: Celebes, Malaya, Penang Is.
Host plant: *Palaquium gutta* (Miller, 1932).
References. Kalshoven, 1955 (Biol.); Miller, 1932 (Biol.).

Quettania coeruleipennis Schwarzer

Distribution. ORIENTAL REGION: West Pakistan (Baluchistan).
Host plants: *Prunus armeniaca* (Beeson and Bhatia, 1939); *Prunus amygdalus*, *P. avium* (Beeson, 1941); *Prunus cerasus* (Janjua and Samuel, 1941).
Mature larva (fig. 108). Rather similar to that of *Nothopeus fasciatipennis* Waterhouse but differing as follows. *Head* with genae, temples and frons with setae dense, longer and finer. Ocellus with lens thick, round and transparent; pigmented spot large and distinctly visible through lens; sclerotization of gena embracing ocellus ventrally; vestigial ocelli absent. Mentum with sides densely fringed with long fine setae. Hypostoma with front margin broadly ferruginous. *Prothorax* with setae long and fine. *Abdomen* with ampullae rather strongly bilobed, microgranulate, strigose and non-tuberculate. Anal lobes (fig. 108) with a minute but distinct sclerotized "pit" at each extremity of the Y-shaped cleft. *Spiracles* with peritreme set vertically to longitudinal axis of body, rather broadly and regularly oval. Length up to 28 mm.; maximum breadth (at prothorax) 6 mm.

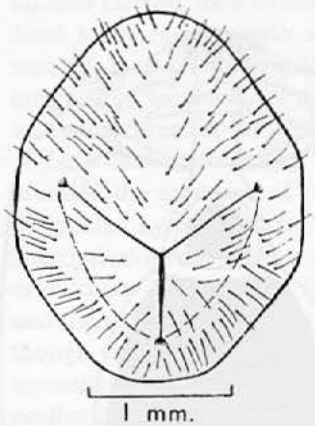

Fig. 108. *Quettania coeruleipennis* Schwarzer. Mature larva. Abdominal segments 9 and 10. Caudal aspect.

The presence of the curious sclerotized areas on the anal segment is apparently unique in cerambycid larvae. It is difficult to suggest the function or purpose of these areas unless this could be a modification to overcome the complications of constipation!

Biology. Infested twigs become hollow and dry up

and places where larvae have entered the shoot or twig are indicated by having a globule of gum on one side. As the larva works its way downwards it leaves a watery fluid which oozes out of the occasional holes made along the branch. Infested shoots and branches are broken off by strong winds. Old trees are preferred. Larvae remain active throughout winter. Adults emerge in May, the life-cycle being completed in one year (Janjua and Samuel, 1941).

Economic importance. Larvae of this species infest the branches of living apricot trees and the top shoots and small branches of cherry trees.

Control. Infested branches should be cut off at the time of pruning (Beeson, 1941).

Material studied. 2 L, India, Quetta, 8.vi.1931, from *Prunus amygdalus*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (E, L (as unidentified larva)), 1944 (L); Janjua and Samuel, 1941 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Aromia moschata (Linnaeus) (including **m. moschata** (Linnaeus) and **m. orientalis** Plavil'shchikov)

[The Musk Beetle]

Distribution. ORIENTAL REGION: China (Manchuria). PALAEARCTIC REGION: Algeria, Asia, British Isles, Europe, Japan, Korea, Mongolia, Morocco, Siberia, Tunisia.

Host plants: *Salix* species, especially *S. atrocinerea*, *S. caprea* and *S. viminalis* (Duffy, 1949); *Salix purpurea*, *Populus suaveolens* (Gressitt, 1951); Paulian and Villiers (1941) record also *Acer pseudoplatanus*.

Mature larva (figs. 109–111). *Head* slightly rugose, with rounded divergent sides (figs. 109–110); frontal sutures indistinct, median adfrontal suture well defined. Front margin of frons narrowly ferruginous. Labrum semicircular. Mandible short, robust; basal part pale, separated from apical pitchy part by a deep transverse impression.

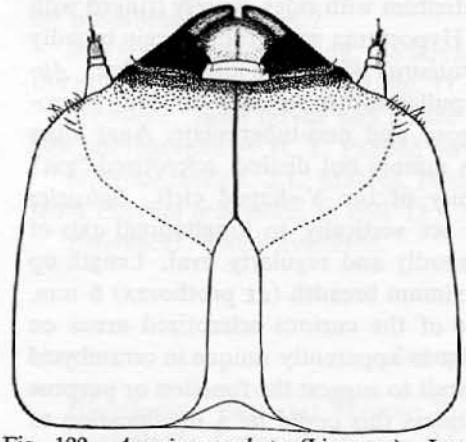

Fig. 109. *Aromia moschata* (Linnaeus). Larva form "b". Head. Dorsal aspect. (Duffy, 1949a)

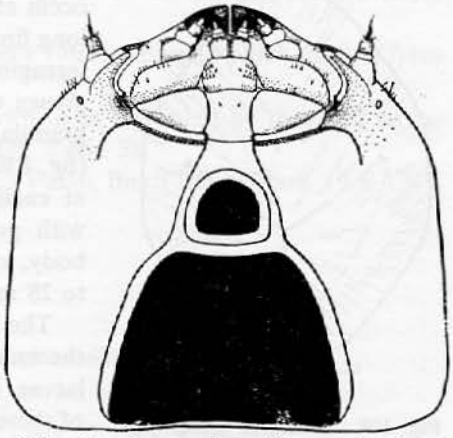

Fig. 110. *Aromia moschata* (Linnaeus). Larva form "b". Head. Ventral aspect. (Duffy, 1949a)

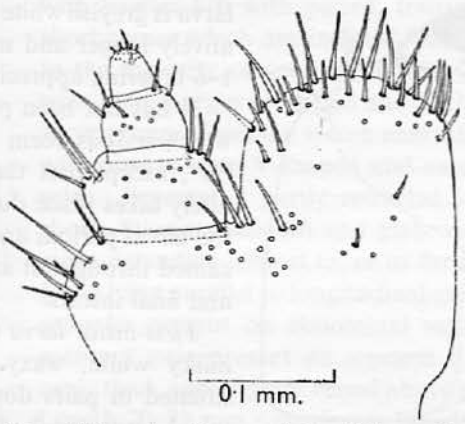

Fig. 111. *Aromia moschata* (Linnaeus). Mature larva. Apical part of maxilla. Ventral aspect. (Duffy, 1949a)

Antenna small, salient; segment 3 cylindrical, at least twice as long as basal width. One pair of ocelli present just behind and ventrad to antenna; lens small, oblong, convex (often indistinct); pigmented spot grey, rather indistinct. Maxilla (fig. 111) with segment 3 of palp shorter than segment 2; maxillary lobe glabrous on entire inner margin; dorso-external process of palpifer extremely small. Hypostoma with front margin very narrowly ferruginous; sutures broadly curved. Gula very broad, sutures indistinct. *Prothorax* with lateral regions bearing numerous short fine setae. Pronotum rectangular, glabrous, milky white and shining; posterior half rather coarsely and longitudinally rugose. *Abdomen* with dorsal ampullae marked by a shallow median longitudinal furrow, one anterior transverse straight furrow and a posterior transverse, bilobed furrow, their extremities being connected with a pair of deep lateral furrows. Anal lobes rugose, with scattered short setae. Pleural discs indistinct. *Legs* 4-segmented, longer than maxillary palp; unguiculus strongly sclerotized, ferruginous and imbricately spinose. *Spiracles* with peritreme thin, testaceous. Length up to 35 mm.; maximum breadth (at prothorax) 8·5 mm.

Later-instar larvae (fig. 112). The examination of a large number of larvae has revealed the existence of two quite diverse larval forms which have previously been designated by the author (1949) as forms "a" and "b". Form "b" corresponds to the description already given of the mature larva, which is yellowish white and almost cylindrical. In form "a" (fig. 112), the mandibles are much more strongly produced and their basal part is much darker than the head capsule, being usually ferruginous, though sometimes as dark as the apical part. The head is more strongly depressed, smoother and darker. The second antennal segment is proportionately longer. The ocellus has a strongly protuberant lens. The gula is narrower. There are no sclerotized weals on the sides of the meso- and metathorax and the legs are smaller. All the setose and pigmented areas of the prothorax are denser and more clearly defined, sclerotized parts such as the mandibles being smooth and shining. This form of the

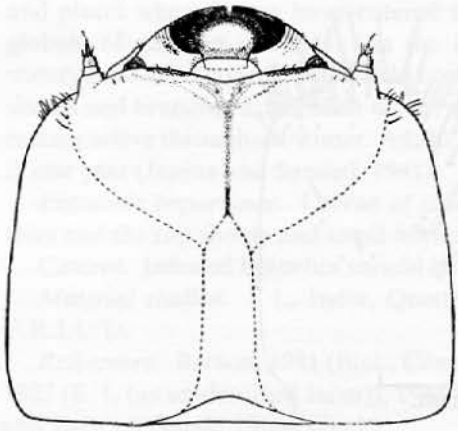

Fig. 112. *Aromia moschata* (Linnaeus). Larva form "a". Head. Dorsal aspect. (Duffy, 1949a)

larva is greyish white in colour and comparatively longer and more slender, segments 1–6 tapering appreciably.

It has not been possible to ascertain at which ecdysis form "a" changes to form "b", except that the transformation definitely takes place during the latter half of the larval period, and that form "b" is assumed throughout at least the penultimate and final instars.

First-instar larva (figs. 113–114). Cuticle milky white, waxy. Egg-bursting spines situated in pairs dorso-laterally on abdominal segments 3, 4, 5, and usually 6, although in some specimens examined the last pair were rudimentary (fig. 113). Each spine (fig. 114) is stout, thorn-like and reddish brown; at the base it merges into a circular, sclerotized plate similarly pigmented. *Spiracles* biforous. Length up to 2·5 mm.

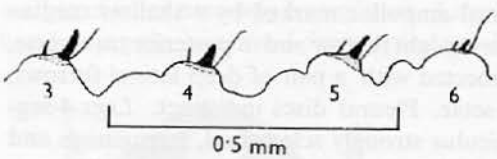

Fig. 113. *Aromia moschata* (Linnaeus). First-instar larva. Egg-bursting spines of abdominal segments 3–6. (Duffy, 1949a)

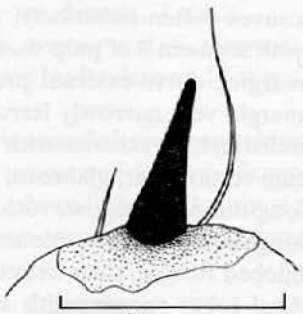

Fig. 114. *Aromia moschata* (Linnaeus). First-instar larva. Egg-bursting spine (greatly enlarged). (Duffy, 1949a)

Pupa (fig. 115). *Head* totally concealed from above; elongate, triangular; vertex dome-shaped, smooth and usually glabrous; front smooth and glabrous; clypeus with a deep transverse impression at base, glabrous. Antennae extending as far as abdominal segment 3 or 4, where they are recurved ventrally. Eyes feebly convex, glabrous. Labrum cordate, glabrous. *Pronotum* with sides bearing a pair of lateral tubercles; front margin strongly produced medially, V-shaped and bearing several groups of short fine setae as figured (their distribution varies somewhat intraspecifically). *Mesonotum* with a few very fine short setae; scutellum pointed, transversely striate, glabrous. *Metanotum* smooth, bearing a few fine short setae; scutellar groove rather broad and shallow. Elytra and wings extending to abdominal segment 4. *Abdomen*

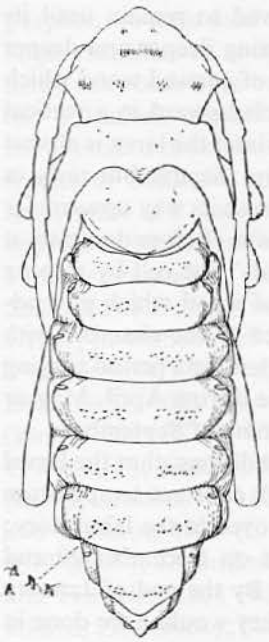

Fig. 115. *Aromia moschata* (Linnaeus). Female pupa. Dorsal aspect. (Duffy, 1949a)

with tergites 1–6 with paired, transversely oval groups of short spines which are inclined forward (not backward, as in the majority of species). Tergite 7 much less transverse, with hind margin produced and V-shaped; bearing a transverse group of similar spines near hind margin. Tergite 8 with hind margin V-shaped and usually bearing a pair of setae. Segment 9 partly retracted in segment 8 and very short. Sternites smooth and glabrous. *Legs* with hind femora extending almost to, or as far as, abdominal segment 6 and lying parallel to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–7 but a rudimentary pair present on segment 8; peritreme narrowly oval, thick and slightly raised above general level of cuticle. Length 20–33 mm.; maximum breadth 6 mm.

Egg. Length 2·9 mm.; breadth 1·2 mm. Form elongate-ovoid, slightly depressed, one pole usually more attenuated than the other. The shape seems to vary considerably, especially the degree of attenuation of one or both poles and the degree of depression; some are straight and enlarged in the middle, whereas others are slightly curved and almost parallel-sided. The newly laid eggs are milky white in colour and the chorion, which at this stage is transparent, is covered with a thin, sticky coating which serves to secure the eggs to the bark. There are no appreciable signs of pigmentation or sculpturing of the chorion until, usually, about twelve hours after the eggs have been deposited; they are then yellowish green, becoming pale green later. The chorion is thick and is marked out into microscopic polygonal areas which correspond with the overlying follicular cells; this reticulation is best seen when the embryo is fully developed. Periods of incubation between fourteen and twenty days have been observed (Duffy, 1949).

Biology. Either the main stem or the bases of the stoutest branches are selected for oviposition, as these invariably bear numerous crevices and fissures suitable for egg sites. Entrance burrows and emergence holes of other wood-boring insects are often utilized. An average of 48 eggs has been obtained from the dissected ovaries of several females (Duffy, 1949).

Although it seems to be a generally accepted fact that larvae of this species infest only old, rugged, though not necessarily rotten, willows, it has been the author's experience that this species shows a decided preference for young slender sallow bushes. In most cases it was the main stems (which varied approximately between 2 and 6 in. in diameter) which showed the most extensive signs of attack. Practically all the most seriously infested bushes were growing in ground subject to flooding during the winter months. Upon leaving the egg-shell, the first-instar larva commences to bore its way through the bark, an operation which usually takes from two to four days, according to the thickness it has to penetrate. As it tunnels, the gnawed wood is excreted in the form of fine powdery frass. When it has passed through the bark, it feeds sub-corti-

cally, where, under laboratory conditions it has been observed to remain until its third stadium. It then proceeds in a horizontal direction, boring deeper and deeper into the sapwood, pushing behind it all the frass and particles of gnawed wood which accumulate. When the heartwood is reached, the larva tunnels upward in a vertical direction, often for a distance of a foot or more. By the third winter the larva is almost full-grown. During the coldest months it remains more or less inactive but early in the spring it bores to just beneath the bark, whereupon it gnaws its way upward for another 4 or 5 in. by which time it is mature and ready to pupate. Before doing so, it enlarges the portion of the tunnel which it occupies and "pads" the cell by rasping the walls with its mandibles; this produces minute shavings of wood which give additional protection to the pupa. Having plugged the entrance to the chamber with coarse wooden shavings, it reverses its position, and lies motionless for a period varying from two to ten weeks until its final ecdysis, which takes place during April, May or June. Adults emerge from about the end of June to the beginning of September.

It is probable, under exceptionally cold and dry weather conditions, that the larval period would be prolonged by an additional year. That a high constant temperature does have an accelerating effect on larval development was proved in the laboratory; first-instar larvae were brought in from their natural habitat on December 29 and were subjected to an average temperature of 65°F [18·3°C]. By the end of January they had pupated; this was at least two months earlier than they would have done in their natural environment.

When molested the larva extrudes from between its parted mandibles a yellowish grey, viscous globule; a litmus test proved this to be acid. Apparently this is its only defence against intruders.

Owing to its prolonged lignicolous existence, it has not been possible to ascertain the exact number of times the larva undergoes ecdysis. Ova were hatched under laboratory conditions, and larvae from these attained their third stadium; unfortunately they later became desiccated owing to overheated conditions. Later, additional material was obtained which chiefly comprised larvae about two-thirds grown; four of these were observed to undergo ecdysis three times, the third revealing the pupa. From this observation it would appear that there are at least five instars. The type of habitat so often harbouring *Aromia* larvae rather suggests that they may be to a certain extent resistant to drowning, since the lower portions of stems known to be infested with them have in several instances been seen to be submerged for weeks at a time (Duffy, 1949).

Parasites. Hymenoptera: *Deuteroxorides albitarsus* Grav. (Duffy, 1949); *Ischnoceros rusticus* Grav. (Brischke, 1810); *Perithous mediator* Grav., ?*Pimpla lignicola* Ratz. (Xambeu, 1898–1902); *Xorides praecatorius* (F.) (Reineck, 1919).

Natural enemies. The Green Woodpecker (*Gecinus viridis*).

Economic importance. Aromia moschata (Linnaeus) has never been regarded as a serious pest in the British Isles as few of the trees which it attacks are of commercial value. Only four of the native willows are grown for their timber, the Bat Willow (*Salix caerulea*) being the only one that is grown systematically. Osiers are grown extensively in riverside beds for the production of shoots for basket-weaving: *Salix viminalis*, *S. purpurea* and *S. aurita*, with numerous varieties, are cultivated for this

purpose. *Aromia* used to be regarded as a serious pest by osier growers but since 1925 large quantities of continental osiers have been imported with the consequence that many osier beds have been neglected as local production proved uneconomical (except for a limited market for certain varieties). It seems probable that this may have resulted in an increase in the numbers and colonies of this insect. As most other species of *Salix* are grown chiefly for ornamental and shade purposes, *Aromia* is really more of a plantation than a timber pest. In the south of England *S. atrocinerea* appears to be the preferred host plant.

Material studied. 28 L, England, Surrey, Ash, 7.vii.1944, in young branches of *Salix*, E.A.J.D. leg., in coll. B.M.; 17 L, 4 P, England, Surrey, Croydon district, v.1947, in branches of *Salix*, E.A.J.D. leg., in coll. B.M.

References. Barbey, 1913 (Biol. fig.); Bedel, 1889 (Biol.); Caillol, 1914 (Biol.); Della Beffa, 1931 (Biol. fig.); Donisthorpe, 1945 (Biol.); Duffy, 1945a (Biol.), 1945b (Biol.), 1949a (E fig., L fig., P fig., Biol. fig.), 1953 (E fig., L fig., P fig., Biol. fig. Paras.), 1947 (L, P); Emden, 1939–1940 (L); Escherich, 1923 (Biol. fig.); Gillanders, 1912 (Biol.); Gressitt, 1951 (Biol.); Haines, 1944 (Biol.); Henriksen, 1914 (L fig.); Houlbert and Monnot, 1908 (L fig.); Jarvis, 1944 (Biol.); Kaltenbach, 1874 (Biol.); Lefroy, 1873 (Biol.); Lunardoni, 1889 (Biol.); Massee, 1945 (Biol.); Ministry of Agriculture and Fisheries, 1931 (Biol.); Mühlmann, 1954 (Biol.); Perris, 1877 (L fig., P, Biol.); Piffard, 1902 (Biol.); Planet, 1890 (L fig., Biol.); 1924 (Biol.); Röthenburg, 1907 (Biol.); Schiödte, 1876 (L); Stephens, 1945 (Biol.); Trägårdh, 1922 (Biol. fig.); Villiers, 1946 (I fig., Biol.); Westwood, 1839 (L fig., Biol.); Xambeu, 1898–1902 (L, P, Biol.).

Aromia bungii (Faldermann)

[The Plum and Peach Longhorn]

Distribution. ORIENTAL REGION: China (Fukien, Kwangtung). PALAEARCTIC REGION: Korea.

Host plants: *Prunus japonica*, *P. mume*, *P. persica* (Gressitt, 1942).

Adult (Pl. IV, fig. 2). Length 22–38 mm. Entirely blue-black, shining, except pronotum which is bright red. *Head* with antennae much longer than body on male but only slightly longer in female. *Prothorax* with a pair of stout lateral tubercles; disc with four rounded tubercles. *Elytra* narrowed posteriorly, with apicies rounded.

Biology. The larva tunnels in both sapwood and heartwood of the trunks or larger branches of living, though generally unhealthy, trees. Larvae feed subcortically until nearly mature, and then penetrate the heartwood, extending obliquely upward to excavate the pupal cell. Adults eclode probably in late winter or early spring (Gressitt, 1942).

Economic importance. When abundant this species can become a serious pest, greatly weakening trees and probably occasionally killing them. The yield of fruit may be considerably reduced (Gressitt, 1942).

Control. Larvae should be extracted by means of a hooked wire. Adults can be collected in the daytime on branches, trunks and flowers (Gressitt, 1942).

Reference. Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.).

Hexamitodera semivelutina Heller

Distribution. ORIENTAL REGION: Celebes.
Host plant: *Eugenia aromatica* (Kalshoven, 1936b).
References. Kalshoven, 1951 (Biol.), 1936b (?); Mühlmann, 1954 (Biol.).

Anubis inermis (White)

Distribution. ORIENTAL REGION: Burma, China, India (Sikkim), Malacca, Thailand, West Pakistan.
Host plant: *Eugenia* sp. (Pakistan Forest Institute).
References. None available.

Osphranteria coerulescens Redtenbacher

Distribution. ORIENTAL REGION: West Pakistan. PALAEARCTIC REGION: Persia.
Host plant: *Pyrus malus*? (Pakistan Forest Institute).
References. None available.

Pyrestini

Pachylocerus pilosus Guérin-Méneville

Distribution. ORIENTAL REGION: Java.
Host plant: Loranthaceae (Kalshoven, 1955).
Biology. This species bores in living semi-parasitic plants in tree crowns. The larval galleries penetrate deeply into the tortuously grained wood. Adults superficially resemble anthribids (Kalshoven, 1955).
Reference. Kalshoven, 1955 (Biol.).

Pachylocerus crassicornis (Olivier)

Distribution. ORIENTAL REGION: Ceylon, India (Goa, Maharashtra, West Bengal), Pakistan.
Host plant: *Loranthus longiflorus* (M. A. Ghani).
References. None available.

Pyrestes cardinalis Pascoe

[The Camphor Reddish Longicorn]

Distribution. ORIENTAL REGION: China, Formosa. PALAEARCTIC REGION: Japan.
Host plants: *Cinnamomum camphora, Machilus thunbergii* (Mühlmann, 1954).
References. Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Erythrus westwoodi White

Distribution. ORIENTAL REGION: India.
Biology. Adults feed on flowers of *Rhus semialata* (Mathur and Balwant Singh, 1960d).
Reference. Mathur and Balwant Singh, 1960d (Biol.).

Clytini

Larval Characters

Form robust, contracted, rather strongly tapering but last two or three segments conspicuously enlarged. *Head* trapezoidal, slightly widened posteriorly. Gena hardly ever shouldered, setae present. One, two or three pairs of ocelli present. Labrum quadrate to transverse, fleshy. Mandible without a deep longitudinal impression on outer face. Hypostoma usually either rugose or longitudinally striate. Subfossal spine usually absent. Dorso-external process of palpifer much shorter than segment 3 of maxillary palp. *Prothorax* with distinct proalar plates and short lateral setae; pronotum slightly inclined anteriorly, glabrous or velvety pubescent, seldom striate, although often longitudinally rugose; median cleavage line absent or impressed. Eusternum indistinctly defined, marked by two round, glabrous, shining areas. *Abdomen* with ampullae broad, oval, flat and with two lateral and one transverse impressions (often indistinct). Pleural discs indistinct, sometimes reticulate. *Legs* absent or very small; femur wider than long.

Chlorophorus annularis (Fabricius)

[The Bamboo Tiger Longicorn or the Slender Black and Yellow Bamboo Longhorn]

Distribution. ORIENTAL REGION: Aru Is., Borneo, Burma, Buru Is., China (Chekiang, Fokien, Hopei, Kiangsu, Kwangtung), Cocos-Keeling Is., Formosa, Hainan Is., India (Assam, Punjab), Indo-China, Java, Malaya, New Guinea, Nicobar Is., Philippines, Sarawak, Singapore, Sumatra, Thailand, Timor Is. PALAEARCTIC REGION: Japan, Korea. AUSTRALASIAN REGION: Australia (imported), Micronesia (Bonin Is., S. Mariana Is.). HAWAIIAN REGION: Hawaiian Is.

Host plants: India: *Bambusa* spp., *Dendrocalamus strictus*, *Shorea robusta*, *Tectona grandis* (Beeson and Bhatia, 1939). China: *Bambusa*, *Sinocalamus*, *Sinobambusa gibbosa*, *Spondias*, *Tectona* (Gressitt, 1942); Japan: *Gossypium*, *Liquidambar formosana* (Shiraki *et al.*, 1937); *Citrus*, *Pyrus malus*, *Vitis* (Shiraki, 1952); *Dipterocarpus tuberculatus* (D. of A., Bangkok); *Phyllostachys reticulata* (F.P.R.L.).

Adult (Pl. XVI, fig. 5). Length 10–15 mm. Densely covered with yellow pubescence, varied with brownish or blackish markings as follows: three spots on pronotum (one median, bifurcated posteriorly), one obliquely oval and one each side before middle; two curved bands and a large rounded spot on each elytron, the spot about halfway between the submedian band and apex. Ventrally with whitish pubescence. *Head* with antennae narrowly separated basally, variable in length but never as long as body. *Prothorax* glabrous, non-tuberculate. *Elytra* truncate apically, with outer angles dentate.

Mature larva. Form rather slender. *Head* subrectangular, slightly wider posteriorly, with sides rounded; entirely milky white except mouthframe, the sclerotization of which is interrupted beneath antennae. Gena gradually narrowed up to mouthframe, smooth, with a few pale setae; frons with front margin narrowly brownish, feebly sinuate medially, smooth. Antenna with segment 3 about three times as long as broad and at least two-thirds as long as segment 2 and slightly tapering apically.

One pair of ocelli present; lens small, round, feebly convex, pigmented spot indistinct. Hypostoma with front margin scarcely darker than remainder. Maxillary palp with segment 3 distinctly longer than segment 2. *Prothorax* with posterior part of pronotum feebly longitudinally striate, median cleavage line distinctly impressed. *Abdomen* with ampullae finely rugose, glabrous, median longitudinal furrow rather broad and deep; ampullae on segment 6 with areas posterior to anterior transverse impression more strongly protuberant than anterior area; all ampullae finely wrinkled. *Legs* vestigial, shorter than segment 3 of maxillary palp. *Spiracles* with peritreme rather narrowly oval, thin and pale testaceous. Length up to 23 mm.; maximum breadth (at prothorax) 4 mm.

Pupa (fig. 116). Similar to those of *Clytus*, from which it differs by the absence of ferruginous tubercles on the pronotum and by the arrangement of the spines on abdominal tergite 7 (fig. 116).

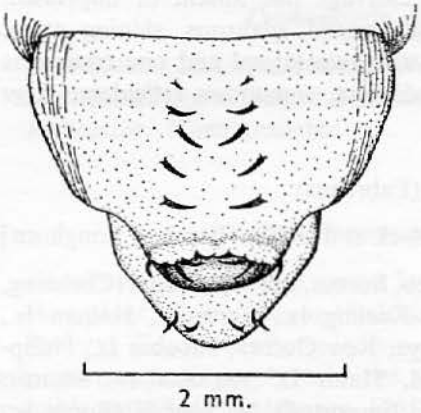

Fig. 116. *Chlorophorus annularis* (Fabricius). Male pupa. Abdominal tergites 7 and 8. (Duffy, 1953b)

Biology. Oviposition occurs most frequently on cut bamboo which has already lost a certain amount of sap. The first-instar larvae bore into the tissues of the walls of the bamboo, making irregular excavations which are packed with powdery wooden particles and frass (Pl. IX, fig. 2). The galleries are not delimited by the nodes. The mature larva excavates a cell in the wood in which it pupates (Pl. IX, fig. 1). Adults emerge from May to September but principally in June (Duffy, 1953). In China the emergence period is from April to July but May is the month of peak emergence (Gressitt, 1942).

Parasites. Hymenoptera: *Duportia cincticornis* Kieff., *Promiscolus sesquistriatus* Kieff., *Doryctes tristriatus* Kieff., *D. strioliger* Kieff., *D. picticeps* Kieff., *D. bistriatus* Kieff., *D. brevipetiolus* Kieff., *Sclerodermus domesticus* Latr. (Kieffer, 1921); *Eurytoma xylotrechi* Ferr. (Ferrière, 1933).

The hymenopterous parasites in Indo-China of possible use against controlling this species are: *Sclerodermus domesticus* Latr., *Doryctes strioliger* Kieff., *D. picticeps* Kieff. and *D. tristriatus* Kieff. (du Pasquier, 1930). See also *Xylotrechus quadripes* Chevrolat, p. 202.

Economic importance. This species is primarily a borer of dry bamboo. Owing to its particular type of habitat, development is often considerably retarded, with the result that emergence often occurs long after the bamboo has been utilized in the construction of furniture, thatching, etc. (Duffy, 1953b). Saalas (1941) gives an account of a consignment of ski-staffs which were found to be infested with larvae of this species. In India the bamboo structure of thatched roofs and field telegraph posts are frequently extensively attacked (Stebbing, 1914).

Control. Stebbing (1914) recommends the following treatment. Immerse the bamboos in water for five days (this causes a gelatinous exudation and renders the

bamboo more highly absorbent), and then allow to dry in a covered shed for several days. When quite dry, they should then be soaked in crude petroleum ("Rangoon oil") for forty-eight hours. This procedure, he maintains, gives complete protection. Craighead (1950) recommends fumigation or heat-treatment.

Material studied. 8 L, 1 P, no data, in coll. F.P.R.L.; 4 L, 1 I, Australia, New South Wales, 5.vii.1956, from bamboo from China, in coll. F.C.N.S.W.; 6 I, Java, Bogor, 19.iii.1936, L.G.E. Kalshoven leg., from bamboo, in coll. L.G.E.K.; 3 L, England, from Japanese timber, in coll. F.P.R.L.; 1 L, England, from bamboo from Thailand, 5.iv.1963, in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Chang, 1963 (Biol.); Cheo, 1935 (Biol.); Craighead, 1950 (Biol. fig., Contr.); Duffy, 1953a (L, P fig., Biol.), 1953b (L, P fig., Biol., Contr.), 1963 (L, P fig., Biol., Contr.); du Pasquier, 1930 (Paras, Contr.); Duport, 1915 (Biol.), 1920c (Biol., Paras.), 1924b (Biol., Paras.), 1925a (Biol., Paras.), 1925b (Biol., Paras.), 1926 (Biol., Paras.); Ferrière, 1933 (Paras.); Franz, 1959 (Biol.); Gardner, 1927 (L), 1945 (Biol., Contr.); Gressitt, 1942 (L, I fig., Biol., Contr.), 1951 (Biol.), 1956 (Biol.); Kalshoven, 1951 (Biol.); Kieffer, 1921 (Paras.), Kojima, 1959 (L fig.); Koningsberger, 1915 (Biol.); Mathur and Balwant Singh, 1959 (Biol.); 1961a (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Mühlmann, 1954 (Biol.); Mukaikawa, 1922 (Biol.), 1925 (Biol.); Newman, 1946 (Biol.); Saalas, 1941 (Biol. fig.); Schmidt, 1962 (Biol.); Shiraki, 1952 (Biol.); Stebbing, 1914 (Biol.); Thompson, 1943 (Paras.).

Chlorophorus anulifer Heller

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Shorea robusta* (Beeson and Bhatia, 1939).

Biology. The life-cycle of this species is usually annual but it may, like *C. annularis* (Fabricius), be prolonged. Adults emerge from June to August, mainly in July.

References. Beeson, 1935 (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Chlorophorus hederatus Heller

Distribution. ORIENTAL REGION: Burma, India (Assam, West Bengal), Thailand.

Host plants: *Pentacme suavis*, *Shorea robusta* (Beeson and Bhatia, 1939); *Albizia odoratissima*, *Anogeissus acuminata*, *Hopea odorata*, *Quercus serrata*, *Q. griffithii* (Beeson, 1941); *Shorea obtusa* (D. of A., Thailand).

Biology. Similar to that of *C. annularis* (Fabricius) except that emergence occurs from April to June but mainly in May.

References. Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961 (Biol.).

Chlorophorus jucundus (Perroud)

Distribution. ORIENTAL REGION: India (Madras, Mysore).

Host plants: *Acacia* sp., *Scutia indica* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Chlorophorus quatuordecimmaculatus Chevrolat

Distribution. ORIENTAL REGION: Burma, India (Madras, Uttar Pradesh).

Host plants: *Lagerstroemia calyculata* (Beeson and Bhatia, 1939); *Prunus avium*, *Xylia xylocarpa* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960c (Biol.), 1960d (Biol.).

Chlorophorus shoreae Gardner

Distribution. ORIENTAL REGION: India.

Host plants: *Shorea robusta* (Beeson and Bhatia, 1939); *Mallotus philippinensis* (Mathur and Balwant Singh, 1961); *Buchanania lanzan* (Bhasin, Roonwal and Balwant Singh, 1956); *Bauhinia vahlii* (Bhasin, Roonwal and Balwant Singh, 1958).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1956 (Biol.), 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Chlorophorus strobilicola Champion

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Pinus longifolia* (Champion, 1919).

Mature larva. According to Gardner (1927) this larva is very similar to that of *C. annularis* (Fabricius) from which it may be distinguished by the less elongate second segment of the antenna.

Egg. "Sausage-shaped, slightly curved on long axis, semi-opaque white in colour, 0·75 × 0·25 mm." (Champion, 1919).

Biology. Eggs are deposited singly in the crevices between the scales of mature green pine cones, approximately 15 to 20 on each cone. After about two weeks the larvae hatch and bore directly into the cone where they feed on the internal woody tissue, chiefly in the cellular parts of the scales and central axes thereby avoiding the more strongly lignified vascular tracts. During the cold weather infested cones may fall to the ground, the scales not separating as in the healthy ripe cone. Pupation takes place nearly always in the broad scale heads but sometimes in the central axis or elsewhere. After a pupation period of about two weeks the adults emerge through oval holes in the scale head. The life-cycle is normally annual with a pre-monsoon emergence period in April and the first half of May.

Economic importance. This species infests cones of pine trees growing at altitudes of from 2,000 ft. to 6,500 ft. and is commonest in open sunny stands. Normally the damage is negligible except in a bad seed year when the proportion of cones infested may rise to 40 per cent.

Control. Infested cones should be burnt (Beeson, 1941).

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Champion, 1919 (E fig., L fig., I fig., Biol. fig.); Duffy, 1953b (Biol.); Gardner, 1927 (L); Mathur and Balwant Singh, 1960d (Biol.); Mathur, Balwant Singh and Kishori Lal, 1958 (Biol.); Mühlmann, 1954 (Biol.).

Chlorophorus sumatrensis Laporte and Gory

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.

Host plant: *Dalbergia latifolia* (Kalshoven, 1955).

Reference. Kalshoven, 1955 (Biol.).

Chlorophorus acrocarpi Gardner

Distribution. ORIENTAL REGION: India (West Bengal).

Host plants: *Acrocarpus fraxinifolius* (Gardner, 1942b); *Albizia procera*, *A. stipulata* (Bhasin and Roonwal, 1954).

References. Bhasin and Roonwal, 1954 (Biol.); Gardner, 1942b (Biol.).

Clytus monticola Gahan

Distribution. ORIENTAL REGION: Jammu and Kashmir, West Pakistan. PALAEARCTIC REGION: Tibet.

Host plants: *Pistacia integerrima* (Gardner, 1931b); *Dipsacus* (Forest Institute, Peshawar).

Mature larva (figs. 117–118). *Head* (fig. 117) thick, only slightly depressed; gena gradually narrowed up to mouthframe. Mouthframe rather narrowly castaneous, with front margin of frons rather strongly sinuate medially. Temples finely strigose, with sparse, short, pale setae. Antenna with segment 2 at least twice as long as basal width; basal membrane rather strongly produced. Mandible without a longitudinal impression. Labrum slightly transversely oval, fringed anteriorly with fine, pale setae. One pair of ocelli present; lens small, round, strongly protuberant and slightly darker

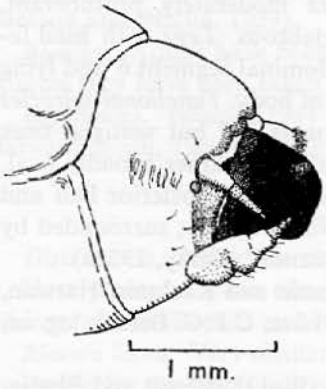

Fig. 117. *Clytus monticola* Gahan. Mature larva. Head. Lateral aspect.

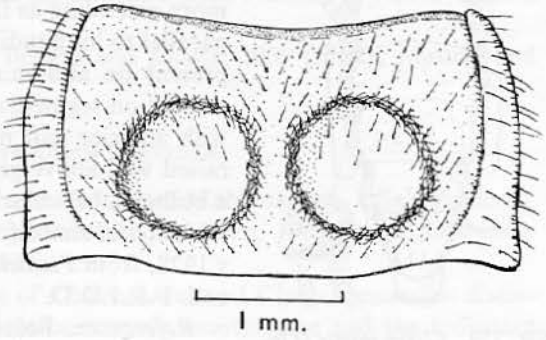

Fig. 118. *Clytus monticola* Gahan. Mature larva. Prosternum.

than surrounding cuticle; pigmented spot indiscernible. Maxillary palpi with segment 3 not longer than segment 2. Hypostoma narrowly pale ferruginous anteriorly and with a few scattered pale setae. Gula distinctly raised, sutures concave. *Prothorax* with pronotum rather coarsely strigose and shining posteriorly; median cleavage line distinctly impressed. Presternum with a pair of paramedian, circular, glabrous, shining areas (fig. 118). *Abdomen* with ampullae finely vermiculately rugose, non-tuberculate. Pleural discs distinct, at least on segments 1–3. *Legs* minute but clearly 3-segmented. *Spiracles* with peritreme pale, thin, rather narrowly oval. Length up to 22 mm.; maximum breadth (at prothorax) 4·5 mm.

Pupa. No material available. The following is a description of the European *Clytus arietis* (Linnaeus) which should be very similar (fig. 119). "Length 7–15 mm.; maximum breadth 4 mm. *Head* with vertex visible from above, smooth; front transversely striate medially, glabrous. Antennae extending as far as first (in female) or second (in male) abdominal segment where they terminate above elytra and wings. Eyes strongly convex, glabrous. Labrum triangular, glabrous. Pronotum slightly elongate, with sides moderately rounded and smooth; posterior half glabrous or almost so; anterior half with numerous scattered, short, fine setae and a few (less than ten) conspicuous spines on each lateral region. *Mesonotum* smooth and glabrous or almost so. *Metanotum* similar; scutellar groove distinct. Elytra and wings extending to third abdominal segment. *Abdomen* with tergites 1–6 each with a broad band of short spines which are stoutest near posterior margin. Tergite 7 transverse, with sides converging posteriorly and hind margin strongly rounded; bearing similar spines but also a transverse row of from four to five very large spines (which are curved forward) near posterior margin. Tergite 8 slightly transverse and posterior margin with from four to five slightly smaller spines which may be directed either posteriorly or recurved. Segment 9 retracted into segment 8. Sternites sometimes glabrous but usually with a few minute setae, especially near lateral regions. Pleura moderately protuberant, longitudinally rugose and glabrous. *Legs* with hind femora extending as far as abdominal segment 6 and lying parallel to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–5 but vestigial ones present on segments 6–8; peritreme rather broadly oval, with anterior half much thicker than posterior half and raised well above general level of cuticle; surrounded by a bulbous, cuticular protuberance" (Duffy, 1953a).

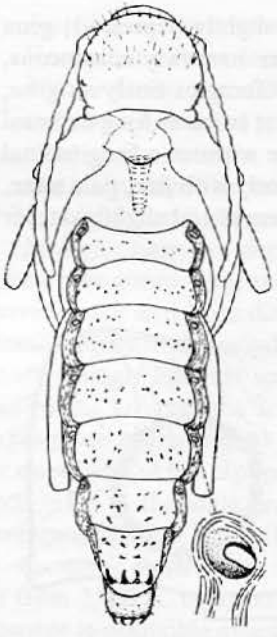

Fig. 119. *Clytus arietis* (Linnaeus). Female pupa. Dorsal aspect.

Material studied. 1 L, Jammu and Kashmir, Harwan, v.1928, from *Pistacia integerrima*, C.F.C. Beeson leg. in, coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Clytus minutus Gardner

Distribution. ORIENTAL REGION: India (Madras, Maharashtra, Mysore).

Host plants: *Strychnos nux-vomica, Tectona grandis, Vangueira spinosa* (Beeson and Bhatia, 139).

Biology. The larval galleries of this species are subcortical, superficially grazing the sapwood, and are packed with fine wood dust. The prepupal gallery is oval and enters the sapwood obliquely. The life-cycle is very variable and may exceed one year. Adults emerge from March to May, mainly in March.

References. Beeson, 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Mathur, 1960 (Biol. fig.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Clytus balwanti Gardner

Distribution. ORIENTAL REGIONS: India (Madras).

Host plants: *Acacia pennata, Zizyphus oenoplia* (Beeson and Bhatia, 1939).

Biology. Adults emerge from April to June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1942b (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Clytus ceylonicus Gardner

Distribution. ORIENTAL REGION: Ceylon.

Host plant: *Vitex altissima* (Beeson and Bhatia, 1939).

Biology. Adults have been bred from April to June, mainly June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Clytocera chionospila Gahan

Distribution. ORIENTAL REGION: India (Madras, Maharashtra, Mysore).

Host plants: *Acacia* sp., *Poinciana elata, Pongamia pinnata, Pterocarpus marsupium* (Beeson and Bhatia, 1939).

Biology. Adults have been reared in October and from January to April. During August they have been taken in flight.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Epipedocera affinis Chevrolat

Distribution. ORIENTAL REGION: India (Madras, Maharashtra, Uttar Pradesh).

Host plants: *Grewia tiliaefolia, Lagerstroemia parviflora, Woodfordia floribunda, Shorea robusta* (Beeson and Bhatia, 1939).

Mature larva. Very similar to those of *Chlorophorus* and *Clytus* species but distinguishable by the feebly sclerotized, pale castaneous mouthframe and the indistinct and scarcely protuberant ocellar lens. Length up to 12 mm.; maximum breadth (at prothorax) 4 mm.

Biology. The life-cycle is annual, emergence occurring from June to September, mainly June.

Material studied. 1 L, India, Uttar Pradesh, Dhera Dun, Jhajra, 23.ii.1929, from dry stems, J.C.M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1935a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L); Mathur and Balwant Singh, 1960b (Biol.), 1960c (Biol.), 1961b (Biol.).

Epipedocera acaciae Gardner

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Acacia arabica* (Beeson and Bhatia, 1939).

Biology. Adults have been taken in August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Epipedocera chakhata Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Bauhinia vahlii* (Beeson and Bhatia, 1939); *Holarrhena antidysenterica* (Mathur and Balwant Singh, 1960b).

Biology. Adults have been taken from June to August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Epipedocera assamensis Gardner

Distribution. ORIENTAL REGION: Burma, India (Assam).

Host plant: *Quercus serrata* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Epipedocera parva Gardner

Distribution. ORIENTAL REGION: India (Madras, Uttar Pradesh, West Bengal).

Host plants: *Bauhinia vahlii*, *Lagerstroemia parviflora* (Beeson and Bhatia, 1939).

Biology. Adults occur from April to August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Epipedocera zona Chevrolat

Distribution. ORIENTAL REGION: Burma, India (Maharashtra, Sikkim, Uttar Pradesh, West Bengal), Nepal.

Host plants: *Grewia tiliaefolia*, *Shorea robusta*, *Terminalia tomentosa* (Beeson and Bhatia, 1939).

Biology. The life-cycle is generally annual but may under unfavourable conditions

be prolonged two or three years. Adults emerge between June and August, mainly July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961a (Biol.), 1961b (Biol.).

Perissus bauhiniae Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Bauhinia vahlii* (Beeson and Bhatia, 1939); *Buchanania lanzan* (Beeson, 1941).

Biology. The life-cycle is annual, with emergence taking place from June to September, mainly August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Perissus dalbergiae Gardner

Distribution. ORIENTAL REGION: India (Punjab, Uttar Pradesh).

Host plant: *Dalbergia sissoo* (Gardner, 1931b).

Mature larva. Similar to that of *Clytus monticola* Gahan from which it may be distinguished as follows. Size smaller: length up to 15 mm.; maximum breadth (at prothorax) 4 mm. *Head* with front margin of frons less strongly sinuate. *Prothorax* with paramedian glabrous areas on prosternum semicircular. *Abdomen* with ampullae dull, micro-granulate. *Legs* vestigial, almost indiscernible.

Biology. Oviposition takes place on the bark of recently dead trees. Living trees are attacked only when they are unhealthy due to such factors as root-disease, impoverished soil or lepidopterous defoliators. Oviposition sites may be recognized by the exudation of a black gummy fluid from the bark. The larval galleries penetrate the bast and sapwood and are tightly packed with wood dust which absorbs the gum. Pupation takes place at a depth of about $\frac{1}{2}$ in. The adult exit-hole is nearly $\frac{1}{8}$ in. wide.

The life-cycle may be completed in one year with an emergence period extending from April to October. In dry wood the larva may take two to four years to attain maturity.

Control. Outbreaks of this species indicate unhealthy growing conditions in shisham plantations. If the dying trees rapidly increase in number they should be felled and burned to prevent the building up of a high population which would spread to healthier trees (Beeson, 1941).

Material studied. 2 L, India, Multan Punjab, Khanewal plantation, 1.ix.1928, from *Dalbergia sissoo*, R. N. Mathur leg., in coll. F.R.I.D.D.

References. Anon, 1938 (Biol., Contr.); Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Perissus quercus Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Quercus incana* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Perissus laetus Lameere

Distribution. ORIENTAL REGION: Burma, Hainan Is., India (Assam), Java, Thailand.

Host plants: *Millettia brandisiana* (Beeson and Bhatia, 1939); *Anogeissus acuminata* (Bhasin and Roonwal, 1954); *Derris robusta* (Miller, 1934); *Acacia catechu, Albizia odoratissima, A. stipulata, Cassia fistula, Dalbergia fusca, Dolichandrone rheedii, Derris eliptica, Ficus obtusifolia, Pyrus communis, Quercus serrata, Xylia xylocarpa* (Beeson, 1941).

Biology. Adults emerge in May and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Corbett, 1934 (Biol.); Duffy, 1953a (Biol.); Gressitt, 1951 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.); Miller, 1934 (Biol.).

Perissus mutabilis Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Sikkim, Uttar Pradesh), Thailand.

Host plants: *Bauhinia retusa, Butea monosperma, Engelhardtia colebrookiana, Garuga pinnata, Mallotus philippinensis, Shorea robusta* (Beeson and Bhatia, 1939); *Dalbergia fusca* (Beeson, 1941).

Biology. Adults emerge in June and July, mainly June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961 (Biol.).

Perissus parvulus Gahan

Distribution. ORIENTAL REGION: Ceylon.

Host plants: *Cupressus lawsoniana, Pinus patula* (Beeson and Bhatia, 1939).

Biology. Adults emerge from April to June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960a (Biol.), 1960d (Biol.).

Perissus glaucinus (Boisduval) (=**femoralis** Chevrolat)

Distribution. ORIENTAL REGION: Moluccas, New Guinea, Thailand.

Host plant: *Samanea saman* (D. of A., Bangkok).

References. None available.

Xylotrechus quadripes Chevrolat

[The Coffee Borer, White Borer or Borer Hula]

Distribution. ORIENTAL REGION: Burma, China, Formosa, Hainan Is., India (Assam, Maharashtra, Madras, Mysore, West Bengal), Indo-China, Philippines, Thailand.

Host plants: *Coffea arabica, C. robusta, C. liberica, Cudrania javanensis, Jasminum*

dispermum, *Rhus semiciliata*, *Tectona grandis*, *Ixora coccinea*, *Olea dioica* (Beeson and Bhatia, 1939); ?*Randia spinosa* (Duport, 1919a); *Sponia wightii* (Dunning, 1868); *Premna pyramidata* (Mathur and Balwant Singh, 1960d); *Albizia*, *Canarium*, *Oroxylon*, *Pterocarpus marsupium* (Subramaniam, 1934).

Adult (fig. 120). Length 10–17 mm. Black; head, prothorax and bands on elytra covered with greyish or yellowish pubescence; disc of pronotum with a round, subasperate, blackish spot medially and a pair of smaller spots sublaterally. *Elytra* with a basal transverse band, a short oblique band on shoulder, a band beginning

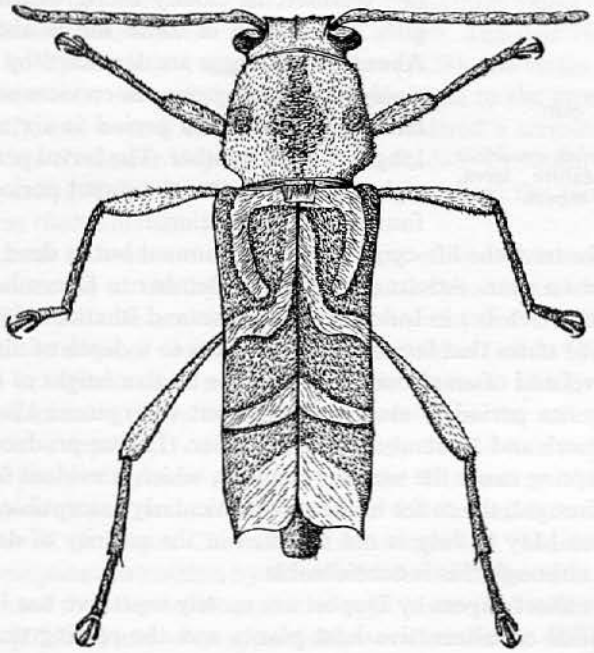

Fig. 120. *Xylotrechus quadripes* Chevrolat. Adult.

immediately behind scutellum, running close to suture, then diverging posteriorly and turning outwards, a transverse or slightly oblique band behind middle, which gradually widens towards suture and an apical band with an oblique front margin. *Head* with antennae less than half length of body. *Prothorax* rounded laterally, with middle of disc asperate. *Elytra* slightly narrowed posteriorly, broadly truncate apically. *Legs* with first segment of hind tarsus about twice as long as segments 2 and 3 combined.

Mature larva (fig. 121). Rather similar to that of *Clytus monticola* Gahan from which it differs as follows. *Head* (fig. 121) with mouthframe broadly ferruginous to pitchy. Ocellus only partly (ventrally) embraced by sclerotization of gena (fig. 121). Hypostoma broadly ferruginous to pitchy anteriorly. Antenna with basal membrane shorter (fig. 121). *Prothorax* with pronotum pale orange-testaceous anteriorly; median cleavage line rather feebly impressed. Presternum with paramedian glabrous areas proportionately larger and roughly semicircular. *Mesonotum* and *metanotum* dull, micro-granulate. *Abdomen* with ampullae dull, micro granulate. *Legs* vestigial

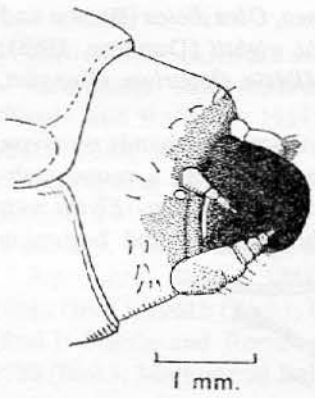

Fig. 121. *Xylotrechus quadripes* Chevrolat. Mature larva. Head. Lateral aspect.

comprising a setose papilla. Length up to 25 mm.; maximum breadth 6·5 mm.

Pupa. For generic characters, see key, p. 38

Egg. Milk-white, becoming pale yellowish later, elongate-oval, one end narrower and more pointed than the other 1·25 mm. long and 0·5 mm. wide (Subramaniam, 1934).

Biology. These beetles are most active in bright hot weather; in cloudy moist weather they are sluggish. The length of adult life is about three weeks. About 50 to 80 eggs are deposited by the female either singly or in small groups in crevices or under scales of bark. The incubation period is six to nine days—or longer in cold weather. The larval period usually lasts eight to ten months, the pupal period being three or four weeks in duration.

In living *Coffea* trees the life-cycle is normally annual but in dead wood there may be two generations a year. Adults emerge from October to December in south India and from August to October in Indo-China (Beeson and Bhatia, 1939).

Caresche (1938) states that larvae infest the roots to a depth of about seven inches below ground-level and often also attack the stems up to a height of two to three feet. The peak emergence period is mainly in July but emergences also occur between February and March and November and December. Larvae produced by the beetles emerging in the spring cause the maximum injury, which is evident from May to July when, owing to drought, the coffee bushes are particularly susceptible. The prevalence of the adults from May to July is not reflected in the severity of damage in August and September, although this is considerable.

The numerous short papers by Duport are mostly repetitive but interesting observations are included on alternative host plants and the rearing and release of hymenopterous parasites.

Parasites. Hymenoptera. The parasites in Indo-China of possible use against *X. quadripes* Chevrolat are *Sclerodermus domesticus* Latr., *Doryctes strioliger* Kieff., *D. picticeps* Kieff., *D. tristriatus* Kieff., *Pristaulacus nigripes* var. *duporti* Kieff. and an unidentified chalcid. It has been possible to breed only the first two of these in sufficient numbers for control purposes. These species, however, would have to be released in such large numbers to afford any appreciable degree of control that perhaps certain exotic species may prove more efficacious.

Other hymenoptera known to parasitise *X. quadripes* Chevrolat are *Promiscobus sesquistriatus* Kieff., *Pristodoryctes striativentris* Kieff., *Doryctes brevipetiolus*, *D. bistriatus* Kieff., *Paraglypta tubigera* Kieff., *Eurytoma xylotrechi* Ferr. and *Mysepyris* grandiceps Kieff. (Duport, (1920e, 1922d), du Pasquier, (1930), Ferrière (1933) and Kieffer (1921)).

Economic importance. This species is undoubtedly the most serious insect pest of *Coffea* in south India, occurring as it does in almost all coffee estates, particularly those at lower altitudes. *Coffea arabica* is the preferred host, *C. robusta* and *C. liberica*

being seldom attacked unless they have already been weakened by adverse conditions. Mature trees are capable of withstanding the ravages of several larvae but in the case of plants up to five years old a single larva can produce fatal results. This species has occasionally been known to breed in dead poles and stumps of *Tectona grandis* (Beeson and Bhatia, 1939). Caresche (1938) has estimated that in Annam this pest causes an annual loss of about 7 per cent of the crop. According to Dunning (1868) trees are more susceptible to attack during drought conditions, for on forest estates in wet localities there is little evidence of attack.

This species is not, however, confined to coffee plantations and is to be found quite commonly in districts where there is no coffee grown. The first reference to borer attack on coffee in Mysore is in a report by Stokes (1838) who states that "in very dry seasons many of the trees die and snap off suddenly close to the ground". But in elevations of 3,500 ft. and over it is rare and not considered a serious pest. The worst areas in Mysore are the lower slopes of the Baba Budans in Kadur District and the areas of Manjar-rabad Taluk in the Hassan District where the rainfall is less than 100 in. per annum (Subramaniam, 1934).

Control. Methods recommended include (a) uprooting and burning infested trees during the monsoon, (b) scrubbing the stems during October and November to dislodge eggs and young larvae and (c) swabbing the stems in October and November with a 10 per cent solution of wood tar distillate emulsion (made by Bhadravati Iron Works, Mysore) or with cashew nut oil emulsion (Beeson, 1941). Dunning (1868) suggests that even in cases where trees are already infested, the soil should be dug up around the roots to a depth of 3 or 4 in. to allow any dew or rain to penetrate rapidly to the roots, thus promoting more vigorous growth. The rearing of belts of the charcoal tree (*Sponia*) on estates, so as to afford shelter for the coffee trees and an alternative host plant for *X. quadripes* Chevrolat is recommended. Most important of all, however, is the complete destruction by fire of all infested coffee trees.

It has been found that the development of eggs is retarded when the temperature falls below 80°F [26·7°C] and very appreciably so when below 65°F [18·3°C] which explains the remedial value of shade, which by retarding development, increases the probability of their being washed off the bark by the rain (Anonymous, 1925). Fletcher (1917) maintains that rain is effective not so much in washing off the eggs as in discouraging oviposition, since females only fly freely on warm sunny days. As a result of experiments conducted by the Department of Agriculture it has been found that scrubbing the stems twice during the adult emergence period will considerably reduce future infestation. Portions of cocoanut fibre have been used effectively as brushes (Coleman, 1925). Kunhi Kannan (1925) provides additional evidence that the hand collecting of adults is unquestionably the most effective and the least expensive method of control.

Subramaniam (1932) refers to experiments involving the application of a ten per cent tar distillate emulsion during the middle of the flight season and, later (1933), discusses the use of washes such as sulphur incorporated with kerosene emulsion and a proprietary wash ("Sulfocide").

The resistance of bushes is increased by fertilizers and they appear to be more vigorous where shade trees are grown. *Aleurites montana* is probably the most suitable

shade tree as its root-system is generally deeper than that of the coffee and it loses its leaves during the winter when the coffee bushes need additional light. Fertilizers should be applied at the beginning of winter. Cultural methods should, whenever possible, be directed towards the conservation of water in the soil (Caresche, 1938). Spraying the leaves with Bordeaux has proved effective in reducing infestation through affording increased leaf cover during September and October (Mayne, 1933).

It has been found experimentally that measures directed against the eggs would be of only limited value if carried out earlier than December. Oviposition studies in 1939–40 indicated that the number of eggs deposited is frequently greater than that previously reported. The eggs hatched in about ten days under fairly dry conditions, in 17 days when kept moist in a receptacle and not at all when in contact with water. In preliminary tests in 1938–39, cashew-nut shell oil applied to the stems of coffee caused no injury within four months of its application to trees eight to ten years old, but the tops of 18-month-old plants dried off and the lateral branches died within four to six weeks. An emulsion of the oil was not injurious, but it was later found that it did not repel the beetles and had no effect on the eggs or larvae. Similar tests indicated that a tar distillate (Mortegg) is of little value as a repellent and that a suspension of paris green had no repelling action. The effectiveness of scrubbing the stems in order to render them unfavourable for oviposition was confirmed. In field tests the application of an ovicide (Mortegg) was slightly more effective, whether accompanied by scrubbing or not, than scrubbing the stems alone, and the ovicide was found to be more effective when applied between the end of October and the end of November than earlier or later. In 1941–42, only ten of 9,000 trees that were treated with Mortegg and only 40 of 12,000 treated with other ovicides were subsequently infested (Mayne, 1939–43).

Kunhi Kannan (1925) provides evidence that the hand-collecting of adults is unquestionably the most effective and the least expensive method of controlling this pest. Taylor (1868), on the other hand, strongly favoured the introduction of guinea-fowls and other insectivorous birds on estates.

There have been numerous attempts to control *Xylotrechus* biologically. *Sclerodermus domesticus* Latr. seems to be the most promising of all the parasites, according to Duport (1922f), as it seems to be the hardiest species, is very active in locating its host and has a longer adult life than the others. The same author (1920d–1924) gives an account of the work in controlling *X. quadripes* Chevrolat through the rearing and releasing of 4,000,000 individuals of the braconid *Doryctes strioliger* Kieff. and of attempts to rear other parasites. In Tonkin, some of these parasites (*Doryctes*, *Sclerodermus*) have been reared in enormous numbers and liberated in the plantations but this has met with little success (Dammerman, 1929).

Material studied. 2 L, India, Assam, Cachar, Lalcherra Teak Plantation, 28.xii.1935, from teak pole, in coll. F.R.I.D.D.

References. Anonymous, 1925 (Contr.); Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bellar and Bhenchitr, 1936 (Biol.); Bidie, 1868 (Biol., Contr.); Boutan, 1905 (Biol.); Caresche, 1938 (Biol. fig., Contr.); Coleman, 1925 (Contr.); Cotes, 1894a (I fig., Biol.); Dammerman, 1929 (Biol.); Delacroix, 1900 (Biol. fig.); Department of Agriculture, Mysore, 1937 (E fig., L fig., P fig., I fig., Biol. fig., Contr.);

Dunning, 1868 (I fig., Biol. Contr.); du Pasquier, 1930 (Paras., Contr.); Duport, 1913 (Biol.), 1915b (Biol.), 1918a (Biol.); 1918b (Biol.); 1919a (Biol.), 1919b (Biol.), 1919c (Biol., Paras.), 1920a (Biol., Paras.), 1920b (Biol., Paras.), 1920c (Biol., Paras.), 1920d (Biol., Paras.), 1920e (Biol., Paras.), 1921 (Biol., Paras.), 1922a (Biol., Paras.), 1922b (Biol., Paras.), 1922c (Biol., Paras.), 1922d (Biol., Paras.), 1922e (Biol., Paras.), 1922f (Biol., Paras.), 1924a (Biol., Paras.), 1924b (Biol., Paras.), 1924c (Biol., Paras.), 1925a (Biol., Paras.), 1925b (Biol., Paras.), 1926 (Biol., Paras.); Ferrière, 1933 (Paras.); Fletcher, 1914 (I fig., Biol., Contr.), 1921 (Biol.); Gardner, 1931b (L, Biol.); Kieffer, 1921 (Paras.); Koningsberger, 1915 (Biol.); Kunhi Kannan, 1925 (Biol.); Mathur, 1960 (Biol.); Mathur and Balwant Singh, 1960 (Biol.), 1961b (Biol.), 1961d (Biol.); Maxwell-Leroy and Howlett, 1909 (I fig., Biol.); Mayne, 1933 (Contr.); Mühlmann, 1945 (Biol.); Pierce, 1918 (Biol.); Ramakrishna Ayyar, 1940 (I fig., Biol.); Stebbing, 1899 (I fig., Biol.), 1914 (I fig., Biol.); Stokes, 1838 (Biol.); Subramaniam, 1921 (L fig., P fig., I fig., Biol. fig., Contr.), 1932 (Contr.), 1933 (Contr.), 1934 (E fig., L fig., P fig., I fig., Biol. fig., Paras. fig., Contr.); Taylor, 1867 (Biol. Contr.), 1868 (L fig., P fig., Biol., Contr.); Veen, 1897 (Biol.).

Xylotrechus basifuliginosus Heller

Distribution. ORIENTAL REGION: India (Punjab, Uttar Pradesh).

Host plants: *Picea morinda*, *Quercus semecarpifolia*, *Q.* sp. (Beeson and Bhatia, 1939); *Quercus incana* (Mathur and Balwant Singh, 1960d).

Biology. Adults emerge from April to June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Xylotrechus buqueti Laporte and Gory

Distribution. ORIENTAL REGION: Andaman Is., Burma, India (Assam, Uttar Pradesh, West Bengal), Java, Thailand.

Host plants: *Acrocarpus fraxinifolius*, *Cedrela toona*, *Celtus australis*, *Cryptocarya wightiana*, *Gmelina arborea*, *Kydia calycina*, *Lagerstroemia parviflora*, *Mallotus philippinensis*, *Millettia pendula*, *Myristica longifolia*, *Pterocarpus dalbergioides*, *Shorea robusta*, *Tectona grandis* (Beeson and Bhatia, 1939); *Cassia fistula* (Bhasin, Roonwal and Balwant Singh, 1955); *Duabanga sonneratioides* (Bathur and Balwant Singh, 1959).

Mature larva. Very similar to that of *X. quadripes* Chevrolat from which it differs as follows. Form less robust. Length up to 19 mm.; maximum breadth (at prothorax) 5 mm. *Head* with ocellus entirely surrounded by sclerotization of gena (as in *X. incurvatus* (Chevrolat)). Ventral front margin of head with a minute tubercle on acetabulum. *Prothorax* with pronotum dull, micro-spiculate.

Biology. Eggs are deposited in the bark in groups of two to five. The irregular larval galleries are usually subcortical but sometimes lie entirely in the sapwood and frequently cross over each other; they are packed with fine particles of wood and bark. The pupal cell is excavated about half an inch deep in the sapwood but is very variable in shape and orientation. The exit-hole is round. The larval galleries depicted in Stebbing's work (1914) as being those of *Hoplocerambyx spinicornis* (Newman) are

actually of this species. The life-cycle may be six months or more in duration. Emergence takes place in almost every month but mainly from March to June.

Material studied. 2 L, India, Bengal, Kurseong, Bagdogra, 25. vi.1935, N. C. Chatterjee leg., from unknown host, in coll. F.R.I.D.D.

References. Beeson, 1916 (Biol.), 1935a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1931 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960a (Biol.), 1960b (Biol.), 1960c (Biol.), 1960d (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Stebbing, 1914 (Biol. fig.).

Xylotrechus australis (Laporte and Gory)

Distribution. ORIENTAL REGION: Aru, Amboyna, Bouru, Ceram, Kaioa, New Guinea, Philippine Is., Sarawak, Singapore, Ternate Is. AUSTRALASIAN REGION: Australia (New South Wales, Queensland), Lord Howe Is.

Host plants: *Gmelina leichardtii*, *Argyrodendron trifoliolatum*, *Acacia aulacocarpa*, *Hemicyclia australasica*, *Tarrietia peralata*, *Loranthus pendulus*, *Vitex lignum-vitae* (A. R. Brimblecombe).

Reference. Duffy, 1963 (Biol. fig.).

Xylotrechus chinensis (Chevrolat)

[The Tiger Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Hopeh, Kiangsu), Formosa, Liu-Kiu Is. PALAEARCTIC REGION: Japan, Korea.

Host plants. *Morus* (Chen, 1933); *Pyrus malus* (Cheo, 1935).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Chu, Chin, Ku and Hu, 1935 (Biol.); Kojima, 1959 (L fig.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol).

Xylotrechus subcarinatus Gardner

Distribution. ORIENTAL REGION: India.

Host plants: *Phoebe lanceolata* (Mathur and Balwant Singh, 1960d); *Maesa indica* (Mathur and Balwant Singh, 1961a); *Terminalia myriocarpa* (Mathur and Balwant Singh, 1961b).

References. Mathur and Balwant Singh, 1960d (Biol.), 1961a (Biol.), 1961b (Biol.). (See also p. 213.)

Xylotrechus carinifrons Laporte and Gory

Distribution. ORIENTAL REGION: Burma, Ceylon.

Host plants: *Chloroxylon swietenia*, *Eugenia* sp., *Tectona grandis* (Beeson and Bhatia, 1939).

Biology. Adults emerge from February to May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur, 1959 (Biol.), 1961b (Biol.).

Xylotrechus contortus Gahan

Distribution. ORIENTAL REGION: Bhutan, China, India (Assam, Sikkim, Uttar Pradesh, West Bengal), West Pakistan (Rawalpindi).

Host plants: *Juglans regia, Rhododendron arboreum* (Beeson and Bhatia, 1939); *Cedrela serrata* (Beeson, 1941).

Biology. Adults have been taken from April to September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1953a (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Xylotrechus incurvatus (Chevrolat)

Distribution. ORIENTAL REGION: Burma, China, Formosa, India (Assam, West Bengal).

Host plants: *Prunus nepalensis* (Gardner, 1931b); *Mallotus roxberghianus* (Mathur and Balwant Singh, 1960d).

Biology. Adults have been taken in September.

Mature larva (fig. 122). Very similar to that of *X. quadripes* Chevrolat but differing as follows. *Head* (fig. 122) with ocellus entirely surrounded by sclerotization of gena. Ventral front margin of head with a small but distinct dentate tubercle on acetabulum (fig. 122). Length up to 22·5 mm.; maximum breadth (at prothorax) 5·5 mm.

From *X. buqueti* Laporte and Gory this species may be distinguished by its shining, glabrous pronotum.

Material studied. 1 L, India, Darjeeling, Debrepani, 16.ix.1929, from *Mallotus roxberghianus*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

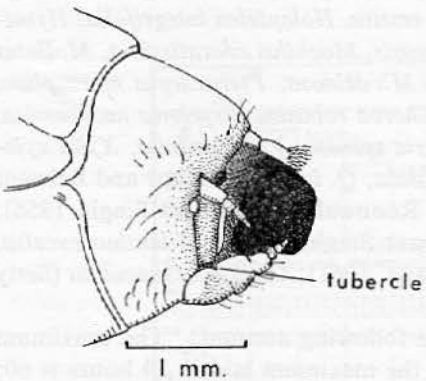

Fig. 122. *Xylotrechus incurvatus* (Chevrolat). Mature larva. Head. Lateral aspect.

Xylotrechus magnicollis Fairmaire (=**renominatus** Beeson)

Distribution. ORIENTAL REGION: Burma, China, Formosa, Hainan Is., India (Assam, Uttar Pradesh). PALAEARCTIC REGION: Siberia.

Host plants: *Diospyros glandulosa* (Mathur and Balwant Singh, 1959); *Ficus elastica, Mimusops elengi* (Beeson and Bhatia, 1939); *Millettia brandisiana, Quercus serrata* (Beeson, 1941).

Biology. The life-cycle is usually annual but may sometimes be prolonged to the second year. Adults have been bred from July to November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.), 1961 (Biol.).

Xylotrechus grayi (White)

[The Grey Tiger Longicorn]

Distribution. ORIENTAL REGION: Formosa, China (Kiangsu, North China). PALAEARCTIC REGION: Japan. AUSTRALASIAN REGION: Marianas.

Host plants: *Tectona grandis* (Mitono, 1941b); *Coffea arabica* (Shiraki *et al.*, 1937); *Paulownia tomentosa* (Cheo, 1935).

References. Cheo, 1935 (Biol.); Gressitt, 1951 (Biol.), 1956 (Biol.); Mitono, 1941b (I fig., Biol. fig.); Shiraki, 1952 (Biol.); Shiraki *et al.*, 1937 (Biol.).

Xylotrechus smei Laporte and Gory

Distribution. ORIENTAL REGION: Bhutan, Burma, India (Assam, Bihar, Madras, Maharashtra, Orissa, Punjab, Uttar Pradesh, West Bengal), West Pakistan (Hyderabad). ETHIOPIAN REGION: Africa (Tanganyika, Zanzibar).

Host plants: *Adina cordifolia, Aegle marmelos, Anogeissus latifolia, Bauhinia retusa, Bridelia retusa, Buchanania latifolia, Butea monosperma, Calycopteris floribunda, Careya arborea, Cassia fistula, Cedrela toona, Dalbergia latifolia, D. paniculata, D. sissoo, Ehretia acuminata, Eugenia cuminii, Ficus gibbosa, F. religiosa, Garuga pinnata, Gmelina arborea, Grewia tiliaefolia, G. vestita, Holoptelea integrifolia, Hymenodictyon excelsum, Kydia calycina, Litsaea chinensis, Machilus odoratissima, Mallotus philippinensis, Mangifera indica, Morus alba, M. acidosa, Pterocarpus marsupium, Salmalia malabarica, Schrebera swietenioides, Shorea robusta, Strychnos nux-vomica, Tectona grandis, Terminalia tomentosa, Vangueria spinosa, Vitis latifolia, Xylia xylocarpa* (Beeson and Bhatia, 1939); [28]*Quercus dilatata, Q. incana* (Mathur and Balwant Singh, 1960d); *Chloroxylon swietenia* (Bhasin, Roonwal and Balwant Singh, 1958); *Vitex altissima, V. pinnata* (Mathur and Balwant Singh, 1961b); *Ailanthus excelsa, Boswellia serrata* (Roonwal, Chatterjee and Thapa, 1961); *Codiaeum maculata* (Setty and Rao, 1953).

Biology. Beeson and Bhatia (1939) give the following account: "The maximum number of eggs laid by one female is 190 and the maximum laid in 24 hours is 60; the longest recorded oviposition period is six days in April. Eggs are laid in crevices and covered depressions on the surface of bark in large clusters. The egg hatches in four or five days in April. The rate of larval development is very variable. By inoculating newly hatched larvae in freshly cut logs (of *Shorea robusta*) between the 5th and 14th April the emergence of beetles was obtained as early as the 14th June. The shortest larval period under these conditions was fifty-two days in April-May, and the pupal period eighteen or nineteen days. ...*X. smei* attacks newly felled trees within a month of felling and also several months after felling; girdled trees and the crowns of dying or stag headed trees are attacked. Logs stored in the sun are more liable to be attacked than logs stored in the shade but the preference is not very strongly marked. The larval tunnels which are excavated on the surface of the sapwood and inner bark, are flattened, oval in section, and tightly packed with bark and wood dust; in a crowded infestation the tunnels closely interlace. The pupal chamber is a cell about $\frac{3}{4}$ in. long

[28] Stebbing's (1909) record of *Quercus dilatata* is erroneous (see *Xylotrechus stebbingi* Gahan).

formed at a short depth in the sapwood. In timbers which have a strongly differentiated heartwood the borings are confined to the sapwood, but in homogeneous wood the tunnels may run right into the centre of the log and trend irregularly, or are more or less concentric with, the zones of growth. The emergence of *X. smei* (in Dehra Dun) begins at the end of March from over-wintered broods and is at its peak in May, and may continue to the end of November. Eggs laid in April and May give rise to short-cycle and long-cycle generations, the former taking two and a half to seven months and emerging between the beginning of July and the end of November, and the latter hibernating to emerge in the second year. Eggs laid at the beginning of July and later in the year do not produce a complete generation in the same year, as the immature beetle or larva passes the cold weather in a resting stage and the adult emerges in the second year between April and November. The shortest life-cycle of overwintering broods is about six months, and the longest might be sixteen months. The following diagram (fig. 123) shows that trees felled in January to May produce complete generations with emergence in August-November of the same year; trees felled June to December produce complete generations with emergence in April-November of the following year. Emergences also occur from long-cycle broods in the second year of felling."

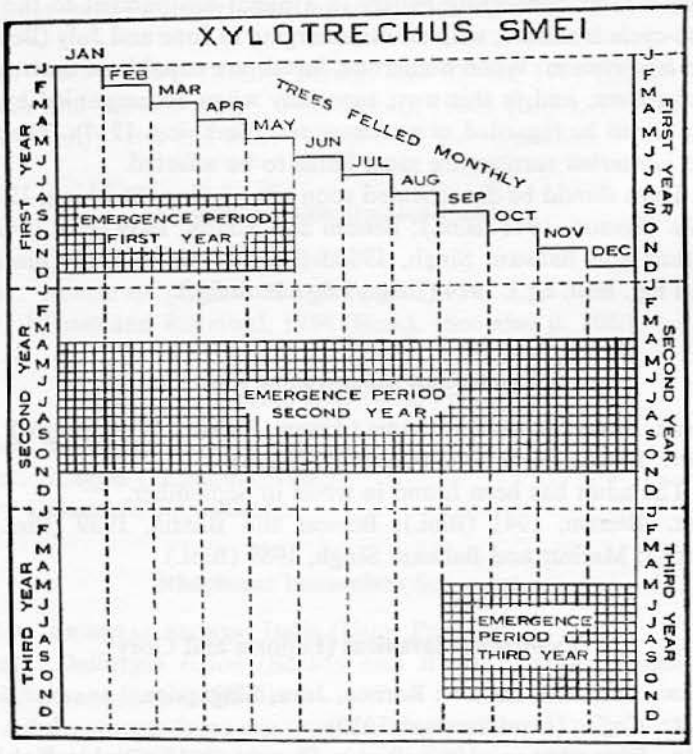

Fig. 123. *Xylotrechus smei* Laporte and Gory. Chart showing emergence periods of adults. (Beeson and Bhatia, 1939)

Control. Damage by this species may be minimized if felled trees are decorticated immediately, particularly during December–February (Chatterjee and Chatterjee, 1951).

References. Beeson, 1922 (Biol.), 1935a (Biol.), 1941 (I fig., Biol. fig.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Bhatia, 1950 (Biol., Contr.); Chatterjee and Chatterjee, 1951 (Contr.); Duffy, 1953a (L fig., Biol. fig.); Gardner, 1927 (L fig., Biol.), 1931 (L); Mathur and Balwant Singh, 1959 (Biol.); 1960b (Biol.), 1960c (Biol.), 1960d (Biol.), 1961b (Biol.); Pierce, 1918 (Biol.); Roonwal, Chatterjee and Thapa, 1961 (Biol.); Setty and Rao, 1953 (Biol.); Stebbing, 1902 (I fig., Biol.), 1909 (I fig., Biol.), 1914 (I fig., Biol.).

Xylotrechus stebbingi Gahan

Distribution. ORIENTAL REGION: China, India (Punjab, Uttar Pradesh), Tibet.

Host plants: *Quercus dilatata* (Beeson and Bhatia, 1939); *Quercus incana* (Mathur and Balwant Singh, 1960d).

Biology. Larvae of this species feed on the inner bark and sapwood of oak logs and stumps. The irregular larval gallery attains a length of about eight inches, and terminates by a short connecting gallery in a pupal cell parallel to the longitudinal axis. The life-cycle is annual, with adults emerging in June and July (Beeson, 1941).

Economic importance. When numerous, larvae are capable of destroying the bast layer of young trees, and in this way, especially when accompanied by the scolytid *Dryocoetes*, it must be regarded as a serious pest (Stebbing, 1914). Trees infested by the parasitic *Loranthus vestitus* are most liable to be affected.

Control. Trees should be decorticated soon after felling (Stebbing, 1914).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1960d (Biol.); Pierce, 1918 (Biol.); Stebbing, 1909 (L fig., I fig., Biol. fig.), 1914 (L fig., I fig., Biol. fig.).

Xylotrechus subdepressus Chevrolat

Distribution. ORIENTAL REGION: India (Assam, Sikkim, West Bengal).

Host plant: *Evodia fraxinifolia* (Gardner, 1931b).

Biology. The adult has been found in wood in September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Xylotrechus javanicus (Laporte and Gory)

Distribution. ORIENTAL REGION: Borneo, Java, Singapore.

Host plant: *Coffea* (Dammerman, 1919).

References. Dammerman, 1919 (Biol.); Duport, 1915 (Biol.); Kalshoven, 1951 (Biol.); Koningsberger, 1908 (Biol.); Pierce, 1918 (Biol.).

Xylotrechus subscutellatus Chevrolat

Distribution. ORIENTAL REGION: Ceylon, India (Keralia, Madras, Maharashtra, Mysore).

Host plants: *Coffea arabica, Dalbergia latifolia, Pterocarpus marsupium, Tectona grandis, Vitex altissima, V. pinnata* (Beeson and Bhatia, 1939); *Codiaeum maculata* (Setty and Rao, 1953); *Kydia calycina* (Beeson, 1941); *Polyalthia coffeoides* (Khan, 1947); *Olea dioica* (Subramaniam, 1934).

Biology. This species infests logs and standing dying trees. The larval galleries may deeply penetrate the heartwood but pupation takes place near the surface. The life-cycle is usually annual but may be prolonged for a second year. Emergence occurs throughout the year but mainly in April, July and August (Beeson and Bhatia, 1939). Khan (1947) found that attack by this species was recorded in *Polyalthia* logs felled in all months of the year, except for May and June. Infestation was heavy for fellings of September to February, especially in timber stored in the open, and low in other months. The minimum time recorded for a larva to reach the sapwood was one month. The life-cycle in this investigation was found to be about three months.

Economic importance. It has been reported that trees of *Dalbergia latifolia* and *Pterocarpus marsupium* have been killed by this beetle but it is suspected that these trees were unhealthy.

Control. Logs must be decorticated as soon as felled to avoid infestation (Khan, 1947).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Khan, 1947 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960d (Biol.), 1961b (Biol.); Setty and Rao, 1953 (Biol.); Subramaniam, 1934 (Biol.).

Xylotrechus subcarinatus Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Acacia* sp. (Bhasin and Roonwal, 1954).

Reference. Bhasin and Roonwal, 1954 (Biol.). (See also p. 208.)

Thranodes pictiventris Pascoe

Distribution. ORIENTAL REGION: Celebes.

Host plant: ?*Coffea* (Delacroix, 1900).

Reference. Delacroix, 1900 (Biol.).

Rhaphuma bimaculata Schwarzer

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Dalbergia sissoo* (Beeson and Bhatia, 1939); *Phyllanthus emblica* (Mathur and Balwant Singh, 1960d).

Biology. Adults emerge from dry twigs in May and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.).

Rhaphuma horsfieldi (White)

Distribution. ORIENTAL REGION: Burma, India (Assam, West Bengal), Indo-China (Viet Nam), ?Java.

Host plants: *Albizia odoratissima, Litsaea elongata* (Beeson and Bhatia, 1939); *Dolichandrone rheedii, Juglans regia, Quercus* sp. (Beeson, 1941).

Biology. Adults emerge in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.).

Rhaphuma acrocarpi Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Acrocarpus fraxinifolius* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Rhaphuma desaii Gardner

Distribution. ORIENTAL REGION: India.

Host plant: *Castanopsis argyrophylla* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Rhaphuma maculata Schwarzer

Distribution. ORIENTAL REGION: India (Madhy Pradesh, Maharashtra, Madras).

Host plants: *Acacia leucophloea, Bauhinia vahlii* (Beeson and Bhatia, 1939).

Biology. Adults emerge from the woody stems of climbers in May and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Rhaphuma rhea Gahan

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Dodonaea viscosa* (Beeson and Bhatia, 1939).

Biology. Adults occur in May and June. Larvae infest dry stems.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Ischnodora macra Chevrolat

Distribution. ORIENTAL REGION: India (Assam, West Bengal).

Host plant: *Alnus nepalensis* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Demonax lineolatus Redtenbacher

Distribution. ORIENTAL REGION: Java.
Host plants: *Quercus* spp., *Castanea* sp. (Kalshoven, 1955).
Reference. Kalshoven, 1955 (Biol.).

Demonax ascendens (Pascoe)

Distribution. ORIENTAL REGION: Ceylon, India (Uttar Pradesh).
Host plant: *Shorea robusta* (Beeson and Bhatia, 1939).
Biology. Larvae of this species infest dead twigs. Adults emerge in June and may be found resting on foliage. The life-cycle is annual.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Demonax balyi (Pascoe)

Distribution. ORIENTAL REGION: India (Madras, Uttar Pradesh).
Host plants: *Albizia lebbek*, *Butea monosperma* (Beeson and Bhatia, 1939).
Biology. Adults emerge in May. The life-cycle is usually annual but may be prolonged into two or three years in dry wood.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Demonax formicoides Lameere

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madras, Uttar Pradesh).
Host plants: *Acacia gageana*, *Bauhinia vahlii* (Beeson and Bhatia, 1939).
Biology. Adults emerge from June to September, mainly in August.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Demonax atkinsoni Gardner

Distribution. ORIENTAL REGION: Burma.
Host plants: *Phyllanthus emblica*, *Quercus* sp. (Beeson, 1941).
Reference. Beeson, 1941 (Biol.).

Demonax buteae Gardner

Distribution. ORIENTAL REGION: India.
Host plants: *Acacia catechu*, *Butea monosperma* (Beeson, 1941).
References. Beeson, 1941 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Demonax limoniae Gardner

Distribution. ORIENTAL REGION: India.
Host plant: *Limonia acidissima* (Beeson, 1941).
References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Demonax literatus Gahan

Distribution. ORIENTAL REGION: Burma.
Host plants: *Diospyros glandulosa, Phyllanthus emblica* (Beeson, 1941).
Biology. Adults emerge from April to June.
References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.).

Demonax sonneratiae Gardner

Distribution. ORIENTAL REGION: India.
Host plant: *Sonneratia apetala* (Beeson, 1941).
Biology. Adults emerge in April and May.
References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

?Aglaophis quadrifasciata Thomson

Distribution. ORIENTAL REGION: India (Sikkim, Uttar Pradesh, West Bengal).
Host plant: *Quercus lamellosa* (Gardner, 1931b).
Mature larva (fig. 124). *Head* subquadrate, slightly depressed. Temples very broadly sclerotized and ferruginous behind ocellus and with a very faint vertical impression with three setal pores (fig. 124); sclerotization of mouthframe rather broadly ferruginous, not interrupted beneath antennae. Antenna with segment 2 about three times as long as basal width; segment 3 not more than half length of segment 2. Mandible short, broad, entirely pitchy. Labrum transversely oval, fringed anteriorly with rather sparse bristly setae. One pair of ocelli present; lens rather large, oval, pigmented spot visible as a greyish blotch. Hypostoma glabrous, with front margin rather broadly ferruginous. Gula distinctly raised, sutures concave. Maxillary

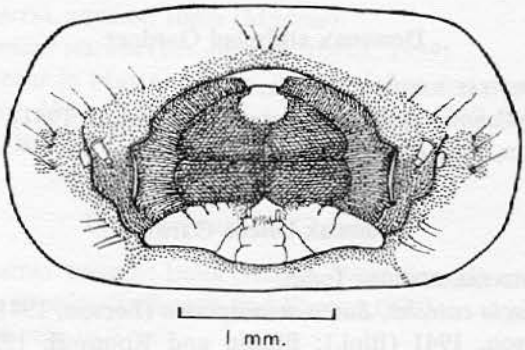

Fig. 124. *?Aglaophis quadrifasciata* Thomson. Mature larva. Head. Frontal aspect.

palpi with segments 2 and 3 subequal in length. *Prothorax* covered laterally with rather long pubescence. Pronotum slightly orange-testaceous and sparsely setose anteriorly; posteriorly rather coarsely and irregularly longitudinally striate. *Abdomen* with ampullae dull, micro-granulate. *Legs* testaceous, 3-segmented, at least half as long as maxillary palp. *Spiracles* with peritreme broadly oval to subcircular. Length up to 19 mm.; maximum breadth (at prothorax) 4 mm.

Although the larvae studied are those collected by Gardner (1931), the possibility that they have been associated with the wrong adult cannot be ruled out, particularly as certain factors such as the broadly pigmented mouthframe and the presence of setal pores are more characteristic of the Phoracanthini than of the Clytini (see also Duffy, 1960, 1963).

Biology. Adults emerge from April to June and from September to October.

Material studied. 2 L, India, Bengal, Darjeeling, ix.1929, from *Quercus lamellosa*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Aglaophis humerosus Chevrolat

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Juglans regia* (Beeson and Bhatia, 1939).

Biology. There are probably two emergence periods a year.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Aglaophis longispinis Gardner

Distribution. ORIENTAL REGION: India (West Bengal).

Host plants: *Beilschmiedia sikkimensis*, *Macaranga denticulata* (Beeson and Bhatia, 1939).

Biology. Adults emerge in October and December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960c (Biol.).

7. LAMIINAE

Larval Characters

Head elongate, with sides parallel or converging posteriorly; dorsal margins of epicranial halves behind frons fused for their entire length; tentorial cross-arm internal, at right angles to hypostoma (*i.e.* occipital foramen not divided). Mandible elongate, with cutting edge oblique and apex rounded. Lower boundary of frons not produced over clypeus; six (occasionally more) epistomal setae present. Clypeus trapezoidal, wide, filling space between mandibles. Labrum transverse to cordate. Ocelli, if present, never more than two pairs (although there may be one to three vestigial ocelli comprising a pigmented spot without a distinct lens), usually one pair

only. Gula usually broad. Maxillae rigid (only movable from stipes); cardo, maxillary articulating area and submentum fused and attached for entire distance between ventral articulations of mandibles; palpifer large, distinct, bearing lobe and with outer margin straight; process of palpifer absent. Antennae very short and retractile, 2- or 3-segmented. *Prothorax* having presternum and epipleurum usually distinctly separated; eusternum sometimes indistinct. Postnotal fold absent. *Abdomen* with region surrounding spiracle not protruding; epipleurum protuberant on from three to all segments; pleural discs absent; hypopleurum small; coxal lobe large. *Legs* absent or occasionally present, but then vestigial. *Spiracles* of mesothorax protruding into prothorax.

Dorcadionini

Dolichostyrax tuberculatus Fisher

Distribution. ORIENTAL REGION: Java.
Host plant: *Quercus* (roots of stumps) (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Lamiini

Trachystola scabripennis Pascoe

Distribution. ORIENTAL REGION: Indo-China (Viet Nam), Java.
Host plant: *Quercus* (roots of stumps) (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Monochamini [Agniini]

Larval Characters

Head depressed; antenna usually 3-segmented but only 2-segmented in *Dihammus*; antennal foramen closed posteriorly. One pair of ocelli present. Gula distinct, protuberant. *Prothorax* with posterior area of pronotum finely velvety micro-pubescent or micro-spiculate (asperate only in *Dihammus*).

Abdomen with dorsal ampullae each with two distinct transverse furrows and (except in *Celosterna*) four rows of moniliform tubercles, which are usually more or less micro-spiculate. Prosternum not spiculate and never asperate, either glabrous or with scattered setae. Epipleurum protuberant on abdominal segments 1–9, except sometimes the first two. *Spiracles* without marginal chambers (except *Dihammus*).

Breuning (1943) merges the "Monochamini" and "Lamiini" with the Agniini, whereas Gressitt (1951) has placed the Agniini and the Monochamini under the Lamiini. For the purposes of the present study it is considered preferable to regard these tribes separately and individually, at least until more larval material becomes available.

Celosterna (=Psaromaia) scabrator (Fabricius)

[The Babul Borer]

Distribution. ORIENTAL REGION: Ceylon, India (Bihar, Kerala, Madras, Maharashtra, Mysore, Orissa, Uttar Pradesh), West Pakistan (Peshawar). MADAGASCAN REGION: La Réunion, Mauritius. ?ETHIOPIAN REGION: Africa (Congo, East Africa).

Host plants: *Acacia arabica, A. catechu, Cassia siamea, Casuarina equisetifolia, Pithecolobium dulce, Prosopis juliflora, Tectona grandis, Zizyphus mauritiana* (Beeson, 1931, 1941); *Shorea robusta* (Cotes, 1889); *Prosopis spicigera, Pyrus malus* (Mathur and Balwant Singh, 1960d); *Mangifera* (Plenet, 1960).

Adult (Pl. XVIII, fig. 2). Length 32–39 mm. Dull, yellowish brown, the sides of body and legs often bluish grey. Elytra yellowish grey, with numerous small, dense black punctures.

The variety *spinator* has the brownish pubescence on the elytra irregularly and extensively broken up by a background of grey. *Head* with antennae much shorter than body in both sexes. *Prothorax* with a strong pair of lateral spines. Elytra truncate apically.

Mature larva. Very similar to that of *C. javana* White but differing as follows. *Head* with gular sutures strongly raised and ferruginous. *Prothorax* as in fig. 126 (of *C. javana* White) but with setae on anterior part of pronotum testaceous and not arising from ferruginous basal discs. *Abdomen* with lower sclerotized pit of pleural tubercle indiscernible or very indistinct. Length up to 55 mm.; maximum breadth (at prothorax) 11 mm.

Egg. Creamy to yellowish white, becoming brown owing to staining through exudation of tannin and gum from host plant. Chorion matt, smooth. Length 5·5 mm.; breadth 2·2 mm (Beeson, 1931).

Biology. Oviposition takes place on young living plants, on stems of at least 2 in. in diameter but not exceeding 9 in. Usually only a single egg is deposited on each stem. It is inserted beneath a horizontal incision in the bark within 6 in. above ground level and sealed with a secretion. The total number of eggs laid by a single female is small (possible 20–40) and the oviposition period is several weeks in duration. The incubation period is two to three weeks. The first-instar larva feeds on the soft surrounding tissues and then tunnels into the centre of the stem and continues in a downward direction. Accumulated frass is ejected through a hole in the stem, forming a heap at the base, which eventually becomes so large that infested trees can be easily recognized at a distance (fig. 125).

For about nine or ten months until mature, the larva travels up and down gradually enlarging its gallery and extending it to the main root, the total length of the gallery being about 2 ft. In thin stems and roots the gallery is kept clear but in thicker stems it is for the greater part packed with wood fibres. The pupal cell is 2 to 3 in. long and is plugged at each end with long interlaced fibres. The duration of the pupal stage is 15 to 17 days. The beetle emerges by gnawing a round hole in the bark, usually just below ground level. Beetles begin to emerge with the onset of the monsoon. In Berar the average rate of emergence from *Acacia arabica* has been recorded thus:

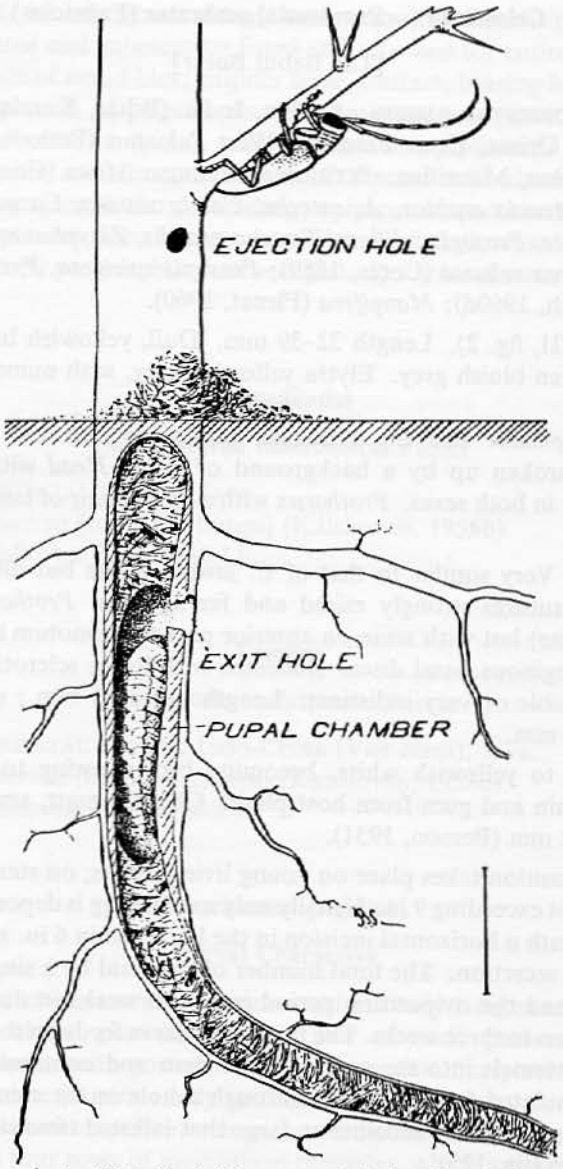

Fig. 125. *Celosterna scabrator* (Fabricius). Damage to babul sapling by larva and adult. (Beeson, 1931)

5 per cent emerged by the beginning of July.
30 ,, ,, ,, ,, ,, middle ,, ,,
65 ,, ,, ,, ,, ,, end ,, ,,
77 ,, ,, ,, ,, ,, middle ,, August.
87 ,, ,, ,, ,, ,, end ,, ,,
99 ,, ,, ,, ,, ,, ,, ,, September.
100 ,, ,, ,, ,, ,, middle ,, October.

The adult normally lives for about 45 days, although some individuals have been known to live 80 days. Consequently the beetle population is at its highest during the latter half of August after which it rapidly decreases owing to the death-rate exceeding the emergence-rate. Adults are mainly nocturnal and feed voraciously on the bark of tender living shoots which are girdled and killed back. The following plants are attacked: *Acacia arabica, Casuarina equisetifolia, Pithecolobium dulce, Prosopis juliflora, Shorea robusta, Tamarix indica, Zizyphus jujuba* and *Gossypium* (Beeson, 1931, 1941).

Economic importance. This species is mainly a pest of babul (*Acacia arabica*) and, to a lesser extent, to *Casuarina, Prosopis spicigera* and teak. In La Réunion it attacks *Casuarina* and *Pithecolobium dulce.* As it is the only cerambycid known to bore into living babul it is not likely to be confused with anything else. Infestation usually results in a complete cessation of growth and stems of weak plants are killed. In localities where babul is grown in poor soil, an incidence of attack of up to 80 per cent has been recorded. This species is evidently a most serious pest which, if disregarded, can easily eliminate an entire plantation. As both roots and stems are infested, heavily-attacked plants inevitably die (Stebbing, 1914). It has been suggested that excessive outbreaks in extensive babul plantations such as at Berar are inhibited by a low reproductive potential, the restriction of one individual per stem and the destruction of part of the population by the reaction of vigorous hosts.

Control. The planting of *Acacia arabica* should be restricted to areas entirely suitable to growth and not on impoverished soils where the trees will become highly susceptible to attack, thus forming permanent breeding centres. Other species of trees should be planted elsewhere. In areas where infestation has already taken place, attacked trees should be uprooted and replaced by suitable non-susceptible species. Or the whole area should be cleared up within three years under a regeneration scheme designed to eliminate in one operation all the serious breeding grounds and to interpose a two-year period during which field crops are cultivated instead of babul. Remedial measures include the grubbing up of attacked trees, the hand collection of the beetles and the application of oil. For the latter, the attacked tree must be cut off at ground-level and a small quantity of crude oil or furnace oil poured into the open tunnel through a tin funnel, one gallon of oil sufficing for about 500 trees. This method, which is the cheapest of all, should be carried out between November and February (Beeson, 1931, 1941).

Material studied. 1 L, India, Uttar Pradesh, Dehra Dun, J.C.M.G. leg., in coll. U.S.N.M.; 1 L, India, Bihar, Ranchi, 3.vi.1939, from *Acacia catechu,* P. M. Glover leg., in coll. F.R.I.D.D.

References. Beeson, 1931 (Biol. fig., Contr.), 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cleghorn, 1868 (Biol.); Cotes, 1889 (I fig., Biol.), 1894a (Biol.), 1896 (I fig., Biol.); Fletcher, 1914 (L fig., I fig., Biol.), 1921 (Biol.); Gardner, 1927 (E, L fig., P fig.); Hutson, 1934 (Biol.); Iyer, 1912 (L fig., I fig., Biol.); Lesne, 1919 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (L fig., I fig., Biol.); Mühlmann, 1954 (Biol., Contr.); Pierce, 1918 (Biol.); Plenet, 1960 (?Biol.); Ramakrishna Ayyar, 1940 (L fig.,

I fig., Biol.); Rivals, 1947 (Biol.); Stebbing, 1899 (I fig., Biol.), 1908 (I fig., Biol.), 1914 (L fig., P fig., I fig., Biol. fig., Contr.).

Celosterna javana (White) (=**Psaromaia tigrina** (Pascoe))

Distribution. ORIENTAL REGION: Java, Sumatra.

Host plants: *Glochidion* spp., *Mallotus repandus*, *Bridelia stipularis*, *Antidesma tetrandrum*, *Allophilus cobbe* and "keruwut" (Kalshoven, 1955b).

Mature larva (fig. 126). Form very elongate, slender, slightly depressed. *Head* strongly depressed, slightly constricted before middle and gradually narrowed posteriorly; frontal sutures indistinct; antennal foramen closed posteriorly; mouthframe moderately strongly sclerotized and ferruginous; six episternal setae present. Mandible

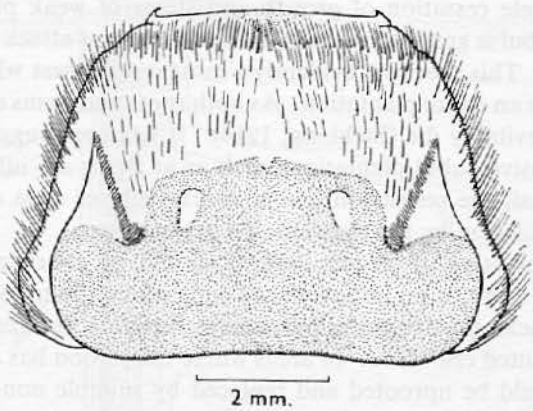

Fig. 126. *Celosterna javana* (White). Mature larva. Prothorax. Dorsal aspect.

slender, about twice as long as basal width, cutting edge feebly sinuate and at least six setae on basal half of outer face. One pair of large ocelli present; pigmented spot rather indistinct. Hypostoma testaceous, with front margin narrowly ferruginous and bearing a transverse row of numerous setae; sutures distinct, incurved; gular sutures indistinct. Antenna minute, 3-segmented; segment 2 strongly transverse; segment 3 subquadrate, with supplementary process conical and nearly as long as segment 3. Labrum transversely oval, densely setose, especially along front margin. Maxilla with segment 3 of palp slightly attenuated and slightly shorter than segment 2. Mentum distinct from submentum. *Prothorax* depressed, subrectangular; anterior area of pronotum bearing numerous scattered, stiff setae; embossed posterior area entirely micro-spiculate except for a pair of large paramedian, glabrous depressions (fig. 126), a pair of sublateral oblique impressions present (fig. 126); prosternum with eusternum and sternellum partly micro-spiculate. Mesothorax and metathorax micro-spiculate, non-tuberculate. *Abdomen* with each dorsal ampulla micro-spiculate, non-tuberculate but with two transverse impressions. Tergite 9 without a sclerotized process. Anus trilobed. Epipleurum protuberant on all segments. Pleural tubercle rectangular, strongly elongate on abdominal segments 1 and 2 and subquadrate on remaining segments; each with a pair of distinct sclerotized pits and bearing two long

setae. *Legs* vestigial, consisting of a minute tubercle bearing several setae. *Spiracles* with peritreme rather broadly oval, marginal chambers absent; thoracic spiracle very large (more than twice as long as abdominal spiracles and about equal in width to labrum). Length up to 60 mm.; maximum breadth (at prothorax) 9·5 mm.

Biology. The larval galleries run right through the wood and are elliptical in cross-section. Adult emergence takes place between August and September and December and March. Adults have been observed to feed on bark of *Bridelia* branches (Kalshoven, 1955b).

Material studied. 6 L, Java, Dempoel, 9.ii.1933, from *Glochidion*, L. G. E. Kalshoven leg., in coll. K.

Reference. Kalshoven, 1955b (Biol.).

Celosterna sp. (**variegata** Aurivillius?)

Distribution. ORIENTAL REGION: Borneo.

Host plant: *Ochroma lagopus* (D. I. Nicholson).

Biology. Frass-ejection holes are made at regular intervals by the larva (D. I. Nicholson).

Celosterna carissima Pascoe

Distribution. ORIENTAL REGION: Burma, Thailand.

Host plant: *Afzelia bijuga* (D. of A., Bangkok).

References. None available.

Blepephaeus ocellatus (Gahan)

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh), Indo-China, Penang Is.

Host plant: *Mallotus philippinensis* (Beeson and Bhatia, 1939).

Biology. Adults occur from April to July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Blepephaeus modicus (Gahan)

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Santalum album* (Beeson and Bhatia, 1939).

Biology. The larval galleries, which are packed with fine wood dust, extend longitudinally in the heart of small branches. Adults emerge from April to May and also in September. There are possibly two generations a year.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Blepephaeus nigrosparsus Pic

Distribution. ORIENTAL REGION: China, India (Uttar Pradesh).

Host plant: *Clerodendron infortunatum* (Beeson and Bhatia, 1939).

Mature larva (fig. 127). Rather similar to those of *Monochamus* species but differing as follows. Form almost cylindrical, robust. *Head* scarcely depressed, oval in cross-section. Frons more broadly sclerotized and ferruginous, the front margin slightly curved. Hypostoma with front margin rather strongly curved and narrowly ferruginous; numerous scattered setae present. *Prothorax* (fig. 127) scarcely depressed; posterior part of pronotum with micro-spiculate area very short and coarsely longi-

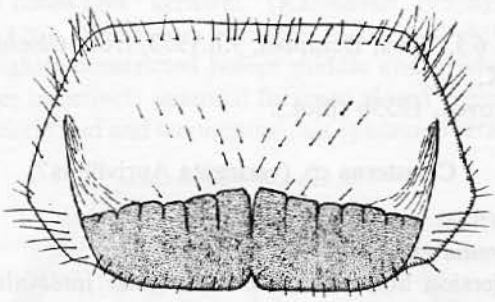

Fig. 127. *Blepephaeus nigrosparsus* Pic. Prothorax. Dorsal aspect.

tudinally striate, confined to about posterior third of pronotum and only slightly produced medially; sublateral impressions oblique, broad and shallow. *Abdomen* with moniliform tubercles of ampullae individually distinct, mostly rounded. Pleural tubercle without distinct sclerotized pits. *Spiracles* small, with peritreme broadly oval to subcircular. Length up to 18·25 mm.; maximum breadth (at prothorax) 4·25 mm.

Biology. This species infests the base of the stem and rootstock of living *Clerodendron;* hard, twisted, knotty roots are particularly vulnerable. Each egg is placed in a shallow longitudinal incision gnawed in the green bark by the beetle. After about five days the egg hatches and the young larva bores downwards into the bast and eventually to the roots. The adult emerges in June or July through an oval hole in the root near ground-level. There is one generation a year (Beeson and Bhatia, 1939).

Material studied. 2 L, India, Uttar Pradesh, Haldwani, vi.1930, from *Clerodendron infortunatum*, S. N. Chatterjee leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner 1931 (L fig. as *B.* sp. nr. *stigmosus* Gahan); Mathur and Balwant Singh, 1960 (Biol.).

Blepephaeus succinctor (Chevrolat)

[The Dark-spotted Gray Longhorn]

Distribution. ORIENTAL REGION: Burma, China (Kiangsu, Szechuan, Kwangtung, Hong Kong), Formosa, Indo-China, (Viet Nam), Hainan Is., India (Assam, Sikkim), Malaya, Thailand.

Host plants: *Adenanthera pavonina*, *Dalbergia balansae* (Gressitt, 1942).

Biology. Eggs are deposited in relatively small branches of living trees. The larvae tunnel along the branches for several inches, in parts nearly hollowing the branches and making small frass-ejection holes at intervals. The hollowed portions are largely

packed with fine powdered frass and rather coarse shreds of wood. Ant nests have been found in some walled-off hollowed portions, within an inch or two of an active larva. The life-cycle is annual. Adults are nocturnal and probably feed on young bark. In China adults emerge during April and May but in Hainan the period extends to late June (Gressitt, 1942).

Economic importance. This species is responsible for weakening branches of shade trees so that they are more readily broken off by typhoons.

Control. The pruning and burning of infested branches is recommended by Gressitt (1942).

References. Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.).

Pelargoderus arouensis (Thomson)

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia, Aru.

Host plant: *Theobroma cacao* (Dumbleton, 1951).

References. Duffy, 1963 (Biol.); Dumbleton, 1951 (Biol.); Dun, 1951 (Biol.); Szent-Ivany, 1961 (Biol.).

Pelargoderus bipunctatus (Dalman)

Distribution. ORIENTAL REGION: Java.

Host plants: *Acacia leucophloea, A. pennata, Albizia procera, Butea monosperma, Citrus, Cassava* (Kalshoven, 1955b). *Canarium commune, Ficus elastica, Theobroma, Albizia, Hevea, Piper* (Dammerman, 1919).

Economic importance. In Java, this species is one of the most serious pests of cocoa (Dammerman, 1929).

References. Dammerman, 1913 (Biol.), 1919 (Biol.), 1929 (Biol.); Haan, 1933 (Biol.); Hall, 1932 (I fig., Biol.); Kalshoven, 1955b (Biol.); Koningsberger, 1903 (I fig., Biol.), 1908 (Biol.), 1915 (Biol.); Mühlmann, 1954 (Biol.); Paerels, 1924 (Biol.); von Faber, 1909 (Biol.).

Epepeotes spinosus (Thomson) (=**lateralis** (Guérin-Méneville)= **meridianus** (Pascoe))

Distribution. ORIENTAL REGION: Borneo, Celebes, Java, Malaya, Singapore, Sumatra.

Host plants: *Ficus, Theobroma, Albizia, Mangifera, Artocarpus integra* (Dammerman, 1919); ?*Hiptage* (L. G. E. Kalshoven).

Mature larva (figs. 128, 129). Form elongate, slender, slightly depressed. *Head* (fig. 128) strongly depressed, slightly wider before middle and abruptly constricted behind middle; frontal sutures distinct only anteriorly; antennal foramen closed posteriorly; mouthframe strongly and broadly sclerotized, with transverse, dorsal, ferruginous band broader than combined length of clypeus and labrum. Six epistomal setae present. Frons with one small and one much smaller rounded tubercle behind each antenna, alongside each frontal suture (fig. 128). Gena ferruginous and moderately swollen around antennal foramen, the basal membrane of antenna fully visible from above. Hypostoma testaceous, with front margin narrowly ferruginous;

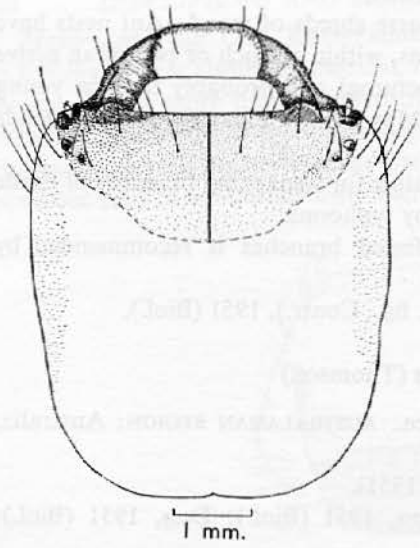

Fig. 128. *Epepeotes spinosus* (Thomson). Mature larva. Head. Dorsal aspect.

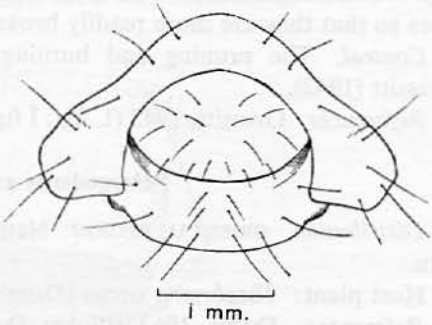

Fig. 129. *Epepeotes spinosus* (Thomson). Mature larva. Abdominal segments 9 and 10. Caudal aspect.

sutures ferruginous, slightly incurved. Gular sutures distinctly raised. Mandible slender, about twice as long as basal width, cutting edge subtruncate; a pair of long setae present on middle of outer face. One pair of ocelli present; lens small, round; pigmented spot rather indistinct. Antenna minute, 2-segmented. Labrum transversely oval, densely fringed with short setae anteriorly. Maxilla with segment 3 of palp slightly shorter than segment 2. Labial palpi with segment 2 cylindrical, about two-thirds length of segment 1. Mentum distinct from submentum. *Prothorax* depressed; posterior area of pronotum velvety micro-spiculate and spotted with lenticulate glabrous pits; sternellum shining, glabrous. *Mesonotum* and *metanotum*, mesosternum and metasternum each with two transverse rows of micro-spiculate, moniliform tubercles, which are more or less contiguous. *Abdomen* with dorsal ampullae each with two transverse furrows and four rows of micro-spiculate, moniliform tubercles which are more or less contiguous. Ventral ampullae with two rows of similar tubercles. Segment 9 without a sclerotized process. Anus a transverse cleft (fig. 129). Epipleurum protuberant on segments 1–9. Pleural tubercle elongate-oval, bearing two very long setae; sclerotized pits absent. *Legs* vestigial, consisting of a minute tubercle bearing several setae. *Spiracles* with peritreme broadly oval, marginal chambers absent. Length up to 26 mm.; maximum breadth (at prothorax) 5·5 mm.

Pupa (fig. 130). *Head* with vertex entirely visible from above, deeply excavated and bearing several stout setae around bases of antennal tubercles. Front with numerous stout setae beneath each antennal tubercle; clypeus with six to eight setae near base and two to four setae near apex. Labrum fringed with similar setae. Antennae extending to between abdominal segments 2 and 3, where they are strongly incurved and each arranged in two coils on top of each elytron. Eyes feebly convex, glabrous.

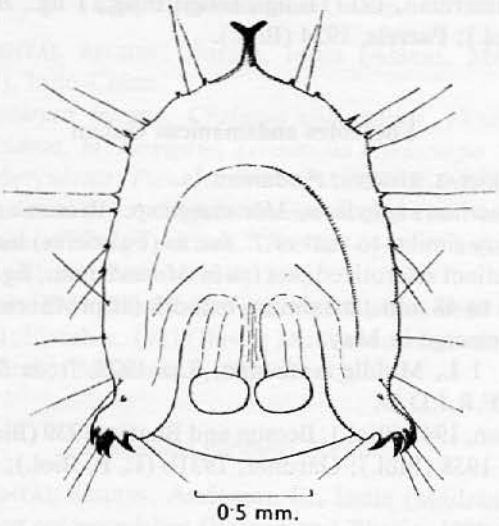

Fig. 130. *Epepectes spinosus* (Thomson). Pupa. Abdominal segment 9. Caudal aspect.

Mandibles with 4–8 setae near middle of outer face. *Pronotum* strongly protuberant laterally; numerous scattered setae present, especially around margins and tubercles. *Mesonotum* smooth, with two oblique rows of similar setae; scutellum not protuberant. *Metanotum* with a pair of converging rows of similar setae. Elytra and wings extending to abdominal segment 4. *Abdomen* with tergites 1–3 with a transverse band (interrupted medially) of closely set, long, fine, setae on posterior half. Tergites 4–5 with setae becoming much less numerous. Tergite 6 with only a few isolated setae. Tergites 7 and 8 each with about 12 irregularly placed setae. Segment 9 very short, produced dorsally into a long, vertical, spine-like process, which is T-shaped apically (fig. 130); lateral margins angulate, and bearing several short stout spines (each with a basal seta). Sternites glabrous. Pleura scarcely protuberant. *Legs* with a row of setae near apex of each femur; middle and posterior femora each with a blunt tuberculate process near base; hind femora extending to abdominal segment 4; tibiae placed obliquely to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6, with a vestigial pair on segment 7; peritreme oval, moderately thick and slightly raised above general level of cuticle. Length up to 22 mm.; breadth 6·5 mm.

Biology. The galleries are about half the diameter of those made by *Batocera*. The eggs hatch in about six to seven days and first-instar larvae average 2·7 mm. in length. The presence of larvae is indicated by brownish black frass depending from the trees. The duration of the larval period is about two months, depending on the time of year (Dammerman, 1913).

Predator. The colydiid *Dastarcus confinis* Pascoe (Dammerman, 1913).

Material studied. 4 L, 1 P, Java, Telawa, 27.x.1932, from ?*Hiptage*, L. G. E. Kalshoven leg., in coll. L.G.E.K.

References. Dammerman, 1913 (E fig., L fig., P fig., I fig., Biol. fig.), 1919 (Biol. fig.); Hall, 1932 (Biol.); Paerels, 1924 (Biol.).

Epepeotes andamanicus Gahan

Distribution. ORIENTAL REGION: Andaman Is.

Host plants: *Canarium euphyllum*, *Macaranga* sp. (Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *E. luscus* (Fabricius) but possessing a pair of rather pale and indistinct sclerotized pits (as in *Monochamus*, fig. 132) on each pleural tubercle. Length up to 48 mm.; maximum breadth (at prothorax) 9 mm.

Biology. Adults emerge in May.

Material studied. 1 L, Middle Andaman, 9.xii.1928, from *Macaranga* sp., B. M. Bhatia leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, P, Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Epepeotes luscus (Fabricius)

Distribution. ORIENTAL REGION: Borneo, Burma, Indo-China (Laos), Java, Malaya, Nicobar Is., Philippine Is., Sumatra, Thailand.

Host plants: *Artocarpus integra*, *Castilla elastica*, *Ficus elastica*, *F. hispida*, *Mangifera*, *Theobroma cacao* (Beeson and Bhatia, 1939); *Taxotrophis ilicifolia* (Corbett and Gater, 1926); *Canarium commune* (Koningsberger, 1915); *Morus laevigata* (Mathur and Balwant Singh, 1961).

Mature larva. Very similar to that of E. *spinosus* (Thomson) from which it may be distinguished by the more strongly swollen, pitchy gena and the antennal foramen, the basal membrane of the antenna being almost completely enclosed and not visible from above.

Biology. Emergence in Burma occurs in May. In Java (Dammerman, 1913) there are three generations a year, the shortest life-cycle being completed in two and a half to three months (with prolongation up to ten months), the beetles emerging mainly in October, November and in January, February and in June, July, in fact in all months except the driest. The female beetle has been known to live for over four months and to lay up to 1,400 eggs, often 400 a month.

Material studied. 2 L, Malaya, Perak, Maxwell's Hill, 7.vi.1933, from *Ficus*, in coll. D.A.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bernard, 1903 (?); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Corbett and Gater, 1926 (Biol.); Dammerman, 1913 (Biol.), 1919 (Biol.), 1929 (Biol.); Hall, 1932 (Biol.); Koningsberger, 1903 (I fig., Biol.), 1908 (Biol.), 1915 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Paerels, 1924 (Biol.); Pierce, 1918 (Biol.); Ridley, 1903 (?); von Faber, 1909 (Biol.); Zehntner, 1903 (?); Zimmermann, 1901 (?).

Epepeotes uncinatus Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Maharashtra, Mysore, Sikkim, West Bengal), Indo-China.

Host plants: *Artocarpus integra, Crataeva unilocularis, Ficus carica, F. elastica, F. religiosa, Morus acidosa, M. laevigata, Terminalia myriocarpa* (Beeson and Bhatia, 1939); *Elaeocarpus tuberculatus; Ficus racemosa* (Mathur and Balwant Singh, 1959).

Biology. Pupation takes place deep in the wood and the beetle emerges through a tunnel from the base of the pupal cell. The life-cycle is annual, with emergence occurring between April and June, mainly May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Fletcher, 1921 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960 (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.).

Epepeotes gardneri Breuning

Distribution. ORIENTAL REGION: Andaman Is., India (Madras, West Bengal).

Host plant: *Lannea coromandelica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May and August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Parepepeotes westwoodi (Westwood)

Distribution. ORIENTAL REGION: India (Sikkim, West Bengal).

Host plant: *Evodia fraxinifolia* (Gardner, 1931b).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Parepepeotes guttatus (Guérin-Méneville)

Distribution. ORIENTAL REGION: Burma, India (Assam, West Bengal).

Host plant: *Ficus foveolata* (Gardner, 1931b) (L, Biol.).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Diochares sp.?

Distribution. ORIENTAL REGION: Bougainville Is.

Host plant: *Theobroma* (E. R. McKillop).

Mature larva. Very similar to those of *Epepeotes* species but differing as follows. *Head* with frons bearing only a single rounded tubercle. *Prothorax* with pronotum bearing a pair of conspicuous paramedian, spot-like, setal pores immediately behind transverse band of setae on anterior margin; sternellum dull, micro-spiculate. *Abdomen* with ampullae bearing four transverse, raised bands which are dull and micro-spiculate.

Anus trilobate but vertical cleft extremely short (as in *Pharsalia*). Length up to 46 mm. maximum breadth (at prothorax) 7 mm.

Material studied. 1 L, Bougainville Is., Arawa Plantation, x.1956, from *Theobroma* branches, E. R. McKillop leg., in coll. B.M.

Macrochenus guerini (White)

Distribution. ORIENTAL REGION: Burma, China, India (Assam, Sikkim, West Bengal), Indo-China (Viet Nam), Thailand.

Host plants: *Ficus elastica*, *F. religiosa*, *Lagerstroemia speciosa*, *Stereospermum chelonoides*, *Salmalia malabaricum* (Beeson and Bhatia, 1939).

Mature larva. Rather similar to those of *Monochamus* species but differing as follows. *Head* rather strongly depressed, with sides slightly diverging to near middle, narrowing posteriorly; a small but distinct, median, semicircular emargination visible from above. Frons more broadly sclerotized and ferruginous to pitchy. *Prothorax* with posterior micro-spiculate area appreciably produced medially; a pair of sub-lateral transverse depressions present near middle. *Legs* very small but distinct. *Abdomen* with anus with a very long transverse cleft and a very short vertical cleft. Length up to 50 mm.; maximum breadth (at prothorax) 8·75 mm.

Biology. The beetle emerges through the lower end of the pupal cell. Emergence occurs in April and May.

Material studied. 3 L, Assam, Cachar, Jiri Forests, 12.iv.1924, from *Stereospermum chelonoides*, S. N. Chatterjee leg., in coll. F.R.I.D.D.; 2 L, 1 P (mutilated), India, West Bengal, Tista, vii.1910, from *Ficus elastica*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L fig.); Mathur and Balwant Singh, 1959 (Biol.), 1960c (Biol.).

Macrochenus tigrinus (Olivier)

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Madras, Maharashtra).

Host plants: *Artocarpus hirsuta*, *A. integra*, *A. nobilis* (Beeson and Bhatia, 1939).

Biology. Emergence occurs from April to October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Hutson, 1938 (Biol.).

Monochamus bimaculatus Gahan

Distribution. ORIENTAL REGION: Burma, China, Formosa, India (Assam, Bihar, Sikkim, Uttar Pradesh, West Bengal), Indo-China (Laos, Viet Nam), Malacca, Thailand.

Host plants: *Cedrela toona*, *Dalbergia sissoo*, *Eugenia jambolana*, *Ficus religiosa*, *Lannea coromandelica*, *Litsaea chinensis*, *Mallotus philippinensis*, *Phoebe lanceolata*, *Randia spinosa*, *Shorea robusta*, *Terminalia myriocarpa*, *T. tomentosa* (Beeson and Bhatia, 1939); *Aporosa villosula*, *Terminalia belerica*, *T. chebula* (Beeson, 1941); *Eugenia cuminii* (Mathur and Balwant Singh, 1959); *Protium serratum* (Mathur and Balwant Singh, 1960d).

Mature larva (figs. 131, 132). Form elongate, slender, slightly depressed. *Head* (fig. 131) rather strongly depressed, slightly wider before middle and abruptly constricted behind middle; frontal sutures indistinct; antennal foramen closed behind. Mouthframe and front margin of frons strongly and broadly sclerotized and ferruginous. Six epistomal setae present. Mandible slender, about twice as long as basal width, cutting edge broadly emarginate. One pair of ocelli present; lens large, round, moderately convex, ferruginous; pigmented spot large, black, distinct. Hypostoma ferruginous, with front margin more darkly so, sutures distinct, incurved; gular sutures slightly raised, with a deep setiferous pore on each side. Antenna minute, 3-segmented; segment 2 transverse, segment 3 subquadrate; supplementary process

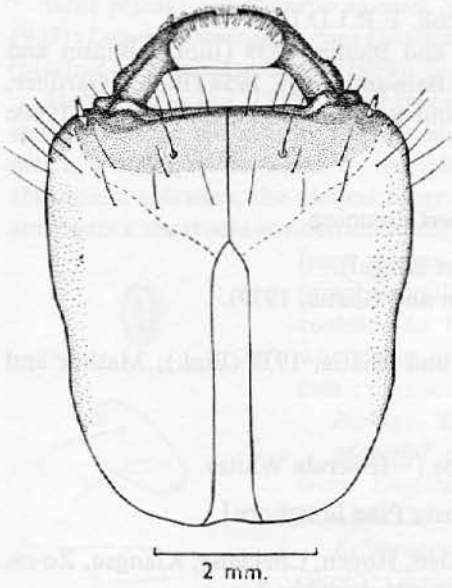

Fig. 131. *Monochamus bimaculatus* Gahan. Mature larva. Head. Dorsal aspect.

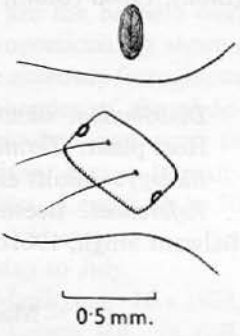

Fig. 132. *Monochamus bimaculatus* Gahan. Mature larva. Spiracle and pleural tubercle of abdominal segment 4.

conical, slightly shorter than segment 3. Labrum transversely oval, densely setose along front margin. Mentum distinct from submentum. *Prothorax* depressed, subrectangular; posterior area of pronotum finely velvety micro-spiculate, spotted with lenticulate glabrous areas; sublateral impressions feebly defined. *Mesonotum* dull and micro-spiculate anteriorly, shining and glabrous posteriorly. *Metanotum* with a single transverse furrow and two rows of glabrous moniliform tubercles. Prosternum with eusternum micro-spiculate postero-laterally; sternellum almost entirely micro-spiculate. *Abdomen* with each dorsal ampulla with two transverse furrows and four rows of more or less confluent, glabrous tubercles. Ventral ampullae with a single transverse furrow and two rows of tubercles which are more or less moniliform. Tergite 9 without a sclerotized process. Anus trilobate, the dorsal lobe slightly protruding beyond the ventral lobes. Epipleurum protuberant on all segments. Pleural tubercle (fig. 132)

rectangular, strongly elongate, each with a pair of distinct sclerotized pits and bearing a pair of setae. *Legs* vestigial, consisting of a minute tubercle bearing several setae. *Spiracles* with peritreme narrowly oval (fig. 132); marginal chambers absent. Length up to 29 mm.; maximum breadth (at prothorax) 7 mm.

Biology. This species has a preference for wood that has become partly dried out, such as dead twigs, poles and logs. Logs stored in full sunlight are apparently not attacked but those stored in the shade, providing they have been felled at least two months previously, are susceptible to attack. The life-cycle is annual, with prolongation to the second year. Emergence takes place from April to August (Beeson and Bhatia, 1939).

Material studied. 1 L, India, Uttar Pradesh, Dehra Dun, Lachiwala, 11.iii.1929, from rotten wood, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1927 (L fig.); Gressitt, 1951 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960c (Biol.), 1960d (Biol.), 1961b (Biol.).

Monochamus gardneri Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Terminalia myriocarpa* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Monochamus alternatus Hope (=**tesserula** White)

[The Pine Sawer or the Rusty Pine Longhorn]

Distribution. ORIENTAL REGION: China (Fukien, Hopeh, Chekiang, Kiangsu, Zo-ce, Kwangtung), Formosa, Hong Kong. PALAEARCTIC REGION: Japan.

Host plants: *Pinus massoniana, Abies, Picea, Cedrus* and possibly *Cunninghamia sinensis* (Gressitt, 1942); *Larix, Liquidambar* (Shiraki, 1952); *Abies firma, A. smithia, Picea excelsa, P. morinda, P. denseflora, P. banksiana, P. strobus, Cedrus deodara* (Kojima, 1931).

Adult. Length 18–31 mm. Rusty red to reddish brown, mottled with whitish grey and black, pronotum with a pair of broad, longitudinal, pinkish stripes. *Head* with antennae about two and one-half times as long as body in male (one and one-half times in female). *Prothorax* slightly transverse, with sides distinctly tuberculate. *Elytra* rounded apically.

Biology. Eggs are deposited in the bark of trunks or branches of dead or weakened trees. The larva feeds subcortically at first but later penetrates the heartwood, making a gallery parallel to the grain of the wood, in which it later constructs a pupal cell with a new connective gallery back to the bark. Adults fly during both day and night (Gressitt, 1942). According to Kojima (1931) the life-cycle is annual.

Economic importance. This species may become very abundant in pine forests

thus causing considerable damage by killing unhealthy or damaged trees and by greatly reducing the value of the timber.

Control. Gressitt (1942) recommends the prompt cutting and disposal of dead trees and branches.

References. Cheo, 1935 (Biol.); Gressitt, 1942 (L, P, I fig., Biol., Contr.); Kojima, 1931 (L fig., P, Biol.); Mitono,? (Biol.); Shiraki, 1952 (Biol.); Sonan, 1925 (Biol.); Yano, 1913 (?).

Sarothrocera lowi White

Distribution. ORIENTAL REGION: Borneo, Burma, Malaya, Sumatra.

Host plants: *Engelhardtia spicata*, *Stereospermum suaveolens* (Beeson and Bhatia, 1939); *Lagerstroemia parviflora* (Mathur and Balwant Singh, 1960c); *Eugenia formosa* (Mathur and Balwant Singh, 1959).

Mature larva (fig. 133). Apart from its larger size, very similar to those of *Monochamus* species but readily distinguishable by the very large mesothoracic spiracle which is subequal in width to the labrum. Other differences are the broadly oval abdominal spiracles, the pleural tubercle (fig. 133), which is proportionately shorter and bears a short seta in addition to the two long setae, the more narrowly ferruginous front margin of the frons and the tubercles of the abdominal ampullae, which are micro-spiculate and tend to coalesce to form two transverse ridges, except laterally where they are more individually distinct. Length up to 70 mm.; maximum breadth (at prothorax) 11 mm.

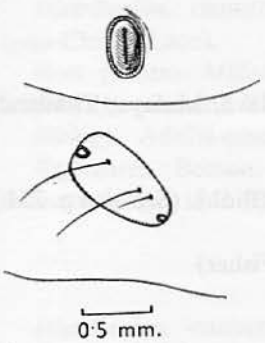

Fig. 133. *Sarothrocera lowi* White. Mature larva. Spiracle and pleural tubercle of abdominal segment 4.

Biology. Emergence occurs from May to July.

Material studied. 1 L, Burma, Myitkyina, 16.v.1928, from *Engelhardtia spicata*, D. J. Atkinson leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960c (Biol.).

Psacothea hilaris Pascoe

[The Yellow-spotted Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Hopeh, Kiangsi, Kiangsu, Szechwan), Formosa. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Fatsia japonica*, *Textaria trifida*, *Morus alba*, *Ficus carica* (Maki, 1916).

Egg. Pale yellow, elongate-cylindrical, rounded at extremities, broader at one end than the other, surface smooth, 4·1–4·6 mm. × 0·9–1·1 mm. (Kojima, 1931).

Biology. In the case of *Ficus* the adult gnaws the bark (chiefly on the basal portion of the trunk), making many small slit-like scars 3–4 mm. long and depositing one egg in each scar. The larva feeds on the cambial region, excavating an irregular subcortical gallery and ejecting frass from a crevice in the bark. Pupation occurs in the wood, the cell being plugged with fibrous shreds at the entrance. In Japan, adults

appear regularly from May to October, but there seems to be only one generation a year (Kojima, 1931). According to Maki (1916), there are two emergences a year in Formosa, the larval and pupal stages lasting for 45 to 70 days in the first generation, and far longer in the second generation, as the larvae overwinter. Adults feed on the leaves of *Ficus carica* (Kojima, Watanabe and Nakamura, 1962).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Chu, Chin, Ku and Hu, 1935 (Biol.); Dammerman, 1913 (Biol.); Kojima, 1931 (E fig., L fig., P, Biol.), 1959 (L fig.); Kojima, Watanabe and Nakamura, 1962 (Biol. fig.); Maki, 1916 (Biol.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Hoplothrix rivulosus (Gahan)

Distribution. ORIENTAL REGION: Burma, India (Assam), Indo-China (Laos).
Host plant: *Strobilanthes* sp. (Beeson, 1941).
Reference. Beeson, 1941 (Biol.).

Hoplothrix griseatus (Gahan)

Distribution. ORIENTAL REGION: India (Assam).
Host plant: *Camellia thea* (Beeson, 1941).
Reference. Beeson, 1941 (Biol.).

Gerania bosci (Fabricius)

Distribution. ORIENTAL REGION: Burma, India (Assam), Java, Malaya, Thailand, Timor.
Host plant: *Ficus elastica* (Dammerman, 1913).
Reference. Dammerman, 1913 (Biol.); Kalshoven, 1955b (Biol.). (See also p. 251.)

Cereopsius javanicus Breuning (=**ornatus** Fisher)

Distribution. ORIENTAL REGION: Java.
Host plant: *Eugenia polyantha* (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Pseudomeges marmoratus (Westwood)

Distribution. ORIENTAL REGION: Burma, India (Assam, West Bengal).
Host plants: *Quercus griffithii* (Beeson and Bhatia, 1939); *Castanopsis tribuloides* (Beeson, 1941).
Biology. Adults occur in September.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gressitt, 1951 (Biol.); Stebbing, 1914 (I fig., Biol.).

Paraleprodera insidiosa (Gahan)

Distribution. ORIENTAL REGION: Burma, Formosa, India (Assam, Bihar, West Bengal), Penang Is., Indo-China (Viet Nam, Laos).

Host plant: *Bauhinia vahlii* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April and also August and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Paraleprodera triangularis (Thomson) (=**Leprodera lecta** Gahan)

Distribution. ORIENTAL REGION: Thailand.

Host plant: *Erythrina fusca* (D. of A., Bangkok).

References. None available.

Paraleprodera stephanus (White) (=**officinator** Lacordaire)

Distribution. ORIENTAL REGION: India (Sikkim), Boutan, Nepal, Viet Nam.

Host plant: *Juglans regia* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Parorsidis birmanica Breuning (=**Paranephelotes laosensis** (Breuning))

Distribution. ORIENTAL REGION: Burma, India (Assam, Madras, Uttar Pradesh), Indo-China (Laos).

Host plants: *Millettia pendula* (Mathur and Balwant Singh, 1961); *Dalbergia latifolia* (Beeson and Bhatia, 1939).

Biology. Adults emerge from May to July.

References. Beeson, 1941 (Biol); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Paradihammus sericeus (Breuning)

Distribution. ORIENTAL REGION: India (Sikkim, West Bengal).

Host plants: *Aesculus punduana* (Beeson and Bhatia, 1939). Also bred from unidentified branchwood, climbers and bamboo.

Biology. Adults emerge from April to August, mainly May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Anamera similis Breuning

Distribution. ORIENTAL REGION: Burma, Indo-China (Laos).

Host plant: *Bambusa tulda* (Beeson and Bhatia, 1939).

Biology. Adults have been observed feeding on bamboo foliage during May and June. This species was wrongly determined by Beeson (1941) as *A. alboguttata* Thomson.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Annamanum indicum Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Albizia lebbek* (Beeson and Bhatia, 1939).

Biology. The larval galleries are confined to the sapwood. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Anoplophora (=Melanauster) chinensis (Förster)

[The Mulberry White-spotted Longicorn, the Black and White Citrus Longhorn or the Citrus-root Cerambycid.]

Distribution. ORIENTAL REGION: Burma, China (Chekiang, Fukien, Kiangsu, Kwangtung, Liaoning, Szechuan), Formosa, Hainan Is., Hong Kong. PALAEARCTIC REGION: Japan, Korea, Ryukyu Is.

Host plants: *Atlantica buxifolia, Broussonetia papyrifera, Carya pecan, Citrus aurantifolia, C. aurantium, C. limonia, C. maxima, C. reticulata, C. sinensis, Hibiscus mutabilis, Morus, Psidium guajava, Pyrus, Salix babylonica, Stransvaesia benthamiana, Stylurus robusta* (Gressitt, 1942); *Cajanus cajan, Casuarina equisetifolium, Mallotus japonicus, Melia azedarach, M. japonica, Malus pumila, Morus alba, Populus alba, Platanus orientalis* (Kojima, 1931); *Ficus* (Cheo, 1935); *Citrus tangerina, ?Fraxinus americana, ?Pinus massoniana* (Lieu, 1945); *Litchi sinensis* (Gressitt, 1940); *Fortunella margarita* (Gressitt, 1951).

Adult (Pl. XVIII, fig. 1). Length 21–40 mm. Entirely shining black, except elytra which are marked with small, scattered, irregular, white blotches and the basal halves of most segments of antennae and tarsi which are powdery blue. *Head* with antennae about one and one-half times as long as body in male but only slightly longer than body in female. *Prothorax* strongly tuberculate laterally. Elytra with numerous rounded tubercles on basal fifth.

Mature larva (figs. 134, 135). Extremely similar to those of *Monochamus* species

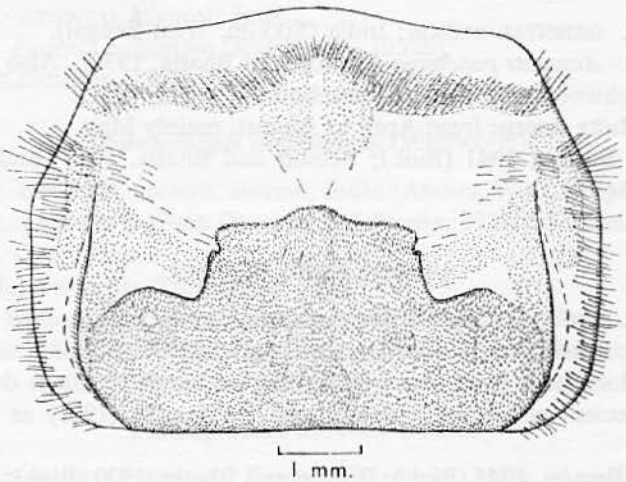

Fig. 134. *Anoplophora chinensis* (Förster). Mature larva. Prothorax. Dorsal aspect.

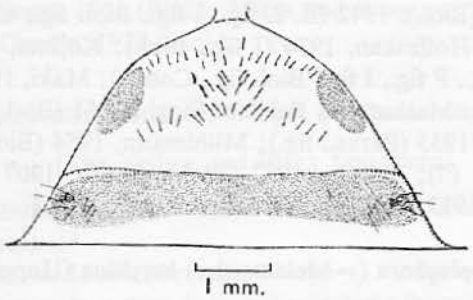

Fig. 135. *Anoplophora chinensis* (Förster). Mature larva. Eusternum and sternellum.

from which it may be distinguished by the presence of a pair of lateral, oval, micro-spiculate areas on the eusternum of prothorax (fig. 135), and by the narrowly ferruginous anterior margin of the posterior micro-spiculate area of the pronotum (fig. 134). The abdominal ampullae are sub-tuberculate (*i.e.*, without distinct moniliform tubercles) and micro-spiculate. Length up to 55 mm.; maximum breadth (at prothorax) 10 mm.

Egg. Elongate, sub-cylindrical, tapering towards ends, varying slightly in form. Chorion smooth, creamy white, turning to yellowish brown. Length 5·5 mm.; maximum breadth 1·7 mm. (Lieu, 1945).

Biology. Larvae tunnel in the roots, trunk and branches of living trees, usually in the lower trunk and main roots. Eggs are usually deposited a few inches above ground level in T-shaped slits prepared by the female with her mandibles. At first the larva tunnels in the sapwood but later penetrates the heart-wood, usually parallel to the growth axis, making tunnels up and down until most of the frass is ejected through the bark. The pupal cell is constructed in the heartwood, with a curved tunnel reaching to the bark. Adults mostly emerge in late April, May and June; they are active day-flyers (Gressitt, 1942). According to Lieu (1945) the life-cycle is annual, but Kojima (1931) states that it is two or three years in Japan.

Economic importance. This is one of the most destructive longhorns in the world and is certainly the most serious in China, being extremely abundant in all lowland orchards. The annual loss caused to fruit growers must reach a very high figure. On the campus of Lingnan University it has been estimated that 90 per cent of the *Citrus* trees alone were affected and 100 young trees have been killed annually, despite preventive measures (Gressitt, 1942).

Control. Lieu (1945) suggests (i) the hand collection and killing of adults, (ii) systematically crushing the eggs and larvae under the bark (during the period July to October) and (iii) whitewashing the basal portions of *Citrus* trunks with a mixture of quick-lime, sulphur and water (details of preparation and application given).

Parasite. Hymenoptera. *Aprostocetus fukutai* Miwa and Sonan (Miwa and Sonan, 1935).

Material studied. 2 L, Japan, Shimane Prefecture, Nita, 15.xii.1955, from *Malus pumila*, T. Fujimura leg., in coll. B.M.

References. Chen, 1933 (Biol.), Cheo, 1935 (Biol.); Chu, Chin, Ku and Hu, 1935

(Biol.); Gressitt, 1940 (Biol.), 1942 (E, L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Hadden, 1928 (Biol.); Hoffmann, 1934 (I fig., Biol.); Kojima, 1931 (L fig., Biol.); Lieu, 1945 (E fig., L fig., P fig., I fig., Biol. fig., Contr.); Maki, 1916 (L, Biol.); Maki and Rin, 1919 (Contr.); Mathur and Balwant Singh, 1961 (Biol.); Matsumura, 1921 (?); Miwa and Sonan, 1935 (Paras., fig.); Mühlmann, 1954 (Biol., Contr.); Mijima, 1913 (?); Sasaki, 1902 (?); Shiraki, 1952 (Biol.); Smith, 1907 (Biol.); Takahashi, 1929 (?); Quaintance, 1913 (Biol.).

Anoplophora (=Melanauster) beryllina (Hope)

Distribution. ORIENTAL REGION: Burma, China, Formosa, India (Assam, Sikkim, Uttar Pradesh), Indo-China (Viet Nam).

Host plant: *Quercus dealbata* (Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *A. chinensis* (Förster) from which it may be distinguished by the absence of a ferruginous border along the front margin of the posterior micro-spiculate area of the pronotum and the non-tuberculate abdominal ampullae. Length up to 25 mm.; maximum breadth (at prothorax) 5 mm.

Biology. Oviposition takes place on living healthy branches or stems of young trees. The larva tunnels subcortically round the branch, which causes the formation of a cankerous swelling of which there may be several on one branch. Pupation occurs in the heartwood and the beetle emerges by excavating a short tunnel, circular in cross-section, from the end of the pupal cell straight out to the exterior. The life-cycle is annual and adults emerge in May and June (Beeson and Bhatia, 1939).

Material studied. 1 L, India, Assam, Shillong, 20.v.1905. from *Quercus dealbata*, C. F. C. Beeson leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L); Mathur and Balwant Singh, 1960d (Biol.).

Anoplophora (=Melanauster) versteegi (Ritsema)

Distribution. ORIENTAL REGION: Burma, Hainan Is., India (Assam, Sikkim, West Bengal), Indo-China (Laos, Viet Nam), Sumatra.

Host plants: *Amoora wallichii, Citrus aurantium* (Beeson and Bhatia, 1939).

Biology. Oviposition takes place on stems or small branches of young living *Citrus*. The larva tunnels up and down the stem. The life-cycle is annual with emergence in April and May (Beeson and Bhatia, 1939).

Economic importance. This species is a minor pest of orange cultivation in Assam; it is probably the species which attacks *Amoora* in plantations there.

Control. Larvae should be killed in their galleries by the introduction of a flexible wire. The wound in the bark should be tarred and sealed with clay (Beeson, 1941). Mitra and Khongwir (1928) suggest white-washing the base of the trees about 3 ft. from the ground and a tie of straw or cotton band will prevent the insects from ascending the trunks.

References. Anonymous, 1936 (?); Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Ebening, 1950 (Biol.); Fletcher, 1919 (Biol.), 1921 (Biol.); Gardner,

1931b (L, Biol.); Gressitt, 1951 (Biol.); Mitra and Khongwir, 1928 (Contr.); Mühlmann, 1954 (Biol.); Quayle, 1938 (Biol.).

Anoplophora (=**Melanauster**) **horsfieldi** (Hope) (=**Cyriocrates horsfieldi** (Thomson)

[The Yellow and Black Longhorn]

Distribution. ORIENTAL REGION: China (Kwangtung), Formosa, India (Assam), Indo-China (Viet Nam).

Host plant: *Melia azedarach* (Gressitt, 1942).

Biology. Adults are quite active during the daytime from May to July.

References. Gressitt, 1942 (I fig., Biol., Contr.), 1951 (Biol.).

Aristobia approximator (Thomson) (=**birmanica** Gahan)

Distribution. ORIENTAL REGION: Burma, India (Assam, Madras), Indo-China, Malaya, Thailand.

Host plants. *Annona cherimolia, Cassia fistula, Hibiscus, Lagerstroemia speciosa, Peltophorum ferrugineum, Pyrus malus, Mitragyna rotundifolia, Tectona grandis, Xylia xylocarpa* (Beeson and Bhatia, 1939); *Eucalyptus* sp. (Mathur and Balwant Singh, 1959); *Adina cordifolia, Annona* sp., *Cassia renigera, Mitragyna diversifolia* (Beeson, 1941).

Adult (Pl. XIV, fig. 4). Length 19–34 mm. Velvety black, with extensive orange-yellow markings on pronotum and elytra. *Head* with segments one and two of antennae black, the remainder orange; third segment with a conspicuous tuft of black hairs, fourth segment sometimes with a much smaller tuft. Antennae about one-third longer than body in male, one-fifth longer in female. *Prothorax* with a pair of large tubercles; disc yellow, with two longitudinal black stripes. *Elytra* with orange pubescence crossed by five subtransverse black bands connected by oblique discal and sutural stripes forming a reticulated pattern.

Mature larva. Only a single very small larva of this species is available and at this juncture it is not possible to distinguish it from the genus *Celosterna.* Assuming this larva has been correctly associated, it would appear to be very closely related to *Celosterna.*

Biology. Oviposition takes place on living trees, usually on branchlets or shoots of the current year, the female first gnawing a crescent-shaped groove in which the egg is placed. The young larva soon tunnels along the branch into the bole where it tunnels downwards for several feet. Frass-ejection holes are made at intervals of about 9 in., the frass being in the form of oval, white pellets. At the end of the tunnel the larva pupates, the terminal portion of the gallery being smoothed off to form the pupal cell, the last 6 in. or so being tightly packed with wood fibres. The adult emerges by the most direct route through a round exit-hole. The life-cycle is annual. Adults are diurnal and feed on the bark of living shoots of various trees (Beeson and Bhatia, 1939, Atkinson, 1931).

Economic importance. Only young trees appear to be susceptible to attack. No infested teak over ten years old has been seen.

Control. As in *Apriona cinerea* Chevrolat.

Material studied. 1 L, Burma, Pynchaung, 11.iii.1929, from *Tectona grandis*, D. S. Atkinson leg., in coll. F.R.I.D.D.

References. Atkinson, 1931 (L fig., I fig., Biol. fig.), 1933 (Biol.); Beeson, 1941 (Biol.), Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Fletcher, 1921 (Biol.); Gardner, 1931b (L, Biol.); Garthwaite, 1938 (Biol.); Mathur, 1960 (Biol.), Mathur and Balwant Singh, 1959 (Biol.), 1960c (Biol.), 1960d (Biol.), 1961b (Biol.).

Aristobia horridula (Hope)

Distribution. ORIENTAL REGION: Burma, China, India (Assam, Sikkim, Uttar Pradesh), Jammu and Kashmir, Indo-China, Thailand.

Host plants: *Dalbergia paniculata* (Beeson and Bhatia, 1939); *Dalbergia volubilis* (Beeson, 1941); *Butea monosperma* (D. of A., Bangkok).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Aristobia testudo (Voet)

[The Lychee Longhorn]

Distribution. ORIENTAL REGION: Burma, China, East Pakistan (East Bengal), Hainan Is., India (Assam, Sikkim), Indo-China (Laos), Thailand.

Host plants: *Lagerstroemia speciosa* (Beeson and Bhatia, 1939); *Litchi sinensis Euphoria longana, Annona squamosa* (Gressitt, 1942).

Biology. Eggs are probably deposited in the bark of trunks and lower branches. Larvae excavate galleries up and down the heartwood, grooving the sapwood to make periodic frass-ejection holes. Living trees up to four or five years old are most commonly attacked. The adults are diurnal and feed on the bark of young branches. Emergence takes place mostly during the period from June to August (Gressitt, 1942).

Economic importance. This species is quite a serious pest because it attacks living fruit trees.

Control. The same measures should be adopted as in the case of *Anoplophora chinensis* (Förster).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1940 (Biol.), 1942 (I fig., Biol., Contr.); Mathur and Balwant Singh, 1960c (Biol.).

Pseudaristobia octofasciculata (Aurivillius)

Distribution. ORIENTAL REGION: Ceylon, India (Madras).

Host plant: *Santalum album* (Beeson and Bhatia, 1939).

Biology. This species infests small branches and stems of saplings. Emergence occurs between May and August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Dihammus australis (Boisduval)

Distribution. ORIENTAL REGION: Aru Is., New Guinea, New Mecklenberg, Saylee. AUSTRALASIAN REGION: Australia (Queensland).

Host plants: *Terminalia kaernbachii, Theobroma* (J. H. Ardley); *Schuurmansia henningsi, Ficus* sp., *Carica papaya* (G. S. Dun).

Mature larva (fig. 136). *Head* elongate, rather strongly depressed, widest at anterior third, with sides rather strongly converging posteriorly. Frontal sutures rather indistinct; antennal foramen closed posteriorly. Frons entirely ferruginous except front margin which is rather more pitchy; bearing eight or more setiferous pores. Six epistomal setae present. One pair of ocelli present, lens large, oval, strongly convex, pigmented spot distinct. Hypostoma flat, with front margin (as is that of frons) very strongly transversely strigose; a pair of setal pores present alongside gular sutures. Clypeus glabrous. Labrum transversely oval, fringed with coarse setae. Antenna

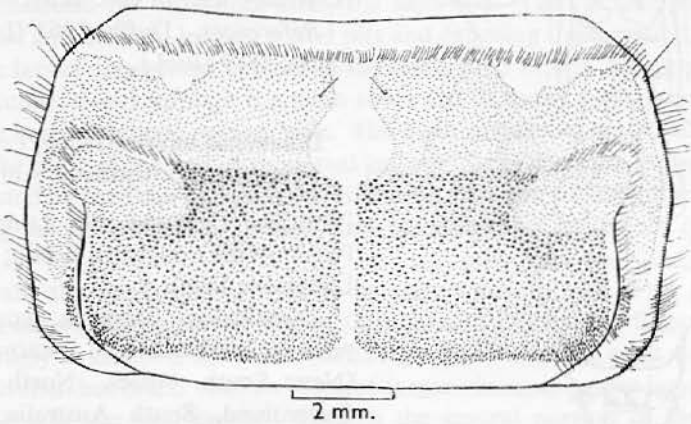

Fig. 136. *Dihammus australis* (Boisduval). Mature larva. Prothorax. Dorsal aspect.

2-segmented. Mentum distinct from submentum and bearing at least six pairs of stout setae. Maxillary palp with segment 3 about two-thirds length of segment 2. Labial palpi with segment 2 about half length of segment 1. *Prothorax* (fig. 136) with anterior part of pronotum testaceous to pale ferruginous, glabrous but fringed anteriorly with setae; posterior area rather densely covered with coarse asperities which are larger towards sublateral grooves; postnotal fold absent. Eusternum and sternellum glabrous. Metathorax dorsally with two transverse rows of micro-spiculate, moniliform tubercles. *Abdomen* with each dorsal ampulla with two transverse furrows and four transverse rows of micro-spiculate moniliform tubercles. Tergite 9 without a sclerotized process. Epipleurum protuberant on abdominal segments 1–9; pleural tubercles each with a pair of sclerotized pits. Anus trilobed. Legs minute but visible with a × 15 lens. *Spiracles* with peritreme broadly oval, rather thick, pale and with a conspicuous pair of subcontiguous marginal chambers on posterior half. Length up to 60 mm.; maximum breadth (at prothorax) 14 mm.

Pupa (fig. 137). Similar to that of *D. mixtus* (Hope) but distinguishable as follows.

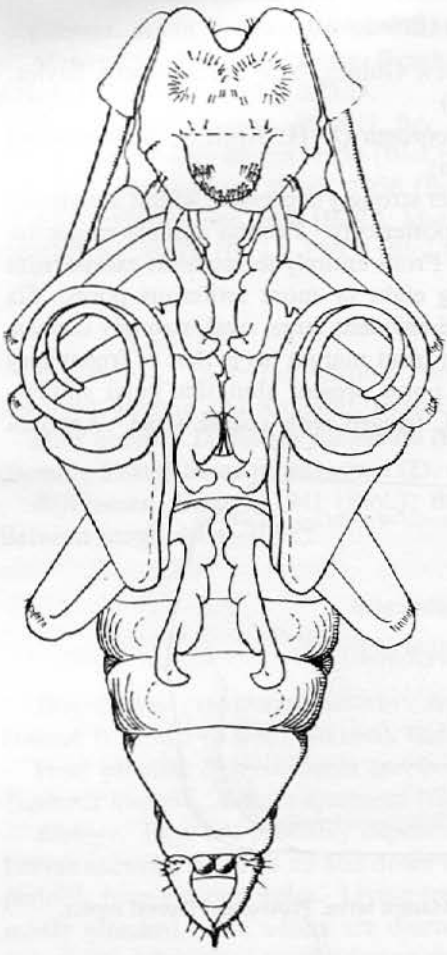

Fig. 137. *Dihammus australis* (Boisduval). Pupa. Ventral aspect.

Head with front plane between eyes. Labrum with setae reddish brown, each arising from a ferruginous basal papilla which gives the labrum a spotted appearance. Length up to 35 mm.; maximum breadth 15 mm.

Biology. The larval galleries, which in Bubia were no longer than 6 in. by $\frac{1}{3}$ to $\frac{1}{2}$ in., ascend for about one-third of their length and then follow the long axis of the tree. This species often infests *Theobroma* but ranks only as a minor pest (J. H. Ardley).

Material studied. 4 L, 2 P, 1 I, New Guinea, Bubia Agricultural Station, Lae, 25.ii.1960, from *Terminalia kaernbachii*, J. H. Ardley leg., in coll. B.M.

References. Duffy, 1963 (L, P, Biol.); Lucas, 1879 (Biol.).

Dihammus mixtus (Hope) (=**vastator** Newman) (=**fistulator** Aulmann)

[The Buff-coloured Fig Longicorn; the Passion Vine Longicorn Beetle; the Fig-tree Longicorn Beetle.]

Distribution. ORIENTAL REGION: Philippine Is. AUSTRALASIAN REGION: Australia (New South Wales, North Australia, Queensland, South Australia, Victoria), Lord Howe Is., Samoa, Kangaroo Is.

Host plants: *Ficus*, *Wistaria* (Froggatt, 1930); ?*Cassinia aculeata*, ?*Helichrysum ferrugineum* (French, 1919a); *Agathis robusta* (A. R. Brimblecombe); *Pinus halepensis P. radiata*, *Araucaria*, *Cedrela australis*, *Cymbidium* (Anonymous, 1940); *Flindersia australis*, *Laportea gigas*, *Maba fasciculosa* (A. R. Brimblecombe); *Excaecaria agallocha* (Duffy, 1963). *Ficus* is the preferred host.

Mature larva. Similar to that of *D. australis* (Boisduval) but distinguishable by the asperities on the pronotum which become smaller but not elongate posteriorly.

Pupa. Head with vertex entirely visible from above, rather shallowly excavated and bearing two pairs of setae near base of each antennal tubercle; front bearing numerous setae, base of clypeus with two pairs of setae. Antennae extending to abdominal segment 3 where they are incurved ventrally and each arranged in two or more coils on top of each elytron. Eyes feebly convex. Mandibles each with two stout setae near middle of outer face. Labrum bearing two groups each of about 10 setae. *Pronotum* with a pair of very prominent lateral tubercles; disc with a pair of

obliquely set, ridge-like tubercles, each bearing a group of about 25 setae. *Mesonotum* with a pair of similar but smaller setose tubercles; scutellum protuberant. *Metanotum* with two similar groups of setae which do not arise from a tubercle. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 2–6 each with a pair of paramedian, transversely-oval tubercles each bearing numerous long stout setae. Segment 9 short, produced into dorsally a long, vertical, spine-like process, which is sclerotized apically; ventrally it is deeply divided and spinose. Sternites glabrous or almost so. Pleura scarcely protuberant. *Legs* with a transverse row of short stout setae near apex of each femur; hind femora extending to abdominal segment 4; tibiae placed obliquely to longitudinal axis of body. *Functional spiracles* present on segments 1–6; peritreme rather broadly oval, moderately thick and slightly raised above general level of cuticle. Length up to 21 mm.; maximum breadth 6·5 mm.

Biology. Females lay their eggs singly on the rough bark of *Ficus* and then cut an irregular circle in the bark, about ½ in. in diameter, around each egg. On hatching, the larva penetrates the bark and, later, the sapwood. The circular pieces of bark eventually die and fall out, leaving round pits and exposing the sapwood. In the case of vines, the larvae may tunnel upward in the stems for 3 or 4 ft. before pupating. At times they tunnel down through the main roots and as many as 51 larvae have been found in the base of a single passion vine. The pupal cell is prepared in a small cavity, just under the bark, at the end of the larval gallery. Sometimes the presence of larvae can be detected by the frass and gnawed wood, mixed with exuding gum, which forms lumps along the infested stem. Adults start to emerge in September (Anonymous, 1940).

In Australia this species has proved to be quite a serious pest of the passion vine. Oviposition occurs during the months of October and December. Eggs appear to be deposited singly in or upon the bark near the ground. In many cases only one larva feeds in each stem but in the swollen bases of larger vines, up to five larvae have been obtained. The larvae feed upward through the central portion of the stem for a distance of three or four feet before preparing their pupal cells (Froggatt, 1919b).

Control. Heavily infested branches should be cut off and burned. All injured or loose bark should be scraped away and the surface painted with bluestone paint. A small quantity of carbon bisulphide may be injected into the holes and the latter then plugged with wax or soap. The painting of trunks or branches of trees or vines with bluestone paint in the spring is also beneficial as it discourages oviposition. The formula for this paint is: Copper sulphate 1½ lb., lime 1 lb., water 2 gallons. The copper sulphate should be dissolved in approximately 1 gallon of water, the lime broken down with the remainder and then poured into the solution. Iron or galvanized iron vessels should not be used for mixing (Anonymous, 1940). Froggatt (1919b) suggests the painting of vine stems with a lime and sulphur wash from October to January. Dead, dying or fallen trees should be removed. French (1919a) recommends spraying the vines with tar-impregnated water to prevent oviposition. This may be prepared as follows: Boil 1 lb. of coal tar in two galls. of water, and, while hot, add from 50–100 gallons of water, then strain before using.

Material studied. 1 L, 1 P, Australia, Queensland, Imbil, 2.ii.1938, from *Agathis obusta*, A. R. Brimblecombe leg., in coll. D.A.S.B.; 2 L, Australia, Queensland,

Taromeo, 15.i.1944, from *Pinus halepensis*, A. R. Brimblecombe leg., in coll. D.A.S.B.; 1 L, Australia, Queensland, Benarkin, 15.i.1944, from *Pinus radiata*, A. R. Brimblecombe leg., in coll. D.A.S.B.

References. Anonymous, 1940 (L fig., P fig., I fig., Biol., Contr.); Duffy, 1963 (L, P, Biol., Contr.); Evans, 1952 (Biol.); French, 1919a (L fig., P fig., I fig., Biol. fig., Contr.) Froggatt, 1919b (L fig., P fig., I fig., Biol. fig.), 1923 (L fig., P fig., I fig., Biol. fig.), 1930 (Biol. fig.); McKeown, 1944 (L fig., I fig., Biol.); Mühlmann, 1954 (Biol.); Ultée, 1916 (Biol.).

Dihammus admixtus (Gahan)

Distribution. ORIENTAL REGION: Andaman Is., Burma.

Host plants: *Adina cordifolia*, *Anogeissus acuminata*, *Aporosa* sp., *Pterocarpus dalbergioides*, *Pterospermum acerifolium* (Beeson and Bhatia, 1939). *Ixora parviflora* (Mathur and Balwant Singh, 1960b).

Biology. The emergence period is in May but adults have also been collected in March, July and August.

References. Beeson and Bhatia, 1939 (Biol.); Beeson, 1941 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.).

Dihammus andamanicus Breuning

Distribution. ORIENTAL REGION: Andaman Is.

Host plants: *Canarium euphyllum*, *Terminalia procera* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Dihammus cervinus (Hope)

[The Teak Canker Borer or the Velvety Longicorn Beetle]

Distribution. ORIENTAL REGION: Burma, China, India (Assam, Bihar, Orissa, Sikkim, Uttar Pradesh, West Bengal), Indo-China (Laos), Nepal. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Adina cordifolia*, *Anthocephalus cadamba*, *Buddleia madagascarensis*, *Clerodendron infortunatum*, *Gmelina arborea*, *Sarcocephalus cordatus*, *Tectona grandis* (Beeson and Bhatia, 1939); *Camellia thea* (Beeson, 1941); *Homalium tomentosum*, *Anogeissus acuminata* (Atkinson, 1933); *Sambucus* (Mathur and Balwant Singh, 1961); *Daphniphyllum macropodum* (Sasaki, 1902); *Duabanga sonneratioides* (Mathur and Balwant Singh, 1959); *Oroxylum indicum* (Mathur and Balwant Singh, 1961); *Ficus religiosa* (Mathur and Balwant Singh, 1959); *Terminalia myriocarpa* (Mathur and Balwant Singh, 1961b).

Adult (Pl. XIV, fig. 2). Length 15–23 mm. Uniformly light or greyish brown, the scutellum buff. *Head* with antennae about twice as long as body in male, only about one and one-half times in female. *Prothorax* with a pair of stout lateral spines. *Elytra* subtruncate apically.

Mature larva. Very similar to that of *Dihammus australis* (Boisbuval) from which it may be distinguished as follows: Form less robust; length up to 48 mm.; maximum breadth (at prothorax) 9·25 mm. *Head* with mentum bearing only two pairs of stout setae. *Prothorax* with asperities entirely confined to pronotum. *Abdomen* with pleural tubercles bearing only two moderately long setae.

Egg. Length 3·25 mm., width 0·75 mm. Surface minutely alveolate, the alveolae hexagonal and separated from one another by narrow elevated reticulate walls. Cigar-shaped, with one end slightly and bluntly produced (Gardner, 1927).

Biology. Before oviposition the beetle first makes a transverse incision deep in the bark. An egg is then forced upwards between the bark and cambium layer and the incision sealed with a secretion. The bark immediately over the site of the egg usually cracks longitudinally. In *Clerodendron* the eggs are generally deposited just above ground level but in *Tectona* and *Gmelina* they are often deposited higher up. The beetle possesses twenty pairs of ovarian tubules and four eggs mature at a time. The average number of eggs laid by a single individual is about 40 and the average rate of oviposition is two eggs per day. The incubation period is five days in May and five to seven days in August. The first-instar larva immediately penetrates the bast and soon starts to eject frass through the crack in the bark. The gallery is irregular and extends downwards and round the stem. Within two or three weeks the larva enters the sap-wood where a gallery up to 10 in. long is excavated during the course of three months. The wood of the stem (of *Tectona* and *Gmelina*) or root (of *Clerodendron*) is then penetrated and a pupal cell excavated. It is 1 to 2 in. long, free from wood dust but plugged with a wad of coarse wood fibres. The pupal period is 14 to 19 days; the beetle may either gnaw its way out within the following two or three days or remain in situ for a much longer period. In the United Provinces emergence from *Clerodendron* (cut mainly in the second half of May) took place between June and August, mainly in July. In Bihar, emergence has been recorded for May and June. In the case of *Clerodendron, Gmelina* and *Tectona* from Bengal and Assam, adults emerged in April (22 per cent), May (72 per cent) and June (6 per cent). Emergence from wood brought to Dehra Dun from Sylhet in August took place during the following April and May (from *Tectona*) and August to October but mainly in September (from *Clerodendron*). On the other hand, adults have been bred out in Sylhet from both *Tectona* and *Clero-dendron* in October. In the United Provinces the life-cycle of this beetle is annual but in eastern Bengal, Assam and probably also in Burma there are two generations a year. The average duration of adult life under laboratory conditions has been found to be 27 days, with a maximum of 70 days for a female and 57 days for a male, but there is a record of a pair living for 119 days in an out-door cage. The beetles feed on the bark of the larval host plants, gnawing away irregular patches thereby exposing the wood. Sometimes, however, they destroy leaf buds and tender shoots. They do not fly far afield and usually remain in the vicinity of infested trees. Although mainly nocturnal they are not attracted to artificial light. Bait-traps effect a concentration of the beetle population for a few hundred square yards.

There appears to be no marked preference for any host plant. Beetles bred from *Clerodendron*—probably the commonest host plant—do not show a preference for it against teak. It has been found that in young plantations where *Tectona* and *Clero-*

dendron grow together the incidence of attack is greater on the latter. But later on, as the canopy closes up, the incidence of attack increases relatively on *Tectona*. It is thus quite evident that the presence of *Clerodendron* in teak plantations makes the latter more prone to attack (Beeson and Bhatia, 1939). In Japan, adults appear in June and July (ovipositing on living trees) and pupation occurs during February and March (Kojima, 1931).

Economic importance. This beetle, known as the canker grub of teak, is a serious pest of living trees in plantations of *Tectona* and *Gmelina* in India and Burma. Partial girdling and injury to the cambium induces an increased growth of wood around the site of the damage. This eventually results in the formation of a callus of a diameter far exceeding that of the stem. Where there has been extensive tunnelling by larvae or excavation by wood-peckers the stem becomes so undermined that it breaks off (fig. 138).

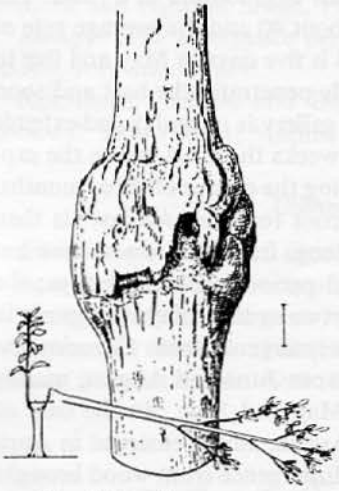

Fig. 138. *Dihammus cervinus* (Hope). Canker produced in the stem of a sapling of *Tectona grandis*, showing exit-hole of beetle; vertical scale line represents one inch. Small figure shows a sapling broken off at the canker from which a subsequent coppice-shoot is growing. (Beeson and Bhatia, 1939)

In the case of *Gmelina* the larval galleries are less extensive and the callus much less pronounced. *Gmelina* may be attacked in its first year, whereas *Tectona* at this age is usually too slender. During its second and third year of growth more than half the growing stock in a plantation of *Gmelina* may be attacked. After this, however, there is a gradual decline and after the seventh or eighth year teak outgrows its susceptibility to attack (Beeson and Bhatia, 1939).

Control. Teak should not be planted on land previously occupied by *Clerodendron infortunatum* until the latter is entirely eradicated. Neither should pure plantations of teak and *Gmelina arborea* be adjacent to each other. Rapid growth during the first six years not only shortens the period during which the tree is susceptible to attack, but it makes it more resistant to larval excavation and restricts the extent of canker-formation. The cutting back of weeds in the first two years reduced incidence of attack to a slight extent. Stems of one to four-year-old plants which are severely cankered should be cut back to ground level to promote growth of new stems but infested trees should never be cut out with the object of destroying the borer (Beeson, 1941).

Material studied. 1 L, East Pakistan, Chittagong Hill Tracts, from *Tectona grandis*, C. F. C. Beeson leg., in coll. F.R.I.D.D.

References. Atkinson, 1931 (L fig., I fig., Biol. fig.), 1933 (Biol.); Beeson, 1916 (Biol.), 1920 (Biol.), 1925 (Biol. fig.), 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1953a (Biol. fig.); Gardner, 1927 (E fig., L fig., P); Gressitt, 1951 (Biol.); Kojima, 1931 (L, Biol.); Mathur, 1960 (I fig., Biol. fig., Contr.); Mathur and

Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Sasaki, 1902 (?); Shiraki, 1952 (Biol.); Stebbing, 1914 (Biol.).

Dihammus gardneri Breuning

Distribution. ORIENTAL REGION: Burma.

Host plants: *Anogeissus acuminata, Tectona grandis* (Beeson, 1941); *Aporosa* sp. (Bhasin and Roonwal, 1954); *Gmelina arborea* (Mathur and Balwant Singh, 1960b); *Adina cordifolia* (Bhasin and Roonwal, 1954); *Hymenodictyon excelsum* (Mathur and Balwant Singh, 1960b).

References. Beeson, 1941 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Dihammus fasciatus (Montrouzier)

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia, Duke of York Is., Caroline Is. (Caroline Atolls, Truk, Kusaie), Lord Howe Is., New Hebrides, Samoa, Solomon Is., Woodlark I.

Host plant: *Artocarpus altilis* (Gressitt, 1956).

References. Duffy, 1963 (Biol.); Gressitt, 1956 (Biol.).

Dihammus elongatus Breuning

Distribution. ORIENTAL REGION: Burma, China, India (Assam, Sikkim, West Bengal).

Host plants: *Acrocarpus fraxinifolius, Aesculus punduana, Anthocephalus cadamba, Casearia glomerata, Clerodendron* sp., *Duabanga sonneratioides, Echinocarpus dasycarpus, Gmelina arborea, Juglans regia, Litsaea kingii, Macaranga denticulata, Mallotus roxburghianus, Michelia excelsa, Ostodes paniculata, Sapium eugeniaefolium, Tectona grandis, Terminalia myriocarpa* (Beeson and Bhatia, 1939); *Anogeissus acuminata* (Bhasin and Roonwal, 1954).

Biology. Larvae of this species infest dead and felled wood. The life-cycle is annual, with adults emerging between April and July (mainly May).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.), 1961b (Biol.).

Dihammus griseipennis (Thomson)

Distribution. ORIENTAL REGION: Burma, India (Assam, Sikkim, West Bengal).

Host plant: *Strobilanthes acrocephalus* (Beeson and Bhatia, 1939).

Biology. Emergence occurs between April and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Dihammus strandiellus Breuning

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Solomon Is.

Host plant: *Theobroma cacao* (Szent-Ivany, 1961).

Reference. Szent-Ivany, 1961 (Biol.).

Dihammus griseoplagiatus Breuning

Distribution. ORIENTAL REGION: Ceylon, India (Madhy Pradesh, Madras, Maharashtra).

Host plants: *Adina cordifolia, Ficus tsiela, Garuga pinnata, Holigarna arnottiana, Hopea wightiana, Lannea coromandelica, Mangifera indica, Salmalia malabaricum, Spondias mangifera, Terminalia belerica, T. paniculata, T. tomentosa, Vateria indica* (Beeson and Bhatia, 1939); *Pterospermum heyneanum* (Beeson, 1941).

Biology. The life-cycle is annual, with emergence occurring between May and August (mainly June).

References. Beeson, 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960d (Biol.), 1961b (Biol.).

Dihammus inaequalis Gardner

Distribution. ORIENTAL REGION: Burma, India (West Bengal).

Host plants: *Alnus nepalensis, Evodia fraxinifolia, Juglans regia, Macaranga denticulata* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with emergence occurring from February to May, mainly in March.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.).

Dihammus longiscapus Gahan

Distribution. ORIENTAL REGION: Burma, India (Maharashtra), Indo-China (Laos).

Host plants: *Ficus tsiela, Holigarna arnottiana, Lannea coromandelica* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with emergence occurring in June and July, mainly the former.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961 (Biol.).

Dihammus punctifrons Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Maharashtra, Sikkim, Uttar Pradesh, West Bengal).

Host plants: *Aesculus punduana, Cajanus cajan, Duabanga sonneratioides, Ficus elastica, Garcinia paniculata, Homalium tomentosum, Tectona grandis, Terminalia belerica, T. myriocarpa* (Beeson and Bhatia, 1939); *Lannea coromandelica* (Mathur and Balwant Singh, 1961); *Garuga pinnata* (Beeson, 1941); *Strobilanthes* sp. (Mathur and Balwant Singh, 1961).

Biology. Although generally infesting felled timber, this species has been known also to breed in transplants of *Ficus elastica*, which it killed, and also in living stems of

Cajanus indicus. The emergence period from felled timber is from April to July, mainly in May. The life-cycle is apparently annual.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961b (Biol.).

Dihammus rusticator (Fabricius) (=**fistulator** Germar)

Distribution. ORIENTAL REGION: Andaman Is., Borneo, Burma, Ceylon, Formosa, India (West Bengal), Indo-China (Viet Nam), Indonesia (Moluccas, Celebes), Java, Malaya, Nicobar Is., Philippine Is., Sarawak, Sumatra, New Britain.

Host plants: *Afzelia bijuga, Artocarpus integra, Excaecaria agallocha, Ficus elastica, Hevea brasiliensis, Ricinus communis, Theobroma cacao* (Beeson and Bhatia, 1939); *Tectona, Citrus, Erythrina, Aleurites, Aegle marmelos, Chydenanthus excelsus, Trema orientalis, Buchanania arborescens, Solanum melanogena, Barringtonia spicata, Pithecolobium saman, Ficus racemosa, Jatropha curcas, Semecarpus heterophylla, Moringa oleifera, Artocarpus integra* (Kalshoven, 1939a); *Coffea, Datura, Manihot utilissima* (Dammerman, 1919); *Parashorea malaanonan* (Mathur and Balwant Singh, 1960d).

Biology. This species is apparently a pest of living cocoa trees. The larval galleries are subcortical, sometimes girdling the tree but not always completely. The life-cycle in dead wood is probably annual with adults emerging in April and May (Beeson and Bhatia, 1939).

In East Java, teak saplings in two-year-old plantations were found to have gall-like swellings where larvae of this species had formed a circular gallery beneath the bark before tunnelling through the wood cylinder into the pith. The adults are nocturnal and feed on bark. In mature trees, pupal cells are excavated superficially in the wood, but in saplings they are formed in the pith. The incubation period is five to six days. The larval stage, in the case where larvae were reared in manihot lasted ten to sixteen weeks and the pupal stage nine to thirteen days. After five to eight days the adults emerge and the ring-barked saplings react through the formation of wooden elements in the bark tissue which bridge over the gap, giving rise to a swelling, thus preventing the top from dying back (Kalshoven, 1939a).

Economic importance. This beetle is regarded as being only of minor importance so far as the cultivation of teak in Java is concerned (Kalshoven, 1939a). There are records of this species attacking *Theobroma* in New Britain.

Control. Larvae should be extracted with a wire or killed by injecting benzene into their galleries (Keuchenius, 1917).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Dammerman, 1913 (Biol.), 1919 (Biol.), 1929 (Biol.); Fletcher, 1921 (Biol.); Haan, 1933 (Biol.); Hall, 1932 (I fig., Biol.); Kalshoven, 1936c (Biol.), 1939a (L fig., Biol. fig.), 1951 (L fig., Biol.); Keuchenius, 1917 (Biol., Contr.); Keuchenius and Corporaal, 1922 (I fig., Biol.); Konigsberger, 1903 (I fig., Biol.), 1908 (Biol.), 1915 (Biol); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.); Opsomer, 1932 (Biol.);

Paerels, 1924 (Biol.); Pierce, 1918 (Biol.); Stellwaag, 1928 (Biol.); von Faber, 1909 (Biol., Contr.).

Dihammus marianarum (Aurivillius)

Distribution. ORIENTAL REGION: Micronesia (S. Mariana Is.).

Host plants: *Artocarpus*, *Ficus*, *Pithecolobium*, *Hibiscus*, *Theobroma*, *Anacardium*, *Mangifera*, *Barringtonia* (Gressitt, 1956).

Reference. Gressitt, 1956 (Biol.).

Dihammus korolensis (Matsushita)

Distribution. ORIENTAL REGION: Micronesia (Caroline Is.: Palau).

Host plant: *Pandanus*? (Gressitt, 1956).

Reference. Gressitt, 1956 (Biol.).

Dihammus sericeus Breuning

Distribution. ORIENTAL REGION: India (Assam, Uttar Pradesh, West Bengal).

Host plant: *Terminalia myriocarpa* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May and have been taken on the wing in July and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Dihammus defector (Pascoe)

Distribution. ORIENTAL REGION: Java, Singapore.

Host plant: *Leea indica* (Kalshoven, 1936c).

Mature larva. Very similar to that of *D. australis* (Boisduval) but distinguishable as follows: Form less robust; maximum breadth 8·5 mm. *Head* with mentum bearing only two pairs of stout setae. *Abdomen* with spiracular peritreme simple.

Biology. Beetles have been reared from the living stems of the host plant, mainly during the months of November, December and January.

Material studied. 14 L, C. Java, 1932, from *Leea* sp., L.G.E. Kalshoven leg., in coll. L.G.E.K.

References. Kalshoven, 1936c (Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Dihammus nivosus White (=**Monochamus nivosus** (White))

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Punjab, Uttar Pradesh), Nepal.

Host plants: *Calotropis gigantea*, *Kydia calycina*, *Stephanotis floribunda* (Beeson and Bhatia, 1939).

Mature larva. See key, p. 29.

Biology. Adults occur between May and September. Larvae feed in dead and dying woody parts (Bhasin, Roonwal and Balwant Singh, 1958).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal

and Balwant Singh, 1958 (Biol.); Fletcher, 1921 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961 (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Stebbing, 1914 (I fig., Biol.).

Dihammus bifasciatus (Westwood) (=**Monochamus perplexus** Gahan)

Distribution. ORIENTAL REGION: India (West Bengal).

Mature larva. See key, p. 29.

Reference. Gardner, 1931b (L, Biol.).

Myagrus vinosus (Pascoe) (=**Pharsalia vinosa** Pascoe) (=**Neopharsalia vagans** Kannegieter)

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.

Host plants: *Ficus elastica* (Dammerman, 1913); *Artocarpus integra*, *A. elastica*, *A. communis*, *Ficus variegata*, *F. alba* (Kalshoven, 1955b).

References. Dammerman, 1913 (Biol.); Kalshoven, 1955b (Biol.).

Gerania bosci (Fabricius)

Distribution. ORIENTAL REGION: Burma, Java, Malacca, Thailand.

Host plant: *Streblus asper* (D. of A., Bangkok).

References. None available. (See also p. 234.)

Myagrus hynesi Pascoe

Distribution. ORIENTAL REGION: India (Madhy Pradesh, Madras, Maharashtra), Java, Sumatra.

Host plants: *Ficus racemosa*, *Ficus* sp., *Grewia* sp. (Gardner, 1931b).

Mature larva (fig. 139). Form very slender. *Head* (fig. 139) very strongly depressed; antennal foramen closed posteriorly. Ocelli very indistinct owing to sclerotization of gena. *Prothorax* with posterior area of pronotum micro-spiculate, interspersed with numerous glabrous spots. Eusternum dull, micro-granulate (possibly micro-spiculate) laterally. *Abdomen* with ampullae non-tuberculate, finely crenulate. Pleural tubercles without sclerotized pits but bearing numerous setae. *Spiracles* with peritreme pale, broadly oval. Length up to 34 mm.; maximum breadth (at prothorax) 5 mm.

Distinguishable from all other genera of the Agniini, Monochamini and allied genera by the presence of sublateral, longitudinal carinae on the head (fig. 139), and by the strongly protuberant dorsal anal lobe.

Biology. Emergence occurs from May to August. In Madras adults also occur from December to February.

Material studied. 2 L, India, Madras, Anamalais, v.1930, from rotten creeper, J.C.M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., P fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.).

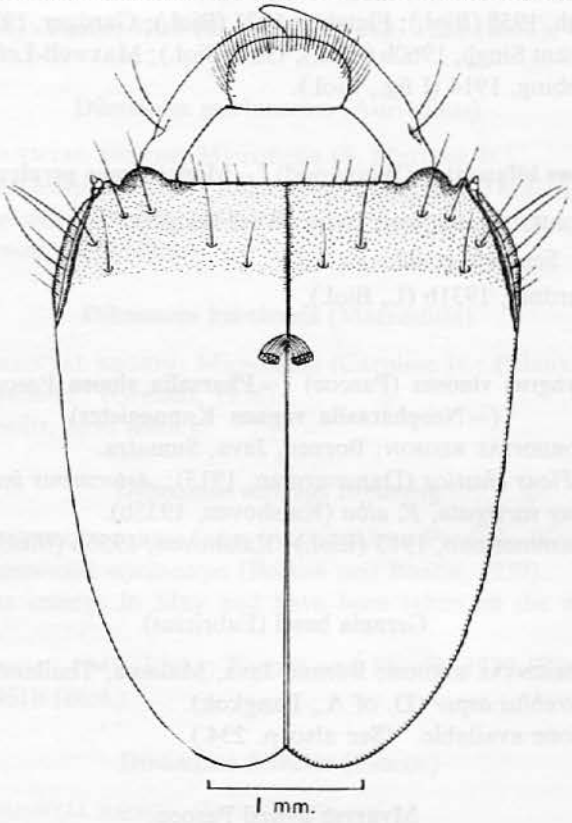

Fig. 139. *Myagrus hynesi* Pascoe. Mature larva. Head. Dorsal aspect.

Pharsalia (Pharsalia) proxima Gahan, var. **intermedia** Heller

Distribution. ORIENTAL REGION: Ceylon, India (Maharashtra, Madras).

Host plants: *Mangifera indica, Terminalia belerica* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual. Adults emerge in September and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Pharsalia (Pharsalia) suturalis Aurivillius

Distribution. ORIENTAL REGION: India (Assam, West Bengal).

Host plants: *Acrocarpus fraxinifolius, Elaeocarpus* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Pharsalia (Pharsalia) saperdoides Pascoe

Distribution. ORIENTAL REGION: Borneo, Java, Sarawak, Sumatra.

Host plants: *Mangifera indica, Canarium* (Kalshoven, 1955b).

Biology. The adult has the curious habit of grasping a twig with its front and middle legs and banded antennae; with its body slanting outward and its hind legs drawn in, it resembles a small dry branchlet (Kalshoven, 1955a).

References. Kalshoven, 1955a (Biol.), 1955b (I fig. Biol. fig.); Linsley, 1959 (Biol.).

Pharsalia (Cycos) subgemmatus (Thomson)

Distribution. ORIENTAL REGION: Andaman Is., Borneo, Burma, India (Assam, Maharashtra, Sikkim, Uttar Pradesh), Indo-China (Laos), Sumatra, Thailand.

Host plants: *Buchanania lanzan, Canarium euphyllum, Garuga pinnata, Terminalia myriocarpa* (Beeson and Bhatia, 1939).

Mature larva. Similar to those of *Monochamus* species but differing as follows. *Abdomen* with tubercles of dorsal ampullae flattened and not regularly moniliform but almost completely glabrous and shining. Anus with transverse cleft very long and curved downwards at extremities. Length up to 50 mm.; maximum breadth (at prothorax) 11 mm.

Biology. There are two periods of emergence; May to July and November.

Material studied. 2 L, Burma, Rangoon, 1933–34, F.J. Meggitt leg., in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Trichagnia fuscomaculata Breuning

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Terminalia paniculata* (Beeson and Bhatia, 1939).

Biology. Adults have been taken in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Xenicotela distincta Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh, West Bengal).

Host plant: *Evodia fraxinifolia* (Beeson and Bhatia, 1939).

Biology. Adults have been bred out in March and been taken on the wing in May and July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Phrissomini

Morimus inaequalis Waterhouse

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Ficus* sp. (Gardner, 1931b).

Mature larva. Similar to those of *Monochamus* and allied genera but distinguishable as follows. *Prothorax* with posterior micro-spiculate area of pronotum partly divided by a narrow but distinct longitudinal, median, glabrous depression. *Abdomen* with abdominal ampullae non-tuberculate or with tubercles very feebly defined. Pleural tubercles each with at least five setae. Anus a transverse cleft (as in *Epepeotes*, fig. 129). Length up to 44 mm.; maximum breadth (at prothorax) 9·5 mm.

Biology. Adults occur in May.

Material studied. 2 L, India, Madras, Anamalais, v.1930, from rotten creeper, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, P fig., Biol.).

Eupromus ruber (Dalman)

[The Red-spotted Longicorn Beetle]

Distribution. ORIENTAL REGION: China, Formosa. PALAEARCTIC REGION: Japan.

Host plants: *Cinnamomum camphora*, *Machilus longifolia* (Kojima, 1931); *Machilus thunbergii* (Shiraki, 1952).

Mature larva. Rather similar to that of *Morimus inaequalis* Waterhouse but differing as follows. *Prothorax* with micro-spiculate area of pronotum uninterrupted medially but with a pair of paramedian, longitudinal slot-like, glabrous areas. *Abdomen* with moniliform tubercles of ampullae very distinct, strongly protuberant and micro-spiculate. Pleural tubercle without sclerotized pits and only two or three setae. Length up to 26 mm.; maximum breadth (at prothorax) 5 mm.

Biology. Adults appear in June and July and deposit their eggs in living trunks and branches of their hosts. The duration of the life-cycle is probably two years (Kojima, 1931).

Economic importance. The damage caused by larvae of this species is serious, as a great deal of the cambial region is consumed (Kojima, 1931).

Material studied. 1 L, Japan, Noné K chi Pref., 18.iii.1956, S. Nakamara leg., in coll. Shimane Agricultural Experiment Station.

References. Kojima, 1931 (L fig., Biol.), 1959 (Biol. fig.); Shiraki, 1952 (Biol.).

Morimopsini

Morimopsis lacrymans Thomson

Distribution. ORIENTAL REGION: India, (West Bengal).

Host plants: *Acer campbelli*, *Juglans regia*, *Litsaea citrata*, *L. elongata*, *Machilus odoratissima*, *Prunus nepalensis* (Beeson and Bhatia, 1939).

Mature larva. Similar to those of *Monochamus* species but differing as follows. *Head* with antenna 2-segmented, there being no sclerotized, setose, third segment. *Abdomen* with ampullae micro-spiculate but non-tuberculate. Pleural tubercles without sclerotized pits. *Spiracles* small (not more than half as wide of labrum), very thick and subcircular. Length up to 35 mm.; maximum breadth (at prothorax) 6 mm.

Biology. Adults emerge in April.

Material studied. 2 L, India, West Bengal, Darjeeling, Sunkona, 8.ix.1929, from *Litsaea elongata*, J.C.M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L, P, Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960c (Biol.).

Gnomini

Gnoma confusa Thomson

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.

Host plant: *Derris* (dead stems) (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Imantocera penicillata (Hope)

Distribution. ORIENTAL REGION: Burma, India (Sikkim), Indo-China (Laos, Viet Nam), Malacca, Nepal.

Host plant: *Ficus religiosa* (Gardner, 1931b).

Mature larva. This larva is closely allied to the Monochamini but appears to be most closely related to the Phrissomini (*Morimus*) from which it differs as follows. Form more slender and elongate. *Prothorax* with posterior part of pronotum very densely covered with orange-testaceous micro-pubescence; eusternum broadly dull and micro-pubescent posteriorly. *Abdomen* with ampullae non-tuberculate but very densely covered with orange-testaceous micro-pubescence. Length up to 40 mm.; maximum breadth (at prothorax) 6·25 mm.

Material studied. 1 L, Burma, Bhamo, from *Ficus religiosa*, D.J. Atkinson leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Imantocera plumosa (Olivier)

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.

Host plants: *Ficus elastica* and *F.* spp. (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Imantocera vicina Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, West Bengal).

Host plant: *Myristica longifolia* (Beeson and Bhatia 1939).

Biology. Adults emerge from April to August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Batocerini

Larval Characters

Head with antennal foramen closed posteriorly. One pair of ocelli present. Antenna 2- or 3-segmented. Gular sutures indistinct. *Prothorax* with posterior area of pronotum, eusternum and sternellum very coarsely asperate. Postnotal fold well developed (except *B. lineolata* Chevrolat), asperate. *Abdomen* with ampullae bearing rows of asperities or spicules. Pleural tubercles each with a pair of sclerotized pits. Segment 9 without a sclerotized process. Anus a transverse cleft.

Batocera rufomaculata (Degeer) (=**rubra** auct.)

[The Mango Tree Borer or Violin]

Distribution. ORIENTAL REGION: Andaman Is., Burma, China, Ceylon, India (Assam, Bihar, Madhy Pradesh, Madras, Maharashtra, Uttar Pradesh), Malaya, Seychelles, West Pakistan (Baluchistan, Peshawar). PALAEARCTIC REGION: Israel, Palestine, Tibet. ETHIOPIAN REGION: East Africa. MADAGASCAN REGION: La Réunion, Madagascar, Mauritius, Rodriguez. NEOTROPICAL REGION: Caribbean (Barbados, Trinidad (?), Virgin Is.

Host plants. Oriental region: *Adina cordifolia, Albizia lebbek, Artocarpus integra, Barringtonia acutangula, Bauhinia acuminata, Salmalia malabarica, Broussonetia papyrifera, Buchanania lanzan, Canarium euphyllum, Carica papaya, Ceiba pentandra, Cocos nucifera, Dalbergia sissoo, Dyera costulata, Erythrina indica, Eugenia cuminii, Ficus benghalensis, F. carica, F. elastica, F. racemosa, F. infectoria, F. religiosa, F. tsjahela, Garuga pinnata* (?), *Hevea brasiliensis, Lannea coromandelica, Mangifera indica, Moringa oleifera, Morus acidosa, Parishia insignis, Platanus orientalis, Semecarpus anacardium, Shorea robusta, Spondias pinnata, Sterculia colorata, S. villosa, Syzygium cumini* (Beeson and Bhatia, 1939; Beeson, 1941); *Artocarpus incisa, Ficus asperrima, F. pedunculata* (Husain and Khan, 1940); *Boswellia serrata* (Roonwal, Chatterjee and Thapa, 1961); *Pyrus malus* (Mathur and Balwant Singh, 1960d); *Hyophorbe verschaffeltii* (Royal Forest Department, Thailand).

Madagascan region: *Acacia, Artocarpus altilis, Ficus benghalensis, Mangifera indica, Spondias dulcis* (Department of Agriculture, Mauritius, 1918).

Neotropical region: *Asimina, Ficus* spp., *Mangifera, Musa, Ochroma lagopus, Persea* (Ballou, 1916b); *Persea gratissima, Spondias lutea* (Department of Agriculture, Tortola, 1918).

Adult (Pl. XIII). Length 26–52 mm. Head, prothorax and elytra covered with grey or yellowish grey pubescence; prothorax with a pair of large orange or orange-yellow marks on disc; elytra very variably maculated with small orange-yellow or pale yellow spots, usually six on each elytron, but often less or with numerous scattered subsidiary spots. *Head* with antennae about one-third longer than body in male, only slightly longer than body in female. *Prothorax* bearing a pair of stout conical tubercles laterally. *Elytra* with shoulders bearing a small spine basal third bearing numerous small, shining, moniliform tubercles; apices slightly obliquely truncate, the sutural angle spined.

Mature larva (fig. 140). *Head* elongate, rather strongly depressed, widest at anterior third and strongly converging posteriorly. Frontal sutures indistinct; antennal foramen closed behind; mouthframe extremely strongly and very broadly sclerotized, pitchy; frons pitchy anteriorly and with numerous setiferous pores; six epistomal setae

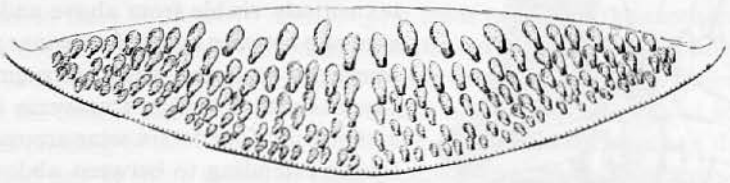

Fig. 140. *Batocera rufomaculata* (Degeer). Mature larva. Postnotal fold.

present. One pair of ocelli present; lens round, feebly convex, pale, sharply contrasting with surrounding sclerotized cuticle; pigmented spot indistinct. Hypostoma flat, ferruginous, with a few transverse rugae; sutures distinct, curved; gular region undefined. Clypeus bearing a few lateral setae. Labrum transversely oval, bearing coarse setae. Antennae 3-segmented; basal membrane long, fleshy; segment 2 about twice as long as basal width; segment 3 small but distinct, slightly elongate and bearing a few apical setae; supplementary process about half length of segment 3. Maxilla with segment 3 of palp conical, much shorter than segment 2. Labial palpi with segment 2 much shorter than segment 1. Mentum distinct from submentum. *Prothorax* with pronotum ferruginous and smooth except for front margin, which is narrowly testaceous, with a transverse fringe of short, dense setae; posterior two-thirds extremely coarsely asperate, the asperities transverse and larger towards lateral grooves; postnotal fold (fig. 140) well developed, bearing about five transverse rows of elongate, subcylindrical, subvertical asperities; anterior row of asperities distinctly larger than those on remaining rows, which become gradually smaller posteriorly. Prosternum with a pair of lateral sclerotized plates which are glabrous; eusternum and sternellum coarsely asperate. *Abdomen* with each dorsal ampulla bearing two transverse furrows and four rows of moniliform, spiculate tubercles. Tergite 9 unarmed. Epipleurum slightly protuberant on all segments; pleural tubercles bearing two long, coarse setae and numerous shorter setae; each with a pair of large sclerotized pits. Anus a transverse cleft. *Legs* minute but visible with a × 15 lens. *Spiracles* broadly oval, without marginal chambers.

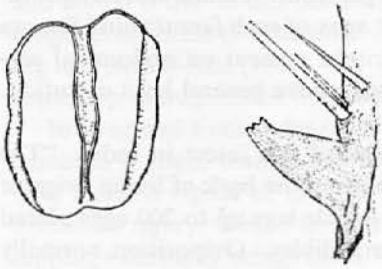

Fig. 141. *Batocera rufomaculata* (Degeer). First-instar larva, showing (*left*) spiracle and (*right*) egg-bursting spine. (Miller, 1936)

Miller (1926) records the maximum length of this larva to be 100 mm.

The larva of *B. rufomaculata* (Degeer), var. *andamana* Thomson cannot be distinguished from the typical form.

First-instar larva (fig. 141). According to Miller (1936), egg-bursting spines are present on abdominal segments 1–8; the apex of each spine is dentate. The spiracles are biforous. The dura-

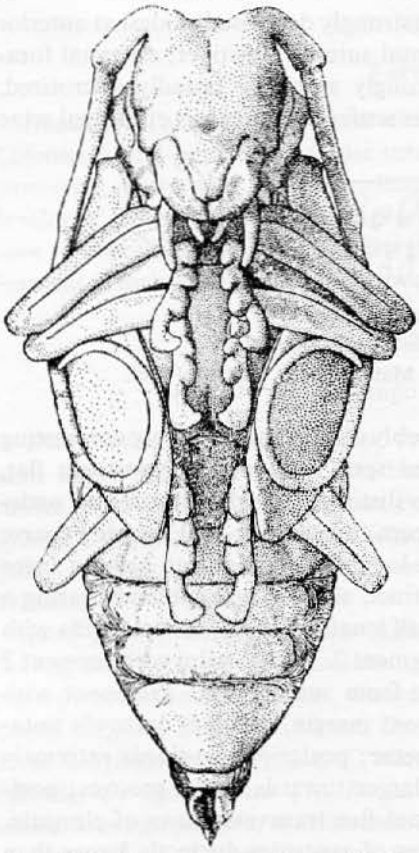

Fig. 142. *Batocera* sp. Pupa. Ventral aspect. (Duffy, 1953a)

tion of this instar is two days.

Pupa. No material available. The following is a description of that of *B. wyllei* Chevrolat, the figure (fig. 142) being that of an unknown species of this genus. *Head* with vertex entirely visible from above and shallowly excavate between bases of antennae; front with numerous scattered, short, ferruginous setae. Clypeus with a shallow transverse impression and bearing four to six setae across base. Antennae extending to between abdominal segments 2 and 3, where they are strongly curved downward and each arranged in a single coil on top of each elytron. Eyes plane, glabrous. Mandibles very robust and each with about twenty stout setae near middle of outer face. Labrum bearing numerous stout ferruginous setae along front and lateral margins. *Pronotum* with disc bearing a pair of paramedian groups of stout setae and sides with a pair of stout tubercles. *Mesonotum* almost glabrous; scutellum very strongly protuberant and setose. *Metanotum* with a pair of paramedian oval discs which are densely covered with coarse ferruginous setae; scutellar groove rather indistinct. Elytra and wings extending to abdominal segment 4. *Abdomen* with tergites 1–4 each with a transverse band (interrupted medially) of closely set stout setae on posterior half. Tergites 5 and 6 with these areas smaller and less conspicuous. Tergite 7 faintly transversely striate, sparsely setose. Tergite 8 extremely short and glabrous. Tergite 9 short and produced dorsally into a long vertical, spine-like process which is strongly sclerotized and attenuated apically; ventrally it is deeply divided and densely covered with coarse, blunt pitchy spines. Sternites glabrous. Pleura scarcely protuberant. *Legs* with a transverse row of fine setae near apex of each femur; hind femora extending to abdominal segment 4. *Functional spiracles* present on abdominal segments 1–5; peritreme thick, narrowly oval and raised above general level of cuticle. Length up to 70 mm.; maximum breadth 23 mm.

Biology. Beeson (1941) gives the following account of this insect in India. "The beetles are nocturnal and feed to some extent by gnawing the bark of living twigs or eating the green tips particularly of *Ficus* spp. The female lays up to 200 eggs placed one by one in incisions cut in the bark with the mandibles. Oviposition normally takes place on dead trees but also on the branches and trunks of living trees that are not in good health and on the roots of trees exposed by erosion, etc. Blazes and wounds and panels, produced on rubber trees and *Dyera costulata* (in Malaya) by tapping for

latex are sites of successful oviposition. Living trees such as figs, rubber and semul may be attacked year after year at the margins of earlier borings and the area of injury is gradually extended till the tree succumbs; often a branch breaks or the trunk gives way, weakened by numerous tunnels.

"The egg is a brownish-white cylinder, 6 × 2 mm., with narrow rounded ends. The newly hatched larva is about 10 mm. long; it feeds at first in the meristem and later penetrates deeper. The larval excavations in the early stages are extensive, irregular and deep in the sapwood. They are packed with very coarse chips and fibres of wood and bark; the bark is often completely hollowed out so that it splits and breaks away, leaving the packing of the tunnels exposed. The tunnels in the depth of the wood are irregular and one or more inches in cross-section. The pupal chamber is a 2 to 3 in. cavity in a widened extension of part of the larval gallery and is surrounded by long, interlaced fibres. This chamber is prepared in the cold weather and occupied by the larva in a resting condition until about March or April; in this stage the larva is bright yellow without any food in the alimentary canal. The pupal period lasts from three to four weeks and is followed by an immature beetle stage of variable duration. The beetle emerges by a short tunnel running direct to the exterior and ending in a circular exit hole. The emergence period in North India is from March to August; 50 per cent of the beetles emerge in May and 30 per cent in June. The life-cycle is thus annual. The life of the beetle is considerable and the maximum life recorded at Dehra Dun is eight months.

"Browne and Foenander (1937) consider the life-cycle in Malaya may be completed in six months. This would be possible in view of the long adult life without excluding an annual cycle as normal."

Adults fly considerable distances at night, making a great noise, and are readily attracted to artificial light. When molested, the beetle stridulates loudly, a habit which, in Mauritius, has gained it the name of "Violin" (Bytinski-Salz, 1952).

Parasites. Hymenoptera: *Louricia ovivora* Ferrière and *Ooencyrtus batocerae* Ferrière. Both are egg parasites (Miller, 1936).

Economic importance. According to Ballou (1916b) this insect was of very recent introduction to the Virgin Is. but it has already been responsible for killing a number of wild fig trees (*Ficus* sp.) in St. Croix.

In Mauritius this insect is responsible for considerable damage to certain trees, and here it is due to this beetle that the cultivation of the kapok tree is apparently no longer practicable (Department of Agriculture, Mauritius, 1918). In Palestine, according to Bytinski-Salz (1952), this species can attack perfectly healthy trees. The beetle continues to oviposit on infested trees, which usually die within two or three years.

Browne and Foenander (1937) state that in Malaya the mortality of tapped *Dyera costulata* is high, mainly due to *B. rufomaculata* (Degeer). Infestation is correlated with reduced vigour of the tree which is usually brought about by age, suppression, disease or injury. Sound trees, irrespective, are apparently resistant to infestation, but tapping eventually brings them within the zone of susceptibility.

In Mauritius, mangos are particularly susceptible to attack which often proves fatal (Emmerez, 1898).

Control. Trees which are severely infested often contain hundreds of larvae and

should be felled and split into sections to kill off as many larvae as possible, the logs being burnt later. In slightly infested trees, however, the larvae may be removed with the aid of a short-bladed knife before the sapwood is penetrated. The hand-picking by children is also suggested (Department of Agriculture, Mauritius, 1918). Biological control and the use of trap logs of alternative hosts have also been suggested (Browne and Foenander, 1937). Rahman (1939) suggests that wire gauze ($\frac{3}{16}$ in. mesh) should be wrapped loosely round the stems during the egg-laying period. In addition, larval galleries should be cleared of frass with a wire and a small quantity of kerosene or one to two grains of potassium cyanide[29] introduced, the orifice then being closed with mud. Ballou (1916b) suggests the killing of larvae *in situ* with wire probes, the use of trap logs, and the hand collection of adults.

Material studied. 1 L, England, Princes Risborough, 26.iv.1933, from log imported from Andaman Is., in coll. F.R.P.L.; 1 L (*B. rufomaculata* (Degeer), var. *andamana* Thomson), North Andaman, 16.xii.1928, from *Canarium euphyllum*, B.M. Bhatia leg., in coll. F.R.I.D.D.

References. Anonymous, 1920 (Contr.); Ballou, 1916a (Biol.), 1916b (Biol., Contr.); Beeson, 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Blanchard, 1845 (L fig., P fig., I fig.); Browne and Foenander, 1937 (Biol. fig.); Bytinski-Salz, 1952 (Biol., Contr.), 1962 (Biol. fig.); Chatterjee, Bhasin and Bhatia, 1950 (Biol.); Corbett, 1935 (Biol.); Department of Agriculture, British Virgin Is., 1919 (Biol.); Department of Agriculture, Mauritius, 1918 (L fig., P fig., I fig.); Department of Agriculture, Tortola, 1918 (Biol.); Duffy, 1953a (Biol.), 1957 (L fig., P, Biol, Contr.), 1960 (L fig., P, Biol., Contr.); Emmerez, 1898 (I fig., Biol., Contr.); Evans, 1952 (Biol.); Ferrière, 1936 (Paras.); Fletcher, 1921 (Biol.); Gardner, 1927 (L fig., P fig.), 1931b (Biol.); Green, 1913 (L fig., I fig., Biol. fig., Contr.); Gressitt, 1951 (Biol.); Husain and Khan, 1941 (E fig., L fig., P fig., I fig., Biol., Contr.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960d (Biol.), 1961 (Biol.); Maxwell-Lefroy, 1909 (P fig., I fig.); Miller, 1936 (E fig., L fig., P fig., I fig., Biol., Contr.); Moutia, 1955 (Biol.); Mühlmann, 1954 (Biol.); Pearson, 1837 (Biol.); Pierce, 1918 (L fig., I fig., Biol. fig.); Quaintance, 1913 (Biol.); Rahman, 1939 (Biol., Contr.); Roonwal, Chatterjee and Thapa, 1961 (Biol.); Saunders, 1834 (Biol.); Schiödte, 1876 (L); Stebbing, 1899 (Biol.), 1907a (L fig., I fig., Biol. fig.), 1914 (L fig., I fig., Biol. fig., Contr.); Tennent, 1861 (L fig., P fig., I fig.); Vinson, 1962 (Biol.); Waterhouse, 1884 (?); Westermann, 1821 (Biol.).

Batocera rubus (Linnaeus) and var. **albofasciata** Degeer

[The Rubber-root Borer or the Lateral-banded Mango Longhorn]

Distribution. ORIENTAL REGION: Borneo, Burma, Ceylon, China (including Hainan), Formosa, India (Assam, Madras, Maharashtra, West Bengal), Indo-China, Indonesia (Lombok Is., Malacca Str., Sipora Is., Sunda Is.), Java, Philippine Is., Palawan Is., Sumatra, Thailand. PALAEARCTIC REGION: Korea.

Host plants: *Alstonia scholaris*, *Artocarpus integra*, *Castilla elastica*, *Erythrina*

[29]This method is considered too dangerous to adopt.

indica, E. lithosperma, Ficus elastica, F. hispida, F. tsjahela, Mangifera indica, Ochroma lagopus (Beeson and Bhatia, 1939); *Artocarpus lingnanensis, Bischofia trifoliata, Ficus lacor, F. retusa, Gossampinus malabrica* (Gressitt, 1942); *Dalbergia sissoo, Ficus carica, F. infectoria* (Mathur and Balwant Singh, 1959); *Dyera costulata, Garuga pinnata* (E.A.J.D.); *Erythrina fusca* (D. of A., Bangkok).

Adult (Pl. I, fig. 2). Similar to *B. rufomaculata* (Degeer) but readily distinguishable by its general coloration which is yellowish grey (brownish yellow in the former) and the less numerous elytral spots (usually four or five in number, the median third spot the largest, a much smaller confluent or subconfluent spot often being present).

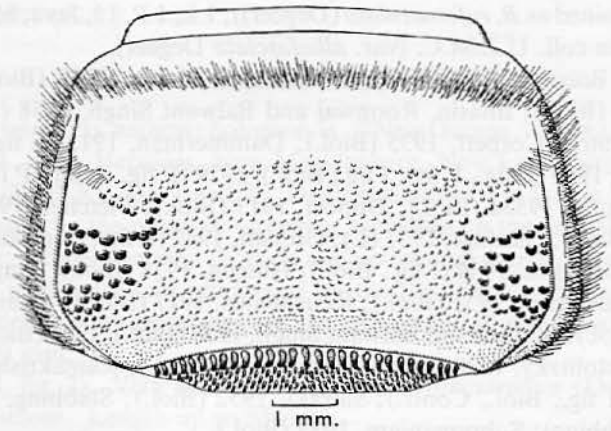

Fig. 143. *Batocera rubus* (Linnaeus). Mature larva. Prothorax. Dorsal aspect.

Mature larva (Pl. XII, fig. 1 and fig. 143). Similar to that of *B. rufomaculata* (Degeer) but differing as follows. *Prothorax* with the large sublateral asperities on pronotum coarser and not flattened and elevated. The semi-cylindric asperities on postnotal fold distinctly smaller than those of the anterior (first) row (fig. 143). Length up to 80 mm. (possibly nearer 100 mm. in some individual specimens); maximum breadth (at prothorax) 15 mm.

Biology. In India emergence occurs between June and January (Beeson and Bhatia, 1939). Larvae of this species infest the trunks of living trees. Eggs are laid in the bark generally within several feet of the ground. Large subcortical cavities are formed by the larvae, which later bore into the heartwood, where pupation takes place. In order to escape, the adult has to gnaw its way out of solid wood. Adults are nocturnal and feed on green stems and leaves during the period June to October (April to September on Hainan I.) (Gressitt, 1942). According to Dammerman (1913) the adult beetles live for about seven months. It has been noticed that when a beetle bites a *Ficus* leaf, little or no latex flows, and it would seem that the saliva of the beetle has the property of arresting the flow of latex. The life-cycle covers three to four months on an average and there are, as a rule, more than three generations a year. It has been calculated that, in a year, one female may be the projenitor of 125,000 larvae.

In Java larvae of this species are consumed by the natives (Netolitzky, 1920).

Economic importance. According to Dias (1931) numerous breadfruit trees have been killed by this pest in Ceylon. It is also of local importance as a pest of mango.

Control. Cherian (1942) suggests the injection of a mixture of chloroform and creosote in equal proportions into the larval galleries and closing the entrance hole with wet clay. Alternatively, a mixture of kerosene and petrol in the proportion of 10:1 may be used. Gressitt (1942) recommends the extraction of larvae with hooked wires and the collection of adults at night.

Material studied. 1 L, Malaya, Selangor, 22.ii.1934, from *Dyera costulata*, in coll. D.A.M.; 6 L, Malaya, no further data, in coll. B.M.; 2 L, India, Madhy Pradesh, Mandla, 17.xii.1926, from *Garuga pinnata*, B.M. Bhatia leg., in coll. F.R.I.D.D. (wrongly determined as *B. rufomaculata* (Degeer)); 1 L, 1 P, 1 I, Java, Malang, 1.x.1904, Rouyer vend., in coll. U.Z.M.C. (var. *albofasciata* Degeer).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cherian, 1942 (Biol., Contr.); Corbett, 1935 (Biol.); Dammerman, 1913 (E fig., L fig., P fig., I fig., Biol. fig.), 1919 (L fig., P fig., I fig., Biol.), 1929 (E fig., L fig., P fig., I fig.); Dias, 1931 (Biol.); Duffy, 1953a (Biol.); Duport, 1913 (Biol.); Fletcher, 1914 (I fig., Biol., Contr.), 1921 (Biol.); Gardner, 1931 (L); Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Hoffmann, 1934 (I fig., Biol.); Hutson, 1938 (Biol.); Janjua and Samuel, 1941 (Biol.); Kalshoven, 1951 (Biol.); Keuchenius, 1917 (Biol.); Koningsberger, 1903 (Biol.), 1908 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.); Mühlmann, 1954 (Biol.); Netolitzky, 1920 (Biol.); Pierce, 1918 (Biol.); Ramakrishna Ayyar, 1940 (L fig., P fig., I fig,, Biol., Contr.); Shiraki, 1952 (Biol.); Stebbing, 1914 (under *B. albofasciata* Stebbing); Subramaniam, 1933 (Biol.).

?**Batocera thomae** Voet (=**armata** Olivier)

Distribution. ORIENTAL REGION: Amboina, Moluccas, New Guinea.

Mature larva. Only a single larva of doubtful origin is available. It appears to be very similar to that of *B. rufomaculata* (Degeer) from which it may be distinguished by the semi-cylindric asperities on the postnotal fold, those of the first (anterior) row being not or scarcely longer than those of the remaining rows.

Material studied. 1 L, "Batavia", in coll. U.Z.M.C.

References. None available.

Batocera tigris Voet, var. **hector** Thomson

[The Dadap Borer]

Distribution. ORIENTAL REGION: Java, Sumatra, Thailand. ?ETHIOPIAN REGION: Congo.

Host plants: *Eriodendron* (Kalshoven, 1951); *Albizia*, *Ficus*, *Spondias dulcis* (Dammerman, 1919); *Erythrina indica* (Dammerman, 1913); *Myristica fragrans*, *Odina gummifera* (Koningsberger, 1915); *Coffea* (Veen, 1897).

Mature larva. Similar to that of *B. lineolata* Chevrolat from which it may be distinguished by the presence of a dentate tubercle on the epicranium behind the

antennal foramen. Length up to 87 mm.; maximum breadth (at prothorax) 18 mm.

Pupa. On the basis of single specimens no characters are apparent whereby the pupa of this species may be distinguished from those of *B. wyllei* Chevrolat and *B. gigas* (Drapiez).

Control. Opsomer (1932) suggests the injection of a 50 per cent solution of carbolineum into the larval galleries.

Material studied. 2 L, 1 P, 1 I, Java, Buitenzorg, 1.iii.1905, in coll. U.Z.M.C.

References. Corbett and Gater, 1926 (Biol.); Dammerman, 1913 (Biol.), 1919 (Biol.,) 1929 (Biol. fig.); Kalshoven, 1951 (Biol.); Koningsberger, 1898 (Biol.), 1908 (Biol.), 1915 (Biol.); Mathur and Balwant Singh, 1959 (Biol.); Opsomer, 1932 (Biol., Contr.); Veen, 1897 (Biol.).

Batocera una White

Distribution. ORIENTAL REGION: Solomon Is., ?New Guinea. AUSTRALASIAN REGION: Duke of York Is., New Hebrides, New Mecklenberg, New Lauenberg.

Mature larva (Plate XI, figs. 1 and 2). Distinguishable from larvae of other known species of this genus by the presence of coarse asperities on the lateral plates of prosternum and by its densely velured thoracic and abdominal cuticle. The semi-cylindric asperities of the post-notal fold are largest on the third or fourth row, those on the anterior and posterior rows being smaller. Length up to 110 mm.; maximum breadth (at prothorax) 20 mm.

Pupa (Pl. XII, fig. 2). Very similar to that of *B. rufomaculata* (Degeer) but with labrum densely setose. Length up to 85 mm.

Material studied. 1 L, 1 P, Duke of York Is., in coll. B.M.

References. None available.

Batocera lineolata Chevrolat

Distribution. ORIENTAL REGION: Burma, China (Chekiang, Fukien, Kiangsu, Kwangsi, Kwangtung), Formosa, India (West Bengal), Quelpart Is. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Quercus griffithi, Q. serrata, Castanea sativa, Fagus japonica, Ulmus americanus* (Beeson, 1941); *Quercus glandulifera* (Cheo, 1935); *Sapium sebiferum, Ligustrum sinense, Morus* (Gressitt, 1942); *Pasania, Castanea, Fagus, Ulmus, Eriobotrya, Salix, Paulownia tomentosa* (Kojima, 1929); *Juglans regia, Trema amboinensis* (Gardner, 1931b); *Quercus acuta, Q. glauca, Q. ilex, Q. acutissima, Q. grossoserrata, Q. dentata, Pasania cuspidata, Fagus japonica, Eriobotrya japonica, Ficus carica* (Kojima, 1929a).

Mature larva (fig. 144). Distinguishable from the larvae of other known species of this genus by the absence of dentate tubercles on the epicranium and of an asperate post-notal fold on the prothorax (fig. 144). Length up to 50 mm.; maximum breadth (at prothorax) 12 mm.

Egg. White with a touch of yellowish pink (yellowish brown in spirit), marked with minute hexagonal reticulations on the surface, more or less depressed when situated under bark, slightly convex above, rounded at both ends, one end much

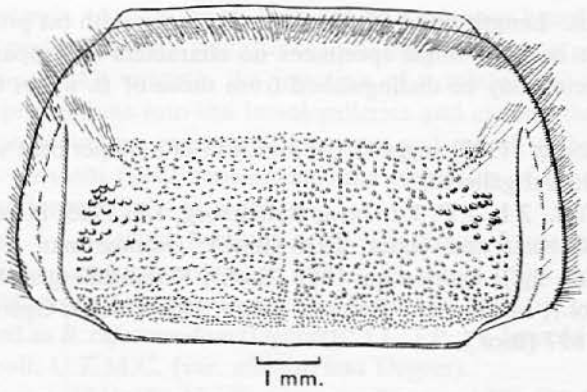

Fig. 144. *Batocera lineolata* Chevrolat. Mature larva. Prothorax. Dorsal aspect.

broader than the other and with a minute fovea. Length 8·7–11 mm.; width 1·5 mm. (Kojima, 1929a).

Biology. According to Kojima (1929a), the adult female deposits eggs under the bark at regular intervals horizontally or obliquely around the trunks and main branches of host plants. Usually the egg is placed about 2–4 mm. up from the gnawed hole in a vertical position; the hole or pit is about 1 cm. long by 1·5 mm. wide. Before boring into the heart of the tree, the young larva tunnels subcortically. The gallery abruptly turns upwards and ends in a moderately wide space; in length this varies from 12·5–16·7 cm. Not only does the larva thrust out a large amount of fibrous shreds but it also presses shreds to the sides of the gallery; these shreds are sometimes more than 6 cm. long. The life-cycle appears to be at least two years in duration, the adult living for at least six months (Kojima, 1929a).

Parasite. Hymenoptera: *Euurobracon yokohamae* (Dalla Torre) (Watanabe, 1934).

Economic importance. Hasegawa and Koyama (1956) have reported a virus disease associated with this lamiid. Gardner (1931b) has recorded larvae causing considerable damage to *Juglans regia* in Bengal.

Control. Eggs may easily be destroyed under the bark even by a slight blow with an implement. The discoloured scars make their presence readily detectable (Kojima, 1929a).

Material studied. 1 L, Japan, nr. Tokyo, N. Nakamura leg., in coll. B.M.; 1 L, Japan, Tokyo Pref., Fuchu City, 20.ix.1953, from *Castanea pubinervis*, T. Fumujira leg., in coll. B.M.

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Gardner, 1931b (L); Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.); 1951 (Biol.); Hasegawa and Koyama, 1956 (Biol.); Kojima, 1929a (E, L fig., P fig., Biol.), 1929b (?), 1959 (L fig.); Linsley, 1959 (Biol.); Mathur and Balwant Singh, 1960d (Biol.); Mühlmann, 1954 (Biol.); Nakamura, 1959b (Biol.); Shiraki, 1952 (Biol.); Watanabe, 1934 (Paras.); Yano, 1934 (Biol. fig.), 1936 (Biol.).

Batocera numitor Newman

[The Mango-tree Longhorn Borer]

Distribution. ORIENTAL REGION: Burma, Celebes, India (Assam, Bihar, Madras, Maharashtra, West Bengal), Java, Nepal, Philippine Is., Sumatra, Thailand.

Host plants: *Anthocephalus cadamba, Hodgsonia heteroclita, Lannea coromandelica, Mangifera indica, Ochroma lagopus, Sterculia villosa* (Beeson and Bhatia, 1939); ?*Quercus griffithii* (Stebbing, 1914).

Biology. This species attacks unhealthy or injured trees. In small branches the larval gallery extends deep into the wood and continues longitudinally parallel to the axis of the branch or bole. At intervals along the gallery there are branch galleries which communicate with frass-ejection holes in the bark. Large infestations destroy so much sapwood that branches and even small trees may be killed. In large branches or boles the prepupal gallery extends to a depth of about three inches and then turns at right angles into the pupal cell which is plugged with long fibres at its upper end. The life-cycle is probably annual and emergence may occur during most months of the year (Beeson and Bhatia, 1939). Stebbing (1914) states that oviposition takes place mainly during July and August.

Control. Adults should be hand-collected at night. Infested branches should be cut off, split open and the larvae destroyed. Heavily infested trees should be felled during cold weather and completely burnt. Infested stems of young trees should be injected through the frass-ejection holes with dilute kerosene and then plugged and coated with tar (Stebbing, 1914).

References. Beeson, 1941 (Biol. fig.); Beeson and Bhatia 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Kalshoven, 1951 (Biol.); Mathur and Balwant Singh, 1960c (Biol.); Stebbing, 1914 (I fig., Biol. fig., Contr. (under *B. titana* Thoms.)).

Batocera horsfieldi (Hope)

[The Large Gray and White Longhorn]

Distribution. ORIENTAL REGION: Burma, China, Formosa, India (Assam, Punjab, Uttar Pradesh, West Bengal), Indo-China (Viet Nam). PALAEARCTIC REGION: Japan.

Host plants: *Alnus nepalensis, Juglans regia, Quercus incana, Salix tetrasperma, Trema amboinensis* (Beeson and Bhatia, 1939); *Paulownia tomentosa* (Yano, 1936); *Sapium sebiferum, Morus, Ligustrum sinense* (Gressitt, 1942); *Quercus, Salix, Pasania, Castanea, Fagus, Ulmus, Eriobotrya, Ficus* (Yano, 1936).

Egg. Oval, brownish, with a thick leathery chorion. 11 mm. × 4·5 mm. (Rhaman and Khan, 1942b).

Biology. Eggs are laid in the bark of trunks of living trees, usually within four or five feet above ground level although sometimes it may be as much as ten to twenty feet, if the tree is heavily infested. The larva first feeds superficially on the sapwood but later it excavates a large gallery upwards into the centre of the heartwood. This gallery usually attains a length of at least 18 in. and a width of two inches; wood fibres from this gallery are thrown out through an ejection hole in the sapwood. It terminates in a pupal cell which is near the bark. The wood fibres torn off by the larva in excavating

the pupal cell are loosely packed into the prepupal tunnel. A single fibre may be as much as six inches in length—that is as long as the larva itself. The adult emerges by gnawing its way through the inch or so of sapwood and leaves a circular exit hole in the bark about 1 in. in diameter. Beetles have been taken in September and October in India. In China the emergence period is from May to August. In India the duration of the life-cycle is not known but in Japan it is annual and in China it appears to be usually two years. Adults fly both by day and by night, though mainly the latter. They feed on leaves and bark of young stems (Beeson and Bhatia, 1939; Gressitt, 1942).

According to Rahman and Khan (1942b) the life-cycle in India is completed in 22–32 months. Adult emergence starts in June, continuing until the end of July. At the end of October or early November the adults die. Adults emerge by excavating a 4–5 in. long, curved gallery from the pupal cell which terminates in a circular hole of 0·75 in. to 1·0 in. in diameter. Adults rest on their food plants, stridulating when disturbed, and feeding on the bark of young twigs. A female lays 55–60 eggs singly in an upright position in a specially prepared transverse slit in the bark. Eggs hatch within eight to fifteen days. The larval stage lasts 20–25 months. There is a distinct prepupal stage which lasts from 50–182 days. Before pupating, a moon-shaped chamber is excavated in the main stem. The pupal stage lasts from 46–90 days. After eclosion the adult remains in the chamber for five or six months.

Economic importance. This borer of living trees is a pest of walnut and alder plantations in the Darjeeling Himalayas and of oak in the Kumaon Himalayas. When the beetle is abundant every tree in a stand may be attacked. Infested trees are not killed but the timber is useless except for firewood.

Control. Owing to the length of the life-cycle and the relatively enormous damage that can be caused by a single larva, tree-to-tree inspection is practicable. Ejection holes should be opened up and filled with tar or viscous oil and the larva killed by means of a flexible wire or splinter of bamboo (the tar will kill the larva should it escape being stabbed). The presence of very young larvae is indicated by a black patch of liquid and frass on the bark; these can be killed by cutting into the bark with a knife. Trees which have been repeatedly attacked should be thinned out and converted or split for fuel. During the emergence period, traps of freshly-cut billets should be distributed and inspected periodically so that the strength of the population may be estimated (Beeson, 1941). To destroy the eggs, Gressitt (1942) suggests that the conspicuous egg scars on the lower trunk should be pierced or pounded. Rahman and Khan (1942b) recommend the insertion of cotton-wool soaked in kerosene into the larval gallery and the hole closed with clay mud.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gressitt, 1942 (E, L fig., P fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961b (Biol.); Rahman and Khan, 1942b (E fig., L fig., P fig., I fig., Biol. fig., Contr.); Yano, 1936 (Biol.).

Batocera roylei (Hope)

Distribution. ORIENTAL REGION: Burma, Hainan Is., India (Assam, Sikkim, Uttar Pradesh, West Bengal), Indo-China (Viet Nam), Jammu and Kashmir, Nepal.

Host plant: *Mangifera indica* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Batocera nebulosa Bates

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia, Fiji, New Hebrides.

Host plant: *Theobroma cacao* (Dumbleton, 1951).

References. Dumbleton, 1951 (Biol.); Dun, 1951 (Biol.).

Batocera boisduvali (Hope)

[The Great Fig Tree Longicorn]

Distribution. ORIENTAL REGION: New Guinea, Solomon Is. AUSTRALASIAN REGION: Australia (New South Wales, South Australia, Queensland), Aru, Kei Is., New Mecklenberg, Woodlark Is.

Host plants: *Ficus macrophylla, F. australis* (French, 1911; Froggatt, 1923).

Biology. Adults usually oviposit only on trunks and branches of damaged or recently fallen trees. They may be collected by cutting down fig trees and waiting for them at twilight, when they come down to feed upon the bark (French, 1911). An account of the curious habits of the West African *Batocera wyllei* Chevrolat has already been given (Duffy, 1957).

References. Duffy, 1963 (I fig., Biol.); French, 1911 (L fig., P fig., I fig., Contr.); Froggatt, 1907 (I fig. Biol.), 1923 (Biol.); Illidge, 1922 (Biol.); McKeown, 1944 (Biol.); Pierce, 1918 (Biol.).

Batocera gigas (Drapiez)

Distribution. ORIENTAL REGION: Java.

Host plant: *Ficus* (Dammerman, 1913).

Mature larva. Distinguishable from those of remaining species of this genus by the form of the semi-cylindric asperities on the postnotal fold, those of the first (anterior) row being mostly very elongate and slender and more than twice the length of those of remaining rows. Length up to 85 mm.; maximum breadth (at prothorax) 21 mm.

Pupa. On the basis of single specimens no characters are apparent whereby the pupa of this species may be distinguished from those of *B. wyllei* Chevrolat and *B. tigris* Voet, var. *hector* Thomson.

Biology. Serious damage to *Ficus* is caused by this species which is nocturnal and rarely seen in daytime.

Material studied. 1 L, 1 P, 1 I, Java, Malang, 1.x.1904, Rouyer vend., in coll. U.Z.M.C.

References. Dammerman, 1913 (I fig., Biol. fig.), 1919 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Rosenbergia megalocephala v.d. Poll.

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia (North Australia, Queensland).

Host plant: *Ficus* (Froggatt, 1907).

Biology. This large insect breeds in fig trees in the forests of North Queensland where its presence may be detected by the number of small branches scattered beneath, which have been cut off with their powerful mandibles (Froggatt, 1907).

References. Duffy, 1963 (Biol.); Froggatt, 1907 (Biol.); Pierce, 1918 (Biol.).

Apriona germari (Hope) (=**rugicollis** Chevrolat)

[The Brown Mulberry Longhorn]

Distribution. ORIENTAL REGION: Burma, China (Chekiang, Fukien, Hong Kong, Hunan, Kiangsi, Kiangsu, Kwangtung, Szechuan), Formosa, India (Assam, Uttar Pradesh), Indo-China, Malaya, Thailand, West Pakistan (Rawalpindi). PALAEARCTIC REGION: Japan, Korea, Ryukyu Is.

Host plants: *Crataegus cordata*, *Ficus carica*, *Lagersrtoemia indica*, *Morus alba*, *Platycarya sternoptera*, *Salix purpurea amplexicaulis*, *S. sieboldiana* (Kojima, 1929a); *Pyrus malus*, *Citrus aurantium* var. *nobilis* (Saito, 1932); *Broussonetia papyrifera*, *Ficus infectoria*, *Morus acidosa*, *M. laevigata*, *Trema amboinensis* (Beeson and Bhatia, 1939); *Artocarpus chaplasha*, *A. integra*, *Ficus hispida*, *Salix tetrasperma* (Beeson, 1941); *Aleurites fordii*, *Cajanus cajan*, *Celtis sinensis*, *Eriobotrya japonica*, *Ficus retusa*, *Salix babylonica* (Gressitt, 1942).

Adult (Pl. XV, fig. 1). Length 26–50 mm. Black, almost entirely covered with dense tawny brown, slightly greenish pubescence. Elytral margins blue-grey. Antennae brownish black, bases of most segments ringed with greyish white. *Head* with antennae about one-third longer than body in male, one-sixth longer in female. *Prothorax* with a pair of spine-like lateral tubercles. *Elytra* with basal fifth coarsely granulate; truncate apically, each with a pair of short sutural pines.

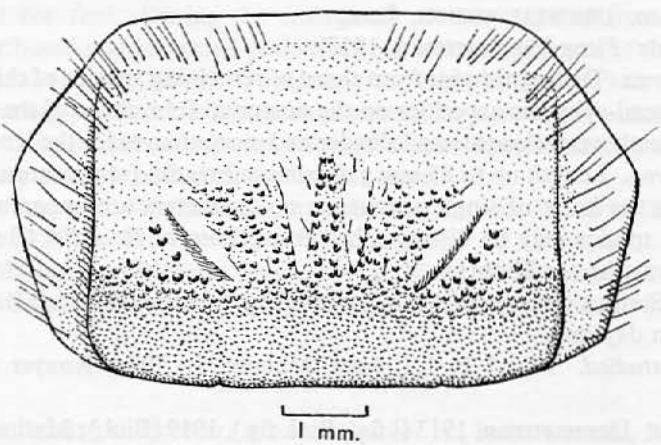

Fig. 145. *Apriona germari* (Hope). Mature larva. Prothorax. Dorsal aspect.

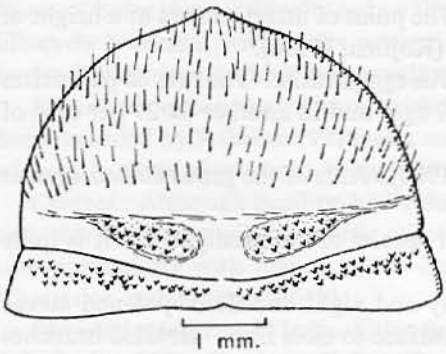

Fig. 146. *Apriona germari* (Hope). Mature larva. Eusternum and sternellum. Ventral aspect.

Mature larva (Pl. XI, fig. 3 and figs. 145, 146). Similar to those of *Batocera* species but differing as follows. *Head* with antenna 2-segmented, segment 2 bearing a minute, conical, hyaline process and a few short setae. Tubercle behind antennal foramen absent. *Prothorax* with asperities on eusternum subconical and not exceeding 55 in number (fig. 145). Postnotal fold absent. Prosternum with ferruginous lateral plates glabrous. Pronotum with two pairs of glabrous, sublateral furrows (one pair oblique); posterior area with asperities more numerous, closely-set, subconical and decreasing in size posteriorly (fig. 146). *Abdomen* with dorsal ampullae non-tuberculate but bearing several rows of stout spinules. Length up to 70 mm., maximum breadth (at prothorax) 13 mm.

Egg. Elongate-oval, 8–9 mm., just over 4 mm. in width, tinged with brown. The egg extracted from oviduct is white (yellowish brown in spirit), marked with hexagonal reticulations on the surface, 6·2–6·4 mm. long by 2·5 mm. wide, convex dorsally, flat ventrally and rounded at both ends, one end being broader than the other and with a minute fovea (Kojima, 1929a).

Biology. Eggs are deposited in slits made in the bark at intervals, from several inches to several feet above ground-level. Young shoots up to trunks several inches thick may be infested. The young larva, after having fed in the sapwood, bores a fairly straight gallery extending sometimes for many feet in the heartwood, with small frass-ejection holes made through the bark at intervals of several inches, from which the fine, wet, sawdust-like frass is ejected. Smaller branches may be so extensively excavated that they collapse. Roots are also bored, with occasionally fatal effects to saplings. In China, adults emerge from May to October, mostly June to August. They feed usually at night on tender bark, killing the sapwood area and often entire stems. The life-cycle is annual (Gressitt, 1942).

According to Nakagawa (1900) and Maki (1916), however, the duration of the life-cycle of this beetle is one year in Formosa and two years in Japan.

The beetle shows a preference for certain varieties of *Morus*. In Japan it prefers the "Akagi" more than the "Roso" and in Formosa the "Roso" and "Jumonji" more than other varieties peculiar to the island.

In China larvae of this species are known as "con sâu dâu" and are eaten by peasants who extract them from trees with wires or barbs. They are also used medicinally for children's maladies and for small-pox (Nguyên-Cong-Tiêu, 1928).

Adults appear during July and August in the latter and from May to August in the former. A captive adult continued oviposition for 79 days, laying less than five eggs a day and 116 in all throughout. The eggs, dormant during winter (when laid in the autumn) usually hatch in about 14 days. The duration of the larval period is 349–397 days. The larva bores into the stem or even into the root, making a long

gallery with frass-ejection holes at intervals. The point of attack occurs at a height of between 29 cm. and 141 cm. above the ground (Kojima, 1929a).

Parasites. Hymenoptera. *Tetrastichus* sp. An egg parasite. The rate of parasitism is high, being in one case 45·49 per cent of 499 eggs and in another 64·29 per cent of 140 eggs.

Bracon sp. Parasitic on larvae (Nakagawa, 1900). Ants of the genus *Crematogaster* seriously attack pupae but not larvae.

Economic importance. This is an important species economically, since it is quite common and attacks only living trees.

Control. Adults should be searched for day and night and destroyed and larvae killed with hooked wires as they come to the surface to eject frass. Isolated branches which have become infested are best removed, care being taken to ensure that the larva is inside and has not travelled further down the stem towards the roots (Gressitt, 1942).

Material studied. 1 L, Malaya, Penang, Pulau Beton, I.ix.1948, from *Ficus*, in coll. D.A.M.; 2 L, Thailand, from *Morus alba*, pres. by Boonsom Meksongsee, in coll. B.M.; 3 L, Formosa, in coll. B.M.

References. Akashi, 1909 (?); Beeson, 1941 (L fig., I fig., Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Chang, 1963 (Biol.); Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Chin, 1937 (Biol.); Chu, Chin, Ku and Hu, 1935 (Biol.); Duffy, 1953a (Biol.); Duport, 1913 (Biol.); Fletcher, 1921 (Biol.); Gardner, 1931b (L, Biol.); Gressitt, 1940 (Biol.); 1942 (E, L fig., P fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Hoffmann, 1934 (Biol.); Kojima, 1929 (E, L fig., P fig., Biol.), 1959 (L fig.); Kojima, Watanabe and Kakamura, 1962 (Biol. fig.); Maki, 1916 (Biol. fig., Contr. fig.); Mathur and Balwant Singh, 1959 (Biol.), 1961a (Biol.); Matsumura, 1902 (?), 1921 (?); Matsushita, 1941 (?); Miller, 1932 (Biol.); Mühlmann, 1954 (Biol.); Nakagawa, 1900 (I fig., Biol.); Nguyên-Cong-Tiêu, 1928 (Biol.); Pierce, 1918 (Biol.); Saito, 1932 (?); Sasaki, 1903 (?), 1910 (?), 1919 (?), 1921 (?); Shiraki, 1952 (Biol.); Stebbing, 1902 (L fig., P fig., I fig., Biol.), 1914 (L fig., P fig., I fig., Biol., Contr.); Yanda, 1906 (?).

Apriona cinerea Chevrolat

Distribution. ORIENTAL REGION: India (Uttar Pradesh), Jammu and Kashmir, West Pakistan (Rawalpindi, Peshawar).

Host plants: *Populus generosa* (Mathur and Balwant Singh, 1960d); *Debregeasia hypoleuca*, *Ficus carica*, *Morus acidosa* (Beeson and Bhatia, 1939); *Prunus persica* (Anonymous, 1941); *Pyrus malus* (Rahman, 1938).

Mature larva. Very similar to that of *A. germari* (Hope) but differing as follows. *Head* with front margin of frons pitchy. *Abdomen* with setae on segment 10 shorter and appreciably thicker than those on segments 5–8. Length up to 70 mm.; maximum breadth (at prothorax) 12 mm.

Biology. Oviposition occurs both on living branches and dead trees and stumps. In *Morus*, the larval galleries extend for several feet up and down the heartwood and often into the main roots. There are frass-ejection holes at intervals along each gallery.

In small boles there is usually only a single larva so that the tree is seldom killed. The life-cycle is annual, and adults emerge between June and August. They feed on the bark of living shoots which are sometimes girdled and killed (Beeson and Bhatia, 1939).

Economic importance. This species is occasionally a pest of plantations and has been recorded by Rahman (1938) as a serious pest of apple, 40 per cent of the branches of trees in some plantations being attacked.

Control. Although dead or badly damaged trees in plantations should be thinned out, this operation will have little effect unless external breeding grounds are cleaned up—particularly with regard to the alternative host plants (Beeson, 1941) (See also Chatterjee and Thapa, 1964b).

Material studied. 1 L, India, Uttar Pradesh, from *Morus acidosa*, in coll. U.S.N.M.; 1 L, India, Uttar Pradesh, Dehra Dun, 11.vi.1926, from *Morus acidosa*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Anonymous, 1941a (Biol.); Beeson, 1941 (Biol. fig., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Chatterjee and Thapa, 1964b (Biol. fig., Contr.); Fletcher, 1921 (Biol.); Gardner, 1927 (L fig.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.), 1961 (Biol.); Mühlmann, 1954 (Biol.); Rahman, 1938 (Biol.); Stebbing, 1914 (Biol.).

Apriona swainsoni (Hope)

Distribution. ORIENTAL REGION: Burma, China, India (Assam), Indo-China.

Host plants: *Butea superba, Dalbergia volubilis, Tectona grandis* (Beeson and Bhatia, 1939).

Mature larva (fig. 147). Differing from other known larvae of this genus in having the asperities of the pro-eusternum much more numerous and scarcely protuberant (fig. 147).

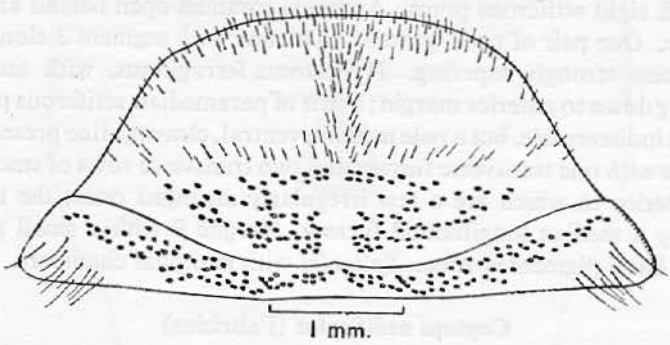

Fig. 147. *Apriona swainsoni* (Hope). Mature larva. Eusternum and sternellum. Ventral aspect.

Biology. Through tunnelling through the living stems of the climber *Butea superba*, the larvae cause gall-like swellings. When mature, the larva passes into the supporting tree at a point where the climber and the tree trunk are in close contact. Only in very few species are larvae known to transfer themselves from one host to another (see also Duffy, 1953a, p. 43).

Teak up to 4 ft. in girth is susceptible to attack and when the climber remains on the tree for several years, the recurring annual infestations of this beetle cause considerable damage. The larval gallery in the teak is square-bracket-shaped and may be over a foot long: one end is undulating with the oval entrance hole of the larva, the other end is straight, with the emergence hole of the beetle. The gallery is packed with wooden fibres except for the pupal cell at one end (Beeson and Bhatia, 1939).

Control. In teak plantations all climbers and creepers should be severed (Beeson, 1941).

Material studied. 1 L, Burma, Kaukkwe, 25.i.1930, from *Tectona grandis*, D.J. Atkinson, in coll. F.R.I.D.D.

References. Atkinson, 1931 (L fig., I fig., Biol. fig.); Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1953a (Biol.); Gardner, 1931b (L, Biol.); Garthwaite, 1936 (?).

Apriona flavescens Kaup

Distribution. ORIENTAL REGION: Sumatra.

Host plants: *Castilla* (Dammerman, 1919); *Artocarpus polyphemia, A. integra* (Gater, 1925).

References. Corbett and Gater, 1926 (Biol.); Dammerman, 1913 (Biol.), 1919 (Biol.), 1929 (Biol.); Gater, 1925 (Biol.); Koningsberger, 1915 (Biol.).

Mesosini

Larval Characters

Head abruptly and strongly constricted near posterior third; strongly sclerotized and front with eight setiferous pores. Antennal foramen open behind and entered by frontal suture. One pair of ocelli present. Antenna with segment 3 elongate; supplementary process strongly tapering. Hypostoma ferruginous, with anterior region steeply sloping down to anterior margin; a pair of paramedian setiferous pores present. Gular sutures indiscernible, but a pale median, ventral, cleavage line present. *Abdomen* with ampullae with one transverse furrow and two transverse rows of smooth glabrous tubercles, anterior to which are a few irregularly arranged ones; the two rows are interrupted by a median longitudinal furrow. Tergite 9 with a small median spine which has no basal pigmented zone. *Spiracles* with marginal chambers.

Coptops aedificator (Fabricius)

Distribution. ORIENTAL REGION: Andaman Is., Ceylon, Formosa, India (Bihar, Madras, Maharashtra, Mysore, Uttar Pradesh, West Bengal), Java, Seychelles, Thailand. HAWAIIAN REGION: Hawaiian Is. ETHIOPIAN REGION: Africa (see Duffy, 1957). MADAGASCAN REGION: Madagascar, Réunion, Mauritius, Rodriguez.

Host plants. India: *Acacia arabica, Acacia* sp., *Acrocarpus fraxinifolius, Aegle marmelos, Albizia lebbek, Bauhinia purpurea, B. retusa, B. vahlii, B. variegata, Salmalia malabarica, Buchanania lanzan, Butea monosperma, B. parviflora, Careya arborea,*

Cassia siamea, *Coffea*, *Cudrania javanensis*, *Dalbergia paniculata*, *Excoecaria agallocha*, *Ficus racemosa*, *F. religiosa*, *F.* sp., *Garuga pinnata*, *Hevea brasiliensis*, *Holoptelea integrifolia*, *Lannea coromandelica*, *Manihot glaziovii*, *Millettia auriculata*, *Mucuna imbricata*, *Pavetta indica*, *Pongamia pinnata*, *Pterocarpus marsupium*, *Pueraria tuberosa*, *Semecarpus anacardium*, *Shorea robusta*, *Terminalia belerica*, *T. tomentosa*, *Wrightia tinctoria* (Beeson and Bhatia, 1939); *Erythrina* (Hutson, 1927); *Boswellia serrata* (Bhasin, Roonwal and Balwant Singh, 1958); *Samanea saman* (D. of A., Bangkok),

Africa: *Antiaris toxicaria*, *Afzelia* sp., *Artocarpus* sp., *Celtis soyauxi*, *Adansonia digitata*, *Anacardium occidentale*, *Ficus* sp., *Albizia zygia*, *Triplochiton scleroxylon*, *Acacia pennata* (Duffy, 1953a, 1957); *Coffee arabica*, *C. canephora*, *C. excelsa*, *Theobroma*, *Funtumia*, *Citrus* (Lepesme and Villiers, 1941); *Albizia sassa*, *Baphia nitida*, *Berlinia acuminata*, *Chlorophora excelsa*, *Cleistopholis patens*, *Discoglypremna caloneura*, *Entandrophragma angolense*, *Ficus polita*, *Macrolobium heudolotianum*, *Hevea brasiliensis*, *Millettia stapfiana*, *Piptadenia aubrevillei*, *Spondias mombin*, *Strombosia pustulata*, *Turraeanthus africana* (Jover, 1953).

Adult (Pl. XVI, fig. 1). Length 13–19 mm. Entirely brown, speckled with black and grey, with angular black or dark brown markings or streaks on elytra. *Head* with

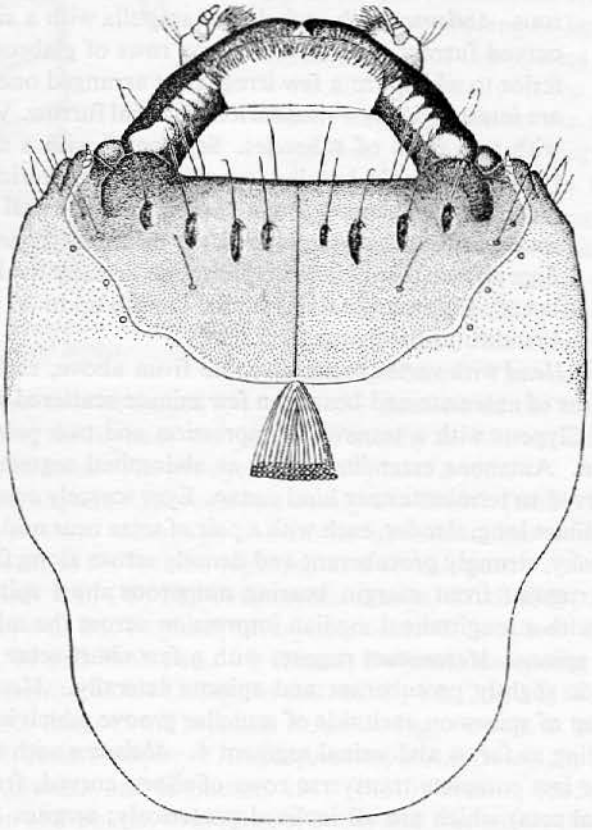

Fig. 148. *Coptops aedificator* (Fabricius). Mature larva. Head. Dorsal aspect.

antennae distinctly longer than body in both sexes. *Prothorax* with a pair of small but distinct, lateral, premedian tubercles. Elytra broadly rounded apically.

Mature larva (figs. 148, 149). *Head* (fig. 148) moderately depressed, slightly elongate, widest at middle and abruptly and strongly constricted near posterior third behind which it is appreciably narrower; frontal sutures distinct for entire length; antennal foramen open behind; mouthframe broadly and strongly sclerotized. Frons entirely ferruginous with eight setiferous pores which are longitudinally impressed; six epistomal setae present. One pair of ocelli present; lens round, feebly convex; pigmented spot rather indistinct. Hypostoma ferruginous, with an abrupt, widely curved ridge across middle; anterior half steeply sloping down to front margin; one pair of distinct setiferous pores present; sutures distinct, pitchy and slightly incurved. Gular region with a pale median ventral cleavage line. Antenna (fig. 149) with segment 2 slightly transverse, segment 3 cylindrical, about three times as long as broad and as long as segment 2; supplementary process shorter than segment 3. Maxilla with segment 3 of palp acutely conical, as long as segment 2. Labial palpi with segment 2 acutely conical, as long as segment 1. Mentum not distinct from submentum. *Prothorax* with pronotum very faintly striate and glabrous. *Abdomen* with each dorsal ampulla with a single transverse, curved furrow and two transverse rows of glabrous tubercles, anterior to which are a few irregularly arranged ones; the two rows are interrupted by a median longitudinal furrow. Ventral ampullae with two rows of tubercles. Segment 9 with a small erect spine (which is simple basally) on middle of posterior margin. Epipleurum protuberant on all segments. Pleural tubercle rather small, with ventral sclerotized pit rather large and very distinct. *Legs* absent. *Spiracles* with peritreme broadly oval and with about twenty-four marginal chambers. Length up to 36 mm.; maximum breadth (at prothorax) 7·5 mm.

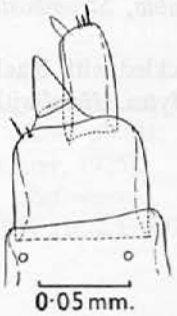

Fig. 149. *Coptops aedificator* (Fabricius). Mature larva. Apical part of antenna. Lateral aspect.

Pupa (fig. 150). *Head* with vertex entirely visible from above, rather deeply excavated between bases of antennae and bearing a few minute scattered setae; front with setae as figured. Clypeus with a transverse impression and two pairs of short setae near basal margin. Antennae extending as far as abdominal segment 3, where they are strongly recurved to terminate near hind coxae. Eyes scarcely convex, each with a single seta. Mandibles long, slender, each with a pair of setae near middle of outer face. Labrum thick, fleshy, strongly protuberant and densely setose along front margin and base. *Pronotum* rugose; front margin bearing numerous short spines (each with a basal seta); disc with a longitudinal median impression across the middle of which is a row of similar spines. *Mesonotum* rugose, with a few short setae on each side of scutellum which is slightly protuberant and spinose laterally. *Metanotum* smooth, with a small group of spines on each side of scutellar groove which is distinct. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 1–4 each with two more or less complete transverse rows of short, curved, ferruginous spines (each with a basal seta) which are all inclined posteriorly; tergites 5–6 with similar spines but with those of posterior row inclined anteriorly. Tergite 7 slightly elongate,

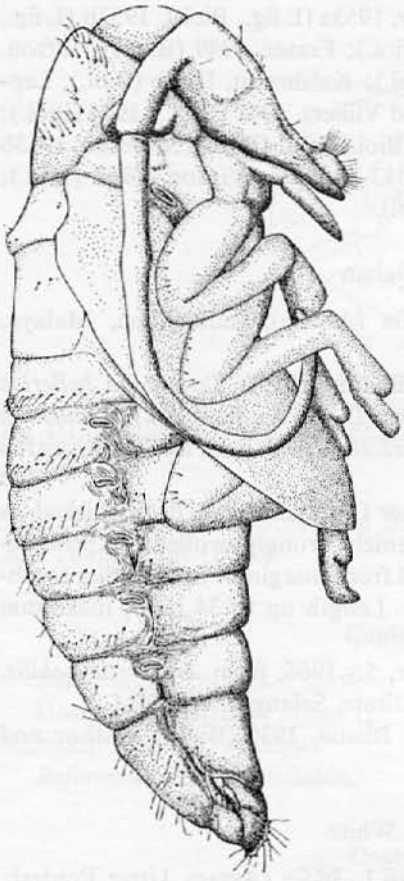

Fig. 150. *Coptops aedificator* (Fabricius). Pupa. Lateral aspect.

with sides converging posteriorly and bearing numerous slightly stouter spines which are inclined posteriorly. Tergite 8 short, transverse, with a row of similar spines. Tergite 9 very short, with hind margin bearing a transverse group of distinctly stouter spines. Sternites glabrous. Pleura moderately protuberant, each with five or more spines. *Legs* with femora each with a transverse row of four to six stout setae near apex and three to four similar setae along apical half of outer margin; hind femora extending to abdominal segment 5; all tibiae more or less at right angles to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6; peritreme narrowly oval, reniform and slightly raised above general level of cuticle. Length up to 18 mm.; maximum breadth 6·75 mm.

Biology. According to Beeson and Bhatia (1939), larvae of this species feed either subcortically or actually in the inner bark, and the damage they do to the sapwood is only superficial, for even the pupal cells are constructed almost entirely in the bark. Fraser (1949c) confirms this, although he noticed that three larvae under observation had burrowed deeply into the sapwood to pupate; but this change of habit, as he points out, was probably occasioned by the excessive drying-out of the wooden block. The emergence hole is circular but usually somewhat ragged (owing to the thinness of the bark?). Emergence occurs more or less throughout the year, but usually in March, although the main period in India is in June. The life-cycle normally lasts a year.

Parasite. Hymenoptera: *Sclerodermus immigrans* Bridw. (Bridwell, 1920).

Economic importance. Although sometimes abundant, the damage this species causes is too superficial for it to be regarded as a serious pest.

Material studied. 4 L, 1 P, 1 I, Tanganyika, Tanga, 27.xii.1951, R.C.H. Sweeney leg., in coll. B.M.; 4 L, 2 I, England, Liverpool, viii.1948, in *Afzelia* from East Africa, M.G. Fraser leg., in coll. B.M.; 4 L, 1 I, Ghana, Dwinasi, Kwapong, 15.iii.1955, from *Triplochiton scleroxylon*, E.A.J.D. leg., in coll. B.M.; 4 L, 2 P, 1 I, Ghana, Bosumkese Reserve, 21.ii.1955, from *Celtis soyauxi*, E.A.J.D. leg., in coll. B.M.; 6 L, 2 P, 1 I, Ghana, Samreboi, 21.iii.1955, from *Acacia pennata*, E.A.J.D. leg., in coll. B.M.

References. Aulmann and la Baume, 1911 (Biol.); Beeson, 1935a (Biol.), 1941 (I fig., Biol.); Beeson and Bhatia, 1939 (Biol.); Beller and Bhenchitr, 1936 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.);

Bredo, 1939 (Biol.); Bridwell, 1920 (Paras.); Duffy, 1953a (L fig., Biol.), 1953b (L fig., Biol.), 1954 (L fig., P fig.), 1957 (L fig., P fig., Biol.); Fraser, 1949 (Biol.); Hutson, 1927 (Biol.); Gardner, 1927 (L); Jover, 1953 (Biol.); Kalshoven, 1955b (Biol.); Lepesme, 1948 (Biol.), 1953 (I fig., Biol.); Lepesme and Villiers, 1941 (Biol.), 1944 (Biol.); Mathur and Balwant Singh, 1960a (Biol.), 1960d (Biol.), 1961 (Biol.); Morstatt, 1913b (Biol.); Mühlmann, 1954 (Biol.); Thompson, 1943 (Paras.); Vinson, 1962 (Biol.); Wisser and Lesne, 1899 (Biol.); Zacher, 1921 (Biol).

Coptops annulipes Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam), Indo-China, Malaya, Thailand.

Host plants: *Pyrus communis* (Beeson and Bhatia, 1939); *Terminalia bellerica* (Mathur and Balwant Singh, 1961b); *Afzelia bijuga* (D. of A., Bangkok); *Amherstia nobilis* (Forest Research Institute, Selangor); *Ficus elastica* (B.S. Rao, Rubber Research Institute, Malaya.)

Mature larva. Similar to that of *C. aedificator* (Fabricius) but distinguished as follows. *Head* with hypostoma with a pair of extremely strongly swollen and protuberant, curved ridges, one each side of gula. Ventral front margin of head with a tooth-like tubercle on acetabulum. Form more robust. Length up to 34 mm.; maximum breadth (at prothorax) 8 mm.

Material studied. 6 L, 2 I, Malaysia, Selangor, 5.v.1966, from *Amherstia nobilis*, Low Chong Moi leg., in coll. Forest Research Institute, Selangor, and B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961b (Biol.).

Coptops leucostictica White

Distribution. ORIENTAL REGION: Burma, Hainan I., India (Assam, Uttar Pradesh, West Bengal), Indo-China (Laos).

Host plants: *Acrocarpus fraxinifolius*, *Albizia lucida*, *A. procera*, *Bauhinia vahlii*, *Lannea coromandelica*, *Shorea robusta*, *Terminalia myriocarpa*, *T. tomentosa* (Beeson and Bhatia, 1939); *Boswellia serrata*, *Pterocarpus marsupium*, (Roonwal, Chatterjee and Thapa, 1961); *Mallotus albus* (Mathur and Balwant Singh, 1961); *Albizia odoratissima* (Bhasin and Roonwal, 1954).

Mature larva (fig. 151). Very similar to that of *C. aedificator* (Fabricius) from which it may be distinguished by the less distinct, pale ferruginous ocellar lens and the caudal spine which is vertical and more than twice as long as basal width (fig. 151). Length up to 30 mm.; maximum breadth (at prothorax) 6·5 mm.

Biology. Larvae of this species tunnel in thick bark. Adults emerge between May and October, mainly in June. The life-cycle is usually annual but may be prolonged in dry wood.

Material studied. 2 L, India, West Bengal, Darjeeling, Tista Valley, 28.ix.1929, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner,

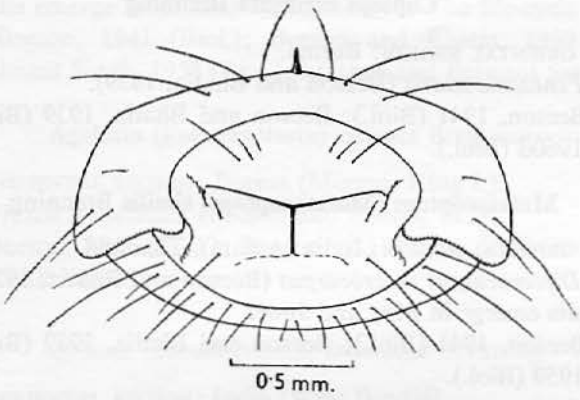

Fig. 151. *Coptops leucostictica* White. Mature larva. Abdominal segments 9 and 10. Caudal aspect.

1927 (L fig., Biol.); Mathur and Balwant Singh, 1961b (Biol.); Roonwal, Chatterjee and Thapa, 1961 (Biol.).

Coptops polyspila Pascoe

Distribution. ORIENTAL REGION: Malacca, Thailand.

Host plants: *Afzelia bijuga* (D. of A., Bangkok); *Ficus elastica* (B.S. Rao, Rubber Research Institute, Malaya).

References. None available.

Coptops lichenea Pascoe

Distribution. ORIENTAL REGION: Burma, Hainan I., India (Assam, Maharashtra, West Bengal), Indo-China (Laos), Malaya, Penang Is., Sumatra.

Host plants: *Derris dalbergioides* (Mathur and Balwant Singh, 1959); *Ficus* sp., *Shorea robusta*, *Terminalia belerica* (Beeson and Bhatia, 1939); *Hevea brasiliensis*, *Mangifera indica* (Corbett and Gater, 1926).

Biology. Emergence occurs from May to October. The life-cycle may be prolonged to two years.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Corbett and Gater, 1926 (Biol.); Koningsberger, 1915 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961a (Biol.), 1961b (Biol.).

Coptops pascoei Gahan

Distribution. ORIENTAL REGION: Burma, Indo-China (Viet Nam), Thailand.

Host plants: *Ficus* spp., *Lannea coromandelica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in November and December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Coptops variegata Breuning

Distribution. ORIENTAL REGION: Burma.

Host plant: *Pentacme suavis* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Mutatocoptops (Mutatocoptops) similis Breuning

Distribution. ORIENTAL REGION: India (Assam), Thailand.

Host plant: *Dipterocarpus macrocarpus* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May and June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Anagelasta apicalis Pic (=**Choeromorpha adspersa** Schwarzer)

Distribution. ORIENTAL REGION: China, India (Assam, Madras, Madhy Pradesh, Maharashtra, Mysore, Uttar Pradesh, West Bengal), Indo-China (Laos, Viet Nam), Thailand.

Host plants: *Acacia* sp., *Adina cordifolia*, *Bauhinia vahlii*, *Buchanania latifolia*, *Ficus rumphii*, *Mucuna imbricata*, *Shorea robusta*, *Terminalia tomentosa* (Beeson and Bhatia, 1939); *Buchanania lanzan* (Bhasin, Roonwal and Balwant Singh, 1958).

Mature larva (fig. 152). Similar to that of *Coptops aedificator* (Fabricius) from which it may be distinguished as follows. *Head* with frons bearing two pairs of lateral longitudinal carinae; entirely testaceous, except front margin and carinae; setiferous pores less deeply impressed. Hypostoma testaceous, the transverse ridge bearing a series of short longitudinal carinae and a pair of paramedian rounded tubercles (fig. 152). Length up to 25 mm.; maximum breadth (at prothorax) 4·75 mm.

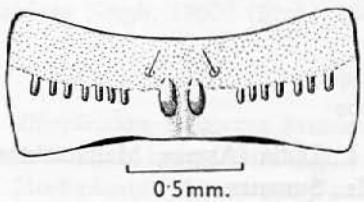

Fig. 152. *Anagelasta apicalis* Pic. Mature larva. Hypostoma.

The peculiarly sculptured hypostoma serves to distinguish this species from any other species yet known.

Biology. Adults emerge in June and July. The life-cycle is annual.

Material studied. 3 L, India, Uttar Pradesh, Dehra Dun, 26.viii.1926, from *Bauhinia vahlii*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L fig., Biol. (as *Choeromorpha adspersa* Schwarzer)); Mathur and Balwant Singh, 1959 (Biol.), 1961b (Biol.).

Agelasta (Pseudagelasta) bifasciana White

Distribution. ORIENTAL REGION: India (Assam, West Bengal), Indo-China (Tonkin).

Host plants: *Beilschmiedia sikkimensis*, *Lasiococca* sp., *Litsaea elongata* (Beeson and Bhatia, 1939).

Biology. Adults emerge from May to September. The life-cycle is annual.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Agelasta (Pseudagelasta) cristata Breuning

Distribution. ORIENTAL REGION: Burma (Mergui, King I.).

Host plant: *Hevea brasiliensis* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Agelasta (Pseudagelasta) fallaciosa Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Lasiococca* sp. (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Agelasta (Dissosira) nigromaculata Gahan

Distribution. ORIENTAL REGION: Burma (Mergui, King I., Tenasserim).

Host plant: *Hevea brasiliensis* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Choeromorpha albofasciata Breuning

Distribution. ORIENTAL REGION: Malaya, Malacca.

Host plant: *Ficus elastica* (B.S. Rao, Rubber Research Institute, Malaya).

References. None available.

Choeromorpha polynesa (White)

Distribution. ORIENTAL REGION: Borneo, Malaya, Malacca, Sarawak.

Host plant: *Ficus elastica* (B.S. Rao, Rubber Research Institute, Malaya).

References. None available.

Choeromorpha pigra Aurivillius

Distribution. ORIENTAL REGION: Java, Sumatra.

Host plants: *Ficus elastica, Artocarpus communis* (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Mesosa griseiventris Breuning

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Dalbergia paniculata* (Beeson and Bhatia, 1939).

Reference. Beeson and Bhatia, 1939 (Biol.).

Mesosa indica Breuning

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Assam, Bihar, Maharashtra, Uttar Pradesh, Madras), Indo-China (Tonkin).

Host plants: *Acacia pennata*, *Bauhinia purpurea*, *B. vahlii*, *Salmalia malabaricum*,

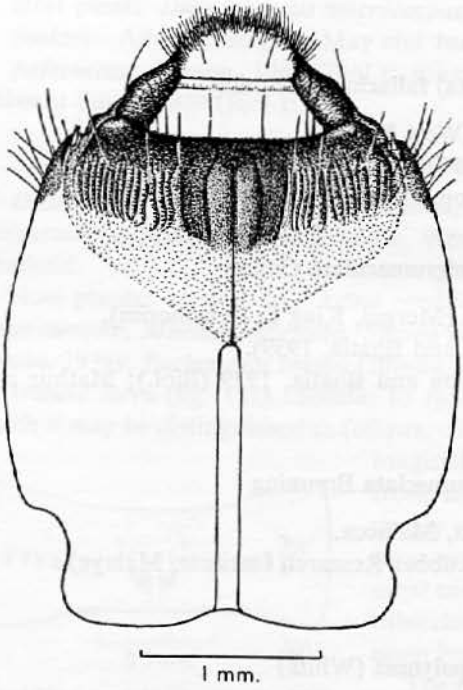

Fig. 153. *Mesosa indica* Breuning. Mature larva. Head. Dorsal aspect.

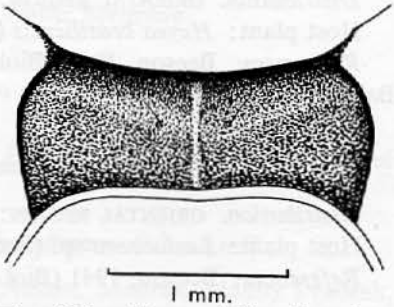

Fig. 154. *Mesosa indica* Breuning. Mature larva. Hypostoma.

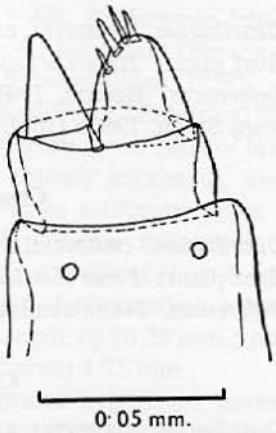

Fig. 155. *Mesosa indica* Breuning. Mature larva. Apical part of antenna. Lateral aspect.

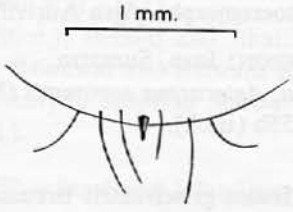

Fig. 156. *Mesosa indica* Breuning. Mature larva. Posterior part of abdominal segment 9. Dorsal aspect.

Buchanania lanzan, *Dendrocalamus strictus*, *Lannea coromandelica*, *Mallotus philippinensis*, *Scutia indica*, *Shorea robusta*, *Terminalia tomentosa* (Beeson and Bhatia, 1939).

Mature larva (figs. 153–156). Similar to that of *Coptops aedificator* (Fabricius) from which it may be distinguished as follows. *Head* with frons distinctly longitudinally striate, with eight setiferous pores (fig. 153). Hypostoma with a transverse median ridge (fig. 154). Antenna with segment 3 dome-shaped, only slightly longer than broad (fig. 155); supplementary process as long as segment 3. *Spiracles* with about six marginal chambers. Length up to 24 mm.; maximum breadth (at prothorax) 5 mm.

Pupa. No material available. The following is a description of *M. nebulosa* (Fabricius) which is essentially similar (fig. 157). *Head* with vertex entirely visible from above; rather deeply excavated between bases of antennae, and bearing a row of three long setae opposite base of each antenna; front with setae as figured; clypeus with a deep transverse impression, and a pair of short setae near basal margin. Antennae extending as far as abdominal segment 3 where they are strongly recurved to terminate near front coxae. Eyes scarcely convex, each with a single seta. Mandibles with a pair of setae near middle of outer face. Labrum transverse, with front margin broadly rounded; exceptionally protuberant and very densely setose at base. *Pronotum* rugose front margin with numerous short spines; disc usually with a longitudinal median impression, on each side of which are several similar spines. *Mesonotum* rugose and with a few short setae on each side of scutellum, which is protuberant and spinose laterally. *Metanotum* generally smooth, and with an oblique row of short spines on each side of scutellar groove, which is very distinct. Elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 1–6 each with two more or less complete transverse rows of stout curved spines. Tergite 7 slightly elongate, with sides converging posteriorly, and bearing numerous slightly stouter spines, some of which are recurved. Tergite 8 short, transverse, and with a row of similar spines. Tergite 9 very short, with hind margin bearing a row of almost straight, stouter spines. Sternites, except last two, each with a pair of fine setae near each lateral margin. Pleura moderately protuberant and with two or three short spines. *Legs* with femur bearing about four fine setae near apex; mid and hind femora each with a small blunt tubercle near base; hind femora extending to abdominal segment 4; all tibiae more or less at right angles to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6; peritreme narrowly oval, reniform and slightly raised above general level of cuticle. Length 9·25–15·25 mm.; maximum breadth 4·75 mm.

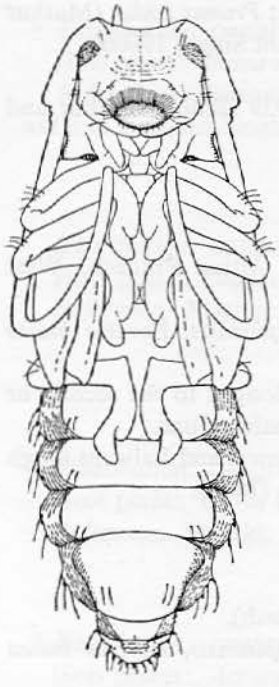

Fig. 157. *Mesosa nebulosa* (Linnaeus). Male pupa. Ventral aspect.

Biology. Larvae of this species infest dry sticks, woody climbers, small branches and the sapwood of

logs. Green bamboo has also been found to be infested. The life-cycle is usually annual but is sometimes prolonged to two or three years. Adults emerge from May to August.

Material studied. 2 L, India, Madhy Pradesh, Raipur, 2.xii.1953, *Shorea robusta*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, as *M. ominosa* Pascoe); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Mesosa rosa Karsch

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Mysore).

Host plant: *Mallotus philippinensis* (Beeson and Bhatia, 1939).

Biology. Larvae infest decaying wood. Adults occur from May to September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Mesosa setulosa Breuning

Distribution. ORIENTAL REGION: India (Punjab).

Host plants: *Prunus racemosa* (Beeson and Bhatia, 1939); *Prunus padus* (Mathur and Balwant Singh, 1960d); *Juglans regia* (Mathur and Balwant Singh, 1960b).

Biology. Adults occur in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.).

Mesosa subfasciata Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh, West Bengal).

Host plants: *Bauhinia retusa, B. vahlii, Mallotus philippinensis, Pavetta indica* (Beeson and Bhatia, 1939).

Biology. The life-cycle is usually annual but may be prolonged to the second or third year in dry wood. Adults emerge from May to July, mainly June.

References. Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh 1958 (Biol.); Mathur and Balwant Singh, 1960d (Biol.), 1961a (Biol.).

Mesosa gardneri Breuning

Distribution. ORIENTAL REGION: India (Assam, Uttar Pradesh).

Host plants: *Bauhinia retusa, B. vahlii, Mallotus philippinensis, Pavetta indica* (Beeson and Bhatia, 1939).

Biology. The life-cycle of this sapwood borer is annual with prolongation to the second or third year in dry wood. Adults emerge from May to July, mainly June.

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Mesosa myops (Dalman) (=**japonica** Bates)

Distribution. ORIENTAL REGION: China (Liaoning), Formosa. PALAEARCTIC REGION: Finland, Japan, Siberia, U.S.S.R.

Host plants: *Citrus* (Noguchi, 1934); *Pyrus malus*, *Prunus cerasus*, *Ulmus* (Cheo, 1935); *Castanea* (Nakamura, 1959b); *Wistaria brachybotry*, *Morus bombycis* (Nakamura and Fujimura, 1958).

References. Cheo, 1935 (Biol.); Nakamura, 1959b (Biol.); Nakamura and Fujimura, 1958 (L fig., P fig., Biol.); Noguchi, 1934 (Biol.).

Mesosa bifasciata Breuning

Distribution. ORIENTAL REGION: India (Madhy Pradesh, Maharashtra).

Host plants: *Bauhinia vahlii* (Beeson and Bhatia, 1939); *Salmalia malabarica* (Mathur and Balwant Singh, 1961).

Biology. Adults emerge in September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Mesosa ornata (Gahan) (=**Cacia ornata** Gahan)

Distribution. ORIENTAL REGION: Burma.

Host plant: *Butea monosperma* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Mesosa nigropunctata Breuning

Distribution. ORIENTAL REGION: Burma.

Host plant: *Thunbergia grandiflora* (Mathur and Balwant Singh, 1961b).

Reference. Mathur and Balwant Singh, 1961b (Biol.).

Mesosa perplexa Pascoe

[The Brown Marmorated Longicorn]

Distribution. ORIENTAL REGION: China, Formosa. PALAEARCTIC REGION: Japan.

Host plant: *Citrus* (Shiraki, 1952).

Reference. Shiraki, 1952 (Biol.).

Mesosa bimaculata Breuning

Distribution. ORIENTAL REGION: Burma, Bhutan, India (Sikkim, West Bengal).

Host plants: *Acrocarpus fraxinifolius* (Beeson and Bhatia, 1939); *Albizia odoratissima* (Beeson, 1941).

Biology. Adults emerge in April and May, mainly April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Mesosa columba Pascoe

Distribution. ORIENTAL REGION: Ceylon.

Host plant: *Artocarpus integra* (Beeson and Bhatia, 1939).

Biology. Adults emerge in December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Cacia cephalotes (Pic)

Distribution. ORIENTAL REGION: India (Assam, West Bengal), Indo-China (Viet Nam).

Host plant: *Quercus spicata* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Cacia cretifera (Hope)

Distribution. ORIENTAL REGION: Andaman Is., Burma, China, India (Assam, Madras, Sikkim, Uttar Pradesh), Nepal.

Host plants: *Albizia odoratissima*, *A.* sp., *Bauhinia retusa*, *Berberis asiatica*, *Clerodendron infortunatum*, *Dalbergia sissoo*, *Ficus* sp., *Flemingia semialata*, *Indigofera tinctoria*, *Lannea coromandelica*, *Mallotus philippinnesis*, *Ougeinia dalbergioides*, *Pterocarpus marsupium*, *Ricinus communis*, *Shorea robusta* (Beeson and Bhatia, 1939); *Acrocarpus fraxinifolius* (Beeson, 1941); *Ficus rumphii* (Mathur and Balwant Singh, 1959).

Mature larva (fig. 158). Very similar to that of *Mesosa indica* Breuning, from which it may be distinguished as follows. *Head* with striae on frons shorter and shallower. Frons and hypostoma entirely testaceous (except front margin). Antenna with segment 3 cylindrical, at least twice as long as broad. Abdomen with caudal spine conical, minute (fig. 158). Length up to 20 mm.; maximum breadth (at prothorax) 5 mm.

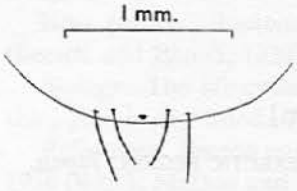

Fig. 158. *Cacia cretifera* (Hope). Mature larva. Posterior part of abdominal segment 9. Dorsal aspect.

Biology. Larvae of this species infest dead sapwood and dry sticks. The life-cycle is usually annual, with emergence periods in June and July but sometimes it is extended to two years, with adults emerging between May and October.

Material studied. 1 L, India, Uttar Pradesh, Dehra Dun, Rajawala, 9.xii.1929, from *Mallotus philippinensis*, A.K. Sharma leg., in coll. F.R.I.D.D.

References. Anonymous, 1939 (Biol.); Beeson, 1935a (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960d (Biol.), 1961 (Biol.).

Cacia herbacea Pascoe

Distribution. ORIENTAL REGION: Java.

Host plants: *Dalbergia latifolia, Tectona grandis, Barringtonia* sp., *Actinophora fragrans, Buchanania arborescens, Semecarpus heterophylla* (Kalshoven, 1955b).

References. Kalshoven, 1955b (Biol.); Koningsberger, 1915 (Biol.).

Aesopida malasiaca Thomson

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh), Malaya, Sumatra, Thailand.

Host plants: *Odina wodier, Acrocarpus fraxinifolius, Salmalia malabaricum, Erythrina vespertilio, Kydia calycina, Lannea coromandelica, Mallotus philippinensis, Mucuna imbricata, Pueraria tuberosa, Acacia pennata, Bauhinia vahlii, Buchanania latifolia, Terminalia tomentosa* (Gardner, 1931b and Beeson and Bhatia, 1939).

Mature larva. No material available. Gardner (1927) gives the following description under *Mesosa ominosa* Pascoe. "Head capsule rather narrowly castaneous; the setiferous pits on frons circular and small, not longitudinally extended. Hypostoma convex but not raised into a transverse ridge. Pronotum weakly striate posteriorly. Pleural tubercles with the ventral chitinous pit distinct. Caudal spine short, sub-erect."

Biology. In north India adults emerge from June to August. The life-cycle is annual. Damage is confined to the sapwood.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1927 (L (as *Mesosa ominosa* Pascoe)), 1931b (L); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.), 1960d (Biol.).

Anancylus griseatus (Pascoe)

Distribution. ORIENTAL REGION: Borneo, Malaya, Sarawak, Sumatra.

Host plant: *Hevea brasiliensis* (Corbett and Gater, 1926).

Reference. Corbett and Gater, 1926 (Biol.).

Paripocregyes fuscovittatus Breuning

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Terminalia belerica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Paripocregyes terminaliae (Fisher)

Distribution. ORIENTAL REGION: India (Madras, Maharashtra).

Host plant: *Terminalia belerica* (Beeson and Bhatia, 1939).

Biology. Adults occur in January, April, May, October and December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Therippia affinis Breuning

Distribution. ORIENTAL REGION: Ceylon.

Host plant: *Acacia melanoxylon* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Mesocacia multimaculata (Pic) (=**assamensis** Heller)

Distribution. ORIENTAL REGION: India (Assam, Uttar Pradesh).

Host plants: *Dipterocarpus macrocarpus, Shorea robusta* (Beeson and Bhatia, 1939).

Biology. There are apparently two generations a year with facultative prolongation to an annual cycle. Adults emerge from April to June and in October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Clyzomedus transversefasciatus Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Ficus rumphii, Mangifera indica* (Beeson and Bhatia, 1939); *Shorea robusta* (Mathur and Balwant Singh, 1961).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Glosinda basicornis Gahan

Distribution. ORIENTAL REGION: Burma, India (Uttar Pradesh, West Bengal), Indo-China (Laos, Viet Nam), Thailand.

Host plant: *Bauhinia vahlii* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April, May and from July to September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Ancylonotini

Larval Characters (see also Duffy (1957), p. 191)

Head scarcely depressed. Antennal foramen open posteriorly, the frontal sutures very distinct. Gular region with a pale median line. Ocelli indistinct. Antenna 2-segmented. *Prothorax* with posterior area of pronotum and sternellum dull, micro-spiculate. *Abdomen* with ampullae bearing irregular rows of moniliform tubercles. Tergite 9 unarmed. Epipleurum protuberant on all segments. Pleural tubercles without sclerotized pits. *Spiracles* with peritreme broadly oval.

Palimna annulata (Olivier)

Distribution. ORIENTAL REGION: Borneo, Burma, Hainan I., India (Assam, Uttar Pradesh, West Bengal), Indo-China (Laos), Java, Malaya, Sarawak, Sumatra.

Host plants: *Lannea coromandelica, Melanorrhoea usitata, Spondias mangifera* (Beeson and Bhatia, 1939); *Mangifera indica, Semecarpus* sp. (Kalshoven, 1955b).

Biology. There are probably two generations a year in Assam and Bengal. Emergence occurs in May and June and adults are also on the wing in December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Kalshoven, 1955b (Biol.); Koningsberger, 1915 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Palimna palimnoides (Schwarzer)

Distribution. ORIENTAL REGION: Burma, China, Formosa, India (Sikkim), Indo-China (Laos).

Host plant: *Pentacme suavis* (Gardner, 1931b).

Mature larva. Head moderately depressed, with anterior third slightly widened; antennal foramen open posteriorly, the frontal sutures pale, very distinct. Frons with front margin broadly ferruginous, becoming pitchy, especially immediately behind mandibular condyles. Ocelli indistinct owing to sclerotization of gena. Hypostoma plane, entirely ferruginous, obliquely strigose on each side of gular region which is denoted by a pale median line. Antenna 2-segmented. Maxillary palp 3-segmented; segment 3 shorter than segment 2. *Prothorax* with posterior area of pronotum dull, densely covered with lemon-yellow micro-pubescence; sternellum similarly covered. *Abdomen* with dorsal ampullae with numerous moniliform tubercles which are irregularly and closely arranged, the tubercles shining and apparently glabrous but under high power magnification prove to be minutely micro-spiculate. Tergite 9 unarmed. Pleural tubercles without sclerotized pits. *Legs* absent. *Spiracles* with peritreme broadly oval. Length up to 24 mm.; maximum breadth (at prothorax) 6 mm.

Material studied. 2 L, India, Uttar Pradesh, Garhwal, Gwaldam, 10.vi.1937, from unknown host, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Gardner, 1931b (L fig., Biol. (as *P.* sp.)); Mathur and Balwant Singh, 1960d (Biol.).

Palimnodes ducalis (Bates)

Distribution. ORIENTAL REGION: Bhutan, India (Sikkim, Uttar Pradesh).

Host plant: *Celtis australis* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May,

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1948 (Biol.).

Ceroplesini

Diastocera wallichi (Hope) and s.sp. **tricincta** (Duncan)

Distribution. ORIENTAL REGION: Borneo, Burma, Celebes, China (Yunnan), India (Assam, Sikkim, Uttar Pradesh, West Bengal), Indo-China (Viet Nam), Java, Sumatra.

Host plants: *Salmalia malabaricum* (Beeson and Bhatia, 1939); *Albizia odoratissima* (Beeson, 1941); ?*Shorea robusta* (Stebbing, 1914).

Mature larva (fig. 159). Form elongate, robust, cylindrical. *Head* scarcely depressed, widest at middle and distinctly constricted near posterior third. Antennal foramen open posteriorly. Mouthframe moderately sclerotized. Frons broadly pale ferruginous, with a transverse row of eight rounded or conical tubercles across front margin. Six epistomal setae present. One pair of ocelli present; lens large and very strongly protuberant, sclerotized ferruginous; pigmented spot black but rather obscured by sclerotization of lens. Hypostoma flat, smooth, pale ferruginous, sparsely setose; sutures distinct, ferruginous, strongly incurved. Gular region with a pale median cleavage line, on each side of which are several scattered setae. Antenna with segment 2 strongly transverse and bearing a conical hyaline process. Maxilla with segment 3 of palp much shorter than segment 2. Mentum distinct from submentum. *Prothorax* with anterior area of pronotum pale orange-testaceous and bearing scattered reddish setae; posterior area coarsely and rather feebly longitudinally strigose; sublateral impressions rather deep and distinct. Prosternum and anterior part of eusternum with scattered long reddish setae; sternellum almost glabrous. *Abdomen* with dorsal ampullae each with four distinct rows of large, glabrous, moniliform tubercles which are not interrupted by the median longitudinal furrow. Tergite 9 bearing a pair of paramedian oval tubercles which are bun-shaped and strongly protuberant and not sclerotized or pigmented (fig. 159). Epipleurum protuberant on all segments. Pleural tubercle without sclerotized pits, elongate-oval and bearing several long setae, which are variable in number. *Legs* vestigial. *Spiracles* with peritreme very thick ferruginous, broadly oval; marginal chambers absent. Length up to 55 mm.; maximum breadth (at prothorax) 12 mm.

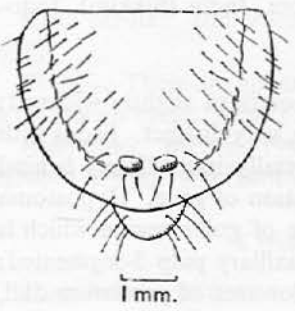

Fig. 159. *Diastocera wallichi*. (Hope). Mature larva. Abdominal tergite 9.

Pupa. Head with vertex almost entirely visible from above, deeply sulcate medially, the bases of antennal tubercles narrowly separated and robust; front bearing a few scattered setae; base of clypeus with a transverse row of four to six setae. Antennae extending to abdominal segments 2 and 3 where they are each arranged in a single coil on top of each middle femur. Eyes plane, glabrous. *Pronotum* bearing laterally a pair of sub-basal, broadly rounded tubercles; numerous stout ferruginous spines (each with an apical seta) present, especially on front and lateral margins. Mesonotum with numerous scattered shorter spines; scutellum slightly protuberant, coarsely transversely striate. Metanotum with similar spines; scutellar groove transversely striate. Elytra and wings extending to between abdominal segments 3 and 4. *Abdomen* with tergites 1–8 bearing numerous stout ferruginous spines (each with a sub-apical seta) arranged more or less in two transverse bands. Segment 9 with much larger spines, especially on lateral and posterior margins, and bearing a pair of slender urogomphi. Sternites bearing numerous smaller spines. Pleura very strongly protuberant, spinulose. *Legs* with numerous small scattered spines near apex of each femur; hind femora extending to abdominal segment 4; tibiae placed obliquely to longitudinal axis of body. *Functional spiracles* present on segments 1–6; peritreme

broadly oval, very thick, pale and strongly raised above general level of cuticle. Length up to 44 mm.; maximum breadth 13 mm.

Biology. Adults are diurnal and feed on the bark of young shoots of various woody plants (Beeson and Bhatia, 1939). Stebbing (1914) suggests that the adults may in fact girdle young sal trees.

Material studied. 3 L, 2 P, no data (purchased), in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961 (Biol.); Stebbing, 1907b (I fig., Biol.), 1914 (Biol.).

Xylorhizini

Larval Characters

The examination of the larva of the African species of the xylorhizine genus *Thylactus* (*T. longipennis* Pascoe[30]) as well as that of the oriental genus *Xylorhiza* has shown them to possess the following characters in common.

Head capsule almost completely and very strongly sclerotized and ferruginous; frontal sutures very distinct and bifurcate posteriorly (fig. 161). Two pairs of large ocelli present, the second pair placed behind and well above the first pair (alongside frontal sutures). Antennal foramen closed posteriorly. Hypostomal and gular sutures undefined. Presternum with a pair of sublateral sclerotized plates. *Prothorax* with pronotum (fig. 162) very strongly sclerotized and ferruginous, thus contrasting strongly with the posterior area which is yellowish white, embossed and coarsely longitudinally striate. *Abdomen* with segment 9 short and rather densely fringed with short coarse setae.

Affinities towards the Hippopsini are suggested by (i) the slightly curved body, (ii) the salient and extensively sclerotized head and pronotum, (iii) the short and densely setose ninth abdominal segment and (iv) the presence of sublateral sclerotized plates on the presternum.

Xylorhiza adusta (Wiedemann)

Distribution. ORIENTAL REGION: Burma, Ceylon, China, Hainan I., Hong Kong, India (Assam, Madras, West Bengal), Indo-China (Laos), Malacca, Nepal, Sumatra.

Host plants: *Callicarpa arborea, Premna pyramidata* (Beeson, 1941); *Callicarpa macrophylla* (Lucas, 1873); *Viburnum odoratissimum* (G.B. Vogt).

Adult (fig. 160). Length 28–45 mm. Black, covered with a mixture of light and dark brown pubescence. Vertex of head and pronotum with a rather broad, median, longitudinal, golden yellow stripe and a pair of much narrower lateral stripes. Basal areas of pronotum and elytra gradually becoming much darker. Elytra with longitudinal yellowish brown and dark brown streaks. *Head* with antennae slightly longer

[30]The larva of this species appears to be unique in having the anterior angles of the prothorax apparently as strongly sclerotized and ferruginous as the head capsule.

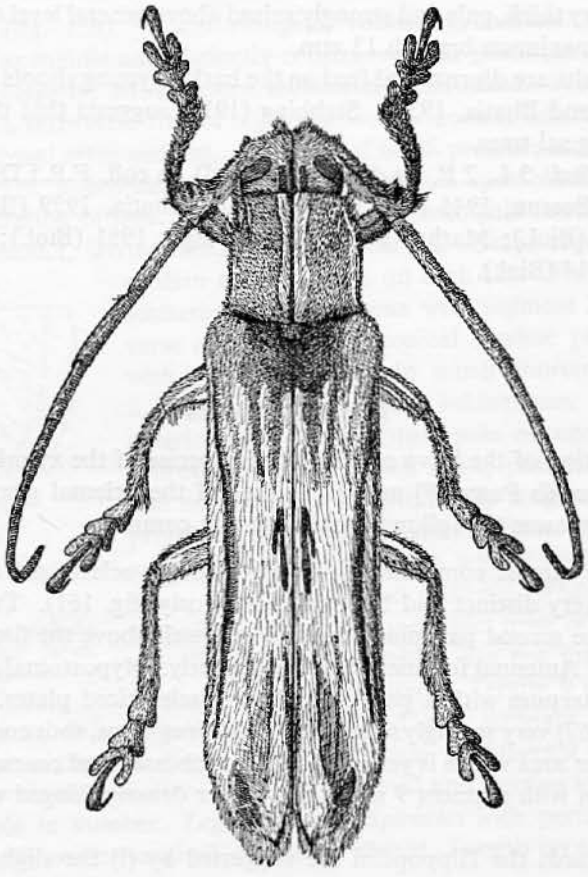

Fig. 160. *Xylorhiza adusta* (Wiedemann). Adult.

than body in male, much shorter than body in female. *Prothorax* quadrate, trilobed basally and without lateral tubercles. *Elytra* extremely elongate, acuminate apically and densely fringed with long shaggy pubescence.

Mature larva (figs. 161 and 162). Form elongate, cylindrical, rather robust, slightly curved anteriorly. *Head* (fig. 161) salient, oval in cross-section, with sides slightly rounded and strongly converging and produced for posterior third; exposed part almost entirely uniformly sclerotized and ferruginous, except for part of the hypostoma which is more testaceous; occipital foramen ventral, very large; antennal foramen closed posteriorly; frontal sutures pale, very distinct and bifurcate posteriorly; six epistomal setae present; genae, temples and frons bearing numerous very long stiff setae (each arising from a deep pore). Two pairs of large ocelli present, the first pair with a strongly protuberant lens, the second pair with lens plane and placed behind and well above the first pair (alongside frontal sutures). Labrum strongly transversely oval and bearing long coarse setae, the paramedian pair being the longest; clypeus strongly sclerotized and ferruginous for about basal half. Mandibles acutely

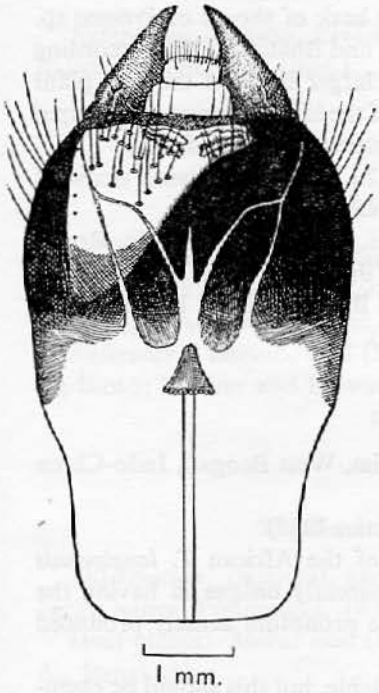

Fig. 161. *Xylorhiza adusta* (Wiedemann) Mature larva. Head. Dorsal aspect.

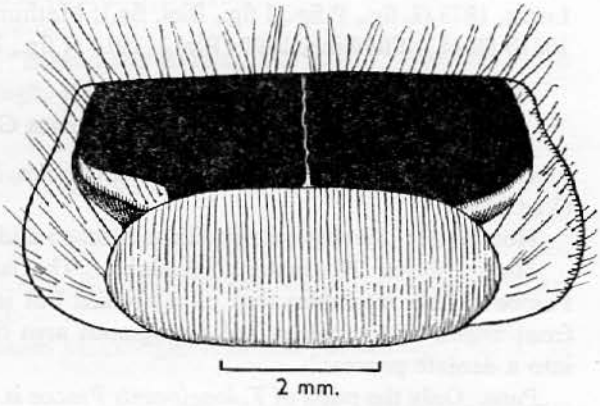

Fig. 162. *Xylorhiza adusta* (Wiedemann). Mature larva. Prothorax. Dorsal aspect.

produced apically. Hypostoma plane, smooth, mainly testaceous and bearing a few scattered bristly setae; gular region with a pale median cleavage line; hypostomal and gular sutures undefined. Antenna minute, 2-segmented; segment 2 very short and bearing a hyaline process. Maxillary palpi 3-segmented, segment 3 as long as segment 2. Labial palpi with segment 2 shorter than segment 1. Mentum distinct from submentum. *Prothorax* with anterior area of pronotum (fig. 162) very strongly sclerotized and ferruginous and contrasting strongly with the posterior area which is yellowish white, embossed and coarsely longitudinally striate; median cleavage line very distinct on anterior part; lateral grooves diverging anteriorly. Presternum with a pair of sublateral sclerotized plates; eusternum and sternellum rather densely setose. Meso- and metanotum each with three rows of moniliform tubercles. Meso- and metasternum each with two rows of large moniliform tubercles and rather densely setose sublaterally. *Abdomen* with each dorsal ampulla with two rows of large moniliform tubercles; intersegmental skin short but becoming progressively longer posteriorly. Ventral ampullae with tubercles less numerous, larger and more strongly protuberant. Segment 9 rather densely setose posteriorly and as wide and high as segment 8. Epipleurum protuberant on all segments. Pleural tubercle without sclerotized pits but bearing several setae. Anus trilobed. *Legs* absent. *Spiracles* broadly oval, the posterior half of peritreme lined with marginal chambers. Length up to 50 mm.; maximum breadth (at prothorax) 9 mm.

Biology. Adults have been observed to feed on the bark of shoots of *Premna* sp. and *Wrightia tinctoria* from May to September (Beeson and Bhatia, 1939). According to Lucas (1873), larvae excavate linear galleries in the larger stems of the host plant which are often rendered completely hollow as a result of the larva's boring. The pupal cell is plugged at both ends with coarse, rather loosely interwoven wood fibres.

Material studied. 2 L, Burma, Akyab, Fakir Pt., 2.i.1952, from living stems of *Viburnum odoratissimum*, G.B. Vogt leg., in coll. U.S.N.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cotes, 1894b (Biol.); Gressitt, 1951 (Biol.); Lucas, 1873 (L fig., P fig., I fig., Biol. fig.); Mathur and Balwant Singh, 1960d (Biol.), 1961b (Biol.); Stebbing, 1899 (Biol.), 1914 (I fig., Biol.).

Thylactus simulans Gahan

Distribution. ORIENTAL REGION: India (Assam, Sikkim, West Bengal), Indo-China (Viet Nam).

Host plant: *Symingtonia populnea* (Beeson and Bhatia, 1939).

Mature larva. No material available. The larva of the African *T. longipennis* Pascoe closely resembles that of *Xylorhiza* but is apparently unique in having the front angles of the sclerotized ferruginous area of the pronotum acutely produced into a dentate process.

Pupa. Only the pupa of *T. longipennis* Pascoe is available, but this should be essentially similar. *Head* with vertex entirely visible from above, deeply excavate between bases of antennae; frons with a group of numerous setae beneath each antennal tubercle. Clypeus with a row of four to six setae, labrum with a row of six to eight setae and two smaller setae near front margin. Antennae extending as far as abdominal segment 4, where they are strongly curved ventrally to terminate alongside inner apical margin of each elytron. Mandibles robust, each with a pair of short setae near middle of outer face. *Pronotum* with a pair of broadly rounded lateral tubercles which are densely setose; disc with a group of setae across middle, posterior to which are several scattered setae. Mesonotum with two groups of setae on scutellum. Metanotum with two groups of setae near posterior margin. Elytra and wings extending as far as abdominal segment 4; apices of elytra sclerotized, pale ferruginous, slightly produced and thickened and embraced by antennae. *Abdomen* with tergites 1–7 each with a transverse band of numerous spinules (each with a fine basal seta). Tergite 8 rather short, with a transverse band of less numerous spinules. Tergite 9 very short, truncate posteriorly and very densely fringed with long setae (each arising from a ferruginous basal disc. Sternites glabrous. Pleura moderately protuberant. *Legs* robust, glabrous; hind femora extending to abdominal segment 3; tibiae more or less at right angles to longitudinal axis of body. *Functional spiracles* present on segments 1–6 but vestigial pairs present on segments 7 and 8; peritreme oval, thick and strongly raised above general level of cuticle. Length up to 35 mm.; maximum breadth 9 mm.

Biology. The adult has been taken in August.

Material studied. 6 L, 1 P, 1 I, Africa, Uganda, Nakawa, 1960, from *Markhamia platycalyx*, K.W. Brown leg., in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Rhodopini

Rhodopsis alboplagiata Gahan

Distribution. ORIENTAL REGION: India (Sikkim, West Bengal).

Host plant: *Machilus odoratissima* (Gardner, 1931b).

Biology. Adults emerge in September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Xenoleini

Xenolea collaris Thomson (=**laticollis** Pascoe)

Distribution. ORIENTAL REGION: Aru, Borneo, Celebes, Ceram, Formosa, Mysol, New Guinea, Philippines, Thailand.

Host plants: *Morus alba* (Boonsom Meksongsee); *Artocarpus heterophyllus* (D. of A., Bangkok).

Mature larva (fig. 163). *Head* (fig. 163) moderately depressed, elongate, with sides slightly converging posteriorly and abruptly but feebly constricted medially. Frontal sutures indistinct; antennal foramen closed posteriorly; mouthframe rather strongly and broadly sclerotized; frons testaceous and smooth. One pair of ocelli present; lens large, round, pigmented spot very distinct. Hypostoma (fig. 163) plane, glabrous, with front margin semicircular; posterior margin having attached to it a membrane with a median sclerotized process; gular region indiscernible. Antenna 3-segmented, with a well developed, hyaline, supplementary process. Maxilla with palpal segments 2 and 3 subequal. Clypeus glabrous. *Prothorax* with pronotum bearing numerous pale setae antero-laterally; posterior area faintly striate, glabrous. *Abdomen* with each dorsal ampulla with a single transverse impression and two rows of rather large, glabrous, moniliform tubercles. Tergite 9 without a sclerotized process. Epipleurum slightly protuberant on all segments; pleural tubercle without sclerotized pits. Anus trilobate. *Legs* absent. *Spiracles* circular, peritreme without marginal chambers. Length up to 12 mm.; maximum breadth 2·1 mm.

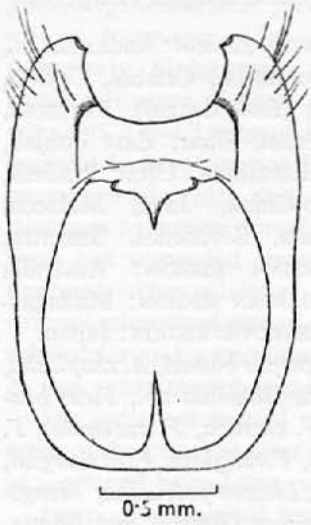

Fig. 163. *Xenolea collaris* Thomson. Mature larva. Head. Ventral aspect.

The curiously formed hypostoma serves to distinguish this genus (tribe?) from all other known genera of the LAMIINAE.

Material studied. 6 L, Thailand, from *Morus alba*, Boonsom Mekongsee pres., in coll. B.M.

References. None available.

Xenolea tomentosa (Pascoe) and s.sp. **asiatica** (Pic)

[The Small Mottled Brown Mulberry Twig Longhorn]

Distribution. ORIENTAL REGION: Andaman Is., Celebes, China (Kwangtung, Szechuan), Formosa, Hainan I., India (North India, Uttar Pradesh), Indo-China (Viet Nam), Singapore, Sumatra, Thailand. PALAEARCTIC REGION: Japan.

Host plants: *Cudrania javanensis*, *Pterocarpus dalbergioides* (Beeson and Bhatia, 1939); *Morus alba* (Gressitt, 1942); *Streblus asper*, *Artocarpus heterophyllus* (D. of A., Bangkok).

Mature larva. Extremely similar to that of *X. collaris* Thomson from which it may be distinguished by the shorter apical segment of the palp. Length up to 15 mm.; maximum breadth (at prothorax) 2·8 mm.

Biology. Emergence occurs from May to September, mainly July. The life-cycle may be prolonged to two or three years.

Material studied. 6 L, 2 I, China, Chengtu, from *Morus*, in coll. U.S.N.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gressitt, 1942 (I fig., Biol., Contr.); Mathur and Balwant Singh, 1960d (Biol.).

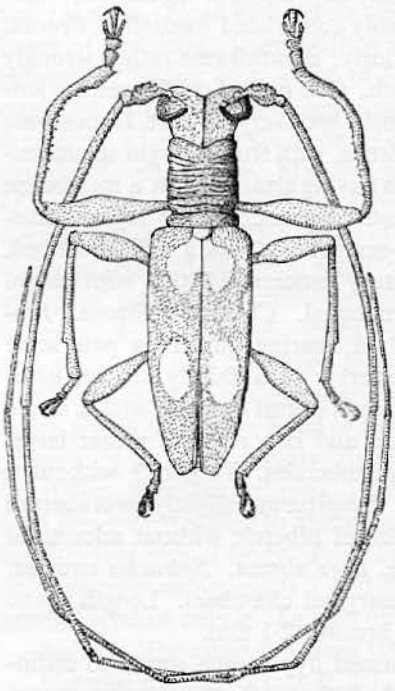

Fig. 164. *Olenecamptus bilobus* (Fabricius). Adult.

Dorcaschematini

Olenecamptus bilobus (Fabricius)

[The Small White-spotted Banyan Longicorn]

Distribution. ORIENTAL REGION: Andaman Is., Borneo, Burma, Caroline Is., Celebes, Ceylon, China, East Pakistan (East Bengal), Formosa, Hainan I., India (Assam, Bihar, East Punjab, Kerala, Madras, Maharashtra, Uttar Pradesh, West Bengal), Indo-China, Java, Malacca, Malaya, New Guinea, Seychelles, Sumatra, Thailand. AUSTRALASIAN REGION: Australia (Queensland). MADAGASCAN REGION: Madagascar, Mauritius. PALAEARCTIC REGION: Japan.

Host plants: *Artocarpus blumei*, *A. chaplasha*, *A. hirsuta*, *A. integra*, *Bauhinia* sp., *Ficus benghalensis*, *F. carica*, *F. elastica*, *F. racemosa*, *F. infectoria*, *F. laccifera*, *F. religiosa*, *F. roxburghii*, *F. rumphii*, *F. tjakela*, *Litsaea polyantha*, *Mangifera indica*, *Morus acidosa* (Beeson and Bhatia, 1939); *Ficus lacor*, *F. retusa* (Gressitt, 1942); *Theobroma* (Dammerman, 1919); *Ficus stipu-*

losa (Ohbayashi, 1944); *Artocarpus elastica* (Kalshoven, 1955b); *Garuga pinnata* (Mathur and Balwant Singh, 1960b); *Ficus minahassae* (Mathur and Balwant Singh, 1959).

Adult (fig. 164). Length 12–20 mm. Head, prothorax and elytra covered with yellowish brown pubescence, the latter with oval areas of white pubescence as figured. *Head* with antennae long and slender; scape swollen and asperate and third segment several times as long as scape. *Prothorax* elongate and transversely strigose.

Mature larva (fig. 165). Form elongate, slender, subcylindrical. *Head* moderately

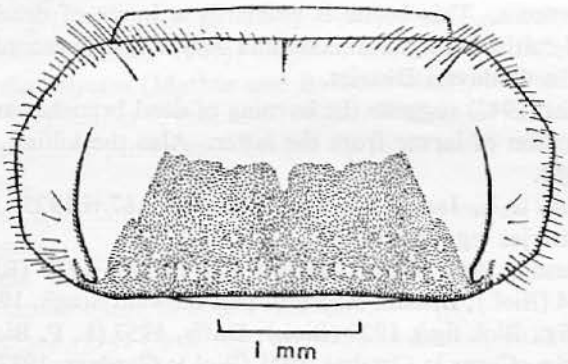

Fig. 165. *Olenecamptus bilobus* (Fabricius). Mature larva. Prothorax. Dorsal aspect.

depressed, slightly elongate, widest at middle and narrowing and slightly constricted posteriorly. Frontal sutures indistinct; antennal foramen closed posteriorly. Mouthframe broadly sclerotized, ferruginous. Frons smooth, testaceous behind front margin; six epistomal setae present. Hypostoma entirely ferruginous and raised posteriorly into a transverse ridge (as in Mesosini); sutures straight, slightly converging posteriorly. Gular region with a pale median line. Ocelli (one pair) indistinct owing to sclerotization of gena. Antenna 3-segmented, segment 3 elongate. Maxilla with segments 2 and 3 subequal in length. Labial palpi with segment 2 much shorter than segment 1. Mentum not distinct from submentum. *Prothorax* with posterior part of pronotum (fig. 165) dull, micro-spiculate, with a nearly straight anterior margin. *Abdomen* with each dorsal ampulla bearing a single transverse furrow and two transverse but somewhat irregular rows of glabrous, moniliform tubercles. Tergite 9 unarmed. Anus trilobate. Epipleurum protuberant on all segments. Pleural tubercle without sclerotized pits. *Legs* absent. *Spiracles* with peritreme thick, pale testaceous, subcircular and with numerous marginal chambers on posterior half. Length up to 23 mm.; maximum breadth (at prothorax) 4 mm.

The indistinct frontal sutures and the closed antennal foramen (and the caudal spine of the pupa) suggest a degree of affinity with the Monochamini and, in the case of the raised hypostoma, with the Mesosini.

Pupa. No material available. Gardner (1927) gives the following description. "Thoracic tergites with sparse short scattered setae. Abdominal tergites with scattered sharp spinules. Caudal segment with an erect, slightly curved spine."

Biology. Adults are active by day and feed by gnawing the green bark of shoots or by eating holes in the blade of large leaves such as those of *Ficus religiosa.* In North India the life-cycle is annual with an extended emergence period from May to November; a portion of the brood may be prolonged to the second year, but if the wood has dried out considerably, these belated individuals do not survive (Beeson and Bhatia, 1939). Dammerman (1913) gives the life-cycle as being only two months.

According to Gressitt (1942), the larval galleries extend through both the bark and the sapwood, the pupal cell, which is long and curved, being in the solid wood. Adults are active both during the daytime and at night and are attracted to artificial light.

Economic importance. This beetle is primarily a borer of dead *Ficus.* It is an occasional pest of cultivated fig. Ramakrishna Ayyar (1924) records it as a serious pest of *Morus* in the Godavari District.

Control. Gressitt (1942) suggests the burning of dead branches and infested living parts, or the extraction of larvae from the latter. Also the killing of mating adults on branches at night.

Material studied. 2 L, India, Madras, Nilambur, 17.vi.1925, from *Artocarpus integra,* S. N. Chatterjee leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Dammerman, 1913 (L fig., Biol. fig.), 1929 (Biol.); Duffy, 1957 (L, P, Biol., Contr.), 1963 (L, P, I, fig., Biol. fig., Contr.); Fletcher, 1921 (Biol.); Gardner, 1927 (L fig., P, Biol.), 1931 (L); Gressitt, 1942 (L, I fig., Contr.), 1951 (Biol.); Kalshoven, 1955b (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1960c (Biol.); Maxwell-Lefroy and Howlet, 1909 (Biol.); Ohbayashi, 1944 (Biol.); Pierce, 1918 (Biol.); Ramakrishna Ayyar, 1924 (Biol.), 1940 (L fig., P fig., I fig., Biol. fig.); Stebbing 1914 (I fig., Biol.); Vinson, 1962 (Biol.).

Olenecamptus anogeissi Gardner

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madhy Pradesh, Madras, Uttar Pradesh).

Host plants: *Anogeissus latifolia, Ougeinia dalbergioides* (Beeson and Bhatia, 1939); *Anogeissus pendula* (Bhasin and Roonwal, 1954).

Mature larva. Very similar to that of *O. bilobus* (Fabricius) from which it may be distinguished by the glabrous, longitudinally striate pronotum.

Biology. Larvae of this species feed subcortically, deeply grooving the bark. The irregular galleries are at first packed with bark dust and later on with wood fibres. The sapwood is seldom grooved more than $\frac{1}{12}$th of an inch by the mature larva. The pupal cell extends from the oblique prepupal gallery to about an inch below the surface; it is broad and curved. The exit tunnel is circular in cross-section and originates from the junction of the prepupal gallery with the cell. In south India there are two generations a year. Adults emerge from May to July and December to February. Part of the brood is prolonged to an annual cycle (Beeson and Bhatia, 1939).

Material studied. 1 L, India, Madras, N. Selam, Aujur, 30.v.1930, from *Anogeissus latifolia,* B. Singh leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Olenecamptus indianus Thomson

Distribution. ORIENTAL REGION: India (Maharashtra, Madhy Pradesh, Uttar Pradesh, West Bengal), Thailand, West Pakistan.

Host plants: *Anogeissus latifolia, Randia spinosa, Terminalia belerica* (Beeson and Bhatia, 1939); *Anogeissus acuminata, Lagerstroemia calyculata, Phyllanthus emblica, Terminalia tomentosa* (Beeson, 1941); *Ougenia dalbergioides* (Mathur and Balwant Singh, 1961); *Kydia calycina* (Mathur and Balwant Singh, 1960b).

Mature larva. Very similar to that of *O. bilobus* (Fabricius): it may be distinguished by the glabrous, rugulose pronotum. Length up to 27 mm.; maximum breadth (at prothorax) 4·5 mm.

Biology. In North India the life-cycle of this species is annual with adult emergence from May to August.

Material studied. 2 L, India, Uttar Pradesh, Dhera Dun, Lachiwala, from *Kydia calycina*, N.C. Chatterjee leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol. fig); Beeson and Bhatia, 1939 (Biol. fig.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L, Biol.); Garthwaite, 1940a (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960c (Biol.), 1960d (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.).

Olenecamptus opatus Pascoe

Distribution. ORIENTAL REGION: Annam, Borneo, Malacca, Singapore, Sumatra, Thailand.

Host plant: *Mangifera indica* (Beller and Bhenchitr, 1936).

Mature larva. Similar to that of *Olenecamptus bilobus* (Fabricius) but differing as follows. *Head* with ocellus black, distinct. *Prothorax* with pronotum glabrous, faintly rugulose. Length up to 28 mm.; maximum breadth (at prothorax) 7 mm.

Material studied. 3 L, Thailand, Thonbari, from *Mangifera indica*, in coll. D. of A., Bangkok.

Reference. Beller and Bhenchitr, 1936 (Biol.).

Olenecamptus formosanus Pic

Distribution. ORIENTAL REGION: Formosa. PALAEARCTIC REGION: Japan.

Mature larva. Similar to that of *O. opatus* Pascoe but distinguishable by the presence of at least three short, longitudinal carinae on the transverse ridge of the hypostoma. Length up to 21 mm.; maximum breadth (at prothorax) 4 mm.

Material studied. 4 L, Japan, Hiroshima, Takano, 15.v.1961, S. Nakamura leg., in coll. Shimane Agricultural Experiment Station.

References. None available.

Olenecamptus pseudostrigosus Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Terminalia myriocarpa* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with adult emergence in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Olenecamptus salweeni Heller

Distribution. ORIENTAL REGION: Burma, India (Uttar Pradesh).

Host plants: *Anogeissus acuminata, A. latifolia, Terminalia pyrifolia* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual, sometimes with prolongation into the second year. Adults emerge from May to July, mainly May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Olenecamptus signaticollis Heller

Distribution. ORIENTAL REGION: Burma, India (Madras).

Host plants: *Lagerstroemia speciosa, L. lanceolata* (Beeson and Bhatia, 1939).

Biology. In southern India there are probably two generations a year with prolongation to the second year. Adults emerge from April to June (mainly May) and from September to January (mainly November).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Olenecamptus clarus Pascoe

[The White Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Kiangsu), Formosa. PALAEARCTIC REGION: Japan, Korea.

Host plant: *Morus* (Cheo, 1935).

References. Cheo, 1935 (Biol.); Shiraki, 1952 (Biol.).

Cylindrepomus giraffa Breuning

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Ficus rumphii* (Beeson and Bhatia, 1939).

Biology. Adults emerge in October and November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Cylindrepomus uniformis Breuning

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Anogeissus latifolia* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Microlenecamptus signatus (Aurivillius)

Distribution. ORIENTAL REGION: Burma, Indo-China (Laos, Viet Nam).

Host plants: *Adina cordifoila*, *Ficus* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge from May to August, mainly in July. The life-cycle is usually annual but occasionally prolonged.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Homonoeini

Heteroclytomorpha punctata Gahan

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Solomon Is.

Host plant: *Theobroma cacao* (Szent-Ivany, 1961).

Reference. Szent-Ivany, 1961 (Biol.).

Tmesisternini

Tmesisternus yorkensis Fairmaire

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Duke of York Is.

Host plant: *Theobroma cacao* (Szent-Ivany, 1961).

Reference. Szent-Ivany, 1961 (Biol.).

Hecyrini

Moechohecyra verrucicollis (Gahan) (=**Moechotypa verrucicollis** Gahan)

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Madras, Uttar Pradesh).

Host plants: *Acacia caesia*, *Acacia* sp., *Albizia lebbek*, *A. odoratissima*, *Hevea brasiliensis*, *Careya arborea* (Beeson and Bhatia, 1939; Gardner, 1931b); *Acacia intsia* (Bhasin and Roonwal, 1954).

Mature larva (fig. 166). *Head* scarcely depressed, about twice as wide as thick, with sides only slightly converging posteriorly. Front margin of frons broadly sclerotized and ferruginous with two distinct sclerotized, elongate tubercles and sometimes a third much smaller tubercle on each side. Antennal foramen open posteriorly; frontal sutures indistinct. Antenna 2-segmented. Hypostoma feebly convex, ferruginous and bearing numerous bristly setae; gular region with a pale median line. One pair of ocelli present; lens large, sclerotized but the black pigmented spot distinct. Maxillary palp 3-segmented; segment 3 slightly shorter than segment 2. *Prothorax* with posterior area of pronotum milky white, feebly strigose, glabrous. Eusternum well defined, triangular, rather densely setose. *Abdomen* with segments 8 and 9 dis-

tinctly wider than segments 5 to 7. Dorsal ampullae each with three rows of moniliform, glabrous tubercles. Tergite 9 with a pair of short, stout, conical urogomphi (fig. 166). Anus trilobed. *Spiracles* with peritreme thin, ferruginous, broadly oval. Length up to 35 mm.; maximum breadth (at prothorax) 7 mm.

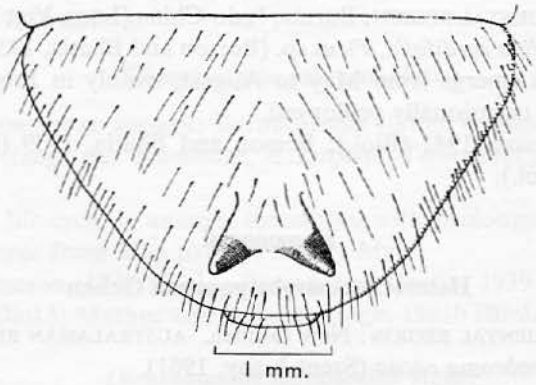

Fig. 166. *Moechohecyra verrucicollis* (Gahan). Mature larva. Abdominal segments 9 and 10. Dorsal aspect.

This larva appears to be closely related to the African genus *Hecyra* (see Duffy, 1957, p. 237).

Pupa. No material available. Gardner (1931b) gives the following description. "General form as in adult. Thoracic tergites with sparse points; abdominal tergites and pleurites rather densely covered with acute brownish points; caudal segment with a pair of acute, slightly divergent and posteriorly directed spines."

Biology. The life-cycle is apparently annual with emergence from July to September, mainly August.

Material studied. 1 L, India, Madras, Sappal, Palghat Divn., 13.v.1930, from *Albizia lebbek*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gardner, 1931b (L fig., P fig., Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Moechotypa sikkimensis Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh, West Bengal).

Host plants: *Acacia gageana*, *Albizia* sp., *Ficus racemosa*, *Mucuna imbricata* (Beeson and Bhatia, 1939).

Biology. Adults occur in June and August to October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Moechotypa suffusa (Pascoe)

Distribution. ORIENTAL REGION: Laos, Thailand.
Host plant: *Ceiba pentandra* (D. of A., Bangkok).
References. None available.

Moechotypa diphysis Pascoe

[The Oak Longicorn Beetle]

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Japan, Korea.
Host plants: *Quercus* spp. (Shiraki, 1952).
Reference. Shiraki, 1952 (Biol.).

Niphonini

Larval Characters

Head moderately depressed. Antenna 3-segmented; antennal foramen open or closed posteriorly. One pair of ocelli present. Hypostoma often protuberant, with anterior region steeply sloping down to anterior margin, the front margin in a lower plane than the hind margin or with a pair of setal pores. *Prothorax* with pronotum and sternellum devoid of asperities and spicules, the former usually feebly striate posteriorly. *Abdomen* with tergite 9 either with urogomphi or a minute median spine or unarmed; this tergite with a tendency to being rounded posteriorly, especially in *Sthenias* in which the anus is ventral (fig. 170).

Mispila curvilinea Pascoe

Distribution. ORIENTAL REGION: India (Assam, West Bengal).
Host plant: Unknown.
Mature larva. Head moderately depressed, with sides rounded and converging posteriorly. Frontal sutures distinct, antennal foramen open posteriorly (as in Mesosini (fig. 148)). Mouthframe moderately strongly and broadly sclerotized, ferruginous; four to six epistomal setae present. One pair of ocelli present; lens rather large, convex, pigmented spot indistinct. Hypostoma entirely ferruginous, moderately strongly convex in cross-section; a single stout seta present on each side of gular region (denoted by a thin pale cleavage line). Antenna 3-segmented, with a well developed hyaline, supplementary process. Maxilla with segment 3 acutely conical, about two-thirds length of segment 2. Labial palpi with segment 2 about two-thirds length of segment 1. Clypeus glabrous. *Prothorax* with posterior part of pronotum glabrous, faintly longitudinally rugulose; eusternum rather feebly defined, sub-triangular, setose. *Abdomen* with each dorsal ampulla with glabrous shining, moniliform tubercles arranged rather irregularly in four transverse rows. Tergite 9 unarmed. Epipleurum rather strongly protuberant on all segments; pleural tubercles without distinct sclerotized pits. Anus trilobate. *Legs* absent. *Spiracles* broadly oval, with numerous marginal chambers on posterior half. Length up to 37 mm.; maximum breadth (at prothorax) 7 mm.

Material studied. 2 L, India, West Bengal, x.1933, B. Singh leg., in coll. F.R.I.D.D.
Reference. Gardner, 1931b (L fig., P. (as *M.* sp.)).

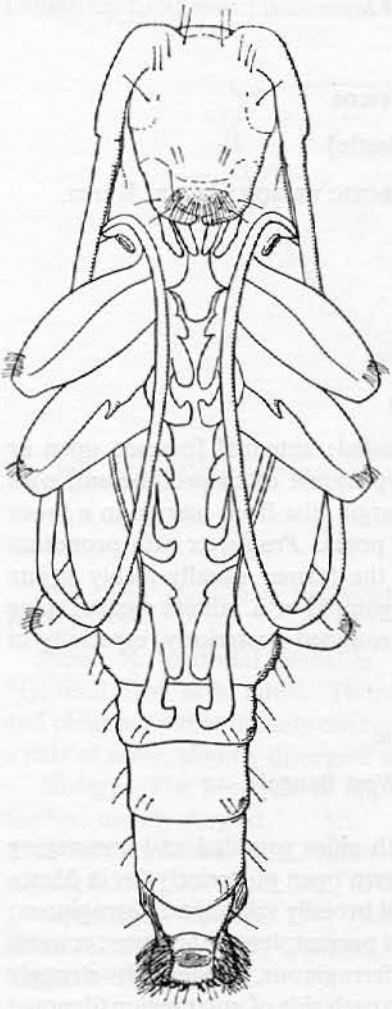

Fig. 167. *Mispila tonkinea* Pic. Pupa. Ventral aspect.

Mispila tonkinea Pic

Distribution. ORIENTAL REGION: Indo-China (Viet Nam).

Host plant: Unknown.

Mature larva. Very similar to that of *M. curvilinea* Pascoe from which it may be distinguished by the presence of only three rows of moniliform tubercles on the dorsal abdominal ampullae. Length up to 25 mm.; maximum breadth (at prothorax) 7 mm.

Pupa (fig. 167). Similar to that of *Coptops aedificator* (Fabricius) but differing as follows. *Head* with antennae much longer and more slender, recurved to form a single coil, the apices extending beyond front coxae (fig. 167). Mandible with the two setae widely separated and not placed one beneath the other (fig. 167). *Abdomen* with all spines on tergites 1–6 inclined posteriorly. Sternites each with two to four pairs of sublateral setae. *Legs* with femora bearing only a transverse row of subapical setae. Length up to 19 mm.; maximum breadth 8 mm.

Material studied. 32 L, 12 P, 3 I, Viet Nam, Vientiane, ii.1964, from unknown creeper, J. Rondon pres., in coll. B.M.

References. None available.

Niphona indica Breuning, var. **assimilis** Breuning

Distribution. ORIENTAL REGION: India (Punjab).

Host plants: *Calotropis procera* (Beeson and Bhatia, 1939); *Solanum melanogena* (Mathur and Balwant Singh, 1961).

Biology. The life-cycle is biannual but sometimes with prolongation to a full year. Adults emerge in April, September and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Niphona cylindracea White

Distribution. ORIENTAL REGION: Ceylon, India (Maharashtra, Madhy Pradesh, Madras).

Host plants: *Casuarina equisetifolia, Terminalia paniculata, T. tomentosa* (Beeson and Bhatia, 1939).

Biology. Adults have been taken in wood in May and December, and on the wing in June, August and November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Niphona hookeri Gahan

[The Tawny Brown Bamboo Longhorn]

Distribution. ORIENTAL REGION: Andaman Is., Burma, China (Kwangtung), Hainan I., Hong Kong, India (Assam, Sikkim).

Host plants: Bamboos of various species.

Adult (Pl. XV, fig. 3). Length 20–25·5 mm. Brown, densely covered with tawny brown or pale buff pubescence; elytra often glabrous and dark brown medially. *Head* with antennae about as long as body in male but slightly shorter in female. *Prothorax* slightly transverse, strongly rugulose and strongly grooved on disc. *Elytra* with a prominent sub-basal carina, sub-truncate apically.

Mature larva (fig. 168). Rather similar to that of *Mispila curvilinea* Pascoe but differing as follows. *Head* with ocellus with pigmented spot large, black and very distinct. Hypostoma with posterior area much more darkly pigmented than anterior area (fig. 168). *Abdomen* with dorsal ampullae with moniliform tubercles arranged in three transverse rows. Segment 10 bearing numerous ferruginous spinules.

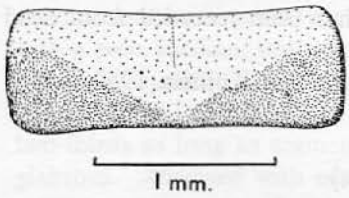

Fig. 168. *Niphona hookeri* Gahan. Mature larva. Hypostoma.

Biology. Adults have been taken in dry bamboo in February and on the wing in May (Beeson and Bhatia, 1939). Gressitt (1951) mentions that in China the adults, which are nocturnal, feed on leaves of *Citrus*.

Control. The prompt disposal of waste and broken or infested bamboo culms and the storage of unused culms in beetle-proof rooms (Gressitt, 1942).

Material studied. 1 L, (dried exuvia), in imported Chinese *Bambusa*, in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Duffy, 1953 (L fig., Biol.); Gressitt, 1942 (I fig., Biol., Contr.), 1951 (Biol.).

Niphona malaccensis Breuning

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Mysore), Indo-China (Viet Nam), Penang Is.

Host plants: *Acacia caesia, Salmalia malabaricum, Careya arborea, Casuarina equisetifolia* (Beeson and Bhatia,1939); *Tectona grandis* (Mathur and Balwant Singh, 1961b); *Acacia intsia* (Bhasin and Roonwal, 1954).

Biology. Adults have been known to emerge from dry sticks from June to October.

They have been taken in wood in December and on the wing in February and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961a (Biol.), 1961b (Biol.).

Niphona stramentosa Breuning

Distribution. ORIENTAL REGION: India (Punjab).

Host plant: *Calotropis procera* (Beeson and Bhatia, 1939).

Biology. Adults occur in June. Larvae probably infest dead twigs.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Niphona sp. **furcata** Bates?

Distribution. ORIENTAL REGION: Formosa, China, ?Java. PALAEARCTIC REGION: Japan.

Host plants: *Bambusa vulgaris, Gigantochloa apus, G. verticillata* (Kalshoven, 1955b); *Arundinaria chino, A. simonii, Sasa japonica, Phyllostachys bambusoides* (Kojima, 1959).

A species of *Niphona*, possibly *N. furcata* Bates, has been recorded from dead bamboo poles in the teak forests of Java.

References. Cheo, 1935 (Biol.); Kalshoven, 1955b (Biol.); Kojima, 1959 (L fig., Biol. fig.).

Niphonoclea capito (Pascoe)

[The Mango-twig Borer]

Distribution. ORIENTAL REGION: Philippine Is.

Host plants: *Acalypha tricolor, Panax fruticosum, Mangifera indica, M. caesia, Persea americana, Lucuma nervosa, Citrus, Ceiba pentandra, Cinnamomum camphora, Terminalia catappa, Barringtonia speciosa* (Otanes and Toquero, 1927); *Theobroma* (Mühlmann, 1954).

Egg. Cucumber-shaped, white, 3·8–4·2 mm. long and 0·9–1·1 mm. wide. Incubation period four to seven days (Otanes and Toquero, 1927).

Biology. The adult girdles the young twigs of the host plants. Generally only one egg is deposited in each twig. Infested twigs eventually die back so that heavily infested mango trees, for example, have the appearance of having been scorched by fire. The larval period is from 126–222 days and the pupal period is from 12–20 days (Otanes and Toquero, 1927).

Control. Measures recommended include that infested twigs should be removed as soon as possible, and the hand collection of adults from June to September (Otanes and Toquero, 1927).

References. Dammerman, 1929 (Biol.); Mühlmann, 1954 (Biol.); Otanes and Toquero, 1927 (E, L fig., P fig., I fig., Biol. fig., Contr.); Uichanco, 1931 (Contr.).

Niphonoclea albata Newman

Distribution. ORIENTAL REGION: Philippine Is.

Host plants: *Theobroma, Mangifera indica, Persea gratissima* (Dammerman, 1929).

References. Dammerman, 1929 (Biol.); Uichanco, 1931 (Contr.).

Prosoplus banki (Fabricius)

Distribution. ORIENTAL REGION: Indonesia, Java, Philippine Is. AUSTRALASIAN REGION: Australia (N. Australia, N.W. Australia). HAWAIIAN REGION: Hawaiian Is. (introduced).

Host plants: *Agave sisalana, Leucaena glauca* (Gressitt, 1956); *Cajanus cajan, Euphorbia, Crotalaria, Prosopis, Capparis, Erythrina, Citrus* (Duffy, 1953b); *Hibiscus* (W. A. McDougall); *Saccharum* (Box, 1953); *Hibiscus tiliaceus, Artocarpus integra* (Kalshoven, 1955b).

Mature larva. Head moderately depressed, elongate, with sides slightly diverging to middle, then strongly converging posteriorly and abruptly constricted at posterior third; frontal sutures indistinct; antennal foramen open behind. Frons smooth, testaceous, with eight setiferous pores near front margin; six epistomal setae present. One pair of ocelli present; lens rather strongly protuberant, pigmented spot indistinct. Hypostoma ferruginous (front margin more darkly so) slightly convex; one pair of distinct setiferous pores present; sutures distinct, slightly incurved. Gular region with a pale, median, ventral cleavage line. Antenna 3-segmented, segment 2 bearing a minute, hyaline, conical supplementary process; segment 3 subquadrate. Maxilla with segment 3 of palp about as long as segment 2. Labial palpi with segment 2 about two-thirds as long as segment 1. *Prothorax* with pronotum very faintly striate and glabrous. *Abdomen* with each dorsal ampulla with a single transverse furrow and two transverse rows of glabrous moniliform tubercles, anterior to which are a few irregularly arranged ones; these rows not interrupted by a median furrow. Ventral ampullae with two rows of tubercles. Segment 9 without a terminal spine (with a few setae only). Epipleurum protuberant on all segments. Pleural tubercle small, with only the ventral sclerotized pit distinct. *Legs* absent. *Spiracles* with peritreme broadly oval. Length up to 21 mm.; maximum breadth (at prothorax) 4·5 mm.

Biology. Adults are attracted to the male flowers of *Zea mays.*

Material studied. 8 L, 1 I, Hawaiian Is., Molokai, 2.xi.1928, from *Cajanus* stem, O. H. Sweezey leg., in coll. B.M.

References. Box, 1953 (Biol.); Duffy, 1953b (L, Biol.), 1963 (L, Biol.); Gressitt, 1956 (Biol.); Kalshoven, 1955b (Biol.).

Milothris irrorata (Fabricius)

Distribution. ORIENTAL REGION: Java.

Host plants: *Crotalaria, Tephrosia, Indigofera, Cassia multijuga, Albizia* (Dammerman, 1919); *Theobroma* (von Faber, 1909).

References. Dammerman, 1913 (Biol.), 1919 (I fig., Biol.), 1929 (I fig., Biol.); Kalshoven, 1951 (Biol.); Koningsberger, 1898 (Biol.), 1915 (Biol.); Mühlmann, 1954 (Biol.); von Faber, 1909 (Biol.).

Lychrosis zebrinus (Pascoe)

Distribution. ORIENTAL REGION: Formosa, Hainan I., India, Indo-China (Viet Nam).
Host plant: *Saccharum spontaneum* (Fletcher, 1920).
References. Box, 1953 (Biol.); Fletcher, 1920 (Biol.); Gressitt, 1951 (Biol.).

Falsomesosella andamanica Breuning

Distribution. ORIENTAL REGION: India (Madras, Maharashtra).
Host plants: *Hopea wightiana* (Beeson and Bhatia, 1939); *Hopea parviflora* (Mathur and Blawant Singh, 1960b).
Biology. Adults emerge in May and June.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Falsomesosella bifasciata Breuning

Distribution. ORIENTAL REGION: India (Madras).
Host plant: *Acacia leucophlaea* (Beeson and Bhatia, 1939).
Biology. Adults emerge in April.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Falsomesosella gardneri Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).
Host plants: *Bauhinia vahlii, Mallotus philippinensis* (Beeson and Bhatia, 1939); *Morus acidosa* (Mathur and Balwant Singh, 1961); *Ventilago calyculata* (Mathur and Balwant Singh, 1961b); *Holarrhena antidysenterica* (Mathur and Balwant Singh, 1960b).
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin,Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Falsomesosella transversefasciata Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).
Host plant: *Butea monosperma* (Beeson and Bhatia, 1939).
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Falsomesosella nilghirica Breuning

Distribution. ORIENTAL REGION: India.
Host plant: *Mallotus philippinensis* (Mathur and Balwant Singh, 1961).
Reference. Mathur and Balwant Singh, 1961 (Biol.).

Enispia cleroides Gahan

Distribution. ORIENTAL REGION: Burma, India (West Bengal).

Host plant: *Evodia fraxinifolia* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Enispia ochraceovittata Breuning

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Ficus* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Desisa quadriplagiata Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Mallotus philippinensis* (Beeson and Bhatia, 1939).

Biology. Larvae infest dry branchwood. The life-cycle is annual, with emergence taking place from May to July, mainly in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Desisa subfasciata (Pascoe)

Distribution. ORIENTAL REGION: India (Mysore, Uttar Pradesh), Indo-China (Cambodia).

Host plants: *Bauhinia vahlii, Mallotus philippinensis* (Beeson and Bhatia, 1939); *Anogeissus acuminata* (Beeson, 1941).

Biology. This species infests small branches and dry climbers. The pupal cell has an upward extension near the junction of the prepupal gallery (the beetle emerges from the latter). The life-cycle is annual with the emergence period extending from May to October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Camptocnema lateralis (White)

Distribution. ORIENTAL REGION: Burma, India (Assam), Thailand.

Host plants: *Mangifera indica, Salmalia insigne* (Beeson and Bhatia, 1939); *Salmalia malabaricum* (Mathur and Balwant Singh, 1961).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1939 (Biol.).

Anaches dorsalis (Pascoe)

Distribution. ORIENTAL REGION: India (Punjab).

Host plant: *Machilus* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Abryna regispetri Paiva

Distribution. ORIENTAL REGION: Burma, Malaya, Sumatra, Thailand.

Host plant: *Bambusa polymorpha* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Zygrita diva Thomson

[The Lucerne Crown Borer]

Distribution. ORIENTAL REGION: New Guinea. AUSTRALASIAN REGION: Australia (New South Wales, North West Australia, Queensland).

Host plants: *Sesbania*, *Crotalaria*, *Medicago sativa*, *Glycine max* (Jarvis and Smith, 1946); *Mimosa pudica* (J.J. H. Szent-Ivany).

Mature larva. Head rather strongly depressed and strongly elongate. Frons entirely ferruginous, the frontal sutures pale, very distinct and strongly contrasting with the ferruginous frons; eight or more epistomal setae present. One pair of ocelli present; lens convex. Hypostoma entirely ferruginous convex in cross section. Three or more setae present on each side of gular region (denoted by a thin pale cleavage line). Antenna 3-segmented, with a well developed, hyaline, supplementary process. *Prothorax* with posterior part of pronotum glabrous, feebly longitudinally striate; eusternum sparsely setose. *Abdomen* with each dorsal ampulla with glabrous moniliform tubercles arranged more or less in three transverse rows. Tergite 9 with posterior margin subangulate and conical medially and rather densely setose posteriorly. Epipleurum strongly protuberant on all segments; pleural tubercle with only a single (lower) sclerotized pit. Anus tri-lobate. *Legs* absent. Length up to 22 mm.; maximum breadth (at prothorax) 4·5 mm.

Biology. Larvae bore in the lower portions of the stems of the host plants. Development is slow and three to four months may elapse before larvae are mature. Pupation takes place in an oval cavity at the end of the larval gallery. It is unlikely that there is more than one generation a year. In the case of *Sesbania* and *Crotalaria*, larvae develop principally in the stem, though the lower part of the gallery may extend below ground level (Jarvis and Smith, 1946).

Economic importance. This borer is present in many fields of lucerne, though the damage it causes seldom attracts attention until it has assumed serious proportions.

Control. Outbreaks are rarely sufficiently serious to warrant insecticidal control measures. Where comparatively large areas are affected, it is best to plough the lucerne

out and to sow another crop in the farm rotation rather than to attempt reseeding the bare patches.

Material studied. 3 L, Australia, Queensland, Darling Downs, 9.iv.1941, in stems of soya bean plants, H. Jarvis leg., in coll. D.A.S.B.; 2 L, Australia, Queensland, Home Hill Station, 6.iv.1925, in lucerne stem, in coll. D.A.S.B.

References. Duffy, 1963 (L, Biol. fig.); Jarvis and Smith, 1946 (L, fig., P fig., I fig., Contr.).

Pterolophia camura (Newman)

Distribution. ORIENTAL REGION: Botel-Tobago, Philippine Is., Taiwan. AUSTRALASIAN REGION: Micronesia (Mariana Is.). HAWAIIAN REGION: Hawaiian Is.

Host plants: *Cynometra?* (Gressitt, 1956); *Persea americana* (Duffy, 1953b).

Mature larva (fig. 169). *Head* rather strongly depressed, elongate, with sides slightly diverging to middle and then strongly and broadly constricted posteriorly; frontal sutures indistinct; antennal foramen open behind. Frons smooth, broadly castaneous and with eight to ten long setae near front margin; six epistomal setae present. One pair of ocelli present; lens oval, protuberant, with pigmented spot distinct. Hypostoma micro-granulate, with front margin very narrowly ferruginous; one pair of distinct setiferous pores present; sutures distinct, slightly incurved. Gular region with a pale median cleavage line. Antenna with segment 2 short, transverse, segment 3 slightly longer than broad and bearing an apical appendage; supplementary process conical, nearly as long as segment 3 (fig. 169). Maxillary palpi with segment 3 almost as long as segment 2. *Prothorax* with pronotum pale testaceous anteriorly and with a fringe of setae across front margin and several long setae laterally; posteriorly smooth and shining. *Abdomen* with each dorsal ampulla with a single transverse furrow and two transverse rows of oval glabrous tubercles surrounded medially and sublaterally by additional tubercles; narrowly but deeply interrupted by the median furrow. Segment 9 with several long ferruginous setae and with a minute median spine near hind margin. Anal lobes with shorter setae. *Spiracles* with peritreme subcircular, thick. Length up to 21 mm.; maximum breadth (at prothorax) 4·2 mm.

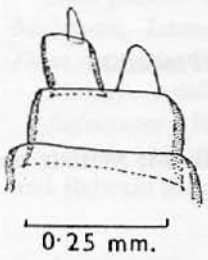

Fig. 169. *Pterolophia camura* (Newman). Mature larva. Apical part of antenna. Lateral aspect.

Pupa. Head with vertex visible from above, smooth, broadly excavated between antennal tubercles and with a pair of setae at base of each of them; front smooth, with about five setae around each eye; clypeus with a transverse row of six setae; labrum with numerous long setae. Antennae short, extending as far as apices of elytra. *Pronotum* slightly transverse, widest posteriorly, disc with a few minute scattered setae. Mesonotum with an oblique row of setae on each side of middle. *Metanotum* with scattered short setae on each side of scutellar groove which is broad and shallow. Elytra and wings extending to abdominal segment 4. *Abdomen* entirely micro-granulate, tergites 1–6 each with two transverse rows of scattered short, stout

spines (each with a basal seta); tergite 7 elongate, tapering posteriorly and with numerous similar scattered setae; tergite 8 short, transverse, with a row of short spines on hind margin. Segment 9 retracted in segment 8. Sternites each with two or three lateral setae. *Legs* with hind femora extending nearly as far as segment 4; femora with a few fine scattered setae, tarsi glabrous. *Functional spiracles* with peritreme narrowly oval. Length up to 14 mm.; maximum breadth 4·5 mm.

Material studied. 3 L, 2 P, 1 I, Hawaiian Is., Honolulu, 6.vi.1951, from dead branch of *Persea*, in coll. B.M.

References. Duffy, 1953b (L fig., P. Biol.), 1963 (L, P, Biol.); Gressitt, 1956 (Biol.).

Pterolophia binodosa Bates

Distribution. ORIENTAL REGION: Formosa. AUSTRALASIAN REGION: New Hebrides.

Host plant: *Theobroma cacao* (Dumbleton, 1951).

Economic importance. Risbec (1937) records this species as a pest of *Theobroma* in the New Hebrides.

References. Cohic, 1953 (?); Duffy, 1963 (Biol.); Dumbleton, 1951 (Biol.); Risbec, 1937 (L fig., P fig., I fig., Biol.).

Pterolophia tuberculata Breuning

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Uttar Pradesh).

Host plant: *Tectona grandis* (Beeson and Bhatia, 1939).

Biology. Adults occur in April, May, October and December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Pterolophia melanura Pascoe

Distribution. ORIENTAL REGION: China, India (Assam), Java, Malacca, Malaya, Thailand.

Host plants: *Derris robusta* (roots) (Duffy, 1953a); *Theobroma*, *Coffea*, *Castilla*, *Hevea* (Dammerman, 1919); *Tectona*, *Actinophora*, *Ficus rempelas*, *Dalbergia latifolia*, *Butea monosperma*, *Cassia auriculata*, *Piper* (dead vines), *Coffea* (in twigs killed by the *Zeuzera* borer), *Artocarpus integra*, *Erythrina lithosperma*, *Derris eliptica* (Mathur and Balwant Singh, 1959); *Citrus* spp., *Ceiba*, *Canarium*, *Deguelia*, *Grevillea robusta*, *Mangifera indica*, *Derris* roots (Kalshoven, 1955b); *Pinus caribaea* (Forest Research Institute, Selangor).

Mature larva. Differing from all other known larvae of this genus in having a robust caudal spine which is curved upwards. Length up to 16 mm.; maximum breadth (at prothorax) 4 mm.

Biology. According to Zehntner (1903), larvae have been found in cocoa pods.

Material studied. 3 L, 2 I, Malaysia, Selangor, Kepong, 17.v.1966, from *Pinus caribaea*, Low Chong Moi leg., in coll. B.M.

References. Beller and Bhenchitr, 1936 (Biol.); Corbett, 1934 (Biol.); Corbett and Gater, 1926 (Biol.); Dammerman, 1919 (Biol.); 1929 (Biol.); Delacroix, 1900

(Biol.); Duffy, 1953a (Biol.); Kalshoven, 1955b (Biol.); Koningsberger, 1915 (Biol.); Mathur and Balwant Singh, 1954 (Biol.); Miller, 1932 (Biol.), 1934 (Biol.); Mühlmann, 1954 (Biol.); Pierce, 1918 (Biol.); Veen, 1897 (Biol.); von Faber, 1909 (Biol.); Zehntner, 1903 (Biol.).

Pterolophia transversefasciata Breuning

Distribution. ORIENTAL REGION: China (Yunnan), India (Assam, Madras, Uttar Pradesh, Sikkim, West Bengal), Thailand.

Host plants: *Albizia lebbek, Millettia auriculata, Shorea robusta, Terminalia myriocarpa* (Beeson and Bhatia, 1939); *Gluta travancorica, Tectona grandis* (Beeson, 1941).

Biology. Adults emerge from dry sticks and branchlets in May, June and August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Pterolophia transverseplagiata Breuning

Distribution. ORIENTAL REGION: Burma, India (Madras, Mysore, Uttar Pradesh).

Host plants: *Acacia gageana, Acrocarpus fraxinifolius, Bauhinia vahlii, Cryptolepis buchanani, Lannea coromandelica, Mallotus philippinensis, Ougeinia dalbergioides, Pinus longifolia* (Beeson and Bhatia, 1939).

Biology. Adults emerge from April to July and in September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960a (Biol.), 1960d (Biol.), 1961a (Biol.).

Pterolophia triangularis Breuning

Distribution. ORIENTAL REGION: Java.

Host plants: *Dalbergia latifolia, Artocarpus integra, Myristica, Ceiba* (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Pterolophia oculata Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Vitis latifolia* (Beeson and Bhatia, 1939).

Biology. Adults occur in June and July, mainly the former.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Pterolophia pallidifrons Breuning

Distribution. ORIENTAL REGION: Andaman Is.

Host plants: *Mimusops littoralis, Sterculia alata* (Beeson and Bhatia, 1939).

Biology. Adults emerge from March to May and in July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Pterolophia persimilis Gahan

Distribution. ORIENTAL REGION: Burma, China?, Hong Kong, India (Assam, Bihar, Uttar Pradesh, West Bengal).

Host plants: *Acacia gageana, Clerodendron infortunatum, Croton tiglium, Dalbergia latifolia, Flemingia stricta, Girardinia heterophylla, Indigofera tinctoria, Morus acidosa, Lannea coromandelica, Michelia champaca, Ougeinia dalbergioides, Prunus* sp., *Tectona grandis, Tephrosia candida, Mallotus philippinensis* (Beeson and Bhatia, 1939); *Derris scandens, Mimosa rubicaulis* (Mathur, 1958).

Biology. The life-cycle is annual. Adults emerge from May to October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Gressitt, 1951 (Biol.); Mathur, 1958 (L fig., P fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1961b (Biol.).

Pterolophia occidentalis Schwarzer

Distribution. ORIENTAL REGION: India (Maharashtra, Madhy Pradesh, Mysore, Madras, Uttar Pradesh).

Host plants: *Acacia* sp., *Acrocarpus fraxinifolius, A.* sp., *Artocarpus hirsuta, Bauhinia vahlii, Cudrania javanensis, Dalbergia paniculata, Engelhardtia colebrookiana, Ficus religiosa, Lagerstroemia parviflora, Lannea coromandelica, Mallotus philippinensis, Mangifera indica, Millettia auriculata, Pterocarpus marsupium, Butea parviflora, Terminalia paniculata, Vitis araneosa, Wistaria* sp. (Beeson and Bhatia, 1939); *Myristica attenuata* (Beeson, 1941).

Biology. The subcortical larval galleries groove the sapwood; the pupal cells are also on the sapwood surface. The life-cycle is usually annual but may be prolonged to the second or third year in the case of dry stems and climbers. Emergence occurs nearly every month of the year but mainly in June and July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960c: (Biol.), 1960d (Biol.), 1961b (Biol.).

Pterolophia annulicornis Pic

Distribution. ORIENTAL REGION: China (Chekiang, Kiangsu).

Host plant: *Morus* (Cheo, 1935).

Reference. Cheo, 1935 (Biol.).

Pterolophia griseofasciata Breuning

Distribution. ORIENTAL REGION: India (Madras, Maharashtra, Mysore).

Host plants: *Acacia* sp., *Albizia lebbek, Vitis araneosa* (Beeson and Bhatia, 1939).

Biology. Adults emerge from April to July, mainly May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Pterolophia maculata Breuning

Distribution. ORIENTAL REGION: India (West Bengal).
Host plant: *Michelia champaca* (Beeson and Bhatia, 1939).
Biology. Adults emerge in August.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Pterolophia penicillata Pascoe

Distribution. ORIENTAL REGION: Cambodia, Thailand.
Host plant: *Artocarpus heterophyllus, Piper nigrum* (D. of A., Bangkok).
References. None available.

Pterolophia quadrifasciata Gahan

Distribution. ORIENTAL REGION: Burma, Thailand.
Host plant: *Piper nigrum* (D. of A., Bangkok).
References. None available.

Pterolophia obscuroides Breuning

Distribution. ORIENTAL REGION: Burma, India (West Bengal).
Host plants: *Acrocarpus fraxinifolius, Cedrela toona, Juglans regia, Sapium eugenaefolium;* also from climber on *Tectona grandis* (Beeson and Bhatia, 1939).
Biology. Adults emerge in March and April.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961 (Biol.).

Pterolophia pseudotincta Breuning

Distribution. ORIENTAL REGION: India.
Host plant: *Acrocarpus fraxinifolius* (Bhasin and Roonwal, 1954).
Reference. Bhasin and Roonwal, 1954 (Biol.).

Pterolophia gardneriana Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Samanea saman* (Beeson and Bhatia, 1939).
Biology. Adults emerge in July.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Pterolophia gerardiniae Breuning

Distribution. ORIENTAL REGION: Burma, India (Uttar Pradesh).
Host plants: *Albizia* sp., *Butea monosperma, Euphorbia pulcherrima, Girardinia heterophylla, Hibiscus mutabilis, Lannea coromandelica* (Beeson and Bhatia, 1939).
Biology. Adults occur in May and from August to November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961 (Biol.).

Pterolophia granulosa Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Juglans regia* (Beeson and Bhatia, 1939).

Biology. Adults occur in September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Pterolophia annulata Chevrolat

Distribution. ORIENTAL REGION: Burma, China, India, Thailand. PALAEARCTIC REGION: Japan.

Host plants: *Manihot glaziovii* (Mathur and Balwant Singh, 1961); *Hevea brasiliensis* (Mathur and Balwant Singh, 1960b); *Albizia* (A. Neboiss); *Piper nigrum* (D. of A., Bangkok).

References. Mathur and Balwant Singh, 1960b (Biol.); 1961 (Biol.).

Pterolophia densefasciculata Breuning

Distribution. ORIENTAL REGION: Burma, India (Assam).

Host plants: *Derris robusta, Millettia* sp. (Beeson and Bhatia, 1939); *Schima wallichii, Thunbergia grandiflora* (Mathur and Balwant Singh, 1961b).

Biology. Adults occur in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961a (Biol.), 1961b (Biol.).

Pterolophia gardneri Schwarzer

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Acacia gageana, Bauhinia vahlii, Lannea coromandelica, Mallotus philippinensis, Morus acidosa, Dalbergia latifolia* (Beeson and Bhatia, 1939).

Biology. In the case of infested cut climbers and small stems, the life-cycle is usually prolonged for more than a year up to three years. Adults emerge in practically every month of the year but mainly in June and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Pterolophia secuta Pascoe

Distribution. ORIENTAL REGION: Borneo, Java.

Host plants: According to Kalshoven (1955b) this species has the same hosts as *P. melanura* Pascoe (see p. 310).

Reference. Kalshoven, 1955b (Biol.).

Pterolophia modesta Gahan

Distribution. ORIENTAL REGION: Burma, India.
Host plant: *Millettia* sp. (Mathur and Balwant Singh, 1961).
Reference. Mathur and Balwant Singh, 1961 (Biol.).

Pterolophia blairiella Breuning

Distribution. ORIENTAL REGION: India (Madras).
Host plant: *Albizia odoratissima* (Beeson and Bhatia, 1939).
Biology. The adult has been taken in February.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Pterolophia infirmior Breuning

Distribution. ORIENTAL REGION: India (Maharashtra).
Host plant: *Artocarpus integra* (Beeson and Bhatia, 1939).
Biology. The adult has been taken in November.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Pterolophia marmorata Breuning

Distribution. ORIENTAL REGION: India (West Bengal).
Host plant: *Michelia champaca* (Beeson and Bhatia, 1939).
Biology. Adults emerge in July and August.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Pterolophia circulata Schwartz

Distribution. ORIENTAL REGION: Java.
Host plants: *Actinophora, Barringtonia, Buchanania, Albizia lebbeck, Millettia* (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Pterolophia arrowiana Breuning

Distribution. ORIENTAL REGION: New Guinea.
Host plant: *Ceiba pentandra* (pods) (L. G. E. Kalshoven).
Mature larva. Apparently indistinguishable from that of *P. camura* Newman.
References. None available.

Pterolophia annularis Pic

Distribution. ORIENTAL REGION: China.
Host plant: *Morus* (Mühlmann, 1954).
References. Chen, 1933 (Biol.); Mühlmann, 1954 (Biol.).

Pterolophia bigibbera Newman

Distribution. ORIENTAL REGION: Philippine Is.
Host plant: *Theobroma* (Mühlmann, 1954).
References. Mühlmann, 1954 (Biol.); Uichanco, 1931 (Contr.).

Pterolophia albivenosa Pascoe

Distribution. ORIENTAL REGION: Java, Malacca, Malaya, Sumatra.
Host plant: Dead stems of "tepus" (giant Zingiberaceae) (Kalshoven, 1955b).
Mature larva. Apparently indistinguishable from that of *P. camura* Newman.
Pupa. Similar to that of *P. camura* Newman from which it may be distinguished by the much more densely and conspicuously setose pronotum. Length up to 19·5 mm.; maximum breadth 5 mm.
Reference. Kalshoven, 1955b (Biol.).

Pterolophia andamanica Breuning

Distribution. ORIENTAL REGION: Andaman Is., Burma.
Host plants: *Albizia lucida, Samanea saman* (Beeson and Bhatia, 1939).
Biology. Adults occur in January from April to June and in September.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Pterolophia servilis Breuning

Distribution. ORIENTAL REGION: India.
Host plant: *Trewia nudiflora* (Mathur and Balwant Singh, 1961b).
Reference. Mathur and Balwant Singh, 1961b (Biol.).

Pterolophia bambusae Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Bambusa polymorpha* (Beeson and Bhatia, 1939).
Biology. Adults occur in May.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Pterolophia dalbergiae Breuning

Distribution. ORIENTAL REGION: India (Bihar, Punjab, Uttar Pradesh).
Host plants: *Acacia gageana, Albizia lebbeck, Dalbergia sissoo* (Beeson and Bhatia, 1939).
Biology. Adults occur from June to August.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.).

Sthenias grisator (Fabricius)

[The Vine Girdler or "Ringer"]

Distribution. ORIENTAL REGION: Ceylon, India (Madras, Maharashtra, Mysore, Uttar Pradesh).

Host plants: *Beaumontia grandiflora*, *Bougainvillaea* sp., *Chloroxylon swietenia*, *Croton* sp., *Erythrina indica*, *E. lithosperma*, *Manihot utilissima*, *Moringa* sp., *Morus alba*, *Nerium odorum*, *Rosa* sp., *Tabernaemontana alba*, *Vitis vinifera*, *Wrightia tinctoria* (Beeson and Bhatia, 1939); *Chlorophora excelsa* (Bhasin, Roonwal and Balwant Singh, 1958); *Morus alba*, *Tinospora cordifolia* (Mathur and Balwant Singh, 1961); *Ficus carica* (Mathur and Balwant Singh, 1959); *Casuarina equisetifolia*, *Mangifera indica*, *Artocarpus integra*, *Morus indica*, *Prunus amygdalus*, *Codiaeum variegatum*, *Ervertimia coronaria*, *Aralia* sp., *Bougainvillaea spectabilis*, *Theritia neriifolia*, *Lannea coromandelica*, *Jatropa glanduiflera*, *Acacia leucophloea*, *Allamanda cathatica*. In South India *Ervertimia coronaria* seems to be the preferred host (Sanjeeva Raj, 1961).

Mature larva (fig. 170). Rather similar to those of *Pterolophia* species but differing as follows. Form rather robust. *Head* with pigmented spot of ocellus indistinct. Hypostoma not micro-granulate but entirely ferruginous (except gular region) and bearing several setae. *Abdomen* with each dorsal ampulla bearing three rows of moniliform tubercles. Pleural tubercle without sclerotized pits. Tergite 9 rounded posteriorly and bearing a large, strongly curved spine (fig. 170). Anus trilobed but placed ventrally (fig. 170). *Spiracles* with peritreme pale, broadly oval. Length up to 22 mm.; maximum breadth (at prothorax) 5·25 mm.

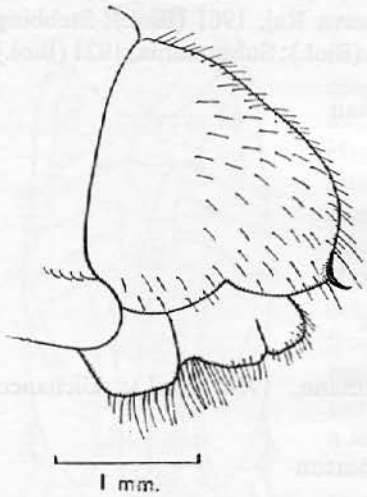

Fig. 170. *Sthenias grisator* (Fabricius). Mature larva. Abdominal segments 9 and 10. Lateral aspect.

Biology. Adults of this species girdle the living shoots of trees and woody climbers; the gnawing is so deep that the shoots ultimately break off. Eggs are deposited singly in slits in the bark, between the bast and sapwood. The incubation period is seven to ten days. The larva tunnels up and down the shoot, completely reducing it to powder with the exception of a thin skin of bark. Pupation takes place in an elongate cell and the beetle emerges through a circular exit-hole. The life-cycle may be completed within five months but under dry or impoverished conditions more than a year may be required. Adults emerge during most months of the year but mainly in July and August (Beeson and Bhatia, 1939).

Girdling by the adults appears to be done with a view to arrest all flow of sap above the "ring" so that the larvae are able to feed without coming into contact with the ascending flow of sap of which they are intolerant. The height above ground level at which girdling takes place is extremely variable. The completely girdled branches

which fall to the ground also afford suitable breeding material in which the larvae are able to mature (Rau, 1937).

Economic importance. This species is a very destructive pest of ornamental climbers, grape vines, flowering shrubs and mulberry plants, the stems of which are girdled by the beetles. Cotes (1894a) describes damage to roses by adults of this species. Usually it is the main stem which is girdled and even those up to $\frac{3}{4}$ in. in diameter are severed with remarkable neatness.

Control. This species can be checked by the hand-collection of beetles and the pruning and burning of girdled shoots as soon as withering is noticed.

Material studied. 2 L, India, Uttar Pradesh, Dehra Dun, New Forest, 15.ii.1951, from *Tinospora cordifolia*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Cotes, 1894a (Biol.), 1896 (I fig., Biol.); Fletcher, 1914 (Biol.), 1921 (Biol.); Gardner, 1927 (L fig., Bio.); Hutson, 1922 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Mühlmann, 1954 (Biol.); Ramachandra Rao, 1919 (Biol.); Rau, 1937 (Biol., Contr.), 1941 (Biol.); Ramakrishna Ayyar, 1940 (E fig., L fig., P fig., I fig., Biol. fig., Contr.); Sanjeeva Raj, 1961 (Biol.); Stebbing, 1899 (I fig., Biol.), 1914 (I fig., Biol.); Stellwaag, 1928 (Biol.); Subramania, 1921 (Biol.).

Sthenias albicollis Gahan

Distribution. ORIENTAL REGION: India (Madras).
Mature larva. See key, p. 30.
Reference. Gardner, 1931b (L).

Sthenias varius (Olivier)

Distribution. ORIENTAL REGION: Java, Philippines.
Host plant: *Theobroma* (Mühlmann, 1954).
References. Dammerman, 1929 (Biol.); Mühlmann, 1954 (Biol.); Uichanco, 1931 (Contr.).

Sthenias franciscanus Thomson

Distribution. ORIENTAL REGION: Borneo, Java.
Host plant: *Erythrina* (Koningsberger, 1908).
Reference. Koningsberger, 1908 (Biol.).

Apomecynini

Larval Characters

Larvae of this tribe show stronger affinities to the Agapanthiini than to the Niphonini, near which this tribe has been placed on the basis of adult classification. The characters common to the Apomecynini and the Agapanthiini are the thick, salient, strongly sclerotized head capsule and the setose abdominal segment 9 which is subtruncate posteriorly.

Apomecyna alboguttata (Megerle) (=**quadrifasciata** Thomson)

Distribution. ORIENTAL REGION: Andaman Is., Borneo, Ceylon, Hainan I., India (Madras, Mysore, Uttar Pradesh), East Pakistan (East Bengal), Indo-China (Laos), Java, Philippine Is., Thailand, West Pakistan (Peshawar). AUSTRALASIAN REGION: Australia (Queensland).

Host plants: *Benincasa hispida, Lagenaria vulgaris, Luffa acutangula, L. aegyptiaca* (Beeson and Bhatia, 1939); *Lagerstroemia vulgaris?* (Mathur and Balwant Singh, 1960c).

Adult (Pl. XV, fig. 4). Length 8–15 mm. Entirely covered with brown pubescence, with scattered spots of thick white pubescence on pronotum (four spots) and elytra. *Head* with antennae much stronger than body in both sexes. *Prothorax* slightly convex laterally; disc coarsely punctured. *Elytra* elongate, finely but deeply punctured, subangulate apically.

Mature larva. Form moderately robust, cylindrical. *Head* feebly depressed, widest at middle, with sides regularly rounded; antennal foramen narrowly but very distinctly open posteriorly. Frons strongly sclerotized and entirely ferruginous, strongly contrasting with the pale frontal sutures and bearing eight setiferous pores; six epistomal setae present. One pair of ocelli present; lens strongly convex; pigmented spot very distinct. Hypostoma flat, ferruginous, bearing three pairs of setae on each side of pale gular line. Antenna 2-segmented; segment 2 bearing a tapering, hyaline process. Maxilla with segment 3 acutely conical, slightly longer than segment 2. Labial palpi with segment 2 slender, cylindrical, as long as segment 1. Mentum not distinct from submentum. *Prothorax* with a transverse, orange-testaceous band just behind front margin; pronotum faintly striate posteriorly; eusternum well defined, with a few long setae. *Abdomen* with each dorsal and ventral ampulla with a single transverse furrow and two transverse rows of glabrous tubercles. Segment 9 with setae distinctly coarser than those on preceding segments. Epipleurum protuberant on all segments. Pleural tubercle without sclerotized pits. Anus trilobed. *Legs* absent. *Spiracles* with peritreme very thick, sub-circular; marginal chambers absent. Length up to 20 mm.; maximum breadth 4·5 mm.

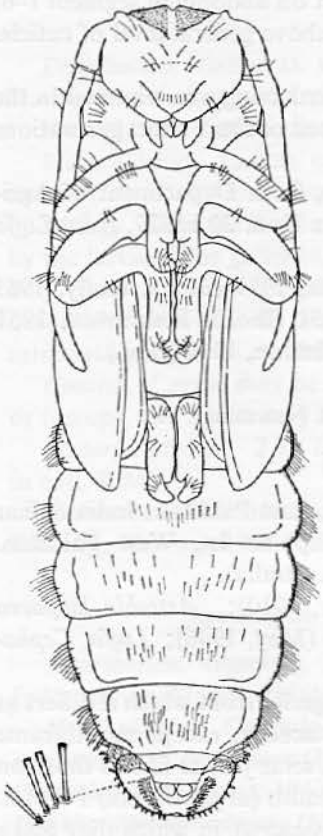

Fig. 171. *Apomecyna binubila* Pascoe. Pupa. Ventral aspect.

Pupa. No material available. The following is a description of that of the African *A. binubila* Pascoe (fig. 171) which should be essentially similar. *Head* with vertex partly visible from above, broadly but rather shallowly excavated between bases of antennae and densely setose or pubescent; front with about six

pairs of long stout, setae; clypeus bearing six setae across base but transverse impression very feeble. Antennae extending as far as abdominal segment 2, where they are slightly curved downward to terminate opposite hind tarsal claws. Eyes feebly convex, glabrous. Mandibles each with two stout setae. Labrum semicircular, with several setae. *Pronotum* with numerous short, fine setae, especially along front margin, and several scattered, much stouter, longer setae around lateral margins. *Mesonotum* with several short setae on each side of scutellum which is scarcely protuberant. *Metanotum* with numerous scattered setae on each side of scutellar groove which is deeply transversely striate. Elytra and wings extending as far as abdominal segment 5. *Abdomen* with tergites 1–6 each with a transverse group of closely set, stout setae near posterior margin, anterior to which are numerous scattered spinules. Tergite 7 bearing numerous scattered, much larger spines, especially across posterior margin. Tergites 8 and 9 short, transverse, bearing similar spines. Segment 9 bearing numerous stout, modified setae (fig. 171) which are enlarged and truncate apically. Sternites bearing numerous very fine setae. *Legs* with femora each bearing several long curved setae; hind femora extending to abdominal segment 4; tarsi each bearing several setae on each segment. *Functional spiracles* present on abdominal segment 1–6; peritreme rather thick, broadly oval and slightly raised above general level of cuticle. Length up to 12 mm.; maximum breadth 4·2 mm.

Biology. Adults emerge from May to September after having overwintered in the dead dry stem of the host. It is probable that there are one or more short generations during the monsoon.

Material studied. 2 L, India, Bombay, Poona, 1960, from Department of Agriculture, in coll. B.M. 3 L, India, Uttar Pradesh, Dehra Dun, 20.i.1929, from *Luffa aegyptiaca*, Ajab Kishore leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1963 (Biol.); Gardner, 1931b (L fig., P, Biol.); Gressitt, 1951 (Biol.); Kalshoven, 1951 (Biol.); Mathur and Balwant Singh, 1960c (Biol.); Mühlmann, 1954 (Biol.).

Apomecyna histrio (Fabricius) (=**proba** Newman)

[The Cucurbit Stem Borer]

Distribution. ORIENTAL REGION: Andaman Is., Burma, East Pakistan, India (Bihar Madras, Maharashtra, Uttar Pradesh), Malaya, Philippine Is., West Pakistan. AUSTRALASIAN REGION: Australia (Queensland, West Australia).

Host plants: *Tinospora cordifolia* (Maxwell-Lefroy, 1910); *Astrebla lappacea* (roots) (H. Jarvis); *Cucumis, Cucurbita maxima, C. pepo* (May, 1946); *Luffa, Cephalandra* (Fletcher, 1921).

Mature larva. Similar to that of *A. alboguttata* (Megerle) from which it differs as follows. *Head* capsule (including hypostoma) pale testaceous, except mouthframe which is pale ferruginous. *Abdomen* with segment 9 with setae just as fine as those on preceding segments. Length up to 9 mm.; maximum breadth (at prothorax) 1·9 mm.

Biology. Larvae infest living stems of the creeper (*Tinospora*), in which they make irregular galleries. In India, emergence occurs between April and July (Maxwell-Lefroy, 1910).

Eggs are laid singly in growth cracks or other scars along the stem of the melon. The larva tunnels steadily downwards towards a node; this causes a swelling in the stem which becomes more prominent as the larva matures within the gallery which is packed with glutinous waste material. Before pupating, the larva constructs a fibrous cocoon. Possibly there may be two or three generations a year (May, 1946).

Control. Risk of infestation may be reduced by rooting out and burning the remains of cucurbit crops after the fruit has been harvested (May, 1946).

Material studied. 3 L, Australia, 16.xi.1944, from *Astrebla lappacea*, H. Jarvis leg., in coll. D.A.S.B.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Dammerman, 1919 (Biol.), 1929 (Biol.); Duffy, 1963 (L, Biol., Contr.); Fletcher, 1921 (Biol.); Mathur and Balwant Singh, 1961b (Biol.); May, 1946 (I fig., Biol., Contr.); Maxwell-Lefroy, 1910 (L, P, I, Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Mühlmann, 1954 (Biol.).

Apomecyna neglecta Pascoe

[The Melon-vine Longhorn]

Distribution. ORIENTAL REGION: Ceylon, China, Formosa, India (West Bengal), Thailand. PALAEARCTIC REGION: Japan.

Host plants: *Luffa cylindrica*, *Cucumis sativa* (Gressitt, 1942).

Mature larva. Larvae of this species apparently cannot be distinguished from those of *A. alboguttata* Megerle.

Biology. Eggs are laid in living stems of melon vines, the stems of which are bored by the larvae. The galleries, which are not very long, are largely filled with fine powdery frass. There is probably only one generation a year and pupation quite likely occurs during winter or early spring. Adults are nocturnal and frequently come to artificial light (Gressitt, 1942).

Control. Larvae may be killed by puncturing them and extracting them with a pin or forceps, and adults may be caught in light traps (Gressitt, 1942).

Material studied. 2 L, Siam, from *Luffa cylindrica*, Boonsom Meksongsee pres., in coll. B.M.

References. Dammerman, 1919 (Biol.), 1929 (Biol.); Gressitt, 1942 (L fig., I fig., Biol. fig., Contr.), 1951 (Biol.); Kalshoven, 1951 (Biol.).

Apomecyna saltator (Fabricius) (=**pertigera** Thomson)

Distribution. ORIENTAL REGION: Ceylon, East Pakistan (East Bengal), Formosa, India (Bihar, Madras, Maharashtra, Uttar Pradesh), Penang I.

Host plants: *Coccinia indica*, *Cucurbita moschata*, *Lagenaria vulgaris*, *Luffa acutangula*, *L. aegyptiaca* (Beeson and Bhatia, 1939); *Cucurbita pepo*, *Telfairia pedata* (Ramakrishna Ayyar, 1940); *Lagerstroemia vulgaris?* (Mathur and Balwant Singh, 1960c); *Nerium odorum* (Mathur and Balwant Singh, 1961).

Biology. Oviposition takes place on the living stems of pumpkins. The larva tunnels along the pith and surrounding tissues. There are three or four generations a

year, each life-cycle lasting only 35–45 days in hot weather. Overwintered adults emerge from dry stems from May to September. Adults feed on the foliage.

Control. The destruction of infested stems and the collection of adults (Fletcher, 1914).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Fletcher, 1914 (E fig., L fig., P fig., I fig., Biol., fig., Contr.), 1921 (Biol.); Hudson, 1939 (?); Mathur and Balwant Singh, 1960c (Biol.), 1961 (Biol.); Maxwell-Lefroy, 1910 (E fig., L fig., P fig., I fig., Biol. fig.); Maxwell-Lefroy and Howlett, 1909 (E fig., L fig., P fig., I fig., I fig., Biol. fig.); Ramakrishna Ayyar, 1940 (Biol.).

Diaxenes dendrobii Gahan

Distribution. ORIENTAL REGION: Burma, India. PALAEARCTIC REGION: England (imported).

Host plants: *Dendrobium nobile*, *D. wardianum* (Gahan, 1894, Xambeu, 1895); *Thunia alba* (J. Abraham).

Mature larva. As the following characters show, this larva conforms more closely to the characteristics of the Tetraopini than to those of the Phrynetini and Pogonocherini, between which this species has been placed on the basis of adult classification.

Form slender, cylindrical. *Head* scarcely depressed, slightly wider before middle, with sides rather strongly converging for posterior half. Antennal foramen very narrowly open behind; mouthframe very narrowly sclerotized, with a row of eight setiferous pores; six epistomal setae present. One pair of ocelli present; lens very strongly convex; pigmented spot very distinct. Hypostoma flat, testaceous, with front margin very narrowly ferruginous; two pairs of paramedian setiferous pores present; sutures distinct, ferruginous, slightly curved. Gular region undefined. Antenna 2-segmented, the second segment slightly elongate and bearing a tapering, hyaline process. Maxilla with segment 3 bulbous, distinctly shorter than segment 2. Labial palp with segment 2 bulbous less, than half length of segment 1. Mentum not distinct from submentum. *Prothorax* with pronotum feebly rugose and with rather long scattered setae near margins. Eusternum well defined, with several long setae. *Abdomen* with each dorsal ampulla with a single transverse furrow and two transverse rows of glabrous tubercles, anterior to which are a few irregularly arranged ones. Ventral ampullae with two rows of tubercles. Segment 9 unarmed. Epipleurum slightly protuberant on all segments. Pleural tubercle with sclerotized pits absent. Anus trilobed. *Legs* absent. Spiracles with peritreme rather thick, almost round. Length up to 21·5 mm.; maximum breadth (at prothorax) 3 mm.

Pupa (Frontispiece). *Head* with vertex partly visible from above, very deeply and broadly excavated between bases of antennae, and bearing two pairs of setae; front with several very long setae arising from papillate bases; clypeus with six setae near base but the transverse impression very feeble. Antennae extending as far as abdominal segment two or three, where they are curved downward to terminate near mid coxae. Eyes feebly convex, glabrous. Mandibles each with two long setae (arising from papillate bases) near middle of outer face. Labrum semicircular, bearing about six setae. *Pronotum* bearing numerous long, fine setae arranged more or less in

three rows. *Mesonotum* smooth, with four to six shorter setae on each side of scutellum which is slightly protuberant. *Metanotum* smooth, and with eight to twelve setae on each side of scutellar groove. Elytra and wings extending as far as fourth or fifth abdominal segment. *Abdomen* with tergites 1–6 each with a transverse row of short, stout spines near posterior margin. Tergite 7 elongate, with sides slightly tapering and bearing a transverse row of much stouter spines near middle, above which are a few smaller ones. Tergite 8 short, transverse, with hind margin slightly rounded and front margin bearing a row of spines. Segment 9 deeply divided beneath and bilobed, each lobe bearing several short, conical spines. Sternites 4–8 glabrous. *Legs* with about five long fine setae near apex of each femur; mid and hind femora each with a tapering tuberculate process near base; hind femora extending to abdominal segment 4; tibiae directed posteriorly. *Functional spiracles* present on first six abdominal segments, but a vestigial pair present on segment 7; peritreme round to very broadly oval, very thick and slightly raised above general level of cuticle. Length 10–15·25 mm.; maximum breadth 5·25 mm.

Biology. The larva of this species feeds in the stems and pseudobulbs of orchids; usually only one larva is found in each stem. Attacked stems soon become slightly greyish and wood-like. The pupa, which frequently performs gyratory movements, rests on top of a wad of fibres torn from the inner walls of the stem by the larva. Adults emerge in November and feed voraciously on leaves and flowers (Fisher, 1937; Franssen and Tiggelovend, 1937). Adults appear to be nocturnal, feeding on the leaves only at night (Xambeu, 1895).

Economic importance. Owing to the high commercial value of exotic orchids, this species is of some economic importance. Fortunately there appears to be no indication that this insect will become acclimatized in orchid houses in temperate regions.

Material studied. 1 L, England, Middlesex, Bush Hill Park Nursery, 12.i.1899, from a pseudobulb of *Dendrobium wardianum* from Burma, in coll. B.M.; 2 L, 2 P, France, Paris, x.1894, from *D. nobile*, in coll. B.M.

References. Dongé, 1894 (Biol.); Duffy, 1953 (L, P fig., Biol. fig.); Emden, 1939–1940 (L); Fisher, 1937 (Biol.); Franssen and Tiggelovend, 1937 (Biol.); Gahan, 1894 (I fig., Biol.); Schwarz, 1904 (Biol.); Xambeu, 1895 (L, P, Biol.), 1903 (Biol.).

Diaxenes taylori Waterhouse

Distribution. ORIENTAL REGION: Philippine Is.

Host plant: *Phalaenopsis* sp. (Gahan, 1894).

Biology. Adults have been observed gnawing the stems of this orchid.

Reference. Gahan, 1894 (Biol.).

Diaxenes phalaenopsidis Fisher

Distribution. ORIENTAL REGION: Java, Sumatra.

Host plants: *Phalaenopsis*, *Renanthera*, *Vanda*, *Onchidium*, *Dendrobium* (Franssen and Tiggelovend, 1937).

Egg. Elongate-ovoid, light green. Length 2·4 mm. breadth 0·75 mm. (Franssen and Tiggelovend, 1937).

Biology. The egg and larval stages were found to last 12–13 and 50–60 days respectively. The eggs are deposited under the epidermis of the roots of the orchids, and the larvae bore into them and eventually pupate in their galleries. Pupation occurs in a strong grey cocoon constructed from fibres from the root. Many larvae may infest one plant but not more than two were found in a single root. The adults are active at night and feed voraciously on the young leaves and, in some cases, the fruit and flowers of certain orchids. Adults collected in orchid nurseries feed for three months on orchid leaves under laboratory conditions (Franssen and Tiggelovend, 1937).

Economic importance. This lamiid appears to be an important pest of cultivated orchids of various genera in Java and Sumatra.

References. Franssen and Tiggelovend, 1937 (E fig., L fig., P fig., I fig., Biol. fig.); Kalshoven, 1951 (?).

Eunidia apicemaculata Breuning

Distribution. ORIENTAL REGION: Burma, India (Uttar Pradesh).

Host plant: *Albizia stipulata* (Beeson and Bhatia, 1939).

Mature larva. No material available. The following is a description of a closely related African species *E. fuscostictica* Breuning (see also key, p. 28) "Form rather slender, cylindrical. *Head* (fig. 172) very slightly depressed, extremely elongate, with sides slightly constricted medially; frontal sutures indistinct; mouth-frame feebly sclerotized, testaceous; six epistomal setae present. One pair of ocelli present; lens strongly protuberant; pigmented spot indistinct. Hypostoma flat, pale testaceous; gular region undefined, two to three pairs of long fine setae present. Antenna 2-segmented; segment 2 bearing a conical hyaline process. Maxillary palp 3-segmented; segment 3 longer than segment 2. Labial palpi with segment 2 as long as segment 1. Mentum distinct from submentum. *Prothorax* (fig. 173). with posterior part of pronotum white, glabrous and extremely finely longitudinally striate. Eusternum white, glabrous and extremely finely striate. *Abdomen* with each dorsal ampulla with a single transverse impression and two rows of shining moniliform tubercles. Tergite 9 unarmed. Epipleurum slightly protuberant on all segments. Pleural tubercles without sclerotized pits, broadly oval and bearing two to three fine setae. Anus trilobate. *Legs* absent. *Spiracles* with peritreme round, rather thick and testaceous. Length up to 20

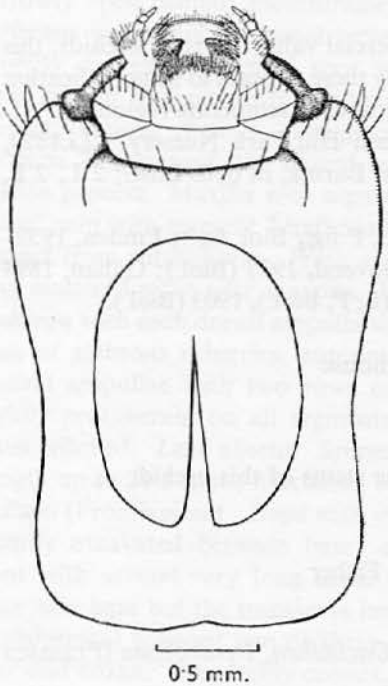

Fig. 172. *Eunidia fuscoctictica* Breuning. Mature larva. Head. Ventral aspect. (Duffy, 1957)

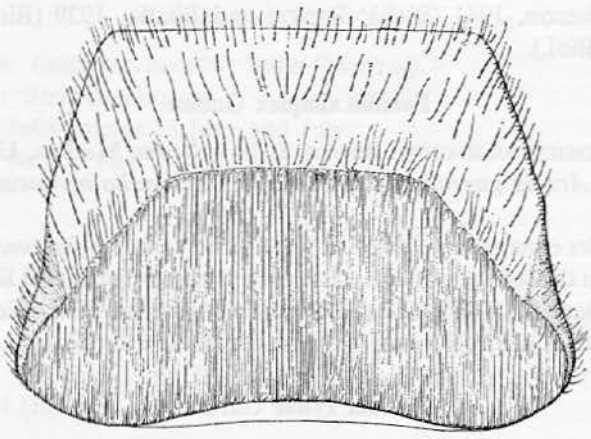

Fig. 173. *Eunidia fuscostictica* Breuning. Mature larva. Pronotum. (Duffy, 1957)

mm.; maximum breadth (at prothorax) 3·8 mm. (Duffy, 1957)".

Pupa. No material available. The following is a description of that of *E. fuscostictica* Breuning. "*Head* with vertex visible from above and bearing a pair of setae opposite base of each antenna. Front with three to four pairs of setae and clypeus bearing a row of six setae across base. Antennae extending to abdominal segment 2, where they are strongly recurved (antennae incomplete in this specimen). Eyes feebly convex, glabrous. Mandibles each with a pair of setae near middle of outer face. Labrum semicircular. *Pronotum* without lateral tubercles; disc bearing groups of setae as follows: one group near middle of front margin; two groups across middle and two paramedian groups near posterior margin. *Mesonotum* and *metanotum* sparsely setose. Elytra and wings extending as far as abdominal segment 5. *Abdomen* with tergites 1–7 each with a transverse row of setae only. Tergite 9 produced dorsally into a vertical tuberculate, spine-like process which is sclerotized apically. Sternites glabrous. *Legs* with each femur bearing two to three subapical setae; middle and hind femora tuberculate sub-basally; hind femora extending to abdominal segment 3; all tibiae more or less at right angles to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6; peritreme broadly oval, thin and pale. Length up to 11 mm.; maximum breadth 2·9 mm. (Duffy, 1957.)"

Biology. Adults emerge in July and August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Eunidia lateralis Gahan

Distribution. ORIENTAL REGION: Hainan I., India (Maharashtra, Madras, Mysore).

Host plant: *Acacia* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge in July and August, mainly the latter; also in October and January.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Eunidia simplex Gahan

Distribution. ORIENTAL REGION: Burma, India (Assam, Madras, Uttar Pradesh).

Host plants: *Acacia gageana, Albizia lucida, Terminalia myriocarpa* (Beeson and Bhatia, 1939).

Biology. Adults emerge in July and August. The variety *bifuscomaculata* Breuning has been taken on the foliage of *Albizia amara* between October and December.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Eunidia xyliae Gardner

Distribution. ORIENTAL REGION: Burma.

Host plant: *Xylia xylocarpa* (Mathur and Balwant Singh, 1961b).

Refernece. Mathur and Balwant Singh, 1961b (Biol.).

Hyagnis persimilis Breuning

Distribution. ORIENTAL REGION: India (Bihar, Maharashtra, Madras, Mysore, Uttar Pradesh).

Host plants: *Albizia lebbek, Morus acidosa* (Beeson and Bhatia, 1939). *Sophora mollis* (Mathur and Balwant Singh, 1961).

Biology. Adults have been obtained from June to December. In South India there is a post-monsoon emergence, mainly in November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Hyagnis fistularius Pascoe

Distribution. ORIENTAL REGION: India (Maharashtra). ETHIOPIAN REGION: Africa (Natal, Transvaal).

Host plant: *Anogeissus latifolia* (Stebbing, 1914).

Reference. Stebbing, 1914 (I fig., Biol.).

Hyagnis sybroides Breuning

Distribution. ORIENTAL REGION: India.

Host plant: *Prunus nepalensis* (Mathur and Balwant Singh, 1960d).

Reference. Mathur and Balwant Singh, 1960d (Biol.).

Falsohyagnis alternata Breuning

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Clerodendron* sp. (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

Reference. Beeson and Bhatia, 1939 (Biol.).

Falsohyagnis biplagiata Breuning

Distribution. ORIENTAL REGION: India (Madras).
Host plant: *Strobilanthes* sp.
Biology. Adults emerge in June and July.
Reference. Beeson and Bhatia, 1939 (Biol.).

Ropica affinis Breuning

Distribution. ORIENTAL REGION: Burma, India (West Bengal).
Host plant: *Acrocarpus fraxinifolius* (Beeson and Bhatia, 1939).
Biology. Adults occur in May, June and September.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Ropica basicristata Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Millettia* sp. (Beeson and Bhatia, 1939).
Biology. Emergence occurs in April and May.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Ropica fusconigrita Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Acrocarpus fraxinifolius* (Beeson and Bhatia, 1939).
Biology. The adult has been taken in August.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Ropica granuliscapa Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Albizia lucida* (Beeson and Bhatia, 1939).
Biology. Adults emerge in June.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Ropica praeusta Pascoe

Distribution. ORIENTAL REGION: Ceylon, India (Bihar, Orissa).
Host plant: *Calotropis procera* (Beeson and Bhatia, 1939).
Biology. Larvae of this species infest the fruits of the host plant. Adults emerge in March.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.) (see under *S. ceylonensis* Breuning, p. 361); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur, Balwant Singh and Kishori Lal, 1958 (Biol.).

Ropica pseudosignata Breuning

Distribution. ORIENTAL REGION: India (West Bengal).

Host plant: *Hibiscus tiliaceus* (Beeson and Bhatia, 1939).

Biology. Adults occur in April and May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Ropica formosana Bates var. **dorsalis** Schwarzer

[The Small Cucumber Longhorn]

Distribution. ORIENTAL REGION: Formosa, Hainan I., China.

Host plant: *Cucumis sativa* (Gressitt, 1942).

Biology. Larvae infest stems of melons. There are possibly two generations a year. Adults have been collected in December (Gressitt, 1942).

Reference. Gressitt, 1942 (I fig., Biol., Contr.).

Ropica honesta Pascoe, **R. illiterata** Pascoe and **R. vinacea** Pascoe

Distribution. ORIENTAL REGION: Java, Moluccas, New Guinea, Sumatra, Thailand.

Host plants: Several species of *Ropica* have been collected in Java from the following hosts: *Ficus elastica, F. septica, F. racemosa, F. hispida, Artocarpus integra, Actinophora, Mallotus* (or *Macaranga*), *Gmelina asiatica, Podocarpus, Ochroma, Ceiba, Uncaria* (Kalshoven, 1955b); *Artocarpus heterophyllus* (D. of A., Bangkok).

These species have mostly been identified as *R. honesta* Pascoe but a few as *R. illiterata* Pascoe and *R. vinacea* Pascoe. *R. honesta* Pascoe has also been recorded from *Hevea brasiliensis* (Corbett and Gater, 1926) and *Solanum melongena* (Mathur and Balwant Singh, 1961).

References. Corbett and Gater, 1926 (Biol.); Kalshoven, 1955b (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Ropica rufescens Pic

Distribution. ORIENTAL REGION: Andaman Is., India (Assam, Bihar, Maharashtra, Madhy Pradesh, Orissa, Uttar Pradesh).

Host plants: *Salmalia malabarica, Cryptolepis buchanani, Curdrania javanensis, Euphorbia pulcherrima, Ficus racemosa, F. hispida, Jatropha curcas, Lannea coromandelica, Luffa aegyptiaca, Mallotus philippinensis, Mezenga zanthoxylum, Millettia auriculata, Ougeinia dalbergioides, Pongamia pinnata* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual. Adults emerge between April and October, mainly in May in the Andaman Is.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960c (Biol.), 1960d (Biol.).

Ropica signata Pic

Distribution. ORIENTAL REGION: India (Maharashtra, Mysore, Madras).

Host plants: *Vitis araneosa* (Beeson and Bhatia, 1939); *Solanum melanogena* (Mathur and Balwant Singh, 1961); *Dendrocalamus strictus* (Mathur and Balwant Singh, 1959).

Biology. Adults occur during February, May, June and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Ropica signatoides Breuning

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Bauhinia vahlii* (Beeson and Bhatia, 1939).

Biology. Adults emerge from July to September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Ropica subnotata Pic

Distribution. ORIENTAL REGION: China (Chekiang).

Host plant: *Morus* (Mühlmann, 1954).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Mühlmann, 1954 (Biol.).

Acanthocinini

Larval Characters

Form variable but usually depressed and slender. *Head* moderately to very strongly depressed and moderately to strongly elongate, with sides abruptly constricted before or at middle; antennal foramen open or closed posteriorly. Gula with sutures not raised, but with a small rugose area on each side (each bearing two to six setae); six epistomal setae present. One pair of ocelli present; pigmented spot indistinct. Mentum distinct from submentum. Antenna 2-segmented and bearing a conical hyaline process. Maxillary palp 2- or 3-segmented. *Prothorax* with posterior area of pronotum remarkably variable, being velvety micro-pubescent or micro-spiculate in the majority of genera but rather coarsely asperate in *Lagocheirus*. *Abdomen* with ampullae similarly variable, ranging from tuberculate and glabrous to non-tuberculate and micro-spiculate. Abdominal tergite 9 usually without a sclerotized process. Epipleurum very strongly protuberant, at least on abdominal segments 7–9. Pleural tubercles each with a pair of sclerotized pits. *Spiracles* broadly oval to circular, with posterior margin of peritreme bearing numerous subcontiguous marginal chambers.

Exocentrus ficicola Fisher

Distribution. ORIENTAL REGION: India (Maharashtra, Uttar Pradesh).

Host plants: *Ficus hispida, Mangifera indica, Thespesia populnea* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual, with emergence occurring from July to December, mainly in August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961b (Biol.).

Exocentrus grewiae Fisher

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Grewia optiva, G. vestita, Millettia auriculata* (Beeson and Bhatia, 1939).

Biology. The life-cycle is annual with emergence occurring from July to September, mainly August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961 (Biol.).

Exocentrus flemingiae Fisher

Distribution. ORIENTAL REGION: India (Madras, Uttar Pradesh).

Host plants: *Acacia gageana, Flemingia stricta* (Beeson and Bhatia, 1939); *Mimosa rubicaulis, Mangifera indica* (Mathur and Balwant Singh, 1961).

Mature larva (fig. 174). Form elongate, rather slender, subcylindrical. *Head* rather strongly depressed with sides feebly but distinctly constricted before middle and slightly converging posteriorly; antennal foramen closed posteriorly; mouthframe moderately strongly sclerotized. Genae shouldered, protuberant. Ocelli indistinct owing to sclerotization of genae. Hypostoma plane, glabrous; sutures testaceous, straight, diverging posteriorly. Gular region with a pale median cleavage line. Antenna 2-segmented; segment 2 quadrate and bearing a small conical hyaline process. Maxillae with palpi 2-segmented; segment 2 conical, elongate, slightly shorter than segment 1. *Prothorax* broadest posteriorly with anterior area rather densely covered with very long, pale setae; posterior part of pronotum embossed, glabrous, shining, longitudinally strigose. Eusternum subtriangular, embossed, shining. Presternum almost smooth, sparsely setose. *Abdomen* with each dorsal ampulla with three or four large rounded or triangular, glabrous tubercles on each side of the broad shallow longitudinal furrow. Tergite 8 with a transverse row of longitudinal sclerites (fig. 174) posteriorly. Tergite 9 with a small median spine posteriorly (fig. 174). Epipleurum strongly protuberant on last three segments only. Pleural tubercle broadly oval. Anus trilobed. *Legs* absent. *Spiracles* round, with peritreme pale and with posterior

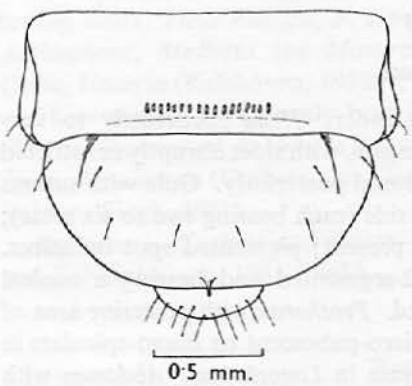

Fig. 174. *Exocentrus flemingiae* Fisher. Mature larva. Abdominal tergites 8–10.

half bearing several marginal chambers. Length up to 10 mm.; maximum breadth (at prothorax) 2·75 mm.

Pupa. Head with vertex visible from above and feebly excavate between antennal tubercles around which are a few long, fine, pale setae; front with a few pairs of similar setae; clypeus with a distinct transverse impression across base and bearing two pairs of setae. Antennae long, extending as far as abdominal segment 5 where they are recurved ventrally to form a single complete coil and to terminate alongside front femora. Eyes feebly convex, glabrous. Mandibles each with a pair of fine setae near middle of outer face. *Pronotum* with sides abruptly constricted sub-basally; disc smooth, glabrous; anterior and lateral margins with numerous extremely long, fine, pale setae. *Metanotum* bearing two groups of similar setae; scutellar groove indistinct. Elytra glabrous; elytra and wings extending as far as abdominal segment 4. *Abdomen* with tergites 1–8 glabrous except for a few sublateral setae. Tergite 9 short, bearing a pair of minute urogomphi between which is a stouter, vertical, median spine. Pleura rather strongly protuberant. *Legs* with front and mid femora clavate; each femur with numerous long, fine setae; mid and hind femora each with a tuberculate process near base; hind femora extending almost to abdominal segment 5; all tibiae more or less at right-angles to longitudinal axis of body and bearing numerous fine, pale setae. *Functional spiracles* present on abdominal segments 1–6; peritreme rather narrowly oval, thin, pale and scarcely raised above general level of cuticle. Length up to 8 mm.; maximum breadth 3 mm. The accompanying figure (fig. 175) is that of an unknown species of *Exocentrus*.

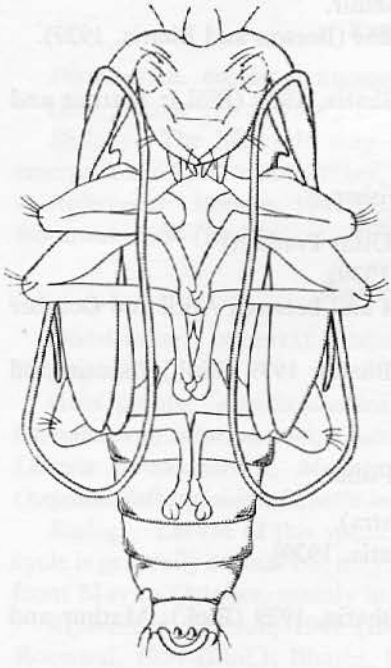

Fig. 175. *Exocentrus* sp. Pupa. Ventral aspect.

Biology. The life-cycle is annual with emergence occurring from May to August, mainly in July.

Material studied. 15 L, 3 P, India, Uttar Pradesh, Dehra Dun, Lachiwala, 14.xii. 1928, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur, 1958 (L fig., P fig., Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1961 (Biol.).

Exocentrus malloti Fisher

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Mallotus albus* (Beeson and Bhatia, 1939).

Biology. Adults have been bred out in October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Exocentrus parrotiae Fisher

Distribution. ORIENTAL REGION: Jammu and Kashmir.

Host plants: *Juglans regia*, *Parrotia jacquemontiana* (Beeson and Bhatia, 1939).

Biology. Adults emerge in August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.).

Exocentrus pubescens Fisher

Distribution. ORIENTAL REGION: India (Madras, Uttar Pradesh).

Host plant: *Albizia lebbek* (Beeson and Bhatia, 1939).

Biology. Adults emerge in August in north India and between April and October in south India.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Exocentrus terminaliae Fisher

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Terminalia belerica* (Beeson and Bhatia, 1939).

Biology. Adults have been bred out in August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Exocentrus actinophorae Fisher

Distribution. ORIENTAL REGION: Java.

Host plants: *Actinophora fragrans* (killed by *Agrilus*), *Grewia paniculata* (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Exocentrus bauhiniae Fisher

Distribution. ORIENTAL REGION: Java.

Host plants: *Dalbergia latifolia*, *Bauhinia malabarica*, *Mangifera odorata* (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Exocentrus tectonae Fisher

Distribution. ORIENTAL REGION: Java.

Host plants: *Tectona* and *Mallotus* (or *Macaranga?*) (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Exocentrus championi Fisher

Distribution. ORIENTAL REGION: India.

Host plant: *Indigofera* sp. (Mathur and Balwant Singh, 1960b).

Reference. Mathur and Balwant Singh, 1960b (Biol.).

Exocentrus albizziae Fisher

Distribution. ORIENTAL REGION: India (Madras).

Host plants: *Acrocarpus fraxinifolius*, *Albizia lebbek* (Beeson and Bhatia, 1939).

Biology. The life-cycle may be prolonged for two years in dry wood. Adults emerge from April to December, mainly May, August and September.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Exocentrus alboguttatus Fisher

Distribution. ORIENTAL REGION: India (Assam, Maharashtra, Uttar Pradesh), Philippine Is.

Host plants: *Acacia arabica*, *A. gageana*, *Anogeissus latifolia*, *Bauhinia vahlii*, *Clerodendron infortunatum*, *Cudrania javanensis*, *Flemingia semialata*, *Grewia optiva*, *Lannea coromandelica*, *Mallotus philippinensis*, *Millettia auriculata*, *Morus alba*, *Ougeinia dalbergioides*, *Pavetta indica* (Beeson and Bhatia, 1939).

Biology. Larvae of this species infest dry branches, stems and climbers. The life-cycle is generally annual but may be prolonged into two or three years. Adults emerge from May to October, mainly in July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1961 (Biol.).

Exocentrus alni Fisher

Distribution. ORIENTAL REGION: India (West Bengal).

Host plants: *Alnus nepalensis*, *Evodia fraxinifolia* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April and May, mainly the former.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960d (Biol.).

Exocentrus carissae Fisher

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Carissa opaca*, *Flemingia stricta*, *Girardinia heterophylla*, *Mallotus philippinensis* (Beeson and Bhatia, 1939).

Biology. This species infests small dry stems and twigs. Adults emerge from June to September, mainly July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960b (Biol.), 1961 (Biol.).

Exocentrus beesoni Fisher

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Cassia siamea* (Beeson, 1941).

References. Beeson, 1941 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Exocentrus cudraniae Fisher

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Acacia gageana, Carissa opaca, Combretum decandrum, Cudrania javanensis, Engelhardtia colebrookiana, Ficus clavata, F. recemosa, Flemingia stricta, Indigofera tinctoria, Lannea coromandelica, Mallotus philippinensis, Millettia auriculata, Ougeinia dalbergioides* (Beeson and Bhatia, 1939).

Biology. The life-cycle is generally annual but may be prolonged to the second year. Adults emerge from May to August, mainly in July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1961 (Biol.).

Exocentrus dalbergiae Fisher

Distribution. ORIENTAL REGION: India (Maharashtra, Uttar Pradesh).

Host plants: *Acacia gageana, Bauhinia vahlii, Clerodendron infortunatum, Dalbergia sissoo, Engelhardtia colebrookiana, Euphorbia pulcherrima, Flemingia stricta, Lannea coromandelica, Mallotus philippinensis, Millettia auriculata, Ougeinia dalbergioides, Pterocarpus marsupium* (Beeson and Bhatia, 1939); *Holarrhena antidysenterica* (Mathur and Balwant Singh, 1960b); *Trewia nudiflora* (Mathur and Balwant Singh, 1961b).

Biology. This species infests dry twigs, stems and climbers. The life-cycle is generally annual but may be prolonged to the second year. Adults emerge from June to December, mainly in July.

References. Anonymous, 1938 (Biol.); Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1959 (Biol.), 1960a (Biol.), 1960b (Biol.), 1960d (Biol.), 1961a (Biol.), 1961b (Biol.).

Rondibilis plagiata Gahan

Distribution. ORIENTAL REGION: Burma, India (Maharashtra, Madhy Pradesh, Uttar Pradesh).

Host plant: *Clerodendron infortunatum* (Beeson and Bhatia, 1939).

Biology. Adults emerge from dead stems from May to August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Rondibilis spinulosa Pascoe

Distribution. ORIENTAL REGION: Java, Moluccas, New Guinea.

Host plants: *Ficus elastica, Theobroma cacao, Mangifera indica, M. foetida* (Kalshoven, 1955b).

Reference. Kalshoven, 1955b (Biol.).

Ostedes pauperata Pascoe

Distribution. ORIENTAL REGION: Aru, Borneo, Celebes, Java, Moluccas, New Guinea.

Host plants: *Tectona grandis, Mallotus, Actinophora, Barringtonia* (Kalshoven, 1955b); *Amhurstia nobilis* (Forest Research Institute, Kepong, Selangor).

Biology. This species is usually found in branches and portions of the trunk of *Tectona* which have been damaged by *Neotermes tectonae* or by lightning (Kalshoven, 1955b).

References. Kalshoven, 1955b (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Ostedes pascoei Thomson

Distribution. ORIENTAL REGION: Indo-China (Cambodia), Malaya.

Host plant: *Ficus elastica* (B. S. Rao, Rubber Research Institute of Malaya).

References. None available.

Acanthocinus griseus (Fabricius)

[The Marmorate Thick-legged Longicorn]

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Europe, Japan.

Host plants: *Abies, Picea, Alnus* (Shiraki, 1952).

Mature larva. No material available. The larva should be essentially similar to that of *A. aedilis* (Linnaeus) of which the following is a description. Form elongate, slender, depressed. *Head* (fig. 176) strongly depressed, with sides slightly constricted before middle and slightly converging posteriorly; antennal foramen closed behind; mouthframe very strongly and rather broadly sclerotized, the transverse, dorsal, ferruginous band as broad as half length of clypeus; frons with a transverse row of eight setiferous pores, behind which it is feebly sclerotized and testaceous. Genae strongly shouldered and protuberant, strongly sclerotized and pitchy and with a conspicuous transverse furrow immediately in front of ocellus; broadly rugose and ferruginous posteriorly. One pair of ocelli present; lens ferruginous, pigmented spot indistinct owing to sclerotization of gena. Clypeus with two to four widely separated, longitudinal impressions. Hypostoma flat, smooth, testaceous, with front and hind margins ferruginous; sutures ferruginous and slightly curved. Gular region with a pale median cleavage line, on each side of which is a ferruginous rugose area bearing four to six setae. Antenna 2-segmented; segment 2 subquadrate, and bearing a small conical, hyaline process. Maxilla strongly sclerotized, with palpi 3-segmented; segment 3 tapering, about two-thirds length of segment 2; palpifer with outer margin strongly rounded and protuberant. Labial palp with segment 3 cylindrical, about

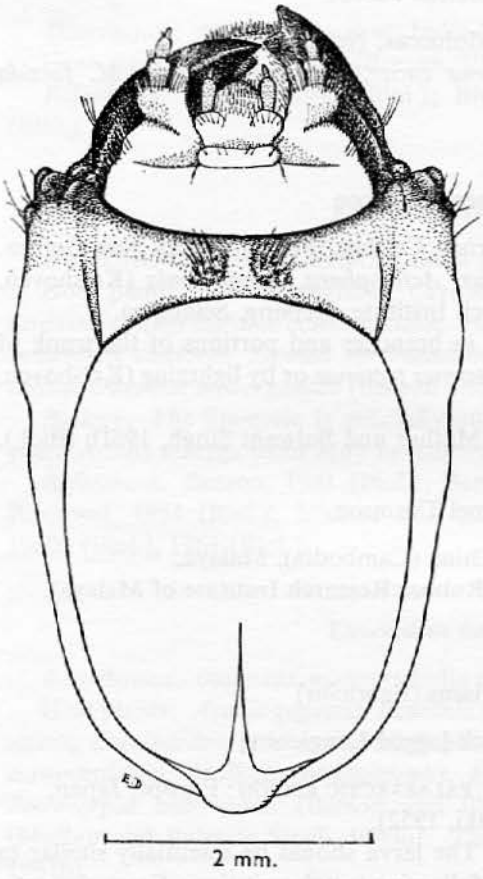

Fig. 176. *Acanthocinus aedilis* (Linnaeus). Mature larva. Head. Ventral aspect. (Duffy, 1953a)

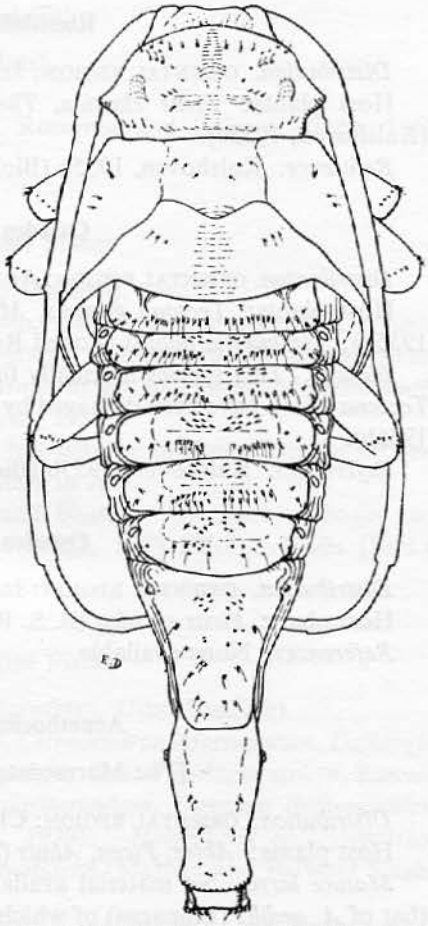

Fig. 177. *Acanthocinus aedilis* (Linnaeus). Female pupa. Dorsal aspect. (Duffy, 1953a)

one-third length of segment 2. Mentum distinct from submentum. *Prothorax* with a transverse row of setae just behind front margin; posterior region of pronotum with two ferruginous areas of very fine dense asperities, with numerous interspaced glabrous spots as in *Arhopalus* (fig. 33). *Abdomen* with ampullae with one transverse furrow, a conspicuous pair of lateral furrows and a broad, rather deep longitudinal median furrow; non-tuberculate, dull, velvety spiculate or pubescent. Segment 9 without a sclerotized process. Epipleurum protuberant on last three segments only. Pleural tubercle broadly oval, with a pair of sclerotized pits and at least ten setae. Anus trilobed. *Legs* absent. *Spiracles* round, with five to eight marginal chambers present on posterior margin of peritreme. Length up to 37 mm.; maximum breadth (at prothorax) 6·5 mm. (Duffy, 1953a).

Pupa. No material available. The pupa should be essentially similar to that of *A. aedilis* (Linnaeus) of which the following is a description (fig. 177). *Head* with

vertex visible from above, deeply excavated between bases of antennae and bearing three or four short spines near base of each antenna; front with about five short spines near mesal margin of eye; clypeus with a transverse impression and about six short spines at base. Antennae extending as far as abdominal segment 6, where they are strongly recurved and directed anteriorly to terminate alongside the head. Eyes scarcely convex, glabrous. Mandible with a pair of long setae near middle of outer face. Labrum quadrate, with front margin strongly rounded, glabrous. *Pronotum* transversely striate medially; sides with a pair of tubercles each with a conspicuous apical spine and a smaller spine near base; several short setae present. chiefly along front margin. *Mesonotum* faintly striate medially and with two to four short spines. *Metanotum* smooth, and with an oblique row of about four spines on each side of scutellar groove which is indistinct. Elytra and wings extending as far as abdominal segment 5. Abdomen with tergites 1–6 each with a transverse row of short spines near posterior margin and, usually, a shorter row near anterior margin. Tergite 7 strongly elongate, with numerous scattered spines. Tergite 8 very short and explanate laterally; a pair of inwardly curved spines present near middle and posterior margin bearing six to eight very stout, inwardly curved spines. Tergite 9 very short, truncate, partly retracted in segment 8, obliquely explanate and rather strongly sclerotized ventrolaterally. Sternites glabrous. Pleura rather strongly protuberant, strongly rugose and each bearing a minute setae. *Legs* with femur with a row of small spines near apex; mid and hind femora with a very long tuberculate process near base; hind femora extending to abdominal segment 4; all tibiae more or less at right angles to longitudinal axis of body. *Functional spiracles* present on abdominal segments 1–6 but vestigial pairs present on segments 7 and 8, where they are placed laterally; peritreme rather narrowly oval, moderately thick and very slightly raised above general level of cuticle. Length 20–24 mm.; maximum breadth 6·25 mm. (Duffy, 1953a).

References. Kojima, 1959 (L fig.); Perris, 1856 (L); Shiraki, 1952 (Biol.); Xambeu, 1902 (L).

Saperdini and Gleneini

Larval Characters

Form elongate, cylindrical. *Head* depressed, with sides subparallel and broadly rounded at base; antennal foramen closed posteriorly. Clypeus with one to six pairs of lateral setae. Antenna 2-segmented and bearing a tapering hyaline process. Mentum setose and not distinct from submentum. Gular indiscernible, with one or more fine setae present on each side. Mandible slender, about twice as long as basal width, the cutting edge obliquely emarginate. Ocelli present or absent. *Prothorax* with pronotum oblique (except *Stenostola*) and sclerotized anteriorly; posteriorly covered with coarse asperities; sublateral impressions transverse, semicircular or subcircular and pale; eusternum semicircular or trapezoidal, usually asperate and distinct. *Abdomen* with ampullae non-tuberculate (except *Serixia*), finely to coarsely asperate or spiculate (except *Serixia*) and bearing two transverse furrows (only one in *Serixia*) and a distinct longitudinal, median furrow. Segment 9 without a sclerotized process.

Epipleurum protuberant on all segments. Pleural tubercle oval, without sclerotized pits but bearing several setae.

Breuning (1950, 1956) regards the Saperdini, Gleneini and Phytoeciini as all belonging to the same tribe. A study of the larvae has shown, however, that although larvae of the Saperdini and Gleneini are fundamentally extremely similar, those of the Phytoeciini possess unique characteristics.

Gleneini

Glenea (Glenea) aluensis Gahan

Distribution. ORIENTAL REGION: New Britain, New Guinea. AUSTRALASIAN REGION: Australia, Solomon Is.

Host plant: *Theobroma cacao* (Dumbleton, 1951).

Adult (fig. 178). Length 13–17 mm. Head and prothorax covered with dense orange-yellow pubescence but with disc glabrous and black with a metallic blue reflection. Elytra metallic blue, with pubescence sparse basally and with markings of white pubescence as figured. *Prothorax* subquadrate, without lateral tubercles. Elytra sinuate and spined apically.

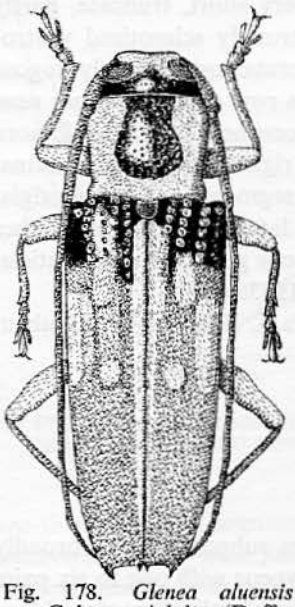

Fig. 178. *Glenea aluensis* Gahan. Adult (Duffy, 1963)

Mature larva (fig. 179). *Head* moderately depressed, with sides subparallel, feebly constricted before middle and broadly rounded at base; antennal foramen closed posteriorly. Mouthframe and frons moderately sclerotized, ferruginous, the latter with a transverse row of eight to twelve setae; six epistomal setae present; gena strongly shouldered and ferruginous. One pair of ocelli present; lens round strongly convex, pigmented spot large and very distinct. Clypeus bearing two or six lateral setae. Hypostoma slightly convex, smooth and ferruginous. Gula indistinct; two widely separated setae present, one on each side. Antenna 2-segmented; segment 2 quadrate and bearing a hyaline process. Maxillary palp with segment 3 conical, slightly shorter than segment 2; palpifer elongate, sub-parallel-sided. Mentum not distinct from submentum. *Prothorax* (fig. 179) obliquely slanting anteriorly; posterior area of pronotum covered with very coarse, individually distinguishable asperities which become gradually smaller towards posterior margin; sublateral impressions rather shallow, transversely oval. Presternum with scattered fine setae; posterior area of eusternum and anterior area of sternellum each with a transverse band of asperities. *Abdomen* with each dorsal ampulla with two curved transverse furrows, a distinct median, longitudinal furrow and bearing numerous scattered, coarse, spinelike asperities. Tergite 9 without a sclerotized process. Epipleurum pro-

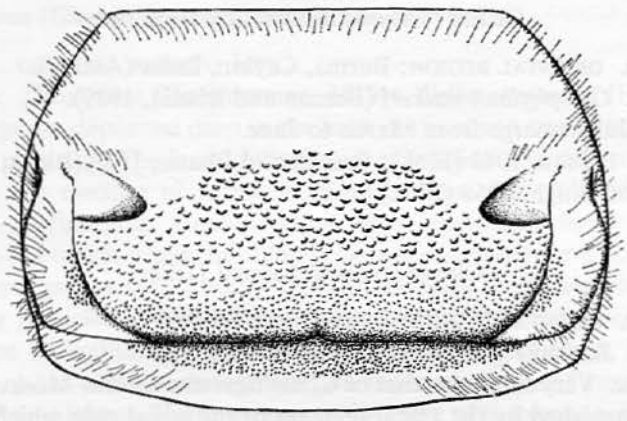

Fig. 179. *Glenea aluensis* Gahan. Mature larva. Prothorax. Dorsal aspect. (Duffy, 1963)

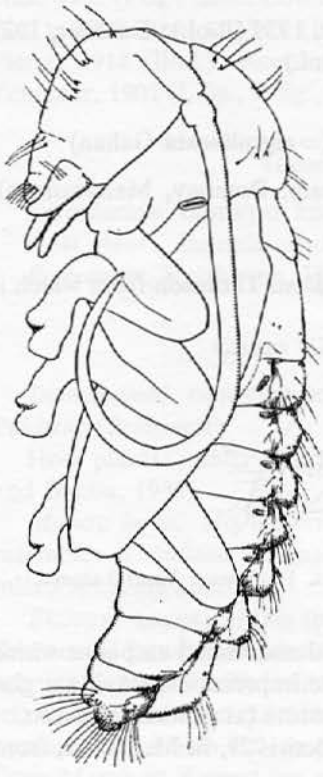

Fig. 180. *Glenea fasciata* (Fabricius). Pupa. Lateral aspect. (Duffy, 1957)

tuberant on all segments. Pleural tubercle oval, bearing about four pale setae; sclerotized pits absent. Anus rather strongly protuberant, trilobate. *Legs* absent. *Spiracles* with peritreme very pale, rather narrowly oval and moderately thick. Length up to 24 mm.; maximum breadth (at prothorax) 4·1 mm.

Pupa. No material available. The accompanying figure (fig. 180) is that of *G. fasciata* (Fabricius). For generic characters, see key p. 40.

Biology. Injury to *Theobroma* is caused by the larva of this species tunnelling in the woody tissue beneath the bark. Damage is accentuated by the fact that it ring-barks the branch which later dies or breaks off. Another type of damage occurs in younger trees, where larval galleries at the point of ramification weaken the tree to a degree where a light wind, or even heavy rain, will cause complete collapse of the upper portion (Dun, 1951).

Economic importance. Before the war this species was not considered a serious pest and it is very probable that overgrowth and neglect of plantations favoured its increase. There is also some indication that its level of population is now declining.

Material studied. 5 L, New Britain, Keravat, ii.1952, from *Theobroma*, G. S. Dun leg., in coll. B.M.

References. Duffy, 1963 (I fig., L fig., Biol.); Dumbleton, 1951 (Biol.); Dun, 1951 (Biol.), 1955 (Biol.); O'Connor, 1952 (Biol.); Szent-Ivany, 1961 (I fig., Biol.).

Glenea (Glenea) arithmetica Thomson

Distribution. ORIENTAL REGION: Burma, Ceylon, India (Assam).

Host plant: *Calophyllum walkeri* (Beeson and Bhatia, 1939).

Biology. Adults emerge from March to June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Glenea (Glenea) beesoni Heller

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Juglans regia* (Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *G. multiguttata* Guérin-Méneville from which it may be distinguished by the apical segment of the labial palp which is shorter and less than twice as long as wide. Length up to 25 mm.; maximum breadth (at prothorax) 6 mm.

Biology. Adults emerge in June.

Material studied. 2 L, India, Uttar Pradesh, Chakrata, Konain, 21.vi.1924, from *Juglans regia*, C. F. C. Beeson leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L fig., P, Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Glenea (Glenea) quadrinotata Guérin-Méneville (=**nigrolineata** Gahan)

Distribution. ORIENTAL REGION: Burma, India (Assam, Bombay, Maharashtra), Malaya.

Host plant: *Kydia calycina* (Gardner, 1931b).

Mature larva (fig. 181). Very similar to that of *G. indiana* Thomson from which it

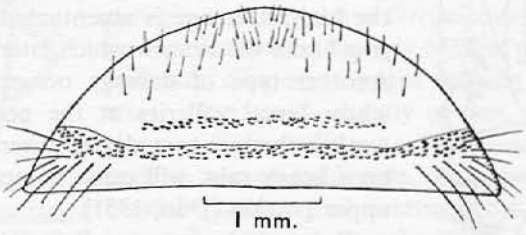

Fig. 181. *Glenea quadrinotata* Guérin-Méneville. Mature larva. Prothorax. Ventral aspect.

may be distinguished by the large asperities on the dorsal abdominal ampullae which are more or less regularly arranged along the transverse impressions, leaving a glabrous area between. Length up to 35 mm.; maximum breadth (at prothorax) 6 mm.

Material studied. 1 L, India, Bombay, E. Kanara, 6.xi.1929, B. M. Bhatia, from *Kydia calycina*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Glenea (Glenea) novemguttata Guérin-Méneville

Distribution. ORIENTAL REGION: Java.

Host plants: *Theobroma* (Dammerman, 1919); *Ceiba pentandra* (Hall, 1932).

Biology. Eggs are deposited deep in the bark of the cocoa tree, a separate incision being made for each egg. The larval galleries are subcortical and the presence of larvae is indicated by the ejection of wood fragments, often with an exudation of gum, through a frass-ejection hole. In about two to three months the larvae are full-grown and tunnel into the wood, where an oblong cavity is excavated for a pupal cell. From this cell a narrow gallery runs directly through the bark to the outside, the aperture being closed by particles of wood fibres covered with a thin veneer of bark, so that adult emergence is facilitated. The pupal period lasts from about 15 to 20 days. Adults live for about one month, and feed on the tender bark of young cocoa twigs (Hall, 1932). According to Dammerman (1929), this pest seems to occur on cocoa plantations bordering on the original jungle.

Control. Larvae should be removed by excision, and adults caught by hand. Dead branches should be removed and burned (Hall, 1932).

References. Dammerman, 1919 (I fig., Biol.), 1929 (I fig., Biol.); Haan, 1933 (Biol.); Hall, 1932 (I fig., Biol., Contr.); Kalshoven, 1951 (Biol.); Koningsberger, 1903 (I fig., Biol.), 1908 (Biol.), 1915 (Biol.); Mühlmann, 1954 (Biol.); Paerels, 1924 (Biol.); Pierce, 1918 (Biol.); Roepke, 1911 (?), 1917 (?); von Faber, 1909 (Biol, Contr.); Zehntner, 1901 (L fig., P fig., I fig., Biol. fig.); Zimmermann, 1901 (?).

Glenea (Glenea) dimidiata (Fabricius)

Distribution. ORIENTAL REGION: Borneo, Java, Singapore, Sumatra.

Host plant: *Eugenia subglauca* (Kalshoven, 1955b).

References. Kalshoven, 1955b (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Glenea (Glenea) quatuordecimmaculata (Hope)

Distribution. ORIENTAL REGION: India (Assam, Punjab, Uttar Pradesh), West Pakistan (Peshawar).

Host plants: *Abies webbiana, Pinus excelsa, P. gerardiana, P. longifolia* (Beeson and Bhatia, 1939).

Mature larva. No material available but according to Gardner (1931) it closely resembles *G. indiana* Thomson from which it may be distinguished by the densely micro-spiculate abdominal ampullae and the indistinct ocelli.

Biology. Larvae of this species infest branches and boles of various conifers. The subcortical larval galleries rather deeply groove both the sapwood and the bark and are tightly packed with long wood fibres. Frequently only a thin "veneer" of bark is left which splits open exposing the galleries beneath. The emergence hole is round and communicates with the prepupal tunnel. The life-cycle is annual. Adults emerge from March to August but mainly in April at elevations of about 2,000 ft. (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and

Roonwal, 1954 (Biol.); Gardner, 1927 (L, P, Biol.), 1931 (L); Mathur and Balwant Singh, 1960d (Biol.).

Glenea (Glenea) sanctae-mariae Thomson

Distribution. ORIENTAL REGION: India (Assam).
Host plant: *Vatica lanceaefolia* (Beeson and Bhatia, 1939).
Biology. Adults occur in May.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.).

Glenea (Glenea) silhetica Plavil'shchikov

Distribution. ORIENTAL REGION: East Pakistan (East Bengal), India (Assam).
Host plant: *Terminalia myriocarpa* (Beeson and Bhatia, 1939).
Biology. Adults emerge in March and April, mainly the former.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Glenea (Glenea) chalybeata Thomson var. **apicalis** Pic

Distribution. ORIENTAL REGION: India.
Host plant: *Elaeocarpus* sp. (Mathur and Balwant Singh, 1959).
Reference. Mathur and Balwant Singh, 1959 (Biol.).

Glenea (Glenea) ornata Gahan

Distribution. ORIENTAL REGION: Bhutan, India (West Bengal).
Host plant: *Castanopsis* sp. (Beeson and Bhatia, 1939).
Biology. Adults emerge in May and June.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Glenea (Glenea) pulchra Aurivillius

Distribution. ORIENTAL REGION: Burma, India (Assam, Maharashtra, West Bengal), Indo-China (Tonkin).
Host plants: *Sterculia alata* (Beeson and Bhatia, 1939); *Buettneria pilosa* (Bhasin, Roonwal and Balwant Singh, 1958).
Biology. Adults occur in May, July, September and November.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Glenea (Glenea) relicta Pascoe

[The White-spotted Longicorn Beetle]

Distribution. ORIENTAL REGION: China. PALAEARCTIC REGION: Japan.
Host plants: *Ulmus* (Shiraki, 1952); *Castanea* (Nakamura, 1959b).

Mature larva. Very similar to that of *G. indiana* Thomson, but unfortunately the latter is no longer available to the author for comparison. Length up to 15 mm.; maximum breadth (at prothorax) 3·75 mm.

Biology. Adults feed on the leaves of *Viburnum sieboldii* (Kojima, Watanabe and Nakamura, 1962).

Material studied. 1 L, Japan, Tokyo, Fuchu, 25.vii.1950, T. Fujimura leg., in coll. Shimane Agricultural Experimental Station.

References. Kojima, 1959 (L fig.); Kojima, Watanabe and Nakamura, 1962 (Biol. fig.); Mühlmann, 1954 (Biol.); Nakamura, 1959b (Biol.); Shiraki, 1952 (Biol.).

Glenea (Glenea) multiguttata Guérin-Méneville

Distribution. ORIENTAL REGION: India (Assam, Bihar, Madras, Mysore, Uttar Pradesh).

Host plants: *Anacardium occidentale* (Gardner, 1931b); *Salmalia malabaricum, Boswellia serrata, Buchanania lanzan, Garuga pinnata, Holigarna arnottiana, Lannea coromandelica, Mangifera indica, Pterocarpus marsupium, Shorea robusta* (Beeson and Bhatia, 1939); *Morus* (Mathur and Balwant Singh, 1961).

Mature larva. Similar to that of *G. indiana* Thomson, from which it may be distinguished by the densely micro-spiculate abdominal ampullae and the indistinct ocelli. Length up to 17 mm.; maximum breadth 4 mm.

Biology. The pupal cell is at right angles to the prepupal tunnel and the beetle emerges from the upper end. The life-cycle is annual with adults emerging from April to June (Beeson, 1941).

Control. Abnormal outbreaks of this species in *Bombax* (*Salmalia*) plantations can usually be attributed to excessive breeding in accumulated felling refuse of the alternative host trees which should be promptly removed (Beeson, 1941).

Material studied. 2 L, India, Madras, S. Mangalore, Parappa, 25.v.1930, from *Pterocarpus marsupium*, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1960d (Biol.), 1961 (Biol.); Stebbing, 1914 (I fig., Biol.).

Glenea (Glenea) indiana Thomson

Distribution. ORIENTAL REGION: Burma, India (Assam, Uttar Pradesh, West Bengal), Penang, Sikkim, West Pakistan.

Host plants: *Symingtonia populnea, Gmelina arborea, Tectona grandis* (Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *G. aluensis* Gahan from which it may be distinguished by the asperities of the abdominal ampullae which are less coarse and simple basally. Length up to 25 mm.; maximum breadth (at prothorax) 4·75 mm.

Biology. Larvae of this species infest dying saplings, stumps and felled trees. The pupal cell, which is 1 to 1½ in. long, is comma-shaped and lies just below and parallel to the surface of the sapwood. The adult emerges from the bark *via* the larval entrance

gallery, leaving a circular exit hole. The life-cycle is annual with adults emerging from May to July, mainly May.

Control. Sometimes there are abnormal outbreaks of this species in living saplings or poles. This indicates an excessive accumulation of fallen breeding material and even high stumps or top-broken trees. This material should be disposed of as soon as possible. Attacked trees should be felled and removed promptly (Beeson, 1941).

Material studied. 1 L, India, Assam, Sylhet, from *Bucklandia*, in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol.); Atkinson, 1931 (I fig., Biol. fig.); Gardner, 1927 (L, P, Biol.), 1931 (L); Mathur and Balwant Singh, 1960b (Biol.), 1961a (Biol.), 1961b (Biol.); Mühlmann, 1954 (Biol.).

Glenea (Glenea) jacintha Thomson

Distribution. ORIENTAL REGION: Andaman Is.

Host plant: *Pterospermum acerifolium* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Glenea (Glenea) lecta Gahan

Distribution. ORIENTAL REGION: India (Assam, West Bengal).

Host plants: *Magnolia pterocarpa, Phoebe lanceolata* (Beeson and Bhatia, 1939).

Biology. Adults emerge during April and May.

References. Beeson, 1941 (Biol. fig.); Beeson and Bhatia, 1939 (Biol. fig.); Mathur and Balwant Singh, 1960d (Biol.), 1961 (Biol.).

Glenea (Glenea) cincticornis Schwartz

Distribution. ORIENTAL REGION: Java.

Host plant: *Actinophora fragrans* (Kalshoven, 1955b).

Biology. This species has been found breeding in trunks of the host which had been killed by a species of *Agrilus* (Buprestidae).

Reference. Kalshoven, 1955b (Biol.).

Glenea (Glenea) galathea Thomson

Distribution. ORIENTAL REGION: Burma, India (Maharashtra), Malacca, Malaya, Sumatra, Thailand.

Host plants: *Gmelina arborea, Tectona grandis* (Beeson and Bhatia, 1939).

Biology. Adults emerge from April to July.

References. Beeson, 1920 (Biol.), 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Glenea (Glenea) belli Gahan

Distribution. ORIENTAL REGION: India (Madras, Maharashtra).
Host plant: *Artocarpus integra* (Beeson and Bhatia, 1939).
Biology. Adults emerge in May and September.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Glenea (Glenea) decolorata Heller

Distribution. ORIENTAL REGION: India (West Bengal).
Host plant: *Heritiera minor* (Beeson and Bhatia, 1939).
Biology. Adults emerge in March and April.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.).

Glenea (Glenea) vaga Thomson

Distribution. ORIENTAL REGION: Burma, India (Maharashtra, Uttar Pradesh).
Host plants: *Grewia vestita, Kydia calycina, Lannea coromandelica* (Beeson and Bhatia, 1939); *Ougeinia dalbergioides, Tectona grandis* (Mathur and Balwant Singh, 1961b).
Mature larva. No material available but according to Gardner, (1927), it closely resembles *G. quadrinotata.* Guérin-Méneville, from which it may be distinguished by the glabrous eusternum.
Biology. Adults occur in March, May, July, September and October.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L, P), 1931 (L); Mathur and Balwant Singh, 1960b (Biol.), 1961b (Biol.).

Glenea (Glenea) acuta (Fabricius)

Distribution. ORIENTAL REGION: Java, Sumatra.
Host plant: *Myristica* sp. (Kalshoven, 1955b).
References. Kalshoven, 1955b (Biol.); Koningsberger, 1915 (Biol.).

Glenea (Glenea) lefeburei (Guérin-Méneville)

Distribution. ORIENTAL REGION: New Guinea.
Host plant: *Coffea* (Thomas, 1961); *Theobroma cacao* (Szent-Ivany, 1961).
Biology. Larvae bore in the bark, making burrows up to 0·8 sq. in. in section and almost ringing the trees. Infestation occurs in both healthy and sickly trees, but not in dead ones (Thomas, 1961).
Economic importance. A major pest of *Coffea.* In one plantation, 50 per cent. of the trees were killed or damaged (Thomas, 1961).
Control. Measures recommended include pruning and cutting out.
References. Szent-Ivany, 1961 (I fig., Biol.); Thomas, 1961 (Biol. fig., Contr.).

Glenea (Macroglenea) elegans (Olivier)

Distribution. ORIENTAL REGION: Borneo, Java, Sumatra.
Host plants: *Mallotus* or *Macaranga* (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Glenea (Stiroglenea) cantor (Fabricius)

Distribution. ORIENTAL REGION: China, Indo-China.
Host plant: *Eriodendron* (Caresche, 1937).
Biology. Eggs are deposited in cracks in the bark of branches of weakened kapok trees during September and October. Larvae feed subcortically, obstructing the flow of sap and sometimes killing the branches. When mature, they penetrate the wood in which the pupal cells are made. The life-cycle does not exceed two months (Caresche, 1937).
Control. In vigorous trees larvae may be killed by the flow of sap and preventive measures consist in the promotion of strong growth by the use of fertilisers and irrigation. Very young larvae may be extracted from their galleries but heavily infested branches should be removed and burnt (Caresche, 1937).
References. Caresche, 1937 (I fig., Biol. fig., Contr.); Mühlmann, 1954 (Biol.).

Glenea (Stiroglenea) angerona Thomson

Distribution. ORIENTAL REGION: Java.
Host plants: *Sterculia campanulata, Butea monosperma, Aegle marmelos, Ceiba pentandra* (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.).

Glenea (Stiroglenea) cancellata Thomson

Distribution. ORIENTAL REGION: Burma, India (Assam, Maharashtra, Sikkim, Uttar Pradesh, West Bengal), Indo-China (Cambodia), Java, Thailand.
Host plant: *Mallotus philippinensis* (Beeson and Bhatia, 1939).
Biology. Adults emerge in April, May, October and November.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Glenea (Stiroglenea) homonospila Thomson

Distribution. ORIENTAL REGION: India (Madhy Pradesh, Maharashtra, Mysore).
Host plants: *Salmalia malabaricum, Sterculia alata* (Beeson and Bhatia, 1939).
Biology. Adults emerge from April to July, mainly June.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Glenea (Stiroglenea) spilota Thomson

Distribution. ORIENTAL REGION: Andaman Is., Burma, India (Assam, Bihar, Sikkim, Uttar Pradesh, West Bengal), Java.

Host plants: *Salmalia malabaricum, Sterculia villosa* (Gardner, 1931b; Beeson and Bhatia, 1939).

Mature larva. Very similar to that of *G. indiana* Thomson but differing in having the asperities of the abdominal ampullae larger and more or less regularly arranged along the two transverse impressions, thus leaving a glabrous area between. Length up to 35 mm.; maximum breadth (at prothorax) 5·75 mm.

Biology. Larvae infest the sapwood of rather dry felled trees and drying poles. The life-cycle is annual with emergence from April to July (mainly May).

Control. As for *G. multiguttata* Guérin-Méneville.

Material studied. 2 L, India, West Bengal, Darjeeling, Tista Valley, 25.ix.1929, from *Salmalia malabaricum*, J. C. M. Gardner leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol., Contr.); Beeson and Bhatia, 1939 (Biol. fig.); Gardner, 1931b (E fig. L fig., Biol.); Maxwell-Lefroy and Howlett, 1909 (Biol.); Stebbing, 1914 (Biol.).

Paraglenea fortunei (Saunders)

[The Rami Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Fukien, Hopeh, Hunan, Kiangsu). PALAEARCTIC REGION: Japan.

Host plants: *Morus, Boehmeria nivea* (Kojima, 1931).

References. Chen, 1933 (Biol.); Cheo, 1935 (Biol.); Kojima, 1931 (L fig., Biol.), 1959 (Biol.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Thyestilla gebleri (Faldermann)

[The Hemp Longicorn Beetle]

Distribution. ORIENTAL REGION: China (Chekiang, Kiangsu, Liaoning). PALAEARCTIC REGION: Japan, Korea, Siberia.

Host plants: *Cannabis sativa* (Kojima, 1929); *Cirsium* (Cheo, 1935).

Mature larva. The larva of this species approximates much more closely to larvae of *Glenea* than to those of *Saperda* and *Serixia* and for this reason has been placed here in the Gleneini for the purposes of the present study. From larvae of *Glenea* it may readily be distinguished by its more robust and less attenuated form and by the presence of two pairs of widely separated setae on the hypostoma. Length up to 20 mm.; maximum breadth (at prothorax) 5 mm.

Biology. The larva infests the stem of hemp, its gallery extending almost to the end of the root. Before pupating it cuts off the root and pupates therein, plugging the end with fibres. The life-cycle is one year in duration, winter being passed in the larval stage. Pupation takes place in March and adults emerge from May to July (Kojima, 1929a).

Material studied. 1 L, Japan, Izumo, Shimane, 16.v.1955, T. Fujimura leg., in coll. Shimane Agricultural Experiment Station.

References. Cheo, 1935 (Biol.); Kojima, 1929a (L fig., P, Biol), 1959 (L fig.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Saperdini

Serixia andamanica Gardner

Distribution. ORIENTAL REGION: Andaman Is., Nicobar Is.

Host plant: *Myristica andamanica* (Gardner, 1931b).

Mature larva. Very similar to those of *Glenea* species but differing as follows. Form rather more slender. *Head* with the single pair of ocelli slightly protuberant but indistinct, being obscured by the sclerotized gena. Clypeus glabrous. *Abdomen* with dorsal ampullae shining, glabrous and distinctly but rather feebly tuberculate; each with a single transverse, curved impression. *Prothorax* with posterior part of eusternum and sternellum dull, micro-spiculate. *Abdomen* with spiracular peritreme subcircular.

Biology. Adults emerge in April and May, mainly the former.

Material studied. 2 L, Andaman Is., N. Andaman, 16.xii.1928, from *Myristica andamanica*, B. M. Bhatia leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Serixia vateriae Gardner

Distribution. ORIENTAL REGION: India (Maharashtra).

Host plant: *Vateria indica* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Nupserha bicolor (Thomson) and s.sp. postbrunnea Dutt

Distribution. ORIENTAL REGION: India (Bihar, West Bengal), Java.

Host plants: *Phaseolus aconitifolius*, *P. radiatus*, *Vigna catjang* (Beeson, 1939); *Corchorus olitorius* (Dutt, 1952); *Sesbania aegyptiaca*, *S. bispinosa*, *Aeschynomene aspera*, *Crotolaria juncea*, *C. saltiana*, *Hibiscus cannabinus* (casual incidence only) (Dutt, 1961).

Adult (Pl. XVI, fig. 3). Length 6–10 mm. Orange-testaceous, with apices of most antennal segments and posterior halves of elytra black. *Head* with antennae longer than body in both sexes. *Prothorax* slightly elongate,with sides unarmed. *Elytra* with longitudinal rows of setose punctures; apicies emarginate.

Mature larva (fig. 182). *Head* thick, subovate in cross-section, widest across posterior limit of frons, with sides strongly converging posteriorly; antennal foramen closed behind; mouthframe very narrowly pale ferruginous; six epistomal setae

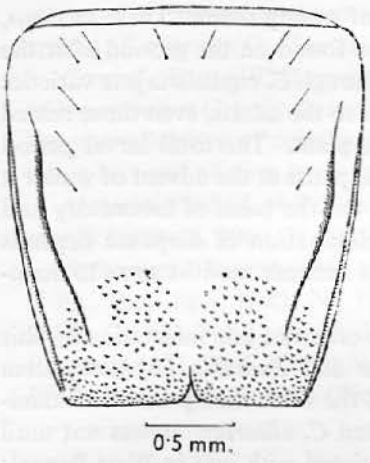

Fig. 182. *Nupserha bicolor* Thomson. Mature larva. Pronotum.

present. One pair of ocelli present; lens round, very strongly protuberant, pigmented spot distinct; two pairs of vestigial ocelli present (one pair placed immediately behind true ocellus, the other pair a short distance beneath. Mandibles long, acutely produced apically. Clypeus glabrous. Hypostoma testaceous with front margin narrowly ferruginous and with a transverse row of fine setae; sutures straight, gula indiscernible. Labrum slightly transversely oval. Antenna 2-segmented; segment 2 bearing a conical hyaline process. Maxillary palp 3-segmented; segment 3 shorter than segment 2. Mentum distinct from submentum. *Prothorax* with pronotum bearing a pair of deep sublateral linear impressions; posterior part with fine asperities which decrease in size towards hind margin (fig. 182). *Abdomen* with all segments rather strongly transverse; each dorsal ampulla moderately protuberant, feebly bilobed, shining, non-tuberculate and glabrous. Tergite 9 without a sclerotized process. Anus trilobate, lobes compact. Pleural tubercles broadly oval and each bearing a pair of setae; sclerotized pits absent. *Legs* absent. *Spiracles* with peritreme narrowly oval. Length up to 14 mm.; maximum breadth (at prothorax) 2·5 mm.

Egg. Yellowish in colour, elongate, slightly curved, with rounded ends, the anterior half being slightly tapered. Length 1·5–1·7 mm.; breadth 0·4–0·5 mm. The incubation period varies from three to four days at 28·9 ± 2°C.

Biology. In the case of oviposition by *N. bicolor postbrunnea* Dutt on jute, a slit is made by two successive indentations of the mandibles and is composed of a central pit and two lateral punctures. Girdling followed by oviposition is restricted to that portion of the stem that falls within the stem diameter range of 0·2–0·4 cm., and girdling without oviposition to the portion within the range 0·4–0·5 cm. A relation was found between the length of the mandibles of the female, which averaged 0·654 mm., the depth of the stem tissue from the epidermis to the periphery of the pith (extra-medullary tissue), and girdling and oviposition. For girdling, the optimum ratio between mandibular length and the depth of the extra-medullary tissue as measured from the epidermal furrow and from the ridge of the stem (which is pentagonal in this region) was L:0·8 and L:0·99 respectively (Dutt, 1956a).

Dutt (1954) has found that in this species there can be either a long or a short life-cycle. The latter coincides with the jute season, while the former is characterized by a prolonged larval diapause—which enables the larva not only to overcome unfavourable weather conditions but also the period of food scarcity. Normally the larvae would be drowned when the green jute is immersed in water for retting. But Dutt observed that the final-instar larva before diapause cuts the jute stem at two levels, above and below itself. The section of stem thus cut and containing the larva drops to the ground. Such sections are readily distinguishable from other pieces by

the fact that both ends are plugged with fine shreds of woody tissue. These sections, which vary in length from one to six inches, are to be found on the ground after the harvest. In a later paper (1956) Dutt explains that although *C. capsularis* jute varieties are acceptable as food to the larvae, they are resistant to the adults, even those reared from larvae which have fed on this particular host plant. The total larval period varies from 30 to 50 days. When the larva starts its diapause at the advent of winter it gradually shrinks to nearly half its original length. On the basis of laboratory and field observations, it has been concluded that the elimination of diapause depends upon the amount and frequency of rainfall during the summer months so as to maintain the soil moisture at a high level.

In his most recent paper (1961) Dutt discusses the origin of jute infestation by this pest, the relative preference for *Corchorus olitorius* and *Sesbania bispinosa*, stem diameter and oviposition in *Sesbania bispinosa*, and the relationship between manibular length and site of oviposition in *S. bispinosa* and *C. olitorius*. It was not until 1949 that *N. bicolor postbrunnea* Dutt was first associated with jute in West Bengal; before this *S. aegyptiaca* appears to have preferred the wild host plant; indeed from which the beetle later transferred its ravages to jute. There has since been a gradual increase of incidence on *S. bispinosa* (an important green-manure crop) which has surpassed that on *olitorius* jute. The stem diameter most favourable for girdling and oviposition in *S. bispinosa* ranges from 3·1 to 5 mm., whilst in *C. olitorius* it is from 2·6 to 3 mm. Despite this discrepancy in preferred stem diameter, the ratio to mandibular length to depth of extramedullary tissue of such stems in the two plants is similar. All the varieties of *capsularis* jute are unacceptable to the adults, although they are acceptable to the larvae. Adults obtained from larvae reared on varieties of *capsularis* jute also show aversion to *capsularis*. This beetle selects the susceptible *olitorius* from amongst *capsularis* jute when these are grown as a mixed crop. Amongst the *olitorius* varieties, C.G. is the most susceptible. Plants attaining a height range of 100–200 cm. are the most susceptible to attack. The girdling causes suspension of unidirectional vertical growth and encourages lateral branching, thus reducing the value of the fibre. The continued exposure of diapause larvae to soil of up to 3 per cent moisture content inhibited termination of the diapause, but in soils with moisture contents ranging from 5 to 18 per cent, diapause development proceeded and pupation and adult emergence started after about three or four months. Under natural conditions, diapause larvae exposed on the soil surface are less likely to survive than are those placed deeper in the soil. Girdling by the adults arrests the flow of sap, thus affording suitable conditions for the development of the egg.

Parasites. Hymenoptera: *Neocatolaccus nupserhae* Dutt and Ferrière and *Norbanus acuminatus* Dutt and Ferrière (parasitizing both larvae and pupae of the ssp. *postbrunnea* Dutt (Dutt and Ferrière, 1961).

Economic importance. In a series of papers by Dutt (1952, 1954, 1956a, 1956b) it has been shown how ovipositing females of *N. bicolor postbrunnea* Dutt can cause immediate and serious loss of stem length in jute in West Bengal by girdling the stem above and below a slit in which the egg is laid. This, however, applies only to *Corchorus olitorius* varieties, those of *C. capsularis* being resistant to attack. This subspecies appears to be of considerable economic importance, as it has attained the

status of an agricultural pest in recent years, being a major pest of jute and is now spread all over the *C. olitorius* tracts of the different states in India.

Control. Dutt (1954) recommends as a cultural method of control, the cultivation of the resistant *C. capsularis*. This, however, is not practicable in West Bengal due to the unavailability of suitable land. Therefore the collection and destruction of the fallen sections of stem is essential.

Material studied. 4 L, India, West Bengal, Barraclepore, Jute Agricultural Research Institute, 1960, N. Dutt leg., in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Dutt, H., 1915 (I fig., Biol. fig.); Dutt, N., 1952 (Biol.), 1954 (Biol. fig., Contr.), 1956a (Biol. fig.). 1956b (L fig., P fig., Biol.), 1961 (E, Biol. fig.); Dutt and Ferriere, 1961 (Paras.); Fletcher, 1921 (Biol., Contr.); Mathur and Balwant Singh, 1960 (Biol.); Mühlmann, 1954 (Biol.); Pruthi, 1936 (Biol.).

Nupserha antennata Gahan[31]

Distribution. ORIENTAL REGION: Burma, India. AUSTRALASIAN REGION: Australia (introduced).

Host plants: *Xanthium* and *Helianthus* (in India) (Stride and Straatman, 1963).

Mature larva. Similar to that of *N. biolor* Thomson from which it differs as follows. *Prothorax* transverse. Asperities on pronotum irregularly arranged in at least nine rows. *Abdomen* with dorsal ampullae glabrous and smooth, with two transverse furrows which join at extremities to enclose an elliptical area.

Biology. This oriental species has recently been imported into Australia for experiments with a view to controlling the noxious weed, *Xanthium pungens*. In India, adult emergence starts with the first monsoon rains in June and July. It attacks *Xanthium* in India, where it is closely associated with *X. indicum* and is also recorded as attacking *Helianthus*. There is one generation a year. When mature, the larvae enter the soil, where they remain active but without feeding or further development, pupation occurring when favourable weather conditions return . The egg and pupal stages of this species, under laboratory conditions, lasted seven to eight and ten to twelve days respectively, at 85°F. There were seven larval instars, of which the first five become progressively longer within the range of four to six to fifteen to twenty-five days, and the last two occupied several months. The young larvae often bore into the tip of the main shoot or branch, killing it and causing axillary branches to develop; the presence of larvae weakens the plant and generally reduces burr production. Adult males survived for ten to nineteen days and females for three to ten weeks in the insectary. Females laid thirty-one to two hundred and sixty-one eggs each (Stride and Straatman, 1963).

Material studied. 9 L, India, pres. by G. O. Stride, in coll. B.M.

Reference. Stride and Straatman, 1963 (L, P, J, Biol. Fig.).

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[31] There is now considerable doubt as to the true identity of these larvae. The recent examination of associated adults suggests that they are not larvae of *N. antennata* Gahan but very probably of *N. vexator* Pascoe, var, *rufiventris* Breuning, which appears to be the actual species used in Australia for control experiments.

Nupserha quadrioculata (Thunberg)

Distribution. ORIENTAL REGION: Burma, India (Assam, Madras).

Host plant: *Convolvulus* sp. (Beeson and Bhatia, 1939). (See also p. 353).

Biology. Adults emerge in May, June and August.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960 (Biol.). (See also p. 353).

Nupserha madurensis Pic and varieties

Distribution. ORIENTAL REGION: India.

Host plants: *Xanthium strumarium* (Mathur and Balwant Singh, 1961b); *Ageratum conyzoides* (Bhasin and Roonwal, 1954), *Bidens pilosa* (Bhasin, Roonwal and Balwant Singh, 1958) (var. *barwayensis* Breuning); *Cynoglossum lanceolatum* (Mathur and Balwant Singh, 1960) (vars. *subtermaculata* Breuning and *ampliata* Breuning).

References. Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1960 (Biol.), 1961b (Biol.).

Nupserha malabarensis Pic and var. **partenigrescens** Breuning

Distribution. ORIENTAL REGION: India.

Host plants: *Xanthium strumarium* (Mathur and Balwant Singh, 1961b); *Bidens pilosa* (Bhasin, Roonwal and Balwant Singh, 1958); *Ageratum conyzoides* (Bhasin and Roonwal, 1954); *Bidens pilosa* (Bhasin, Roonwal and Balwant Singh, 1958) (var. *partenigrescens* Breuning).

References. Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Nupserha cosmopolita Thomson

Distribution. ORIENTAL REGION: India.

Host plant: *Quercus luzoniensis* (Mathur and Balwant Singh, 1960d).

Reference. Mathur and Balwant Singh, 1960d (Biol.).

Nupserha variabilis Gahan

Distribution. ORIENTAL REGION: Burma, India (Uttar Pradesh), Thailand.

Host plants: *Dalbergia* sp., *Spondias mangifera*, *Tectona grandis*, *Thunbergia grandiflora* (Beeson and Bhatia, 1939); *Gmelina arborea* (Beeson, 1941).

Biology. Larvae of this species feeding in living *Thunbergia* cause large swellings or galls to appear on the stems. When mature the larva tunnels from the climber into the bark of the supporting tree. Here a comma-shaped pupal cell about 1 to 1½ in. long is made. The beetle emerges from the original pre-pupal entrance hole. Adults emerge in April and May, mainly the latter.

References. Atkinson, 1931 (I fig., Biol. fig.); Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960b (Biol.); 1961a (Biol.), 1961b (Biol.).

Nupserha fricator (Dalman)

Distribution. ORIENTAL REGION: Borneo, Burma, Celebes, Java, Malacca.
Host plant: *Ipomoea batatas* (Koningsberger, 1915).
References. Kalshoven, 1955b (Biol.); Koningsberger, 1915 (Biol.).

Nupserha quadrioculata (Thunberg)

Distribution. ORIENTAL REGION: Burma, Java.
Host plant: *Ipomea* sp. (Kalshoven, 1955b).
Reference. Kalshoven, 1955b (Biol.). (See also pp. 351-2).

Nupserha holoxantha Fairmaire

Distribution. ORIENTAL REGION: China, Formosa.
Host plant: *Pyrus malus* (Chang, 1963).
Reference. Chang, 1963 (Biol.).

Linda nigroscutata (Fairmaire)

Distribution. ORIENTAL REGION: China (Yunnan), India (Assam).
Host plant: *Pyrus malus* (Beeson and Bhatia, 1939).
Biology. Beetles feed on the bark of tender shoots which they almost completely girdle and kill during June and July. The female gnaws a slit at right angles to the girdle through which an egg is deposited subcortically. The twig is hollowed out for several inches above the girdle by the larva; frass-ejection holes are made in the twig which eventually shrivels up.
Economic importance. This species is a serious pest, often causing considerable damage.
Control. Fletcher (1919) suggests the hand-collection of adults and the pruning of infested twigs.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Fletcher, 1919 (Biol.), 1921 (L fig., I fig., Biol. fig., Contr.); Mathur and Balwant Singh, 1960d (Biol.).

Linda fraterna (Chevrolat)

[The Slender Black and Orange Longhorn]

Distribution. ORIENTAL REGION: China (South to Yunnan and Kiangsu).
Host plants: *Rubus* sp. (Gressitt, 1942); *Prunus japonica, P. persica, Cydonia japonica* (Savio, 1929); *Pyrus malus, P. communis* (Shen and Chang, 1965).
Biology. According to Savio (1929), the larva hollows the slender branches of host trees, finally girdling the end of the mined portion so that the part beyond falls off. The open end of the branch, which the larva packs with frass, later forms the emergence hole of the adult. The pupal cell is from 70 to 85 mm. in length. Adults are diurnal and emerge from April to June.
Control. The pruning of infested stems or branches (Gressitt, 1942).
References. Gressitt, 1942 (I fig., Biol., Contr.); Savio, 1929 (Biol.); Shen and Chang, 1965 (L fig., P fig., I fig., Biol. fig).

Oberea modica Gahan

Distribution. ORIENTAL REGION: Burma, India (West Bengal).

Host plant: *Clerodendron infortuntaum* (Gardner, 1931b).

Mature larva. No material available. Gardner (1931b) gives a full description. The accompanying figures (figs. 183 and 184) are of *O. ruficollis* (Fabricius). For generic characters see key, p. 27.

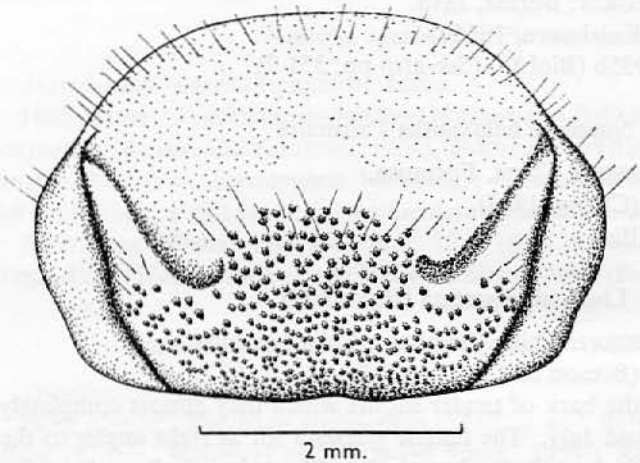

Fig. 183. *Oberea ruficollis* (Fabricius). Mature larva. Prothorax. Dorsal aspect. (Duffy, 1953a)

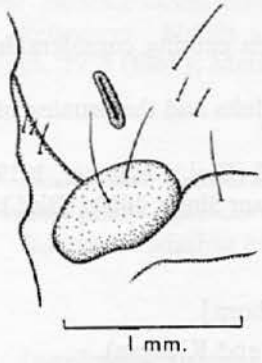

Fig. 184. *Oberea ruficollis* (Fabricius). Mature larva. Spiracle and pleural tubercle of abdominal segment 1. (Duffy, 1953a)

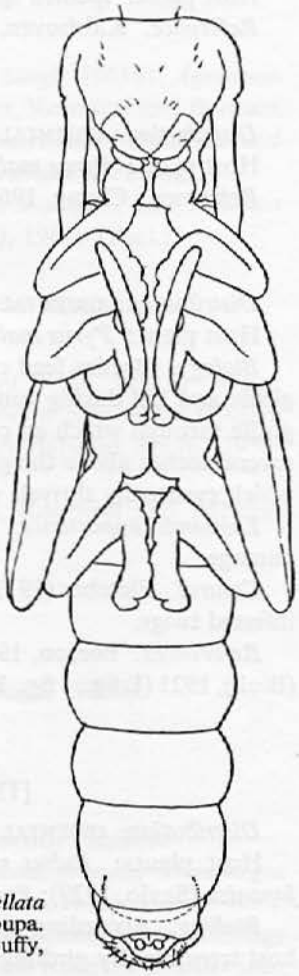

Fig. 185. *Oberea ocellata* Haldeman. Female pupa. Ventral aspect. (Duffy, 1953a)

Pupa. No material available. The accompanying figure (fig. 185) is that of *O. ocellata* Haldeman. For generic characters, see key, p. 40.

Biology. Larvae infest living stems of the host plant. Adults emerge in June.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Oberea artocarpi Gardner

Distribution. ORIENTAL REGION: India.
Host plant: *Artocarpus integra* (Bhasin and Roonwal, 1954).
Reference. Bhasin and Roonwal, 1954 (Biol.).

Oberea lateapicalis Pic

Distribution. ORIENTAL REGION: India (Mysore).
Host plant: *Citrus aurantium* (Bhasin, Roonwal and Balwant Singh, 1958).
Reference. Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Oberea sericea Gahan

Distribution. ORIENTAL REGION: Burma.
Host plant: *Strobilanthes* sp. (Beeson, 1941).
Reference. Beeson, 1941 (Biol.).

Oberea posticata Gahan

Distribution. ORIENTAL REGION: Burma, India.
Host plant: *Citrus medica* (Bhasin, Roonwal and Balwant Singh, 1958).
Reference. Bhasin, Roonwal and Balwant Singh, 1958 (Biol.).

Oberea fuscipennis Chevrolat

Distribution. ORIENTAL REGION: China (Chekiang, Hunan, Kiangsu).
Host plant: *Morus* (Chen, 1933).
References. Chen, 1933 (Biol.); Cheo, 1955 (Biol.); Mühlmann, 1954 Biol.).

Oberea japonica Thunberg

Distribution. ORIENTAL REGION: China, Formosa. PALAEARCTIC REGION: Japan, Korea.

Host plants: *Pyrus malus, P. cerasus, P. domestica, P. communis, Cydonia oblonga,* (Cheo, 1935).

Biology. Adults feed on leaves of *Prunus yedoensis* (Kojima, Watnabe and Nakamura, 1962).

References. Cheo, 1935 (Biol.); Kojima, 1959 (L fig.); Kojima, Watnabe and Nakamura, 1962 (Biol. fig.).

Phytoecia rufiventris Gautier var. **ventralis** Bates

[The Chrysanthemum Longhorn]

Distribution. ORIENTAL REGION: China (Chekiang, Hopeh, Kiangsu, Kwangsi, Shantung), Formosa. PALAEARCTIC REGION: Japan, Korea, Siberia.

Host plants: *Chrysanthemum morifolium* (Gressitt, 1942); *Solidago serotina* (Nakamura, 1960); *Chrysanthemum* sp., *Aster yomena*, *Erigeron anuus* (Nakamura and Fujimura, 1958).

Mature larva (fig. 186.) Form elongate, slender, cylindrical. *Head* thick, subovate,

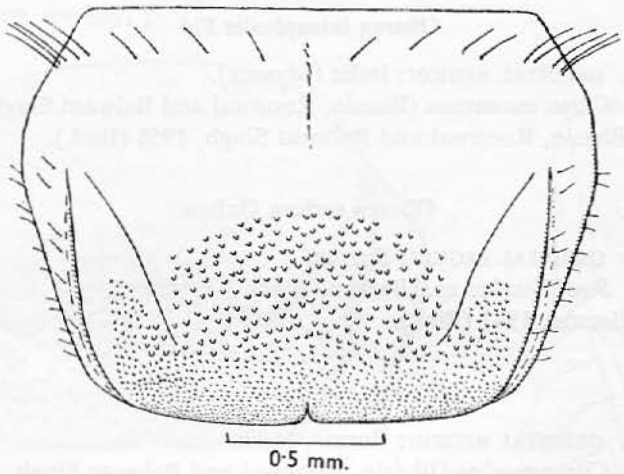

Fig. 186. *Phytoecia rufiventris* Gautier. Mature larva. Prothorax. Dorsal aspect.

in cross-section, widest across posterior limit of frons, with sides strongly converging posteriorly; antennal foramen closed behind; mouthframe rather feebly but broadly sclerotized; frons with a transverse row of setae; six epistomal setae present. One pair of ocelli present; lens small, slightly protuberant, pigmented spot rather indistinct. Two pairs of vestigial ocelli present. Mandible short, less than twice as long as basal width. Clypeus glabrous. Hypostoma smooth, testaceous, with a transverse row of setae; sutures slightly curved. Gula indiscernible. Labrum transversely oval. Antenna 2-segmented; segment 2 bearing a slender, tapering, hyaline process. Maxilla with palp 3-segmented; segment 3 slightly shorter than segment 2. *Prothorax* (fig. 186) obliquely slanting, with sides diverging posteriorly; anterior part of pronotum with a transverse row of fine setae; posterior area with numerous coarse asperities which are more or less uniform, except the posterior fourth where they become extremely small; sublateral impression linear, oblique. Presternum, eusternum and sternellum setose, non-asperate. *Abdomen* with each dorsal ampulla strongly protuberant, bilobed, dull, micro-granulate and non-tuberculate. Abdominal segment 10 trilobed, sparsely setose. Epipleurum protuberant on all segments. Pleural tubercle with two setae but without sclerotized pits. *Legs* absent. *Spiracles* with peritreme thick, narrowly oval. Length up to 18 mm.; maximum breadth (at prothorax) 2·25 mm.

Pupa. No material available. The following is a description of the Palaearctic *P. cylindrica* (Linnaeus) (fig. 187). *Head* entirely visible from above, feebly excavated and with three to four fine setae opposite base of each antenna; front with three to

four setae near mesal margin of each eye; clypeus with a transverse impression and about six setae across base. Antennae extending as far as abdominal segment 1, where they are strongly curved downward to terminate alongside maxillary palpi. Eyes moderately convex, glabrous. Mandibles with two short setae near middle of outer face. Labrum triangular, glabrous. *Pronotum* bearing several fine scattered setae, especially along front and lateral margins. *Mesonotum* smooth and usually bearing two to four setae; scutellum scarcely protuberant, glabrous. *Metanotum* smooth, with two to three fine setae on each side of scutellar groove, which is narrow and very distinct. Elytra and wings extending to fourth abdominal segment. *Abdomen* with tergites 1–7 with strongly protuberant, bilobed ampullae, which bear several short, straight spines (each arising from a papillate base), some of which are inclined anteriorly. Tergite 7 elongate. Tergite 8 rather short, transverse and with a row of similar spines near base. Tergite 9 very short, the posterior margin bearing several similar but slightly stouter spines. Sternites 4–7 with ampullae each bearing a minute seta. Pleura moderately protuberant on segments 5–8 and each with two or three short spines. *Legs* with hind femora extending to abdominal segment 4; tibiae directed posteriorly. *Functional spiracles* present on abdominal segments 1–7 and a vestigial pair on segment 8; peritreme rather narrowly oval, moderately thick, surrounded by a tuberculate rim and raised above general level of cuticle. Length 8–11 mm.; maximum breadth 2·25 mm. (Duffy, 1953a).

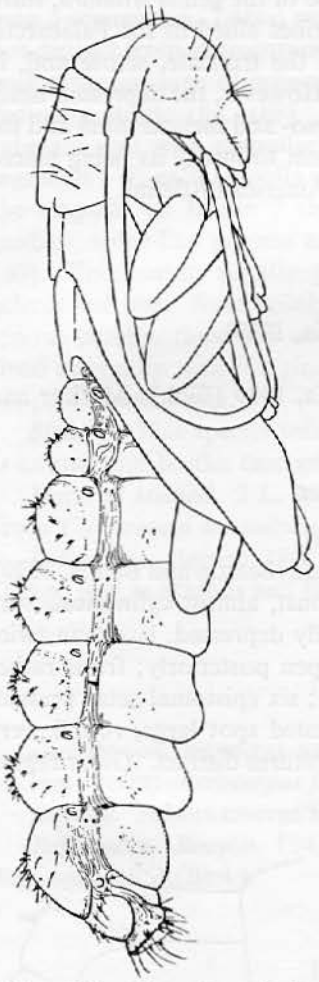

Fig. 187. *Phytoecia cylindrica* (Linnaeus). Female pupa. Lateral aspect. (Duffy, 1953a)

Biology. Larvae infest living stems of the host plant, the eggs being laid in the plant tissue several inches above ground level. The larva eventually tunnels down the centre of the stem into the roots, where pupation takes place in August and September. Adults feed, copulate and oviposit on the stalks during the daytime; they emerge during April and early May (Gressitt, 1942).

Control. The detection and destruction of infested plants and the collection of adults with a sweeping net (Gressitt, 1942).

Material studied. 2 L, Japan, Tokyo Prefecture, Suginami, 23.vii.1948, from *Chrysanthenum molifolium*, T. Fukimura leg., in coll. B.M.

References. Fujimura, 1958 (E fig., L fig., Biol. fig.); Gressitt, 1942 (I fig., Biol. Contr.); Kojima, 1959 (L fig.); Mühlmann, 1954 (Biol.); Nakamura, 1960 (P fig., Biol.); Nakamura and Fujimura, 1958 (L fig., Biol.); Shiraki, 1952 (Biol.).

Ptericoptini

In some respects larvae of this tribe, particularly those of the genus *Atimura*, show an affinity to the Hippopsini, Spalacopsini and other tribes allied to the Palaearctic Agapanthiini, especially in the general body form and the truncate, setose and, in *Atimura*, somewhat swollen ninth abdominal segment. However, the depressed head, the distinct hypostomal sutures, the non-protuberant meso- and metasternum and the presence of both dorsal and ventral ampullae would seem to justify its being placed nearer the Apomecynini and Apodasyini and the South American Adetini.

Atimura affinis Breuning

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Terminalia tomentosa* (Beeson and Bhatia, 1939).

Biology. Adults emerge in May and October.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Atimura combreti Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Combretum decandrum*, *Terminalia chebula* (Beeson and Bhatia, 1939).

Mature larva (figs. 188, 189). Form moderately robust, almost cylindrical, very slightly curved. *Head* slightly salient, thick, very slightly depressed, less than twice as wide as thick; sides subparallel. Antennal foramen open posteriorly; frons rather broadly pale ferruginous. Frontal sutures pale, distinct; six epistomal setae present. One pair of ocelli present; lens round, convex, pigmented spot large, round, very distinct. Hypostoma pale ferruginous, slightly convex, sutures distinct. Gular region

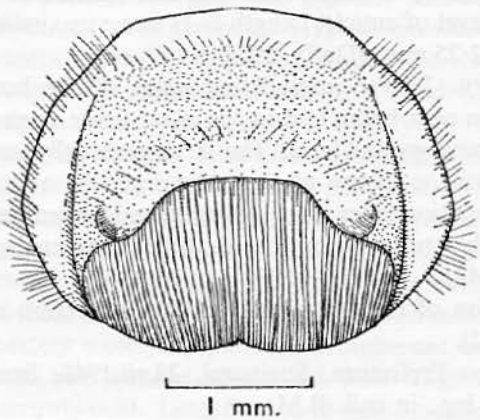

Fig. 188. *Atimura combreti* Gardner. Mature larva. Prothorax. Dorsal aspect.

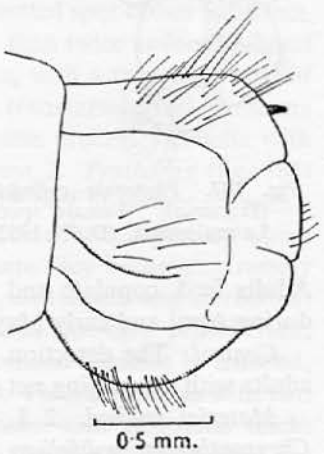

Fig. 189. *Atimura combreti* Gardner. Mature larva. Abdominal segment 9. Lateral aspect.

with a distinct, pale, median cleavage line on each side of which are three pairs of fine setae. Antenna 2-segmented, segment 2 bearing a tapering hyaline process. Maxillary palp 3-segmented. Labial palpi with segments 1 and 2 subequal in length. Mentum not distinct from submentum. Mandible rounded or subtruncate apically. *Prothorax* with posterior area of pronotum strongly embossed, milky white and coarsely longitudinally striate (fig. 188). *Metanotum*, mesosternum and metasternum non-protuberant and with ampullae. *Abdomen* with both dorsal and ventral ampullae on segments 1–7; each ampulla with two transverse rows of smooth moniliform tubercles, the ampulla on tergite 7 the widest. Segment 9 somewhat swollen with a small, median, spine-like process and rather densely fringed posteriorly with fine setae (fig. 189). Epipleurum slightly protuberant on all segments; pleural tubercle without sclerotized pits. Anus trilobed, only slightly protuberant. *Legs* vestigial but ferruginous basally, thus very conspicuous. *Spiracles* with peritreme circular and entirely lined internally with marginal chambers. Length up to 20 mm.; maximum breadth (at prothorax) 3 mm.

Biology. This species infests climbers and small branches of trees. The life-cycle is annual and beetles emerge in April and May.

Material studied. 2 L, India, Uttar Pradesh, Dehra Dun, Tons Nadi, 25.vi.1929, from *Combretum decandrum*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L fig., Biol.); Mathur and Balwant Singh, 1960 (Biol.), 1961b (Biol.).

Neosybra ropicoides Breuning

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Acrocarpus fraxinfolius* (Beeson and Bhatia, 1939).

Biology. Adults emerge in April.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.).

Platyzorilispe variegata Fisher

Distribution. ORIENTAL REGION: India (Madras).

Host plant: Unknown liana.

Mature larva (fig. 190). Rather similar to that of *Atimura combreti* Gardner but differing as follows. Form subcylindrical, slender, straight. *Head* strongly narrowed posteriorly, broadly oval in cross-section. Hypostoma swollen. *Prothorax* with pronotum (fig. 190) bearing a conspicuous dark brown, oval transversely carinate area, behind which it is finely longitudinally strigose. *Abdomen* with segment 9 without a spine-like process. Length up to 15 mm.; maximum breadth (at prothorax) 2 mm.

Material studied. 2 L, India, Madras, S. Mangalore, v.1930, from unknown liana, J.C.M.G. leg., in coll. F.R.I.D.D.

Reference. Gardner, 1944 (L fig.).

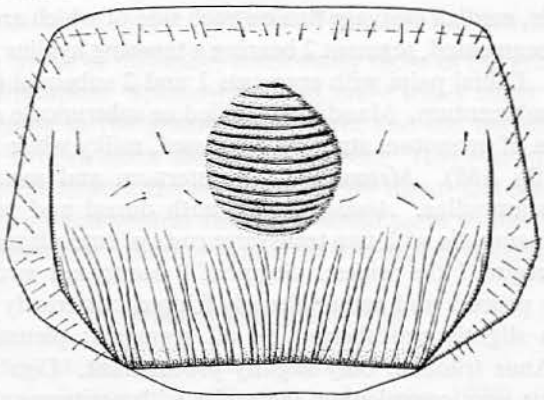

Fig. 190. *Platyzorilispe variegata* Fisher. Mature larva. Prothorax. Dorsal aspect.

Sybra alternans (Wiedemann)

Distribution. ORIENTAL REGION: Indonesia, Philippine Is, Thailand. AUSTRALASIAN REGION: Micronesia (S. Mariana Is., Palau, Yap, Caroline Atolls, Kusaie). HAWAIIAN REGION: Hawaiian Is. (Hawaii).

Host plants: *Artocarpus, Barringtonia, Cycas, Triphasia* (Gressitt, 1956); *Hibiscus, Ficus, Cordia;* also in pseudo-bulbs of orchids *Dendrobium* and *Cattleya* spp. (Duffy, 1953b); *Artocarpus integra, Ficus hispida, F. ampelas, F. septica, Streblus asper, Tectona grandis, Barringtonia, Mallotus* (or *Macaranga*), *Actinophora fragrans, Anthocephalus indicus, Bauhinia hirsuta* (and its pods), *Ochroma, Piper* (dead vines,) *Ricinus* and *Manihot* (Kalshoven, 1955b); *Artocarpus heterophyllus* (D. of A., Bangkok).

Mature larva (fig. 191). *Head* rather strongly depressed, elongate, with sides converging behind middle; frontal sutures indistinct; antennal foramen open posteriorly. Frons smooth, with eight setiferous pores; six epistomal setae present. One pair of ocelli present; lens thick, oval, convex, pigmented spot very distinct but in specimens examined deeply retracted. Hypostoma very slightly convex, micro-granulate; a pair of paramedian, setiferous pores present, the setae fine and very long; sutures subparallel, straight. Gular region with a pale median cleavage line. Antenna 2-segmented; segment 2 bearing a minute hyaline process. Maxilla with segment 3 of palp attenuated, at least as long as segment 2. *Prothorax* with posterior part of pronotum shining, faintly longitudinally rugose. *Meso-* and *metanotum* smooth, glabrous. *Abdomen* with moniliform tubercles of dorsal ampullae arranged more or less irregularly in three rows. Tergite 9 with a pair of sublateral, curved impressions and bearing a minute transversely oval, sclerotized, ferruginous plate, the

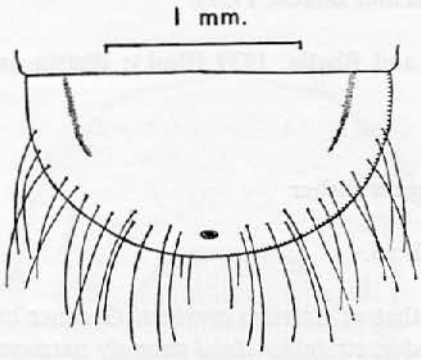

Fig. 191. *Sybra alternans* (Wiedemann). Mature larva. Abdominal tergite 9. (Duffy, 1963)

centre of which is produced into a very short blunt tubercle (fig. 191). Length up to 12 mm.; maximum breadth (at prothorax) 2·9 mm.

Material studied. 1 L, 1 I, Hawaii, Honolulu, 3.i.1952, from *Hibiscus*, in coll. B.M.

References. Duffy, 1953b (L fig , Biol.), 1963 (L fig., Biol.); Gressitt, 1956 (Biol.); Kalshoven, 1955b (Biol.); Linsley, 1959 (Biol.); Swezey, 1928 (Biol.).

Sybra ceylonensis Breuning

Distribution. ORIENTAL REGION: Ceylon, India (Orissa).

Host plant: *Calotropis procera* (Beeson and Bhatia, 1939).

Biology. Larvae of this species infest the fruits of the host plant. Adults have been taken in January and March.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.) (under *Ropica praeusta* Pascoe); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Mathur, Balwant Singh and Kishori, 1958 (Biol.).

Sybra signatoides Breuning

Distribution. ORIENTAL REGION: Ceylon.

Host plant: *Pinus patula* (Beeson and Bhatia, 1939).

Biology. Adults occur in January and March.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960d (Biol.).

Sybra ordinata Bates

Distribution. ORIENTAL REGION: Formosa, Java. PALAEARCTIC REGION: Japan.

Host plant: *Gossypium* (Hargreaves, 1948).

Reference. Hargreaves, 1948 (Biol.).

Sybra praeusta (Pascoe)

Distribution. ORIENTAL REGION: Ceylon, India.

Host plant: *Solanum melongena* (Mathur and Balwant Singh, 1961).

Reference. Mathur and Balwant Singh, 1961 (Biol.).

Hippopsini and **Spalacopsini**

The larvae of these two tribes are remarkable and represent strikingly aberrant forms in the LAMIINAE. They possess several fundamental and unusual characteristics in common and there seems to be no doubt that they are all closely related to the palaearctic Agapanthiini, despite the fact that in the adult classification these two tribes are rather remotely separated from the Agapanthiini. The main characters which these three tribes possess in common are: Form very elongate to very slender, curved and cylindrical. *Head* salient, oval in cross-section; occipital foramen posterio-ventral. One pair of ocelli present. *Mesosternum* and *metasternum* strongly protuberant. *Abdomen* with segment 9 enlarged, as wide and high as apex of segment 8, densely

setose and usually with a caudal process or anal tubercles. Ventral ampullae absent. *Spiracles* with inner margin of peritreme entirely lined with subcontiguous marginal chambers.

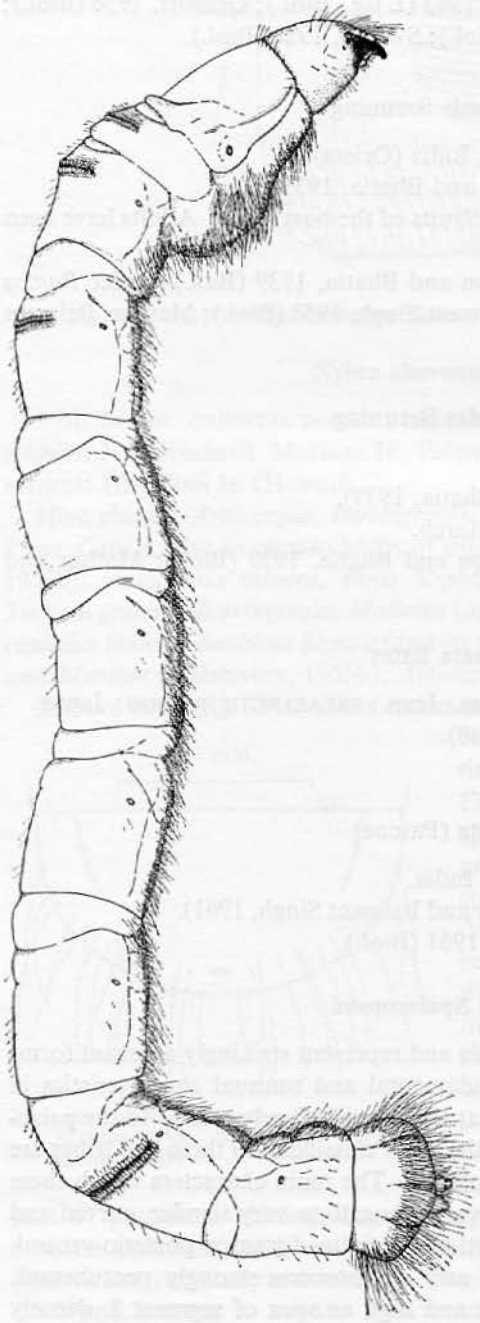

Fig. 192. *Pothyne combreti* Gardner. Mature larva. Lateral aspect.

Hippopsini

Pothyne combreti Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Combretum decandrum* (Gardner, 1931b).

Mature larva (fig. 192). *Head* salient, oval in cross-section, with sides slightly rounded and converging for posterior third; almost entirely and uniformly sclerotized and pale testaceous in colour; occipital foramen postero-ventral; antennal foramen closed posteriorly; frontal sutures faintly discernible, median suture very distinct; genae broadly rounded smooth, sparsely setose; six epistomal setae present. One pair of ocelli present; lens indiscernible, pigmented spot irregularly linear, black, very distinct. Labrum thick strongly transverse, densely setose. Mandible acute with apex not bifurcate. Hypostoma slightly convex, smooth, testaceous, bearing numerous scattered setae; hypostomal and gular sutures undefined. Antenna minute, 2-segmented. Maxillary palp 3-segmented, segment 3 as long as segment 2. Mentum distinct from submentum. *Prothorax* with pronotum not laterally defined, uniformly shining, smooth and testaceous. Prosternum with two lateral testaceous patches. Mesosternum and metasternum very strongly protuberant, each with a dense transverse fringe of long setae. *Abdomen* (fig. 192) with segments elongate and cylindrical; dorsal ampullae present only on segments 1, 2 and 7, each ampulla bilobed, with two approximate, regular, transverse rows of moniliform tubercles; ventral ampullae

absent. Segment 9 swollen, with a dorsal fringe of moderately long setae, as wide and as high as apex of segment 8. Epipleurum protuberant on all segments. Pleural tubercle without sclerotized pits but bearing numerous setae. Anus trilobed and in centre of apical truncature of segment 9; lobes each produced into a conical tubercle (fig. 192). *Legs* absent. *Spiracles* broadly oval, the inner margin of peritreme entirely lined with subcontiguous marginal chambers. Length (extended) up to about 30 mm.; maximum breadth (at prothorax) 3 mm.

Biology. Adults emerge in April and May, mainly the former.

Material studied. 1 L, India, Uttar Pradesh, Dehra Dun, Kandanli, iv.1929, from *Combretum decandrum*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1931b (L, Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Pothyne distincta Breuning

Distribution. ORIENTAL REGION: India.

Host plant: *Michelia champaca* (Mathur and Balwant Singh, 1961).

Reference. Mathur and Balwant Singh, 1961 (Biol.).

Pothyne convexifrons Gardner

Distribution. ORIENTAL REGION: India (Bihar, Uttar Pradesh).

Host plant: *Saccharum spontaneum* (Beeson and Bhatia, 1939).

Biology. Adults emerge in July.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1930 (L); Mathur and Balwant Singh, 1961 (Biol.).

Pothyne indica Breuning

Distribution. ORIENTAL REGION: India.

Host plant: *Saccharum spontaneum* (Mathur and Balwant Singh, 1961).

Reference. Mathur and Balwant Singh, 1961 (Biol.).

Pothyne acaciae Gardner

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Acacia gageana* (Gardner, 1931b); *Cassia fistula* (Bhasin, Roonwal and Balwant Singh, 1958).

Mature larva. Very similar to that of *P. combreti* Gardner from which it may be distinguished by its more robust form, the feebly protuberant anal lobes and the apex of the mandible which is bluntly bifurcate.

Biology. Adults emerge in May and June.

Material studied. 1 L, India, Uttar Pradesh, Dehra Dun, Asan Nadi, 9.viii. 1928, from *Acacia gageana*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Bhasin, Roonwal and Balwant Singh, 1958 (Biol.); Gardner, 1931b (L fig., Biol.).

Pothyne variegata Thomson

Distribution. ORIENTAL REGION: Burma, India (Assam), Malaya, Thailand.
Host plant: *Ficus elastica* (B. S. Rao, Rubber Research Institute of Malaya).
References. None available.

Pothyne moringae Aurivillius

Distribution. ORIENTAL REGION: East Pakistan (Chittagong), India (Mysore, West Bengal).
Host plant: *Gmelina arborea* (Beeson and Bhatia, 1939).
Mature larva. Similar to that of *P. combreti* Gardner from which it may be distinguished by its more robust form, the presence of dorsal ampullae on segments 1–7 and the somewhat conically protuberant ventral lobes of the anus.
Biology. Emergence occurs in April and May.
Material studied. 1 L, East Pakistan, Chittagong Hill Tracts, 18.iv.1924, from *Gmelina arborea* S. N. Chatterjee leg., in coll. F.R.I.D.D.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1927 (L (as Hippopsini, not named)), 1931 (L); Mathur and Balwant Singh, 1960b (Biol.).

Pothyne sericeomaculata Breuning

Distribution. ORIENTAL REGION: Burma.
Host plant: *Prunus puddum* (Mathur and Balwant Singh, 1960d).
Reference. Mathur and Balwant Singh, 1960d (Biol.).

Smermus mniszechi Lacordaire

Distribution. ORIENTAL REGION: India (Assam, West Bengal).
Host plant: *Laportea terminalis* (Beeson and Bhatia, 1939).
Biology. Adults occur in September and October.
References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1960c (Biol.).

Smermus fisheri Gardner

Distribution. ORIENTAL REGION: India.
Host plant: *Clerodendrum infortunatum* (Mathur and Balwant Singh, 1960).
Reference. Mathur and Balwant Singh, 1960 (Biol.).

Spalacopsini

Tetraglenes insignis Newman

Distribution. ORIENTAL REGION: Burma, India (Madras, Mysore, Uttar Pradesh), Philippine Is.
Host plant: *Cryptolepis buchanani* (Gardner, 1931b).
Mature larva (fig. 193). Rather similar to those of *Pothyne* species but differing as

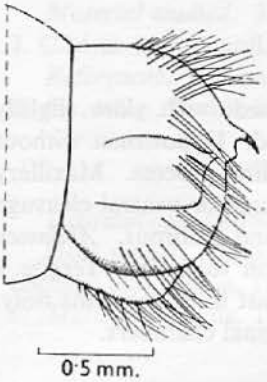

Fig. 193. *Tetraglenes insignis* Newman. Mature larva. Abdominal segment 9. Lateral aspect.

follows. Form appreciably more slender. *Head* more darkly pigmented ventrally than dorsally. Gular region with a very distinct pale median cleavage line. *Prothorax* with pronotum striate posteriorly and with lateral furrows defined. *Abdomen* with dorsal ampullae present on segments 1 and 7 only, the latter considerably wider than the former. Segment 9 bearing a small spine-like median tubercle (fig. 193) above the anal segment. *Spiracles* with peritreme round. Length up to 18 mm.; maximum breadth (at prothorax) 1·75 mm.

Pupa. Gardner (1931) gives the following brief description. "The pupa with bilobed ampullae on typical abdominal tergites, each lobe with from five to eight brownish points; the posterior extremity without spines but with several long fine setae."

Biology. This species, which infests dry climbers, emerges from May to August.

Material studied. 3 L, India, Uttar Pradesh, Dehra Dun, 23.i.1930, from *Cryptolepis buchanani*, J.C.M.G. leg., in coll. F.R.I.D.D.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Duffy, 1953a (L fig.); Gardner, 1931b (L fig., P, Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Nyctimenini

According to Gardner (1931b), this tribe is closely related to the Hippopsini on the basis of larvae of a single unknown species of *Nyctimene*, despite the fact that in the adult classification they appear to be only distantly related owing to the diversity in claw structure. Gardner concludes that either the divaricate claws of *Nyctimene* are anomalous, or this is a remarkable case of convergence of larval characters.

Nyctimene sp?

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: Unknown creeper (Gardner, 1931b).

Mature larva. No material available. Gardner (1931b) gives the following description. "Larva strongly curved, slender. Head thick, broadly oval in cross-section; frontal suture apparently entering antennal ring; one ocellus on each side. Labrum strongly transverse with anterior margin nearly straight. Maxillary palps three-jointed. Mandibles with two apical teeth and a third postapical tooth. Thoracic sternites enlarged, strongly protuberant, with fringes of long setae. Ampullae each consisting of two transverse rows of smooth tubercles separated by an impressed line, present on tergites of metathorax and abdominal segments 1, 2, 6 and 7; absent ventrally. Ninth abdominal segment swollen, truncate, with dense fringe of silky setae, with no spine. The larva has much in common with *Pothyne* spp."

Reference. Gardner, 1931b (L fig.).

Apodasyini

Larval Characters

Form slender, subcylindrical. *Head* moderately depressed, with sides slightly constricted behind middle. Antennal foramen closed behind. Hypostoma without setiferous pores. Antenna 2-segmented and bearing a hyaline process. Maxillary palp 2- or 3-segmented. Gular region without distinct sutures or ventral cleavage line. *Prothorax* with posterior area of pronotum shining and glabrous. *Abdomen* with ampullae each with two transverse rows of moniliform tubercles. Tergite 9 bearing spine-like urogomphi. Epipleurum protuberant on last three segments only. Pleural tubercle without sclerotized pits. *Spiracles* with marginal chambers.

Eupogonioides gardneri Fisher

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plant: *Cryptolepis buchanani* (Beeson and Bhatia, 1939).

Mature larva (fig. 194). Form rather robust, subcylindrical and abruptly constricted behind thoracic legs. *Head* moderately depressed, very slightly constricted medially, posteriorly very broadly rounded. Mouthframe rather broadly castaneous, especially laterally. One pair of ocelli present; lens large, pale ferruginous, pigmented spot black, very distinct. Hypostoma smooth, glabrous with front margin narrowly pale ferruginous; gular sutures undefined. Maxillary palp 2-segmented. Mentum distinct from submentum. *Prothorax* with posterior half of pronotum feebly strigose, glabrous; prosternum and sternellum tuberculate, eusternum triangular, well-defined, glabrous. *Abdomen* with each dorsal ampulla with a single transverse impression and two rows of rather large moniliform, glabrous tubercles, the posterior tubercles larger and four in number. Tergite 9 with a pair of almost erect urogomphi (fig. 194), which are broad and fleshy basally and acutely produced and ferruginous apically. Pleural tubercle without sclerotized pits. *Spiracles* with peritreme circular, pale. Length up to 13 mm.; maximum breadth (at prothorax) 3 mm.

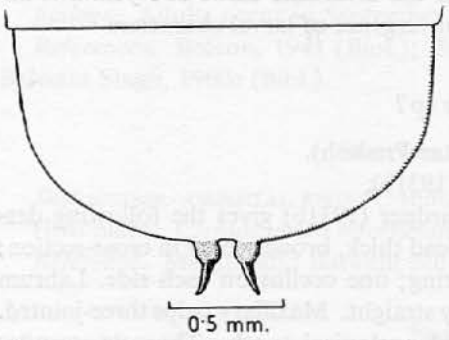

Fig. 194. *Eupogonioides gardneri* Fisher. Mature larva. Abdominal segment 9. Dorsal aspect.

Pupa. No material available. Gardner (1930) gives the following description. "—. Yellowish. Mesonotum and metanotum with a short medially interrupted brown line along anterior margin; the first six abdominal tergites each with a narrow brown line along anterior margin, that of first segment bowed, the remainder straight; seventh tergite with a less distinct line; posterior to these lines are numerous short brown setae; in addition each abdominal segment (except discally) with numerous longer setae. The terminal segment with a pair of rather narrowly separated spines. each wide basally and acute and castaneous apically."

Material studied. 3 L, India, Uttar Pradesh, Dehra Dun, xii.1928, from creeper, J. C.M.G. leg., in coll. B.M.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Gardner, 1930 (L fig., P fig., Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Eupogonioides carissae Fisher

Distribution. ORIENTAL REGION: India (Uttar Pradesh).

Host plants: *Carissa spinarum*, *Cryptolepis buchanani*, *Holarrhena antidysenterica* (Beeson and Bhatia, 1939).

Mature larva (fig. 195). Very similar to that of *E. gardneri* Fisher but differing as follows. *Head* broadly oval in cross-section, distinctly narrower posteriorly and without a median constriction. Urogomphi on tergite 9 very small, separated from one another by a distance equal to about five times their length (fig. 195).

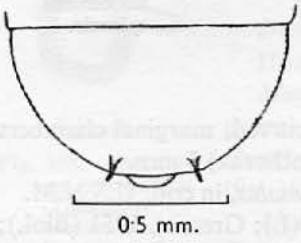

Fig. 195. *Eupogonioides carissae* Fisher. Mature larva. Abdominal segment 9. Dorsal aspect.

Pupa. No material available. Gardner (1930), however, remarks that the caudal spines are more widely separated than they are in *E. gardneri* Fisher.

Biology. Larvae of this species infest dry stems of climbers and twigs in which the pith channel is penetrated for several inches. Adults emerge from February to May.

Material studied. 1 L, India, Uttar Pradesh, Dhera Dun, 23.i.1930, from *Cryptolepis*, J.C.M.G. leg., in coll. F.R.I.D.D.

Pseudonaesthetis lauyana Pic

Distribution. ORIENTAL REGION: India.

Host plant: *Prunus persica* (Mathur and Balwant Singh, 1960d).

Reference. Mathur and Balwant Singh, 1960d (Biol.).

Chreonoma dioica (Fairmaire)

Distribution. ORIENTAL REGION: China, India.

Host plant: *Pyrus malus* (Lieu, 1945).

Mature larva (figs. 196, 197). Form slender, gradually tapering posteriorly. *Head* rather strongly depressed, widest before the slightly constricted middle, slightly narrowed posteriorly. Frons with sutures entering antennal foramen. Gula indiscernible. One pair of ocelli present. Maxillary palp 3-segmented. *Prothorax* with testaceous plates anteriorly; pronotum with posterior part densely covered with fine asperities and numerous longitudinal narrow, glabrous areas (fig. 196). Eusternum and sternellum with a small asperate patch on each side. *Abdomen* with each dorsal ampulla bearing three rows of glabrous moniliform tubercles. Pleural tubercle without sclerotized pits. Tergite 9 without a sclerotized process. Anus trilobate. *Spiracles* with

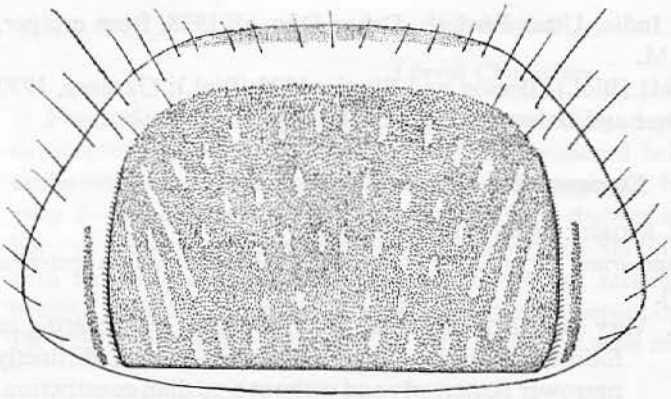

Fig. 196. *Chreonoma dioica* (Fairmaire). Mature larva. Prothorax. Dorsal aspect.

Fig. 197. *Chreonoma dioica* (Fairmaire). Mature larva. Peritreme of abdominal spiracle.

peritreme subcircular, with a pair of contiguous, slightly curved, marginal chambers (fig. 197). Length up to 20 mm.; maximum breadth (at prothorax) 3 mm.

Material studied. 2 L, 2 I, China, Chengtu, from *Pyrus malus*, in coll. U.S.N.M.

References. Duffy, 1953a (L fig., Biol.); Gardner, 1944 (L); Gressitt, 1951 (Biol.); Lieu, 1945 (Biol.).

Chreonoma testacea (Thomson)

Distribution. ORIENTAL REGION: Java.

Host plants: *Gardenia augusta, Ixora coccinea, Nauclea orientalis, Tarenna incerta* (Kalshoven, 1955b).

Mature larva. Apparently indistinguishable from that of *C. nigriventris* (Thomson).

Biology. Larvae tunnel beneath the bark of the host plants, girdling and killing the stems. The bark is slightly raised where the galleries run and later cracks, revealing plugs of coarse fibres. Pupation takes place in the wood. Adults are on the wing from August to October. They gnaw narrow strips in the leaf tissue parallel to the veins (Kalshoven, 1955b).

Material studied. 2 L, West Java, Bogor, xi.1924, L. G. E. Kalshoven, in coll. B.M.; 2 L, Java, 1932, L. G. E. Kalshoven leg., in coll. F.R.I.D.D.

References. Gardner, 1944 (L. fig.); Kalshoven, 1951 (Biol.), 1955b (Biol.); Mühlmann, 1954 (Biol.).

Chreonoma frontalis Gahan

Distribution. ORIENTAL REGION: Burma, India.

Host plants: *Nauclea excelsa, Mitragyna diversifolia* (Beeson, 1941); *Mitragyna rotundifolia* (Mathur and Balwant Singh, 1961).

References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Chreonoma fortunei Thomson

[The Blue Longicorn Beetle or the Pear Borer]

Distribution. ORIENTAL REGION: China (Kiangsu). PALAEARCTIC REGION: Japan, Korea.

Host plants: *Pourthiaea laevis, Photina glabra, Cydonia vulgaris, Ficus, Pyrus malus, P. communis* (Shiraki, 1952); *Prunus persica, P. armeniaca, P. domestica* (Cheo, 1935).

Biology. Adults feed on leaves of *Malus sieboldii* (Kojima, Watanabe and Nakamura, 1962).

References. Cheo, 1935 (Biol.); Kojima, 1959 (L fig.); Kojima, Watanabe and Nakamura, 1962 (Biol. fig.); Mühlmann, 1954 (Biol.); Shiraki, 1952 (Biol.).

Chreonoma nigriventris (Thomson)

Fig. 198. *Chreonoma nigriventris* (Thomson). Mature larva. Peritreme of abdominal spiracle.

Distribution. ORIENTAL REGION: Malaya, Singapore.

Host plant: *Gardenia florida.*

Mature larva (fig. 198). Very similar to that of *C. dioica* (Fairmaire) from which it may be distinguished by the marginal chambers of the spiracular peritreme which are longer and straight (fig. 198).

Material studied. 4 L, Malaya, Johore, Segamat Tenang, Voules Estate, 20.xi.1950, from stem of *Gardenia florida,* in coll. D.A.M.

References. None available.

Calliini

Neocallia pubescens Fisher

Distribution. ORIENTAL REGION: India (Madras).

Host plant: *Zanthoxylum rhetsa* (Beeson and Bhatia, 1939).

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Mathur and Balwant Singh, 1961b (Biol.).

Estolini

Larval Characters

Like the Apomecynini, which this tribe most closely resembles, there are stronger affinities to the Agapanthiini than to the Niphonini, near which this tribe has been placed on the basis of adult classification. The characters in common with the Apomecynini and Agapanthiini are the thick, strongly sclerotized head-capsule and the setose ninth abdominal segment which is subtruncate posteriorly (Duffy, 1960).

Diboma procera (Pascoe) (=**Sybra procera** Pascoe)

Distribution. ORIENTAL REGION: Ceylon, India (Assam, Mysore, Uttar Pradesh, West Bengal).

Host plants: *Acacia gageana* (Beeson and Bhatia, 1939); *Clerodendron* (Mathur and Balwant Singh, 1960).

Biology, Adults emerge in March, May, August, September and November.

References. Beeson, 1941 (Biol.); Beeson and Bhatia, 1939 (Biol.); Bhasin and Roonwal, 1954 (Biol.); Mathur and Balwant Singh, 1960 (Biol.).

Diboma alternata Breuning

Distribution. ORIENTAL REGION: India (Madras).
Host plant: *Clerodendron* sp. (Beeson, 1941).
Reference. Beeson, 1941 (Biol.).

Diboma biplagiata Breuning

Distribution. ORIENTAL REGION: India (Madras).
Host plant: *Strobilanthes* sp. (Beeson, 1941).
References. Beeson, 1941 (Biol.); Mathur and Balwant Singh, 1961 (Biol.).

Diboma posticata (Gahan)

Distribution. ORIENTAL REGION: Burma, India.
Host plant: *Dendrocalamus strictus* (Mathur and Balwant Singh, 1959).
Reference. Mathur and Balwant Singh, 1959 (Biol.).

Falsodiboma elongata Breuning

Distribution. ORIENTAL REGION: India.
Host plant: *Alnus nitida* (Bhasin and Roonwal, 1954).
Reference. Bhasin and Roonwal, 1954 (Biol.).

Trichodiboma clytoides Breuning

Distribution. ORIENTAL REGION: India.
Host plant: *Polyalthia simiarum* (Mathur and Balwant Singh, 1960d).
Reference. Mathur and Balwant Singh, 1960d (Biol.).

CATALOGUE OF HOST PLANTS OF ORIENTAL CERAMBYCIDAE

Abies firma. *Megopis sinica sinica, Monochamus alternatus.*

Abies pindrow. *Leptura rubriola, Prionus corpulentus, Teledapus dorcadioides.*

Abies sachalinensis. *Megopis sinica sinica, Prionus insularis.*

Abies webbiana. *Glenea quatuordecimmaculata, Prionus corpulentus, Stromatium barbatum.*

Abies spp. *Acanthocinus griseus, Apheles gracilis, Arhopalus rusticus, Callidiellum rufipenne, Hylotrupes bajulus, Monochamus alternatus, Spondylis buprestoides.*

Acacia arabica. *Aeolesthes holosericea, Celosterna scabrator, Coptops aedificator, Epipedocera acaciae, Exocentrus alboguttatus, Stromatium barbatum, Purpuricenus sanguinolentus, Xystrocera globosa.*

Acacia aulacocarpa. *Xylotrechus australis.*

Acacia caesia. *Moechohecyra verrucicollis, Niphona malaccensis, Polyzonus tetraspilotus, Stromatium barbatum.*

Acacia catechu. *Celosterna scabrator, Ceresium leucostictum, Demonax buteae, Dere acaciae, Hypoeschrus indicus, Perissus laetus, Stromatium barbatum, Xystrocera globosa, Zoodes compressus.*

Acacia confusa. *Xystrocera globosa.*

Acacia dealbata. *Stromatium barbatum.*

Acacia eburnea. *Stromatium barbatum.*

Acacia farnesiana. *Stromatium barbatum.*

Acacia gageana. *Demonax formicoides, Diboma procera, Eunidia simplex, Exocentrus alboguttatus, E. cudraniae, E. dalbergiae, E. flemingiae, Moechotypa sikkimensis, Pothyne acaciae, Pterolophia dalbergiae, P. gardneri, P. persimilis, P. transverseplagiata.*

Acacia intsia. *Ceresium leucostictum, Moechohecyra verrucicollis, Niphona malaccensis.*

Acacia jacquemontii. *Stromatium barbatum.*

Acacia latronum. *Stromatium barbatum.*

Acacia leucophloea. *Dere posticata, Diorthus cinereus, Falsomesosella bifasciata, Kunbir telephoroides, Pelargoderus bipunctatus, Rhaphuma maculata, Sthenias grisator, Stromatium barbatum.*

Acacia melanoxylon. *Megopis cingalensis, Therippia affinis.*

Acacia modesta. *Derolus discicollis, Stromatium barbatum, Xystrocera globosa.*

Acacia mollissima. *Xystrocera globosa.*

Acacia nilotica. *Hylotrupes bajulus.*

Acacia pennata. *Aesopida malasiaca, Ceresium leucostictum, Clytus balwanti, Coptops aedificator, Mesosa indica, Pelargoderus bipunctatus, Stromatium barbatum.*

Acacia senegal. *Hypoeschrus indicus, Stromatium barbatum.*

Acacia smithia. *Monochamus alternatus.*

Acacia spp. *Anagelasta apicalis, Batocera rufomaculata, Ceresium unicolor, Chlorophorus jucundus, Clytocera chinospila, Coptops aedificator, Dere thoracica, Derolus volvulus, Diorthus sericeus, Eunidia lateralis, Moechohecyra verrucicollis, Pterolophia griseofasciata, P. occidentalis, Xystrocera subcarinatus.*

Acalypha tricolor. *Niphonoclea capito.*

Acer campbelli. *Morimopsis lacrymans, Stromatium barbatum.*

Acer caudatum. *Stromatium barbatum.*

Acer pictum. *Aeolesthes sarta, Stromatium barbatum.*

Acer pseudoplatanus. *Aromia moschata, Stromatium barbatum.*

Acer villosum. *Stromatium barbatum.*

Acer spp. *Aeolesthes sinensis.*

Acrocarpus fraxinifolius. *Aesopida malasiaca, Cacia cretifera, Ceresium rufum, Chlorophorus acrocarpi, Coptops aedificator, C. leucostictica, Dihammus elongatus, Exocentrus albizziae, Mesosa bimaculata, Neosybra ropicoids, Pterolophia obscuroides, P. occidentalis P. pseudotincta, P. transverseplagiata, Rhaphuma acrocarpi, Ropica affinis, R. fusconigrita, Stromatium barbatum, Xylotrechus buqueti, Xystrocera globosa.*

Acrocarpus sp. *Pterolophia occidentalis.*

Actinophora fragrans. *Cacia herbacea, Dialeges undulatus, Exocentrus actinophorae, Glenea cincticornis, Hesperophanes javanus, Sybra alternans.*

Actinophora spp. *Ostedes pauperata, Pterolophia circulata, P. melanura, ?P. secuta, Ropica honesta, R. illiterata, R. vinacea.*

Adansonia digitata. *Coptops aedificator.*

Adenanthera pavonina. *Blepephaeus succinctor, Xystrocera globosa.*

Adina cordifolia. *Anagelasta apicalis, Aristobia approximator, Batocera rufomaculata, Dihammus admixtus, D. cervinus, D. gardneri, D. griseoplagiatus, Microlenecamptus signatus, Stromatium barbatum, Xylotrechus smei, Xystrocera globosa.*

Adinandra formosana. *Oplatocera oberthuri.*

Aegle marmelos. *Aeolesthes holosericea, Coptops aedificator, Derolus volvulus, Dihammus rusticator, Glenea angerona, Stromatium barbatum, Xylotrechus smei.*

Aeschynomene aspera. *Nupserha bicolor.*

Aesculus hippocastanum. *Stromatium barbatum.*

Aesculus indica. *Aeolesthes sarta, Stromatium barbatum.*

Aesculus punduana. *Dihammus elongatus, D. punctifrons, Paradihammus sericeus.*

Afzelia bijuga. *Celosterna carissima, Coptops polyspila, C. annulipes, Dihammus rusticator.*

Afzelia spp. *Coptops aedificator.*

Agathis robusta. *Dihammus mixtus.*

Agave sisiana. *Prosoplus banki.*

Ageratum conyzoides. *Nupserha madurensis, N. malabarensis.*

Ailanthus excelsa. *Xylotrechus smei.*

Ailanthus malabarica. *Rhaphipodus subopacus.*

Alangium salvifolium. *Stromatium barbatum.*

Albizia chinensis. *Stromatium barbatum, Xystrocera festiva, X. globosa.*

Albizia distachya. *Stromatium barbatum.*

Albizia falcata. *Xystrocera festiva.*

Albizia julibrissin. *Dere thoracica, Stromatium barbatum.*

Albizia lebbek. *Annamanum indicum, Batocera rufomaculata, Ceresium nilgiriense, Coptops aedificator, Demonax balyi, Derolus volvulus, Exocentrus albizziae, E. pubescens, Hyagnis persimilis, Leptepania indica, Moechohecyra verrucicollis, Pterolophia circulata, P. dalbergiae, P. griseofasciata, P. transversefasciata, Xystrocera festiva, X. globosa.*

Albizia lebbekoides. *Stromatium barbatum.*

Albizia lophantha. *Stromatium barbatum.*

Albizia lucida. *Ceresium leucostictum, Coptops leucostictica, Eunidia simplex, Pterolophia andamanica, Ropica granuliscapa, Xystrocera globosa.*

Albizia moluccana. *Xystrocera globosa.*

Albizia odoratissima. *Cacia cretifera, Ceresium leucostictum, Chlorophorus hederatus, Coptops leucostictica, Diastocera wallichi, Diorthus cinereus, Gnatholea simplex, Mesosa bimaculata, Moechohecyra verrucicollis, Perissus laetus, Pterolophia blairiella, Rhaphuma horsfieldi, Xystrocera globosa.*

Albizia procera. *Chlorophorus acrocarpi, Coptops leucostictica, Pelargoderus bipunctatus, Stromatium barbatum, Xystrocera globosa.*

Albizia sassa. *Coptops aedificator.*

Albizia stipulata. *Chlorophorus acrocarpi, Eunidia apicemaculata, Perissus laetus, Stromatium barbatum, Xystrocera festiva, X. globosa.*

Albizia sumatrana. *Xystrocera festiva.*

Albizia zygia. *Coptops aedificator.*

Albizia spp. *Batocera tigris* var. *hector, Cacia cretifera, Epepeotes spinosus, Milothris irrorata, Moechotypa sikkimensis, Pelargoderus bipunctatus, Pterolophia annulata, P. gerardiniae, Xylotrechus quadripes.*

Albizzia, see **Albizia.**

Aleurites fordii. *Apriona germari.*

Aleurites sp. *Dihammus rusticator.*

Allamanda cathatica. *Sthenias grisator.*

Allophilus cobbe. *Celosterna javana.*

Alnus glutinosa. *Stromatium barbatum.*

Alnus nepalensis. *Batocera horsfieldi, Dihammus inaequalis, Exocentrus alni, Ischnodora macra, Stromatium barbatum.*

Alnus nitida. *Falsodiboma elongata, Aeolesthes holosericea, Stromatium barbatum, Sarmydus subcoriaceus.*

Alnus spp. *Acanthocinus griseus, Hylotrupes bajulus, Leptura succedanea.*

Alseodaphne semecarpifolia. *Megopis cingalensis.*

Alstonia scholaris. *Batocera rubus.*

Amhurstia nobilis. *Coptops annulipes, Ostedes pauperata.*

Amoora wallichii. *Anoplophora versteegi.*

Anacardium occidentale. *Aeolesthes holosericea, Coptops aedificator, Glenea multiguttata, Plocaederus ferrugineus.*

Anacardium sp. *Dihammus marianarum.*

Angophora intermedia. *Coptocercus biguttatus, Phoracantha semipunctata.*

Anisoptera glabra. *Hoplocerambyx spinicornis.*

Anona cherimolia. *Aristobia approximator.*

Annona squamosa. *Aristobia testudo, Stromatium barbatum.*

Annona sp. *Aristobia approximator.*

Anogeissus acuminata. *Chlorophorus hederatus, Desisa subfasciata, Dihammus admixtus, D. cervinus, D. elongatus, D. gardneri, Margites exiguus, M. modicus, Nyphasia apicalis, N. pascoei, Olenecamptus indianus, O. salweeni, Perissus laetus, Stromatium longicorne.*

Anogeissus latifolia. *Aeolesthes holosericea, Ceresium leucostictum, Cylindrepomus uniformis, Diorthus cinereus, Exocentrus alboguttatus, Gelonaetha hirta, Hyagnis fistularius, Margites modicus, Olenecamptus anogeissi, O. indianus, O. salweeni, Stromatium barbatum, Xylotrechus smei.*

Anogeissus pendula. *Olenecamptus anogeissi, Stromatium barbatum.*

Anogeissus sericea. *Stromatium barbatum.*

Anthocephalus cadamba. *Batocera numitor, Dihammus cervinus, D. elongatus, Stromatium barbatum.*

Anthocephalus indicus. *Sybra alternans.*

Antiaris toxicaria. *Coptops aedificator.*

Antidesma tetrandrum. *Celosterna javana, Ceresium zeylanicum.*

Aporosa villosula. *Margites exiguus, Monochamus bimaculatus.*

Aporosa sp. *Dihammus admixtus, D. gardneri.*

Aralia sp. *Sthenias grisator.*

Araucaria sp. *Dihammus mixtus.*

Ardisia humilis. *Stromatium barbatum.*

Ardisia solanacea. *Stromatium barbatum.*

Argyrodendron trifoliolatum. *Xylotrechus australis.*

Artocarpus altilis. *Batocera rufomaculata, Dihammus gardneri.*

Artocarpus blumei. *Olenecamptus bilobus.*

Artocarpus calophylla. *Stromatium barbatum.*

Artocarpus chaplasha. *Apriona germari, Olenecamptus bilobus.*

Artocarpus communis. *Choeromorpha pigra, Myagrus vinosus.*

Artocarpus elastica. *Myagrus vinosus, Olenecamptus bilobus.*

Artocarpus fraxinifolius. *Pharsalia saturalis.*

Artocarpus heterophyllus. *Pterolophia penicillata, Ropica honesta, Sybra alternans, Xenolea tomentosa, X. collarts.*

Artocarpus hirsuta. *Macrochenus tigrinus, Olenecamptus bilobus, Pterolophia occidentalis.*

Artocarpus incisa. *Batocera rufomaculata.*

Artocarpus integra. *Batocera rufomaculata, Olenecamptus bilobus, Apriona flavescens, A. germari, Batocera rubus, Dihammus rusticator, Epepeotes luscus, E. spinosus, E. uncinatus, Glenea belli, Macrochenus tigrinus, Mesosa columba, Myagrus vinosus, Oberea artocarpi, Prosoplus banki, Pterolophia infirmior, P. melanura, ?P. secuta, P. triangularis, Ropica honesta, R. illiterata, R. vinacea, Sthenias grisator, Sybra alternans.*

Artocarpus integrifolia, see **A. integra.**

Artocarpus lakoocha. *Stromatium barbatum.*

Artocarpus lingnanensis. *Batocera rubus.*

Artocarpus nobilis. *Macrochenus tigrinus.*

Artocarpus polyphemia. *Apriona flavescens.*

Artocarpus spp. *Ceresium flavipes, C. unicolor, Coptops aedificator, Dihamnus marianarum, Sybra alternans.*

Arundinaria chino. *Niphona furcata?*

Arundiharia simonii. *Niphona furcata.*

Asina sp. *Batocera rufomaculata.*

Aster yomena. *Phytoecia rufiventris* var. *ventralis.*

Astrebla lappacea. *Apomecyna histrio.*

Atlantica buxifolia. *Anoplophora chinensis.*

Averrhoa carambola. *Stromatium barbatum.*

Balanites roxburghii. *Stromatium barbatum.*

Bamboo. *Niphona hookeri.*

Bambusa polymorpha. *Abryna regis-petri, Pterolophia bambusae.*

Bambusa tulda. *Anamera similis.*

Bambusa vulgaris. *Niphona furcata?*

Bambusa spp. *Chlorophorus annularis, Dorysthenes buqueti, Purpuricenus san, guinolentus, Sternoplistes temminckiStromatium barbatum.*

Baphia nitida. *Coptops aedificator.*

Barringtonia acutangula. *Batocera rufomaculata.*

Barringtonia speciosa. *Niphonoclea capito.*

Barringtonia spicata. *Dihammus rusticator.*

Barringtonia spp. *Cacia herbacea, Ceresium raripilum, Dihammus marianarum, Ostedes pauperata, Pterolophia circulata, Sybra alternans.*

Bauhinia acuminata. *Aeolesthes holosericea, Batocera rufomaculata, Xystrocera globosa.*

Bauhinia foveolata. *Stromatium barbatum.*

Bauhinia hisuta. *Sybra alternans.*

Bauhinia malabrica. *Ceresium zeylanicum, Exocentrus bauhiniae.*

Bauhinia purpurea. *Coptops aedificator, Mesosa indica, Stromatium barbatum.*

Bauhinia racemosa. *Stromatium barbatum.*

Bauhinia retusa. *Aeolesthes holosericea, Cacia cretifera, Coptops aedificator, Mesosa gardneri, M. subfasciata, Perissus mutabilis, Stromatium barbatum, Xylotrechus smei.*

Bauhinia vahlii. *Aesopida malasiaca, Anagelasta apicalis, Chlorophorus shoreae, Coptops aedificator, C. leucostictica, Demonax formicoides, Desisa subfasciata, Diorthus cinereus, Epipedocera chakhata, E. parva, Exocentrus alboguttatus, E. dalbergiae, Falsomesosella gardneri, Glosinda basicornis, Kunbir telephoroides, Mesosa bifasciata, M. gardneri, M. indica, M. subfasciata, Paraleprodera insidiosa, Perissus bauhiniae, Pterolophia gardneri, P. occidentalis, P. transverseplagiata, Rhaphuma maculata, Ropica signatoides, Stromatium barbatum.*

Bauhinia variegata. *Aeolesthes holosericea, Coptops aedificator, Stromatium barbatum.*

Bauhinia sp. *Olenecamptus bilobus.*

Besumontia grandiflora. *Sthenias grisator, Stromatium barbatum.*

Beilschmiedia sikkimensis. *Agelasta bifasciana, Aglaophis longispinis.*

Benincasa hispida. *Apomecyna alboguttata.*

Berberis asiatica. *Cacia cretifera.*

Berlinia acuminata. *Coptops aedificator.*

Berrya cordifolia. *Ceresium rotundicolle, Dialeges undulatus, Gelonaetha hirta.*

Betula alnoides. *Stromatium barbatum.*

Betula utilis. *Stromatium barbatum.*

Betula verrucosa. *Stromatium barbatum.*

Betula sp. *Hylotrupes bajulus, Trinophylum cribratum.*

Bidens pilosa. *Nupserha madurensis, N. malabarensis.*

Bischofia javanica. *Stromatium barbatum.*

Bischofia trifoliata. *Batocera rubus.*

Boehmeria nivea. *Paraglenea fortunei.*

Bombax, see **Salmalia.**

Boswellia serrata. *Aeolesthes holosericea, Batocera rufomaculata, Coptops aedificator, C. leucostictica, Glenea multiguttata, Margites modicus, Plocaederus ferrugineus, P. obesus, Prionomma atratum, Stromatium barbatum, Xylotrechus smei.*

Bougainvillaea spectabilis. *Sthenias grisator.*

Bougainvillaea sp. *Sthenias grisator.*

Bridelia retusa. *Aeolesthes holosericea, Derolus volvulus, Xylotrechus smei.*

Bridelia stipularis. *Celosterna javana.*

Bridelia tomentosa. *Stromatium barbatum.*

Broussonetia papyrifera. *Anoplophora chinensis, Apriona germari, Batocera rufomaculata, Stromatium barbatum.*

Bruguiera rheedii. *Olethrius tyrannus.*

Buchanania arborescens. *Cacia herbacea, Dihammus rusticator.*

Buchanania florida. *Chloridolum cyanipes.*

Buchanania lanzan. *Aesopida malasiaca, Anagelasta apicalis, Aphrodisium cantori, Apiocephalus licheneus, Batocera rufomaculata, Chlorophorus shoreae, Coptops aedificator, Derolus volvulus, Glenea multiguttata, Mesosa indica, Perissus bauhiniae, Pharsalia subgemmatus, Plocaederus ferrugineus, P. obesus, Xylotrechus smei.*

Buchanania latifolia, see **B. lanzan.**

Buchanania sp. *Pterolophia circulata.*

Bucklandia, see **Symingtonia.**

Buddleia madagascarensis. *Dihammus cervinus.*

Buettneria pilosa. *Glenea pulchra.*

Butea frondosa, see **B. monosperma.**

Butea monosperma. *Aeolesthes holosericea, Aristobia horridula, Coptops aedificator, Demonax balyi, D. buteae, Falsomesosella transversefasciata, Glenea angerona, Mesosa ornata, Pelargoderus bipunctatus, Perissus mutabilis, Plocaederus obesus, P. pedestris, Pterolophia gerardiniae, P.*

melanura, ?P. secuta, Stromatium barbatum, Xylotrechus smei.

Butea parviflora. *Coptops aedificator, Pterolophia occidentalis, Stromatium barbatum.*

Butea superba. *Apriona swainsoni, Diorthus cinerus.*

Cajanus cajan. *Anoplophora chinensis, Apriona germari, Dihammus punctifrons.*

Cajanus indicus, see **C. cajan.**

Callicarpa arborea. *Xylorhiza adusta.*

Callicarpa macrophylla. *Xylorhiza adusta.*

Calophyllum apetalum. *Epania calophylli.*

Calophyllum walkeri. *Glenea arithmetica.*

Calophyllum wrightianum, see **C. apetalum.**

Calotropis gigantea. *Dihammus nivosus.*

Calotropis procera. *Niphona indica* var. *assimilis, N. stramentosa, Ropica praeusta, Sybra ceylonensis.*

Calycopteris floribunda. *Xylotrechus smei.*

Camellia sinensis. *Trachylopis sinensis.*

Camellia thaea. *Aeolesthes induta, Dihammus cervinus, Hoplothrix griseatus.*

Canarium commune. *Epepeotes luscus, Pelargoderus bipunctatus, Rhytidodera simulans.*

Canarium euphyllum. *Batocera rufomaculata, Dihammus andamanicus, Epepeotes andamanicus, Pharsalia subgemmatus.*

Canarium strictum. *Stromatium barbatum.*

Canarium sp. *Ceresium rufum, Pharsalia saperdoides, Pterolophia melanura, ?P. secuta, Xylotrechus quadripes.*

Cannabis sativa. *Thyestilla gebleri.*

Capparis sp. *Prosoplus banki.*

Carallia brachiata. *Stromatium barbatum.*

Carallia integerrima, see **C. brachiata.**

Carapa granatum. *Stromatium barbatum.*

Carapa moluscanum, see **C. granatum.**

Careya arborea. *Aeolesthes holosericea, Ceresium leucosticticum, C. zeylanicum, Coptops aedificator, Derolus volvulus, Niphona malaccensis, Xylotrechus smei.*

Carica papaya. *Batocera rufomaculata, Dihammus australis.*

Carpinus betulus. *Stromatium barbatum.*

Carpinus viminea. *Stromatium barbatum.*

Careya arborea. *Moechohecyra verrucicollis.*

Carissa opaca. *Exocentrus carissae, E. cudraniae.*

Carissa spinarum. *Eupogonioides carissae.*

Carpinus. *Trinophylum cribratum.*

Carya pecan. *Anoplophora chinensis.*

Caryota urens. *Plocaederus obesus.*

Casearia glomerata. *Dihammus elongatus.*

Casearia tomentosa. *Aeolesthes holosericea.*

Cassava. *Pelargoderus bipunctatus.*

Cassia auriculata. *Pterolophia melanura. ?P. secuta, Stromatium barbatum.*

Cassia fistula. *Aristobia approximator, Artimpaza bicolor, Ceresium flavipes, Ceresium leucostictum, C. rotundicolle, C. rufum, Dere cassiae, Diorthus cinereus, Perissus laetus, Pothyne acaciae, Stromatium barbatum, S. longicorne, Xylotrechus buqueti, X. smei.*

Cassia glauca. *Xystrocera globosa.*

Cassia multijuga. *Milothris irrorata.*

Cassia nodosa. *Stromatium barbatum.*

Cassia renigera. *Aristobia approximator.*

Cassia siamea. *Celosterna scabrator, Ceresium leucosticticum, Coptops aedificator, Derolus volvulus, Exocentrus beesoni, Stromatium barbatum.*

Cassinia aculeata. *?Dihammus mixtus.*

Castanea crenata. *Stenygrinum quadrinotatum.*

Castanea mollissima. *Macrotoma fisheri.*

Castanea pubinervis. *Stenygrinum quadrinotatum.*

Castanea sativa. *Batocera lineolata, Mallambyx raddei.*

Castanea sp. *Batocera horsfieldi, B. lineolata, Demonax lineolatus, Glenea relicta, Mesosa myops.*

Castanopsis argyrophylla. *Ceresium leucosticticum, C. rufum, Rhaphuma desaii.*

Castanopsis tribuloides. *Pseudomeges marmoratus.*

Castanopsis sp. *Glenea ornata.*

Castilla elastica. *Batocera rubus, Epepeotes luscus.*

Castilla sp. *Apriona flavescens, Pterolophia melanura, P. secuta.*

Castilloa, see **Castilla.**

Casuarina equisetifolium. *Anoplophora chinensis, Celosterna scabrator, Ceresium flavipes, Macrotoma spinosa, Niphona cylindracea, N. malaccensis, Sthenias grisator, Stromatium barbatum.*

Casuarina sp. *Ceresium unicolor.*

Cattleya sp. *Sybra alternans.*

Clerodendron infortunatum. *Dihammus cervinus.*

Cryptocarya wightiana. *Xylotrechus buqueti.*

Ceiba pentandra. *Batocera rufomaculata, Glenea angerona, G. novemguttata, Moechotypa suffusa, Niphonoclea capito, Plocaederus obesus, Pterolophia arrowiana.*

Ceiba sp. *Pterolophia melanura, ?P. secuta, P. triangularis, Ropica honesta, R. illiterata, R. vinacea.*

Cedrela australis. *Dihammus mixtus.*

Cedrela serrata. *Xylotrechus contortus.*

Cedrela sinensis. *Aeolesthes sinensis.*

Cedrela toona. *Aeolesthes holosericeus, Monochamus bimaculatus, Plocaederus obesus, Pterolophia obscuroides, Xylotrechus buqueti, X. smei.*

Cedrus deodara. *Arhopalus tibetanus, Dorysthenes hugeli, Leptura rubriola, Monochamus alternatus, Stromatium barbatum, Teledapus dorcadioides, Tetropium oreinum, Trinophylum cribratum.*

Cedrus sp. *Monochamus alternatus.*

Celtis australis. *Palimnodes ducalis, Stromatium barbatum, Xylotrechus buqueti.*

Celtis sinensis. *Apriona germari, Rhytidodera bowringi.*

Celtis soyauxi. *Coptops aedificator.*

Cephalandra sp. *Apomecyna histrio.*

Chamaecyparis obtusa. *Callidiellum rufipenne, Prionus insularis, Semanotus bifasciatus.*

Chlorophora excelsa. *Coptops aedificator, Sthenias grisator.*

Chloroxylon swietenia. *Aeolesthes holosericea, A. induta, Sthenias grisator, Stromatium barbatum, Tetraommatus filiformis, Xylotrechus carinifrons, X. smei.*

Chrysanthemum morifolium. *Phytoecia rufiventris* var. *ventralis.*

Chrysanthemum sp. *Phytoecia rufiventris var. ventralis.*

Chydenanthus excelsus. *Dihammus rusticator.*

Cinnamomum burmanni. *Ceresium raripilum.*

Cinnamomum camphora. *Ceresium sinicum, Eupromus ruber, Niphonoclea capito, Pyrestes cardinalis.*

Cinnamomum glanduliferum. *Stromatium barbatum.*

Cinnamomum tamala. *Stromatium barbatum.*

Cinnamomum sp. *Eurypoda batesi.*

Cirsium sp. *Thyestilla gebleri.*

Citrus aurantifolia. *Anoplophora chinensis, Chelidonium argentatum, Nadezhdiella cantori.*

Citrus aurantium. *Anoplophora chinensis, A. versteegi, Apriona germari, Chelidonium argentatum, C. cinctum, Chloridolum alcmene, Gnatholea eburifera, Oberea lateapicalis, Stromatium barbatum.*

Citrus deliciosa. *Aeolesthes sinensis.*

Citrus grandis, see **C. maxima.**

Citrus limon. *Nadezhdiella cantori.*

Citrus limonia. *Anoplophora chinensis, Chelidonium argentatum, Nadezhdiella cantori.*

Citrus maxima. *Anoplophora chinensis, Chelidonium cinctum, Gnatholea eburifera, Nadezhdiella cantori, Stromatium barbatum.*

Citrus medica. *Chelidonium cinctum, Chloridolum alcmene, Oberea posticata, Stromatium barbatum.*

Citrus microcarpa. *Chelidonium argentatum.*

Citrus nobilis, see **C. reticulata.**

Citrus reticulata. *Anoplophora chinensis, Chelidonium argentatum, Chloridolum alcmene.*

Citrus sinensis. *Anoplophora chinensis, Nadezhdiella cantori.*

Citrus tangerina. *Anoplophora chinensis, Nadezhdiella cantori.*

Citrus sp. *?Aeolesthes induta, Ceresium flavipes, C. sinicum, Coptops aedificator, Chelidonium gibbicolle, Chlorophorus annularis, Dihammus rusticator, Megopis sinica, Mesosa myops, M. perplexa, Niphonoclea capito, Pelargoderus bipunctatus, Philus antennatus, Priotyrannus closteroides, Prosoplus banki, Pterolophia melanura, ?P. secuta.*

Clausena lansium. *Stromatium barbatum.*

Cleistopholis patens. *Coptops aedificator.*

Clerodendron colebrookianum. *Stromatium barbatum.*

Clerodendron infortunatum. *Blepephaeus nigrosparsus, Cacia cretifera, Exocentrus alboguttatus, E. dalbergiae, Oberea modica, Pterolophia persimilis, Rondibilis plagiata, Smermus fisheri.*

Clerodendron sp. *Diboma alternata, D. procera, Dihammus elongatus, Falsohyagnis alternata.*

'climber.' *Pterolophia obscuroides.*

Coccinia indica. *Apomecyna saltator.*
Cocos nucifera. *Batocera rufomaculata, Olethrius tyrannus.*
Codiaeum maculata. *Xylotrechus smei, X. subscutellatus.*
Codiaeum variegatum. *Sthenias grisator.*
Coffea arabica. *Coptops aedificator, Stromatium barbatum, Xylotrechus grayi, X. quadripes, X. subscutellatus.*
Coffea canephora. *Coptops aedifiactor.*
Coffea excelsa. *Coptops aedificator.*
Coffea liberica. *Xylotrechus quadripes.*
Coffea robusta. *Xylotrechus quadripes.*
Coffea sp. *Batocera tigris* var. *hector, Coptops aedificator, Dihammus rusticator, Glenea lefeburei, Pterolophia melanura, ?P. secuta, ?Thranodes pictiventris, Xylotrechus javanicus, Xystrocera festiva.*
Combretum decandum. *Atimura combreti, Exocentrus cudraniae, Pothyne combreti.*
Coniferae. *Asemum amurense.*
Conium maculatum. *Hylotrupes bajulus.*
Convolvulus sp. *Nupserha quadrioculata.*
Corchorus olitorius. *Nupserha bicolor.*
Cordia dichotoma. *Plocaederus obesus, Stromatium barbatum.*
Cordia myxa, see **C. dichotoma.**
Cordia sp. *Ceresium unicolor, Sybra alternans.*
Cordyline australis. *Stromatium barbatum.*
Cornus macrophylla. *Stromatium barbatum.*
Corylus colurna. *Aeolesthes sarta, Stromatium barbatum.*
Corylus ferox. *Stromatium barbatum.*
Corylus sp. *Hylotrupes bajulus.*
Cotoneaster bacillaris. *Stromatium barbatum.*
Cotoneaster microphylla. *Stromatium barbatum.*
Couroupita guianensis. *Rhytidodera simulans.*
Crataegus cordata. *Apriona germari.*
Crataegus crenulata. *Stromatium barbatum.*
Crataegus oxyacantha. *Stromatium barbatum.*
Crataegus scabrifolia. *Aeolesthes sinensis.*
Crataeva unilocularis. *Epepeotes uncinatus.*
'creeper.' *Nyctimene* sp.
Crotolaria juncea. *Nupserha bicolor.*
Crotolaria saltiana. *Nupserha bicolor.*
Crotolaria sp. *Milothris irrorata, Prosoplus banki, Zygrita diva.*
Croton tiglium. *Pterolophia persimilis.*
Croton sp. *Sthenias grisator.*
Cryptolepis buchanani. *Eupogonioides carissae, E. gardneri, Pterolophia transverseplagiata, Ropica rufescens, Tetraglenes insignis.*
Cryptomeria japonica. *Callidiellum rufipenne, Dorysthenes socius, Prionus insularis, Sarmydus antennatus, Stromatium barbatum.*
Cryptomeria sp. *Arhopalus rusticus, Spondylis buprestoides.*
Cucumis sativa. *Apomecyna neglecta, Ropica formosana* var. *dorsalis.*
Cucumis sp. *Apomecyna histrio.*
Cucurbita maxima. *Apomecyna histrio.*
Cucurbita moschata. *Apomecyna saltator.*
Cucurbita pepo. *Apomecyna histrio, A. saltator.*
Cudrania javanensis. *Coptops aedificator, Exocentrus alboguttatus, E. cudraniae, Pterolophia occidentalis, Ropica rufescens, Stromatium barbatum, Xenolea tomentosa, Xylotrechus quadripes.*
Cunninghamia sinensis. *?Monochamus alternatus.*
Cupressus lawsoniana. *Perissus parvulus.*
Cupressus torulosa. *Stromatium barbatum.*
Cupressus sp. *Arhopalus rusticus, Callidiellum rufipenne, Stromatium longicorne.*
Cycas sp. *Sybra alternans.*
Cydonia japonica. *Linda fraterna.*
Cydonia oblonga. *Aeolesthes sarta, Oberea japonica.*
Cydonia vulgaris. *Chreonoma fortunei.*
Cymbidium sp. *Dihammus mixtus.*
Cynoglossum lanceolatum. *Nupserha madurensis.*
Cynometra ramiflora. *Aeolesthes holosericea.*
Cynometra sp. *?Pterolophia camura.*

Dacrydium cupressinum. *Hylotrupes bajulus.*
Dalbergia balansae. *Blepophaeus succinctus.*
Dalbergia fusca. *Ceresium leucosticticum, Diorthus cinereus, Perissus laetus, P. mutabilis.*
Dalbergia hircina. *Stromatium barbatum.*
Dalbergia kurzii. *Stromatium barbatum.*
Dalbergia lanceolaria. *Stromatium barbatum.*
Dalbergia latifolia. *Cacia herbacea, Chlorophorus sumatrensis Exocentrus bauhiniae, Parorsidis birmanica, Pterolophia gardneri,*

P. melanura, ?P. secuta, P. persimilis, P. triangularis, Stromatium barbatum, Xylotrechus smei, X. subscutellatus.

Dalbergia ovata. *Stromatium barbatum.*

Dalbergia paniculata. *Aristobia horridula, Coptops aedificator, Mesosa griseiventris, Pterolophia occidentalis, Stromatium barbatum, Xylotrechus smei.*

Dalbergia rimosa. *Stromatium barbatum.*

Dalbergia sericea. *Stromatium barbatum.*

Dalbergia sissoo. *Acanthophorus serraticornis, Batocera rubus, B. rufomaculata, Cacia cretifera, Diorthus cinereus, Exocentrus dalbergiae, Monochamus bimaculatus, Perissus dalbergiae, Pterolophia dalbergiae, Rhaphuma bimaculata, Stromatium barbatum, Xylotrechus smei.*

Dalbergia stipulacea. *Stromatium barbatum.*

Dalbergia volubilis. *Aristobia horridula, Apriona swainsoni.*

Dalbergia sp. *Diorthus cinereus, Nupserha variabilis.*

Daphniphyllum macropodum. *Dihammus cervinus.*

Datura sp. *Dihammus rusticator.*

Debregeasia hypoleuca. *Apriona cinerea, Stromatium barbatum.*

Deguelia sp. *Pterolophia melanura, ?P. secuta.*

Delonix elata, see **Poinciana elata.**

Delonix regia. *Aeolesthes induta.*

Dendrobium nobile. *Diaxenes dendrobii.*

Dendrobium wardianum. *Diaxenes dendrobii.*

Dendrobium sp. *Diaxenes phalaenopsidis, Sybra alternans.*

Dendrocalamus strictus. *Chlorophorus annularis, Diboma posticata, Merionoeda nigriceps, Mesosa indica, Purpuricenus sanguinolentus, Ropica signata, Stromatium barbatum.*

Derris dalbergioides. *Coptops lichenea.*

Derris eliptica. *Perissus laetus, Pterolophia melanura, ?P. secuta.*

Derris robusta. *Perissus laetus, Pterolophia densefasciculata, P. melanura, ?P. secuta.*

Derris scandens. *Pterolophia persimilis.*

Derris sp. *Gnoma confusa, Pterolophia melanura, ?P. secuta.*

Desmodium tiliaefolium. *Stromatium barbatum.*

Deutzia corymbosa. *Stromatium barbatum.*

Deutzia staminea. *Stromatium barbatum.*

Dichopsis grandis. *Ceresium rotundicolle, Diorthus cinereus, Hypoeschrus indicus.*

Diospyros chloroxylon. *Stromatium barbatum.*

Diospyros embryopteris. *Stromatium barbatum.*

Diospyros glandulosa. *Demonax literatus, Xylotrechus magnicollis.*

Diospyros humilis. *Stromatium barbatum.*

Diospyros kaki. *Aeolesthes sinensis, Macrotoma fisheri, Stromatium barbatum.*

Diospyros lotus. *Aeolesthes sinensis.*

Diospyros melanoxylon. *Plocaederus ferrugineus. Stromatium barbatum.*

Diopsyros microphylla. *Stromatium barbatum.*

Diospyros montana. *Stromatium barbatum.*

Diospyros ovalifolia. *Epania cingalensis.*

Diospyros tomentosa. *Stromatium barbatum.*

Dipsacus sp. *Clytus monticola.*

Dipterocarpus alatus. *Euryphagus lundi.*

Dipterocarpus indicus. *Aeolesthes holosericea, Distenia dravidiana.*

Dipterocarpus macrocarpus. *Mesocacia multimaculata, Mutatocoptops similis, Stromatium barbatum.*

Dipterocarpus tuberculatus. *Chlorophorus annularis, Dialeges pauper, Euryphagus lundi, Examnes frontalis.*

Dipterocarpus turbinatus. *Rhaphipodus hopei.*

Dipterocarpus sp. *Gelonaetha hirta.*

Discoglypremna caloneura. *Coptops aedificator.*

Docynia indica. *Stromatium barbatum.*

Dodonaea viscosa. *Rhaphuma rhea.*

Dolichandrone stipulata. *Ceresium leucosticticum.*

Dolichandrone rheedii. *Perissus laetus, Rhaphuma horsfieldi.*

Dracontomelon dao. *Aeolesthes induta, Plocaederus obesus, Rhytidodera bowringi.*

Duabanga sonneratioides. *Aeolesthes holosericea, Artimpaza obscura, Dihammus cervinus, D. elongatus, D. punctifrons, Hoplocerambyx spinicornis, Xylotrechus buqueti, Xystrocera globosa.*

Dyera costulata. *Batocera rubus, B. rufomaculata.*

Echinocrapus dasycarpus. *Dihammus elongatus.*

Ehretia acuminata. *Xylotrechus smei.*

Elaeagnus conferta. *Stromatium barbatum.*
Elaeagnus latifolia. *Stromatium barbatum.*
Elaeagnus sp. *Dere thoracica.*
Elaeocarpus grandiflorus. *Rhytidodera simulans.*
Elaeocarpus lanceaefolius. *Stromatium barbatum.*
Elaeocarpus tuberculatus. *Epepeotes uncinatus.*
Elaeocarpus sp. *Glenea chalybeata* var. *apicalis, Pharsalia suturalis.*
Engelhardtia colebrookiana. *Exocentrus cudraniae, E. dalbergiae, Perissus mutabilis, Pterolophia occidentalis.*
Engelhardtia spicata. *Sarmydus antennatus, Sarothrocera lowi.*
Entandrophragma angolense. *Coptops aedificator.*
Enterolobium, see **Samanea.**
Eriodendron anfractuosum. *Plocaederus obesus.*
Eriodendron sp. *Batocera tigris* var. *hector, Glenea cantor.*
Erigeron anuus. *Phytoecia rufiventris* var. *ventralis.*
Eriobotrya dubia. *Stromatium barbatum.*
Eriobotrya japonica. *Apriona germari, Batocera lineolata, Stromatium barbatum.*
Eriobotrya petiolata. *Stromatium barbatum.*
Eriobotrya sp. *Batocera horsfieldi, B. lineolata.*
Erioglossum rubinosum. *Ceresium raripilum.*
Eriolobus indica. *Stromatium barbatum.*
Ervertimia coronaria. *Sthenias grisator.*
Erythrina fusca. *Batocera rubus, Paraleprodera triangularis.*
Erythrina indica. *Batocera rubus, B. rufomaculata, B. tigris* var. *hector, Sthenias grisator.*
Erythrina lithosperma. *Batocera rubus, Pterolophia melanura, ?P. secuta, Sthenias grisator.*
Erythrina suberosa. *Stromatium barbatum.*
Erythrina vespertilio. *Aesopida malasiaca.*
Erythrina sp. *Coptops aedificator, Dihammus rusticator, Prosoplus banki, Sthenias franciscanus.*
Eucalyptus acmenioides. *Phoracantha semipunctata.*
Eucalyptus calophylla. *Stromatium barbatum.*
Eucalyptus camaldulensis. *Phoracantha recurva, P. semipunctata.*
Eucalyptus crebra. *Phoracantha semipunctata.*
Eucalyptus diversicolor. *Phoracantha semipunctata.*
Eucalyptus globulus. *Megopis cingalensis, Phoracantha semipunctata, Stromatium barbatum.*
Eucalyptus gracilis. *Phoracantha semipunctata.*
Eucalyptus grandis. *Phoracantha semipunctata.*
Eucalyptus intermedia. *Phoracantha recurva.*
Eucalyptus leucoxylon. *Phoracantha semipunctata.*
Eucalyptus longifolia. *Phoracantha semipunctata.*
Eucalyptus maculata. *Phoracantha recurva, P. semipunctata.*
Eucalyptus microcorys. *Phoracantha semipunctata.*
Eucalyptus nova-anglica. *Phoracantha recurva.*
Eucalyptus oleosa. *Phoracantha semipunctata.*
Eucalyptus phaeotricha. *Phoracantha semipunctata.*
Eucalyptus pilularis. *Phoracantha semipunctata.*
Eucalyptus piperita. *Phoracantha semipunctata.*
Eucalyptus resinifera. *Phoracantha semipunctata.*
Eucalyptus robusta. *Aeolesthes holosericea, Macrotoma plagiata, Phoracantha semipunctata.*
Eucalyptus saligna. *Phoracantha semipunctata.*
Eucalyptus salubris. *Phoracantha semipunctata.*
Eucalyptus tereticornis. *Phoracantha semipunctata, Stromatium barbatum.*
Eucalyptus triantha. *Phoracantha semipunctata.*
Eucalyptus viminalis. *Phoracantha semipunctata.*
Eucalyptus sp. *Aristobia approximator, Macrotoma crenata, Phoracantha recurva, P. semipunctata.*
Eugenia aquea. *Nothopeus hemipterus.*
Eugenia aromatica. *?Coptocercus biguttatus, Hexamitodera semivelutina, Niraeus tri-*

color, Nothopeus fasciatipennis, N. hemipterus.

Eugenia bracteata. *Stromatium barbatum.*

Eugenia cuminii. *Batocera rufomaculata, Derolus volvulus, Monochamus bimaculatus, Nothopeus hemipterus, Xylotrechus smei.*

Eugenia caryophyllata. *Chelidonium brevicorne.*

Eugenia formosa. *Saorthrocera lowi.*

Eugenia jambolana, see **E. cuminii.**

Eugenia jambos. *Chelidonium brevicorne.*

Eugenia laeta. *Stromatium barbatum.*

Eugenia malaccensis. *Nothopeus hemipterus.*

Eugenia operculata. *Aeolesthes induta.*

Eugenia polyantha. *Ceropsius javanicus, Nothopeus hemipterus.*

Eugenia subglauca. *Glenea dimidiata.*

Eugenia sp. *Anubis inermis, Diorthus cinereus, Xylotrechus carinifrons.*

Euonymus frigidus. *Stromatium barbatum.*

Euonymus hamiltonianus. *Stromatium barbatum.*

Euonymus lacerus. *Stromatium barbatum.*

Euphorbia longana. *Aristobia testudo.*

Euphorbia pulcherrima. *Exocentrus dalbergiae, Pterolophia gerardiniae, Ropica rufescens.*

Euphorbia sp. *Prosoplus banki.*

Eurya symplocina. *Stromatium barbatum.*

Eusideroxylon zwageri. *Euryclelia cardinalis.*

Evodia fraxinifolia. *Dihammus inaequalis, Enispia cleroides, Exocentrus alni, Megopis tibialis, Parepepeotes westwoodi, Rosalia hariola, Xenicotela distincta, Xylotrechus subdepressus.*

Excaecaria agallocha. *Aeolesthes holosericea, Coptops aedificator.*

Fagus japonica. *Batocera lineolata, Dere thoracica.*

Fagus sieboldi. *Prionus insularis.*

Fagus sylvatica. *Stromatium barbatum.*

Fagus sp. *Batocera horsfieldi, B. lineolata, Trinophylum cribratum.*

Fatsia japonica. *Psacothea hilaris.*

Feronia elephantum. *Stromatium barbatum.*

Ficus alba. *Myagrus vinosus.*

Ficus ampelas. *Sybra alternans.*

Ficus asperrima. *Batocera rufomaculata.*

Ficus australis. *Batocera boisduvali.*

Ficus benghalensis. *Aeolesthes holosericeus, Batocera rufomaculata, Olenecamptus bilobus.*

Ficus carica. *Apriona cinerea, A. germari, Batocera lineolata, B. rubus, B. rufomaculata, Epepeotes uncinatus, Olenecamptus bilobus, Psacothea hilaris, Rhytidodera robusta, Sthenias grisator, Stromatium barbatum.*

Ficus clavata. *Exocentrus cudraniae.*

Ficus elastica. *Batocera rubus, B. rufomaculata, Choeromorpha albofasciata, C. polynesa, C. pigra, Coptops lichenia, C. annulipes, C. polyspila, Dihammus punctifrons, D. rusticator, Epepeotes luscus, E. uncinatus, Gerania bosci, Gnatholea eburifer, Imantocera plumosa, Macrochenus guerini, Myagrus vinosus, Olenecamptus bilobus, Ostedea pascoei, Pelargoderus bipunctatus, Pothyne variegata, Rondibilis spinulosa, Ropica honesta, R. illiterata, R. vinacea, Xoanodera regularis, Xylotrechus magnicollis.*

Ficus foveolata. *Parepepeotes guttatus.*

Ficus glaberrima. *Stromatium barbatum.*

Ficus glomerata, see **F. racemosa.**

Ficus gibbosa. *Xylotrechus smei.*

Ficus hispida. *Apriona germari, Batocera rubus, Epepeotes luscus, Exocentrus ficicola, Ropica honesta, R. illiterata, R. vinacea, R. rufescens, Stromatium barbatum, Sybra alternans.*

Ficus infectoria. *Apriona germari, Batocera rubus, B. rufomaculata, Olenecamptus bilobus.*

Ficus japonica. *Batocera lineolata.*

Ficus laccifera. *Olenecamptus bilobus.*

Ficus lacor. *Batocera rubus, Olenecamptus bilobus.*

Ficus macrophylla. *Batocera boisduvali.*

Ficus minahassae. *Olenecamptus bilobus.*

Ficus nemoralis. *Stromatium barbatum.*

Ficus obtusifolia. *Perissus laetus.*

Ficus pedunculata. *Batocera rufomaculata.*

Ficus polita. *Coptops aedificator.*

Ficus racemosa. *Batocera rufomaculata, Coptops aedificator, Dihammus rusticator, Epepeotes uncinatus, Exocentrus cudraniae, Moechotypa sikkimensis, Myagrus hynesi, Olenecamptus bilobus, Ropica honesta, R. illiterata, R. vinacea, R. rufescens.*

Ficus religiosa. *Batocera rufomaculata, Coptops aedificator, Dihammus cervinus, Epepeotes uncinatus, Imantocera penicillata, Macrochenus guerini, Macrotoma*

crenata, Monochamus bimaculatus, Olenecamptus bilobus, Pterolophia occidentalis, Xylotrechus smei.

Ficus rempelas. *Pterolophia melanura, ?P. secuta.*

Ficus retusa. *Apriona germari, Batocera rubus, Olenecamptus bilobus, Rhytidodera integra, Stromatium barbatum.*

Ficus roxburghii. *Olenecamptus bilobus.*

Ficus rumphii. *Anagelasta apicalis, Cacia cretifera, Clyzomedus transversefaciatus, Cylindrepomus giraffa, Olenecamptus bilobus.*

Ficus scandens. *Stromatium barbatum.*

Ficus septica. *Ropica honesta, R. illiterata, R. vinacea, Sybra alternans.*

Ficus stipulosa. *Olenecamptus bilobus.*

Ficus tjakela. *Olenecamptus bilobus.*

Ficus tsiela. *Dihammus griseoplagiatus, D. longiscapus.*

Ficus tsjahela. *Batocera rubus, B. rufomaculata.*

Ficus variegata. *Myagrus vinosus.*

Ficus sp. *Anoplophora chinensis, Batocera gigas, B. horsfieldi, B. rufomaculata, B. tigris* var. *hector, Cacia cretifera, Chreonoma fortunei, Coptops aedificator, C. lichenea, C. pascoei, Dihammus australis, D. marianarum, D. mixtus, Enispia ochraceovittata, Epepeotes spinosus, Imantocera plumosa, Microlenecamptus signatus, Morimus inaequalis, Myagrus hynesi, Rosenbergia megalocaphala, Sybra alternans.*

Flemingia semialata. *Cacia cretifera, Exocentrus alboguttatus.*

Flemingia stricta. *Exocentrus carissae, E. cudraniae, E. dalbergiae, E. flemingiae, Pterolophia persimilis.*

Flindersia australis. *Dihammus mixtus.*

Forsythia mandshurica. *Megopis sinica sinica.*

Fortunella margarita. *Anoplophora chinensis, Chelidonium argentatum.*

Fraxinus americana. *?Anoplophora chinensis.*

Fraxinus floribunda. *Stromatium barbatum.*

Fraxinus mandshurica. *Megopis sinica sinica.*

Fraxinus sp. *Aeolesthes sarta, Megopis sinica sinica, Trinophylum cribratum.*

Funtumia sp. *Coptops aedificator.*

Gamblea ciliata. *Stromatium barbatum.*

Garcinia indica. *Stromatium barbatum.*

Garcinia paniculata. *Dihammus punctifrons.*

Garcinia wightii. *Stromatium barbatum.*

Gardenia augusta. *Chreonoma testacea.*

Gardenia florida. *Chreonoma nigriventris.*

Gardenia obtusifolia. *Stromatium barbatum.*

Gardenia turgida. *Stromatium barbatum.*

Garuga pinnata. *Batocera rubus, ?B. rufomaculata, Coptops aedificator, Derolus volvulus, Dihammus griseoplagiatus, D. punctifrons, Glenea multiguttata, Olenecamptus bilobus, Perissus mutabilis, Pharsalia subgemmatus, Plocaederus obesus, Xylotrechus smei.*

Gaya lyallii. *Stromatium barbatium.*

Genista scorpius. *Hylotrupes bajulus.*

Gigantochloa apus. *Niphona furcata?*

Gigantochloa verticillata. *Niphona furcata?*

Girardinia heterophylla. *Exocentrus carissae, Pterolophia gerardiniae, P. persimilis.*

Glochidion lanceolarium. *Stromatium barbatum.*

Glochidion spp. *Celosterna javana.*

Gluta travancorica. *Pterolophia transversefasciata.*

Glycine max. *Zygrita diva.*

Gmelina arborea. *Dihammus cervinus, D. elongatus, D. gardneri, Glenea galathea, G. indiana, Nupserha variahilis, Plocaederus obesus, Pothyne moringae, Stromatium barbatum, Xylotrechus buqueti, X. smei.*

Gmelina asiatica. *Ropica honesta, R. illiterata, R. vinacea.*

Gmelina leichardtii. *Xylotrechus australis.*

Gossampinus malabarica. *Batocera rubus.*

Gossypium sp. *Chlorophorus annularis, Sybra ordinata.*

Gouania leptostachya. *Stromatium barbatum.*

Grevillea robusta. *Pterolophia melanura, ?P. secuta, Stromatium barbatum.*

Grewia asiatica. *Stromatium barbatum.*

Grewia disperma. *Stromatium barbatum.*

Grewia elastica. *Stromatium barbatum.*

Grewia hainesiana. *Stromatium barbatum.*

Grewia laevigata. *Stromatium barbatum.*

Grewia oppositifolia, see **G. optiva.**

Grewia optiva. *Aeolesthes holosericea, Exocentrus alboguttatus, E. grewiae, Stromatium barbatum.*

Grewia paniculata. *Exocentrus actinophorae.*

Grewia subinaequalis. *Stromatium barbatum.*

Grewia tiliaefolia. *Ceresium leucostictum, Epipedocera affinis, E. zona, Gelonaetha hirta, Stromatium barbatum, Xystrocera globosa, Xylotrechus smei.*

Grewia vestita. *Exocentrus grewiae, Glenea vaga, Xylotrechus smei.*

Grewia sp. *Gelonaetha hirta, Myagrus hynesi.*

Gymnosporia montana. *Hypoeschrus indicus.*

Gynocardia odorata. *Stromatium barbatum.*

Haematoxylon campechianum. *Xystrocera globosa.*

Hardwickia binata. *Aeolesthes holosericea, Diorthus cinereus, Gnatholea simplex, Plocaederus ferrugineus.*

Hedera helix. *Molorchus hederae, Stromatium barbatum.*

Helianthus sp. *Nupserha antennata.*

Helichrysum ferrugineum. *?Dihammus mixtus.*

Helicia robusta. *Stromatium barbatum.*

Helicteres isora. *Stromatium barbatum.*

Hemicyclia australasica. *Xylotrechus australis.*

Heritiera zomes, see **H. minor.**

Heritiera littoralis. *Ceresium unicolor.*

Heritiera minor. *Ceresium zeylanicum, Derolus discicollis, Diorthus cinereus, Gelonaetha hirta, Glenea decolorata, Macrotoma plagiata, Stromatium barbatum.*

Heteropanax fragrans. *Stromatium barbatum.*

Hevea brasiliensis. *Agelasta cristata, A. nigromaculata, Anancylus griseatus, Batocera rufomaculata, Coptops aedificator, C. lichenea, Dihammus rusticator, Hoplocerambyx spinicornis, Moechohecyra verrucicollis, Neocerambyx paris, Pterolophia annulata.*

Hevea sp. *Cersium flavipes, Pelagoderus bipunctatus, Pterolophia melanura, ?P. secuta.*

Hibiscus cannabinus. *Nupserha bicolor.*

Hibiscus mutabilis. *Anoplophora chinensis, Pterolophia gerardiniae.*

Hibiscus tiliaceus. *?Ceresium unicolor, Prosoplus banki, Ropica pseudosignata.*

Hibiscus sp. *Aristobia approximator, Dihammus marianarum, Prosoplus banki, Sybra alternans.*

Hiptage benghalensis. *Stromatium barbatum.*

Hiptage sp. *Epepeotes spinosus.*

Hodgsonia heteroclita. *Batocera numitor.*

Hoheria lyallii. *Stromatium barbatum.*

Holarrhena antidysenterica. *Epipedocera chakhata, Eupogonioides carissae, Exocentrus dalbergiae, Falsomesosella gardneri.*

Holigarna arnottiana. *Dihammus griseoplagiatus, D. longiscapus, Distenia dravidiana, Glenea multiguttata, Stromatium barbatum.*

Holigarna helferi. *Stromatium barbatum.*

Holmskioldia sanguinea. *Stromatium barbatum.*

Holoptelea integrifolia. *Coptops aedificator, Stromatium barbatum, Xylotrechus smei.*

Homalium tomentosum. *Ceresium raripilum, Dihammus cervinus, D. punctifrons.*

Hopea odorata. *Chlorophorus hederatus, Dialeges pauper, Hoplocerambyx spinicornis.*

Hopea parviflora. *Massicus venustus.*

Hopea wightiana. *Dihammus griseoplagiatus, Falsomesosella andamanica, Stromatium barbatum.*

Hopea sp. *Euryphagus lundi.*

Hymenodictyon excelsum. *Aeolesthes induta, Dihammus gardneri, Xylotrechus smei.*

Hyophorbe verschaffeltii. *Batocera rufomaculata.*

Hypericum mysorense. *Stromatium barbatum.*

Ilex dipyrena. *Stromatium barbatum.*

Ilex hookeri. *Megopis tibialis.*

Ilex pulchella. *Stromatium barbatum.*

Ilex sikkimensis. *Stromatium barbatum.*

Ilex wightiana. *Stromatium barbatum.*

Indigofera heterantha. *Stromatium barbatum.*

Indigofera tinctoria. *Cacia cretifera, Exocentrus cudraniae, Pterolophia persimilis.*

Indigofera sp. *Exocentrus championi, Milothris irrorata.*

Ipomoea batatas. *Nupserha fricator.*

Ipomoea sp. *Nupserha quadrioculata.*

Ixora coccinea. *Chreonoma testacea, Xylotrechus quadripes.*

Ixora parviflora. *Dihammus admixtus.*

Jasminum dispermum. *Xylotrechus quadripes.*
Jatropha curcas. *Dihammus rusticator, Ropica rufescens.*
Jatropha glandulifera. *Sthenias grisator.*
Juglans regia. *Aeolesthes holosericea, A. sarta, Aglaophis humerosus, Batocera horsfieldi, B. lineolata, Dihammus elongatus, D. inaequalis, Exocentrus parrotiae, Glenea beesoni, Macrotoma plagiata, Mesosa setulosa, Morimopsis lacrymans, Paraleprodera stephanus, Prionus corpulentus, Pterolophia granulosa, P. obscuroides, Rhaphuma horsfieldi, Stromatium barbatum, Xylotrechus contortus.*
Juglans sp. *Hylotrupes bajulus, Trinophylum cribratum.*
Juniperus chinensis. *Arhopalus rusticus.*
Juniperus polycarpa. *Semanotus semenovi.*
Juniperus semiglobosa. *Semantous semenovi.*
Juniperus sp. *Semanotus bifasciatus.*

Kalopanax ricinifolium. *Prionus insularis.*
"keruwut." *Celosterna javana.*
Kiriya sp. *Ceresium leucosticticum.*
Kydia calycina. *Aeolesthes holosericea, Aesopida malasiaca, Dihammus nivosus, Glenea quadrinotata, G. vaga, Olenecamptus indianus, Plocaederus obesus, Stromatium barbatum, Xylotrechus buqueti, X. smei, X. subscutellatus.*

Lagenaria vulgaris. *Apomecyna alboguttata, A. saltator.*
Lagerstroemia calyculata. *Chlorophorus quatuordecimmaculatus, Olenecamptus indianus.*
Lagerstroemia flos-reginae, see **L. speciosa.**
Lagerstroemia indica. *Apriona germari.*
Lagerstroemia lanceolata. *Olenecamptus signaticollis, Stromatium barbatum.*
Lagerstroemia parviflora. *Aeolesthes holosericea, Ceresium leucostictum, C. zeylanicum, Epipedocera affinis, E. parva, Pterolophia occidentalis, Sarothocera lowi, Xylotrechus buqueti.*
Lagerstroemia speciosa. *Aristobia approximator, A. testudo, Ceresium rufum, Macrochenus guerini, Nothopeus fulvus, N. hemipterus, Olenecamptus signaticollis.*
Lagerstroemia villosa. *Stromatium barbatum.*
Lagerstroemia vulgaris. *?Apomecyna alboguttata, ?A. saltator.*
Lannea coromandelica. *Aeolesthes holosericea, Aesopida malasiaca, Arhopalus tibetanus, Batocera numitor, B. rufomaculata, Cacia cretifera, Ceresium leucostictum, Coptops aedificator, C. leucostictica, C. pascoei, Derolus volvulus, Dihammus griseoplagiatus, D. longiscapus, D. punctifrons, Diorthus cinereus, Epepeotes gardneri, Exocentrus alboguttatus, E. cudraniae, E. dalbergiae, Glenea multiguttata, G. vaga, Macrotoma spinosa, Mesosa indica, Monochamus bimaculatus, Palimna annulata, Plocaederus ferrugineus, P. obesus, P. pedestris, Pterolophia gardneri, P. gerardiniae, P. occidentalis, P. persimilis, P. transverseplagiata, Ropica rufescens, Sthenias grisator, Stromatium barbatum.*
Lannea grandis, see **L. coromandelica.**
Laportea gigas. *Dihammus mixtus.*
Laportea terminalis. *Smermus mniszechi.*
Larix griffithii. *Stromatium barbatum.*
Larix liptolepis. *Leptura succedana.*
Larix sp. *Monochamus alternatus, Trinophylum cribratum.*
Lasiococca sp. *Agelasta bifasciana, A. fallaciosa.*
Lasiosiphon eriocephalus. *Stromatium barbatum.*
Leea indica. *Dihammus defector.*
Lettisomia strigosa. *Zonopterus corbetti.*
Leucaena glauca. *Olethrius tyrannus, Prosoplus banki.*
Leucomeris spectabilis. *Stromatium barbatum.*
'liane.' *Platyzorilispe variegata.*
Ligustrum sinense. *Batocera horsfieldi, B. lineolata.*
Limonia acidissima. *Demonax limoniae.*
Lindera pulcherrima. *Megopis tibialis.*
Liquidambar formosana. *Chlorophorus annularis.*
Liquidambar sp. *Monochamus alternatus.*
Litchi sinensis. *Anoplophora chinensis, Aristobia testudo.*
Litsaea chinensis. *Monochamus bimaculatus, Xylotrechus smei.*
Litsaea citrata. *Morimopsis lacrymans, Thranius triplagiatus.*
Litsaea elongata. *Agelasta bifasciana, Morimopsis lacrymans, Rhaphuma horsfieldi.*

Litsaea kingii. *Dihammus elongatus.*
Litsaea polyantha. *Olenecamptus bilobus.*
Litsaea sebifera, see **L. chinensis.**
Litsaea wightiana. *Stromatium barbatum.*
Loranthaceae. *Pachylocerus pilosus.*
Loranthus longiflorus. *Pachylocerus crassicornis.*
Loranthus pendulus. *Xylotrechus australis.*
Lucuma nervosa. *Niphonoclea capito.*
Luffa acutangula. *Apomecyna alboguttata, A. saltator.*
Luffa aegyptiaca. *Apomecyna alboguttata, A. saltator, Ropica rufescens.*
Luffa cylindrica. *Apomecyna neglecta.*
Luffa sp. *Apomecyna histrio.*

Maba fasciculosa. *Dihammus mixtus.*
Macaranga denticulata. *Aglaophis longispinis, Dihammus elongatus, D. inaequalis.*
Macaranga sp. *Epepeotes andamanicus, ?Exocentrus tectonae, ?Glenea elegans, ?Ropica honesta, R. illiterata, R. vinacea, ?Sybra alternans.*
Machilus bombycina. *Stromatium barbatum.*
Machilus duthiei. *Stromatium barbatum.*
Machilus edulis. *Thranius triplagiatus.*
Machilus longifolia. *Eupromus ruber.*
Machilus odoratissima. *Megopis tibialis, Morimopsis lacrymans, Rhodopsis alboplagiata, Stromatium barbatum, Xylotrechus smei.*
Machilus thunbergii. *Eupromus ruber, Pyrestes cardinalis.*
Machilus sp. *Anaches dorsalis.*
Macrolobium heudolotianum. *Coptops aedificator.*
Madhuca butyracea. *Stromatium barbatum.*
Maesa indica. *Xylotrechus subcarinatus.*
Magnolia campbellii. *Stromatium barbatum.*
Magnolia pterocarpa. *Glenea lecta.*
Mallotus albus. *Coptops leucostictica, Exocentrus malloti.*
Mallotus japonicus. *Anoplophora chinensis, Megopis sinica sinica.*
Mallotus nepalensis. *Stromatium barbatum.*
Mallotus philippinensis. *Aeolesthes holosericeus, Aesopida malasiaca, Aphrodisium cantori, Blepepheus ocellatus, Cacia cretifera, Ceresium leucosticticum, Chlorophorus shoreae, Desisa quadriplagiata, D. subfasciata, Diorthus cinereus, Exocentrus alboguttatus, E. carissae, E. cudraniae, E. dalbergiae, Falsomesosella gardneri, F. nilghirica, Glenea cancellata, Kunbir telephoroides, Mesosa gardneri, M. indica, M. rosa, M. subfasciata, Monochamus bimaculatus, Perissus mutabilis, Pterolophia gardneri, P. occidentalis, P. persimilis, P. transverseplagiata, Ropica rufescens, Stromatium barbatum, Xxlotrechus buqueti, X. smei.*
Mallotus repandus. *Celosterna javana.*
Mallotus roxburghianus. *Dihammus elongatus, Rosalia hariola, Xylotrechus incurvatus.*
Mallotus sp. *?Exocentrus tectonae, ?Glenea elegans, Ostedes pauperata, ?Ropica honesta, ?R illiterata, ?R. vinacea, ?Sybra alternans.*
Malus baccata. *Stromatium barbatum.*
Malus pumila. *Anoplophora chinensis, Macrotoma fisheri.*
Mangifera caesia. *Niphonoclea capito.*
Mangifera foetida. *Rhondibilis spinulosa, Rhytidodera simulans.*
Mangifera indica. *Acanthophorus serraticornis, Aeolesthes holosericea, Batocera numitor, B. roylei, B. rubus, B. rufomaculata, Camptocnema lateralis, Ceresium furtivum, Clyzomedus transversefasciatus, Coptops lichenea, Dihammus griseoplagiatus, Distinea dravidiana, Epepeotes luscus, Exocentrus ficicola, E. flemingiae, Glenea multiguttata, Macrotoma crenata, Niphonoclea albata, N. capito, Olenecamptus bilobus, O. optatus, Palimna annulata, Pharsalia proxima* var. *intermedia, P. saperdoides, Plocaederus fulvicornis, P. obesus, P. pedestris, Pterolophia melanura, ?P. secuta, P. occidentalis, Rhytidodera bowringi, R. simulans, R. robusta, Rondibilis spinulosa, Stromatium barbatum, Sthenias grisator, Xylotrechus smei.*
Mangifera odorata. *Exocentrus bauhiniae, Rhytidodera simulans.*
Mangifera sp. *Batocera rufomaculata, Celosterna scabrator, Dihammus marianarum, Epepeotes spinosus.*
Manihot glaziovii. *Coptops aedificator, Pterolophia annulata.*
Manihot utilissima. *Dihammus rusticator, Sthenias grisator.*
Manihot sp. *Sybra alternans.*
Mappia foetida. *Stromatium barbatum.*

Medicago sativa. *Zygrita diva.*

Melanorrhoea usitata. *Palimna annulata.*

Melia azedarach. *Aeolesthes induta, Anoplophora chinensis, A. horsfieldi, Ceresium sinicum.*

Melia japonica. *Aeolesthes induta, Anoplophora chinensis.*

Meliosma dilleniifolia. *Stromatium barbatum.*

Meliosma thomsoni. *Stromatium barbatum.*

Mezenga zanthoxylum. *Ropica rufescens.*

Michelia champaca. *Pothyne distincta, Pterolophia maculata, P. marmorata, P. persimilis, Stromatium barbatum.*

Michelia excelsa. *Dihammus elongatus, Stromatium barbatum.*

Michelia nilagirica. *Megopis cingalensis, Stromatium barbatum.*

Miliusa velutina. *Aeolesthes holosericea.*

Millettia auriculata. *Coptops aedificator, Dialeges pauper, Exocentrus alboguttatus, E. cudraniae, E. dalbergiae, E. grewiae, Pterolophia occidentalis, P. transversefasciata, Ropica rufescens.*

Millettia brandisiana. *Stromatium barbatum, Perissus laetus, Xylotrechus magnicollis.*

Millettia pendula. *Gnatholea simplex, Parorsidis birmanica, Xylotrechus buqueti.*

Millettia pulchra. *Stromatium barbatum.*

Millettia racemosa. *Stromatium barbatum.*

Millettia stapfiana. *Coptops aedificator.*

Millettia sp. *Pterolophia circulata, P. densefasciculata, P. modesta, Ropica basicristata.*

Mimosa pudica. *Zygrita diva.*

Mimosa rubicaulis. *Exocentrus flemingiae, Pterolophia persimilis.*

Mimusops elengi. *Epania amoorae, Stromatium barbatum, Xylotrechus magnicollis.*

Mimusops littoralis. *Pterolophia pallidifrons.*

Mitragyna diversifolia. *Aristobia approximator, Chreonoma frontalis.*

Mitragyna rotudifolia. *Aristobia approximator, Chreonoma frontalis.*

Moringa oleifera. *Batocera rufomaculata, Dihammus rusticator.*

Moringa pterygosperma, see **M. oleifera.**

Moringa sp. *Sthenias grisator.*

Morus acidosa. *Apriona cinerea, A. germari, Batocera rufomaculata, Epepeotes uncinatus, Falsomesosella gardneri, Hyagnis persimilis, Olenecamptus bilobus, Pterolophia gardneri, P. persimilis, Sthenias grisator, Stromatium barbatum, Xylotrechus smei.*

Morus alba. *Acanthophorus serraticornis, Aeoloesthes holosericea, A. sarta, Anoplophora chinensis, Apriona germari, Ceresium sinicum, Exocentrus alboguttatus, ?Megopis sinica sinica, Philus antennatus, Psacothea hilaris, Sthenias grisator, Stromatium barbatum, Xenolea collaris, X. tomentosa, Xylotrechus smei.*

Morus bombycis. *Mesosa myops.*

Morus indica, see **M. acidosa.**

Morus laevigata. *Apriona germari, Epepeotes luscus, E. uncinatus.*

Morus sp. *Anaesthetobrium luteipenne, Anoplophora chinensis, Batocera horsfieldi, B. lineolata, Glenea multiguttata, Mallambyx raddei, ?Megopis sinica ornaticollis, Oberea fuscipennis, Olenecamptus clarus, Paraglenea fortunei, Pterolophia annularis, P. annulicornis, Ropica subnotata, Stenygrinum quadrinotatum, Xylotrechus chinensis.*

Mucuna imbricator. *Aesopida malasiaca, Anagelasta apicalis, Coptops aedificator, Moechotypa sikkimensis.*

Murraya exotica. *Stromatium barbatum.*

Musa. *Batocera rufomaculata.*

Myrica nagi. *Stromatium barbatum.*

Myristica andamanica. *Aeolesthes basicornis, A. holosericea, Serixia andamanica.*

Myristica attenuata. *Pterolophia occidentalis.*

Myristica fragrans. *Batocera tigris* var. *hector.*

Myristica longifolia. *Imantocera vicina.*

Myristica longifolia. *Tetraommatus insignis, Xylotrechus buqueti.*

Myristica sp. *Glenea acuta, Pterolophia triangularis.*

Myrsine semiserrata. *Stromatium barbatum.*

Nauclea excelsa. *Chreonoma frontalis.*

Nauclea orientalis. *Chreonoma testacea.*

Nerium odorum. *Apomecyna saltator, Sthenias grisator.*

Ochroma lagopus. *Batocera numitor, B. rubus, B. rufomaculata, Celosterna* sp. (*variegata?*).

Ochroma sp. *Ropica honesta, R. illiterata, R. vinacea, Sybra alternans.*

Odina gummifera. *Batocera tigris* var. *hector.*

Odina woodier, see **Lannea coromandelica.**

Odina sp. *Plocaederus obesus.*

Olea dioica. *Xylotrechus quadripes, X. subscutellatus.*

Olearia avicenniifolia. *Stromatium barbatum.*

Onchidium sp. *Diaxenes phalaenopsidis.*

Oroxylum indicum. *Dihammus cervinus, Xylotrechus quadripes.*

Ostodes paniculata. *Dihammus elongatus.*

Ougeinia dalbergioides. *Aeolesthes holocericea, Cacia cretifera, Exocentrus alboguttata, E. cudraniae, E. dalbergiae, Glenea vaga, Olenecamptus anogeissi, O. indianus, Pterolophia persimilis, P. transverseplagiata, Ropica rufescens, Stromatium barbatum.*

Oxyspora paniculata. *Stromatium barbatum.*

Palaquium gutta. *Pachyteria virescens.*

Panax fruticosum. *Niphonoclea capito.*

Pandanus sp. *?Dihammus korolensis.*

Parashorea malaanonan. *Aeolesthes induta, Dihammus rusticator, Hoplocerambyx spinicornis.*

Parashorea robusta. *Hoplocerambyx spinicornis.*

Parashorea stellata. *Dialeges pauper, Hoplocerambyx spinicornis.*

Parishia insignis. *Batocera rufomaculata.*

Parkia speciosa. *Xystrocera globosa.*

Parkia sp. *Xystrocera globosa.*

Parkinsonia aculeata. *Stromatium barbatum.*

Parrotia jacquemontiana. *Exocentrus parrotiae, Stromatium barbatum.*

Pasania cuspidata. *Batocera lineolata, Mallambyx raddei.*

Pasania sp. *Batocera horsfieldi, B. lineolata.*

Paulownia tomentosa. *Batocera horsfieldi, B. lineolata, Megopis sinica sinica, Xylotrechus grayi.*

Pavetta indica. *Coptops aedificator, Exocentrus alboguttatus, Mesosa gardneri, M. subfasciata.*

Peltophorum ferrugineum. *Aristobia approximator.*

Pentacme suavis. *Aeolesthes holosericea, Chlorophorus hederatus, Coptops variegata, Cyriopalus wallacei, Dialeges pauper, Hoplocerambyx spinicornis, Palimna palimnoides, Stromatium barbatum, Trirachys atkinsoni.*

Persea americana. *Niphonoclea capito, Pterolophia camura.*

Persea gratissima. *Batocera rufomaculata, Niphonoclea albata.*

Persea sp. *Batocera rufomaculata.*

Phalaenopsis sp. *Diaxenes phalaenopsidis D. taylori.*

Phaseolus aconitifolius. *Nupserha bicolor.*

Phaseolus radiatus. *Nupserha bicolor.*

Phlogacanthus thyrsiflorus. *Stromatium barbatum.*

Phoebe lanceolata. *Artimpaza dehra, Glenea lecta, Merionoeda phoebe, Monochamus, bimaculatus, Nida kala, Xylotrechus subcarinatus.*

Phoenix dactylifera. *Jebusea hammerschmidti.*

Photina glabra. *Chreonoma fortunei, Dere thoracica.*

Photinia notoniana. *Stromatium barbatum.*

Phyllanthus emblica. *Ceresium raripilum, Demonax atkinsoni, D. literatus, Olenecamptus indianus, Rhaphuma bimaculata.*

Phyllostachys bambusoides. *Niphona furcata?*

Phyllostachys reticulata. *Chlorophorus annularis.*

Picea ajanensis. *Prionus insularis.*

Picea banksiana. *Monochamus alternatus.*

Picea denseflora. *Monochamus alternatus.*

Picea excelsa. *Monochamus alternatus.*

Picea morinda. *Arhopalus tibetanus, Leptura rubiola, Monochamus alternatus, Teledapus dorcadioides, Tetropium oreinum, Xylotrechus basifuliginosus.*

Picea smithiana. *Stromatium barbatum.*

Picea strobus. *Monochamus alternatus.*

Picea sp. *Acanthocinus griseus, Arhopalus ferus, Hylotrupes bajulus, Monochamus alternatus.*

Picea sp. *Spondylis buprestoides.*

Pieris ovalifolia. *Sarmydus subcoriaceus.*

Pinus canariensis. *Hylotrupes bajulus.*

Pinus caribaea. *Hylotrupes bajulus, Pterolophia melanura.*
Pinus denseflora. *Megopis sinica sinica, Prionus insularis.*
Pinus euphratica. *Aeolesthes sarta.*
Pinus excelsa. *Arhopalus tibetanus, Glenea quatuordecimmaculata, Leptura rubriola, Prionus corpulentus, Purpuricenus montanus, Tetropium oreinum.*
Pinus gerardiana. *Arhopalus tibetanus, Glenea quatuordecimmaculata.*
Pinus halepensis. *Dihammus mixtus, Hylotrupes bajulus.*
Pinus insularis. *Megopis sanchezi.*
Pinus khasya. *Arhopalus unicolor, Ceresium rufum.*
Pinus longifolia. *Aeolesthes holosericea, Arhopalus brunneus, A. tibetanus, Chlorophorus strobilicola, Glenea quatuordecimmaculata, Leptura rubriola, Nothorhina gardneri, Pterolophia transverseplagiata, Tetraommatus ocularis continentalis.*
Pinus maritima. *Hylotrupes bajulus.*
Pinus massoniana. *?Anoplophora chinensis, Monochamus alternatus, Spondylis buprestoides.*
Pinus nigra. *Aeolesthes sarta.*
Pinus palustris. *Hylotrupes bajulus.*
Pinus patula. *Perissus parvulus, Sybra signatoides.*
Pinus pinea. *Hylotrupes bajulus.*
Pinus ponderosa. *Hylotrupes bajulus.*
Pinus radiata. *Callidiellum rufipenne, Dihammus mixtus, Hylotrupes bajulus.*
Pinus sylvestris. *Hylotrupes bajulus.*
Pinus taeda. *Hylotrupes bajulus.*
Pinus wallichiana. *Stromatium barbatum.*
Pinus sp. *Aeolesthes induta, Apheles gracilis, Arhopalus ferus, A. rusticus, Asemum amurense, Callidiellum rufipenne, Hylotrupes bajulus, Prionus insularis, Spondylis buprestoides, Trinophylum cribratum.*
Piper nigrum. *Pterolophia penicillata, P. annulata, P. quadrifasciata.*
Piper sp. *Pelargoderus bipunctatus, Pterolophia melanura, ?P. secuta, Sybra alternans.*
Piptadenia aubrevillei. *Coptops aedificator.*
Piptadenia oudhensis. *Stromatium barbatum.*
Piptanthus nepalensis. *Stromatium barbatum.*
Pipturus sp. *Ceresium unicolor.*
Pistacia chinensis. *Macrotoma fisheri.*
Pistacia integerrima. *Clytus monticola, Stromatium barbatum.*
Pithecolobium angulatum. *Dere affinis, D. cassiae.*
Pithecolobium begeminum. *Stromatium barbatum.*
Pithecolobium dulce. *Celosterna scabrator.*
Pithecolobium lobatum. *Xystrocera festiva.*
Pithecolobium saman. *Dihammus rusticator.*
Pithecolobium sp. *Dihammus marianarum.*
Pittosporum eriocarpum. *Stromatium barbatum.*
Pittosporum eugenioides. *Stromatium barbatum.*
Pittosporum floribundum. *Stromatium barbatum.*
Platanus orientalis. *Aeolesthes sarta, Anoplophora chinensis, Batocera rufomaculata.*
Platanus sp. *Trinophylum cribratum.*
Platycarya sternoptera. *Apriona germari.*
Platymitra macrocarpa. *Epania paulla.*
Plecospermum spinosum. *Stromatium barbatum.*
Podocarpus sp. *Ropica honesta, R. illiterata, R. vinacea.*
Polyalthia coffeoides. *Aeolesthes holosericea, Xylotrechus subscutellatus.*
Polyalthia simiarum. *Paramimistena polyalthiae, Trichodiboma clytoides.*
Poinciana elata. *Clytocera chinospila, Stromatium barbatum.*
Poinciana regia. *Stromatium barbatum.*
Polygala arillata. *Stromatium barbatum.*
Pongamia glabra, see **P. pinnata.**
Pongamia pinnata. *Clytocera chionospila, Coptops aedificator, Gnatholea simplex, Ropica rufescens, Stromatium barbatum.*
Populus alba. *Aeolesthes sarta, Anoplophora chinensis.*
Populus ciliata. *Purpuricenus indus, Stromatium baratum.*
Populus generosa. *Apriona cinerea.*
Populus suaveolens. *Aromia moschata.*
Populus tremula. *Stromatium barbatum.*
Populus sp. *Chloridolum thaliodes, Hylotrupes bajulus, Megopis sinica sinica.*
Pourthiaea laevis. *Chreonoma fortunei.*
Premna integrifolia. *Stromatium barbatum.*
Premna pyramidata. *Xylorhiza adusta, Xylotrechus quadripes.*
Premna serratifolia. *Stromatium barbatum.*

Prinsepia utilis. *Stromatium barbatum.*

Prosopis juliflora. *Celosterna scabrator, Stromatium barbatum.*

Prosopis spicigera. *Celosterna scabrator, Stromatium barbatum.*

Prosopis sp. *Prosoplus banki.*

Protium serratum. *Monochamus bimaculatus, Plocaederus obesus.*

Prunus amygdalus. *Aeolesthes sarta, Macrotoma crenata, Quettania coeruleipennis, Sthenias grisator.*

Prunus aremniaca. *Aeolesthes holosericea, A. sarta, Chreonoma fortunei, Macrotoma fisheri, Quettania coeruleipennis.*

Prunus avium. *Aeolesthes holosericea, Chlorophorus quatuordecimmaculatus, Quettania coeruleipennis.*

Prunus cerasus. *Arhopalus ferrus, Mesosa myops, Obera japonica, Quettania coeruleipennis.*

Prunus communis. *Aeolesthes holosericea, Stromatium barbatum.*

Prunus domestica. *Aeolesthes holosericea, Chreonoma fortunei, Oberea japonica.*

Prunus eburnea. *Stromatium barbatum.*

Prunus japonica. *Aromia bungii, Linda fraterna.*

Prunus microcarpa. *Stromatium barbatum.*

Prunus mume. *Aromia bungii, Dere thoracica.*

Prunus nepalensis. *Hyagnis sybroides, Morimopsis lacrymans, Xylotrechus incurvatus.*

Prunus padus. *Aeolesthes sarta, Mesosa setulosa, Stromatium barbatum.*

Prunus persica. *Aeolesthes holosericea, A. sarta, Apriona cinerea, Aromia bungii, Chreonoma fortunei, Linda fraterna, Macrotoma plagiata, M. fisheri, Pseudonaesthetis lauyana, Stromatium barbatum, Xystrocera globosa.*

Prunus puddum. *Dialeges undulatus, Pothyne sericeomaculata.*

Prunus racemosa. *Aeolesthes sarta, Mesosa setulosa, Stromatium barbatum.*

Prunus sp. *Pterolophia persimilis.*

Pseudotsuga taxifolia. *Hylotrupes bajulus.*

Psidium guajava. *Aeolesthes holosericeus, Anoplophora chinensis, Nothopeus hemipterus.*

Pterocarpus dalbergioides. *Capnolymma cingalensis, Dihammus admixtus, Xenolea tomentosa, Xylotrechus buqueti.*

Pterocarpus marsupium. *Aeolesthes holosericeus, Cacia cretifera, Clytocera chionospila, Coptops aedificator, C. leucostictica, Derolus volvulus, Diorthus sericeus, Exocentrus dalbergiae, Glenea multiguttata, Plocaederus obesus, Pterolophia occidentalis, Stromatium barbatum, Xylotrechus quadripes, X. subscutellatus, X. smei.*

Pterospermum acerifolium. *Dihammus admixtus, Glenea jacintha.*

Pterospermum heyneanum. *Dihammus griseoplagiatus.*

Pterygota alata. *Stromatium barbatum.*

Pueraria tuberosa. *Aesopida malasiaca, Coptops aedificator.*

Pyracantha crenulata, *see* **Crataegus crenulata.**

Pyrus baccata. *Aeolesthes holosericea.*

Pyrus communis. *Aeolesthes holosericea, A. sarta, Ceresium rufum, Chreonoma fortunei, Coptops annulipes, Dialeges undulatus, Linda fraterna, Oberea japonica, Perissus laetus, Stromatium barbatum.*

Pyrus lanata. *Stromatium barbatum.*

Pyrus malus. *Aeolesthes holosericeus, A. sarta, Apriona cinerea, A. germari, Aristobia approximator, Batocera rufomaculatus, Celosterna scabrator, Chlorophorus annularis, Chreonoma dioica, C. fortunei, Dorysthenes hugeli, Linda fraterna, L. nigroscutata, Macrotoma plagiata, Megopis sinica sinica, Mesosa myops, Oberea japonica, O. holoxantha, ?Osphranteria coerulescens, Prionus insularis, Purpuricenus lituratus, Xylotrechus chinensis.*

Pyrus pashia. *Stromatium barbatum.*

Pyrus serotina. *Macrotoma fisheri.*

Pyrus ursina. *Stromatium barbatum.*

Pyrus variolosa. *Stromatium barbatum.*

Pyrus sp. *Anoplophora chinensis.*

Quercus acuta. *Batocera lineolata.*

Quercus acutissima. *Batocera lineolata, Mallambyx raddei, Stenegrynum quadrinotatum.*

Quercus dealbata. *Anoplophora beryllina, Stromatium barbatum.*

Quercus dentata. *Batocera lineolata.*

Quercus dilatata. *Dorysthenes hugeli, Macrotoma crenata, Megopis tibialis, M. buckleyi, Necydalis indicola, Purpuricenus montanus, Rosalia lateritia, Stro-*

matium barbatum, ?Teledapus dorcadioides, Trinophylum cribratum, Xylotrechus stebbingi.

Quercus glandulifera. *Batocera lineolata, Mallambyx raddei, Stenegrinum quadrinotatum.*

Quercus glauca. *Batocera lineolata.*

Quercus griffithi. *Batocera lineolata, B. numitor, Chlorophorus hedertaus, Massicus unicolor, Pseudomeges marmoratus.*

Quercus grossoserrata. *Batocera lineolata.*

Quercus ilex. *Batocera lineolata, ?Dorysthenes granulosus, D. hugeli, Stromatium barbatum.*

Quercus incana. *Aeolesthes holosericea, Aphrodisium hardwickianum, Batocera horsfieldi, Diorthus cinereus, Dorysthenes hugeli, Entetraommatus quercicola, Macrotoma crenata, Necydalis indicola, Perissus quercus, Sarmydus subcoriaceus, Stromatium barbatum, Trinophylum cribratum Xylotrechus basifuliginosus, X. smei, X. stebbingi, Zoodes basalis.*

Quercus lamellosa. *?Aglaophis quadrifasciata.*

Quercus languinosa. *Stromatium barbatum.*

Quercus lindleyana. *Chelidonium sinicum.*

Quercus luzoniensis. *Nupserha cosmopolita.*

Quercus mespilifolia. *Massicus unicolor.*

Quercus pubescens. *Stromatium barbatum.*

Quercus robur. *Trinophylum cribratum.*

Quercus semecarpifolia. *Necydalis indicola, ?Prionus corpulentus, Rosalia laterita, Stromatium barbatum, Xylotrechus basifuliginosus.*

Quercus semiserrata. *Stromatium barbatum.*

Quercus serrata. *Batocera lineolata, Ceresium rufum, Chlorophorus hederatus, Dere thoracica, Epipedocera assamensis, Mallambyx raddei, Perissus laetus, Stenygrinum quadrinotatum, Stromatium barbatum, Xylotrechus magnicollis.*

Quercus spicata. *Cacia cephalotes.*

Quercus variabilis. *Macrotoma fisheri.*

Quercus sp. *Batocera horsfieldi, Demonax atkinsoni, D. lineolatus, Dere thoracica, Dolichostyrax tuberculatus, Hylotrupes bajulus, Megopis costata, Moechotypa diphysis, Neocerambyx paris, Rhaphuma horsfieldi, Trachystola scabripennis, Xylotrechus basifuliginosus.*

Randia dometorum, see **R. spinosa.**

Randia spinosa. *Monochamus bimaculatus, Obrium randiae, Olenecamptus indianus, Stromatium barbatum, ?Xylotrechus quadripes.*

Randia uliginosa. *Stromatium barbatum.*

Rapanea urvillei. *Stromatium barbatum.*

Renenthera sp. *Diaxenes phalaenopsidis.*

Rhamnus persicus. *Stromatium barbatum.*

Rhizophora mucronata. *Olethrius tyrannus.*

Rhododendron arboreum. *Megopis cingalensis, Xylotrechus contortus.*

Rhododendron argenteum, see **R. grande.**

Rhododendron campanulatum. *Stromatium barbatum.*

Rhododendron falconeri. *Stromatium barbatum.*

Rhododendron grande. *Stromatium barbatum.*

Rhododendron sp. *Dorysthenes hugeli.*

Rhus insignis. *Stromatium barbatum.*

Rhus punjabensis. *Stromatium barbatum.*

Rhus semiciliata. *Xylotrechus quadripes.*

Rhus wallichii. *Stromatium barbatum.*

Ribes rubrum. *Stromatium barbatum.*

Ricinus communis. *Cacia cretifera, Dihammus rusticator.*

Ricinus sp. *Sybra alternans.*

Robinia pseudacacia. *Aeolesthes sarta, Megopis sinica sinica.*

Rosa macrophylla. *Stromatium barbatum.*

Rosa moschata. *Stromatium barbatum.*

Rosa sericea. *Stromatium barbatum.*

Rosa sp. *Sthenias grisator.*

Rubus lasiocarpus. *Stromatium barbatum.*

Rubus sp. *Linda fraterna.*

Saccharum officinarum. *Dorysthenes hydropicus, Philus pallescens.*

Saccharum spontaneum. *Lychrosis zebrinus, Pothyne convexifrons, P. indica.*

Saccharum sp. *Prosoplus banki.*

Salix aemophylla. *Aeolesthes sarta.*

Salix alba. *Aeolesthes sarta.*

Salix atrocinerea. *Aromia moschata.*

Salix babylonica. *Aeolesthes sarta, Anoplophora chinensis, Apriona germari, Megopis sinica sinica, Stromatium barbatum.*

Salix caprea. *Aromia moschata.*

Salix daphnoides. *Stromatium barbatum.*

Salix elegans. *Stromatium barbatum.*

Salix purpurea. *Aromia moschata.*

Salix purpurea amplexicaulis. *Apriona germari.*

Salix sieboldiana. *Apriona germari.*

Salix tetrasperma. *Aeolesthes sarta, Aphrodisium cantori, Apriona germari, Batocera horsfieldi.*

Salix viminalis. *Aromia moschata.*

Salix sp. *Aeolesthes indicola, Aromia moschata, Batocera horsfieldi, B. lineolata, Chloridolum thaliodes, Megopis sinica ornaticollis.*

Salacia sp. *?Ceresium raripilum.*

Salmalia insigne. *Camptocnema lateralis.*

Salmalia hepataphyllum. *Plocaederus pedestris.*

Salmalia malabarica. *Acanthophorus serraticornis, Aeolesthes holosericeus, Aesopida malasiaca, Artimpaza obscura, Batocera rufomaculata, Camptocnema lateralis, Coptops aedificator, Diastocera wallichi, Dihammus griseoplagiatus, Glenea homonospila, G. multiguttata, G. spilota, Macrochenus guerini, Macrotoma crenata, Mesosa bifasciata, M. indica, Niphona malaccensis, Plocaederus ferrugineus, P. obesus, Rhaphipodus gahani, Ropica rufescens, Stromatium barbatum, Derolus volvulus, Xylotrechus smei, Xystrocera globosa.*

Salvadora persica. *Stromatium barbatum.*

Samanea saman. *Coptops aedificator, Perissus glaucinus, Pterolophia andamanica, P. gardneriana, Xystrocera globosa.*

Sambucus sp. *Dihammus cervinus.*

Santalum album. *Apiocephalus licheneus, Blepephaeus modicus, Pseudaristobia octofasciculata.*

Sapindus sp. *Ceresium unicolor.*

Sapium eugeniaefolium. *Dihammus elongatus, Pterolophia obscuroides.*

Sapium sebiferum. *Aeolesthes holosericeus, A. induta, Batocera horsfieldi, B. lineolata, Dorysthenes hugeli, Rhaphipodus gahani, Stromatium barbatum.*

Sarcocephalus cordatus. *Dihammus cervinus,*

Sasa japonica. *Niphona furcata?*

Saurauja napaulensis. *Stromatium barbatum.*

Schima noronhae. *Trachylophus approximator.*

Schima wallichii. *Pterolophia densefasciculata.*

Schrebera swietenioides. *Macrotoma crenata, Xylotrechus smei.*

Schuurmansia henningsi. *Dihammus australis.*

Scutia indica. *Ceresium leucosticticum, Chlorophorus jucundus, Diorthus cinereus, Mesosa indica.*

Semecarpus anacardium. *Batocera rufomaculata, Coptops aedificator, Stromatium barbatum.*

Semecarpus heterophylla. *Cacia herbacea, Dihammus rusticator.*

Semecarpus thwaitesii. *Megopis cingalensis.*

Semecarpus sp. *Palimna annulata.*

Sesbania aegyptiaca. *Nupserha bicolor. Stromatium barbatum.*

Sesbania bispinosa. *Nupserha bicolor.*

Sesbania sp. *Zygrita diva.*

Shiia cuspidata. *Eurypoda batesi.*

Shorea assamica. *Aeolesthes holocericea, Dialeges pauper, Hoplocerambyx spinicornis.*

Shorea obtusa. *Chlorophorus hederatus, Hoplocerambyx spinicornis, Stromatium barbatum.*

Shorea robusta. *Acanthophorus serraticornis, Aeolesthes holosericeus, Anagelasta apicalis, Batocera rufomaculata, Cacia cretifera, Celosterna scabrator, Ceresium nilgiriense, C. zeylanicum, Chlorophorus annularis, C. annulifer, C. hederatus, C. shoreae, Coptops aedificator, C. leucostictica, C. lichenea, Demonax ascendens, Derolus volvulus, Dialeges pauper, ?Diastocera wallichi, Diorthus cinereus, Dorysthenes hugeli, Epipedocera affinis, E. zona, Euryphagus lundi, Glenea multiguttata, Gnatholea simplex, Hoplocerambyx spinicornis, Hypoeschrus indicus, Kunbir telephoroides, Macrotoma crenata, Margites modicus, Mesocacia multimaculata, Mesosa indica, Monochamus bimaculatus, Nyphasia apicalis, Perissus mutabilis, Plocaederus obesus, P. pedestris, Pterolophia transversefasciata, Rhitidodera robusta, Stromatium barbatum, Xylotrechus buqueti, X. smei.*

Shorea siamensis, see **Pentaeme suavis.**

Shorea talura. *Massicus venustus.*

Shorea sp. *Stromatium longicorne.*

Sinobambusa gibbosa. *Chlorophorus annularis.*

Sinocalamus sp. *Chlorophorus annularis.*

Siphonodon celastrineus. *Stromatium barbatum.*
Solanum melanogena. *Dihammus rusticator, Niphona indica* var. *assimilis, Ropica signata, Sybra praeusta.*
Solidago serotina. *Phytoecia rufiventris* var. *ventralis.*
Sonneratia apetala. *Demonax sonneratiae, Stromatium barbatum.*
Sonneratia sp. *Euryphagus lundi.*
Sorbus foliolosa. *Stromatium barbatum.*
Soymida febrifuga. *Aeolesthes holosericea.*
Spatholobus, see **Butea.**
Spiraea canescens. *Stromatium barbatum.*
Spondias axillaris. *Stromatium barbatum.*
Spondias dulcis. *Batocera rufomaculata, B. tigris* var. *hector.*
Spondias lutea. *Batocera rufomaculata.*
Spondias mangifera. *Dihammus griseoplagiatus, Nupserha variabilis, Palimna annulata, Plocaederus obesus, Stromatium barbatum.*
Spondias mombin. *Coptops aedificator.*
Spondias pinnata. *Batocera rufomaculata, Stromatium barbatum.*
Spondias sp. *Chlorophorus annularis.*
Sponia wightii. *Xylotrechus quadripes.*
Staphylea emodi. *Stromatium barbatum.*
Stephanotis floribunda. *Dihammus nivosus.*
Sterculia alata. *Glenea homonospila, G. pulchra, Pterolophia pallidifrons, Stromatium barbatum.*
Sterculia campanulata. *Glenea angerona.*
Sterculia colorata. *Batocera rufomaculata, Plocaederus obesus.*
Sterculia urens. *Plocaederus obesus.*
Sterculia villosa. *Batocera numitor, B. rufomaculata, Glenea spilota, Plocaederus obesus.*
Stereospermum chelonoides. *Macrochenus guerini.*
Stereospermum suaveolens. *Sarothrocera lowi.*
Stransvaesia benthamiana. *Anoplophora chinensis.*
Streblus asper. *Ceresium flavipes, Gerania bosci, Sybra alternans, Xenolea tomentosa.*
Strobilanthes acrocephalus. *Dihammus griseipennis.*
Strobilanthes sp. *Diboma biplagiata, Dihammus punctifrons, Falsohyagnis biplagiata, Hoplothrix rivulosus, Oberea sericea.*
Strombosia postulata. *Coptops aedificator.*
Strychnos nux-vomica. *Clytus minutus, Xylotrechus smei.*
Stylurus robusta. *Anoplophora chinensis.*
Styrax serrulatum. *Stromatium barbatum.*
Symingtonia populnea. *Glenea indiana, Thylactus simulans.*
Symplocos theaefolia. *Megopis tibialis, Molorchus darjeelingensis.*
Syncarpia laurifolia. *Coleocoptus senio, Phoracantha semipunctata.*
Syzygium cumini. *Batocera rufomaculata, Stromatium barbatum.*
Syzygium hemisphericum. *Stromatium barbatum.*

Tabernaemontana alba. *Sthenias grisator.*
Tamarix articulata. *Aeolesthes holosericea, Macrotoma crenata.*
Tamarix gallica. *Macrotoma crenata.*
Tamarix sp. *Hylotrupes bajulus.*
Tarenna incerta. *Chreonoma testacea.*
Tarrietia peralata. *Xylotrechus australis.*
Taxotrophis ilicifolia. *Epepeotes luscus.*
Tectona grandis. *Aeolesthes holosericeus, Apriona swainsoni, Aristobia approximator, Cacia herbacea, Celosterna scabrator, Ceresium leucosticticum, Chlorophorus annularis, Clytus minutus, Dihammus cervinus, D. elongatus, D. gardneri, D. punctifrons, Gelonaetha hirta, Glenea galathea, G. indiana, G. vaga, Niphona malaccensis, Megopis costipennis, Nupserha variabilis, Ostedes pauperata, Pterolophia persimilis, P. transversefasciata, P. tuberculata, Stromatium barbatum, Sybra alternans, Xylotrechus buqueti, X. carinifrons, X. grayi, X. quadripes, X. smei, X. subscutellatus.*
Tectona sp. *Dihammus rusticator, Exocentrus tectonae, Pterolophia melanura, ?P. secuta.*
Telfairia pedata. *Apomecyna saltator.*
Tephorosia candida. *Pterolophia persimilis.*
Tephorosia sp. *Milothris irrorata.*
"tepus." *Pterolophia albivenosa.*
Terminalia belerica. *Aeolesthes holosericea, Coptops aedificator, C. annulipes, C. lichenea, Dihammus griseoplagiatus, D. punctifrons, Exocentrus terminaliae, Margites modicus, Monochamus bimaculatus, Olenecamptus indianus, Paripocregyes fuscovittatus, P. terminaliae, Pharsalia*

proxima var. *intermedia*, *Stromatium barbatum*.

Terminalia catappa. *Niphonoclea capito.*

Terminalia chebula. *Atimura combreti, Margites modicus, Monochamus bimaculatus.*

Terminalia kaernbachii. *Dihammus australis.*

Terminalia myriocarpa. *Aeolesthes holosericea, Coptops leucostictica, Dihammus cervinus, D. elongatus, D. punctifrons, D. sericeus, Epepeotes uncinatus, Eunidia simplex, Glenea silhetica, Monochamus bimaculatus, M. gardneri, Olenecamptus pseudostrigosus, Pharsalia subgemmatus, Pterolophia transversefasciata, Xylotrechus subcarinatus.*

Terminalia paniculata. *Capnolymma cingalensis, Dihammus griseoplagiatus, Niphona cylindracea, Pterolophia occidentalis, Trichagnia fuscomaculata.*

Terminalia procera. *Dihammus andamanicus.*

Terminalia pyrifolia. *Margites exiguus, Nyphasia pascoei, Olenecamptus salweeni.*

Terminalia tomentosa. *Aeolesthes holosericea, Aesopida malasiaca, Anagelasta apicalis, Atimura affinis, Coptops aedificator, C. leucostictica, D. griseoplagiatus, Epipedocera zona, Margites modicus, Mesosa indica, Monochamus bimaculatus, Niphona cylindracea, Nyphasia apicalis, N. pascoei, Olenecamptus indianus, Plocaederus obesus, Stromatium barbatum, Xylotrechus smei.*

Textaria trifida. *Psacothea hilaris.*

Theobroma cacao. *Batocera nebulosa, Dihammus rusticator, D. strandiellus, Epepeotes luscus, Glenea aluensis, G. lefebueri, Heteroclitomorpha punctata, Pelargoderus arouensis, Pterolophia binodosa, Rondibilis spinulosa, Tmesisternus yorkensis.*

Theobroma sp. *Aeolesthes induta, Coptops aedificator, Dihammus australis, D. marianarum, Diochares* sp. *?, Epepeotes spinosus, Glenea novemguttata, Megaceresium horni, Milothris irrorata, Niphonoclea albata, N. capito, Olenecamptus bilobus, Olethrius tyrannus, Pelargoderus bipunctatus, Pterolophia bigibbera, P. melanura, ?P. secuta, Sthenias varius, Xystrocera festiva, X. globosa.*

Thespesia populnea. *Exocentrus ficicola.*

Thevitia neriifolia. *Sthenias grisator.*

Thujopsis delabrata. *Semanotus bifasciatus.*

Thunbergia grandiflora. *Mesosa nigropunctata, Nupserha cosmopolita, Pterolophia densefasciculata.*

Thunia alba. *Diaxenes dendrobii.*

Tilia cordata. *Stromatium barbatum.*

Tilia parvifolia. *Stromatium barbatum.*

Tinospora cordifolia. *Apomecyna histrio, Sthenias grisator.*

"tjongtjoran." *Pachyteria bicolor.*

Toddalia aculeata. *Stromatium barbatum.*

Toddalia asiatica. *Stromatium barbatum.*

Torricellia tiliaefolia. *Stromatium barbatum.*

Trema amboinensis. *Apriona germari, Batocera horsfieldi, B. lineolata.*

Trema orientalis. *Dihammus rusticator.*

Trewia nudiflora. *Exocentrus dalbergiae, Pterolophia servilis, Stromatium barbatum.*

Triphasia sp. *Sybra alternans.*

Triplochiton scleroxylon. *Coptops aedificator.*

Tristania conferta. *?Nothopeus hemipterus.*

Tristania sp. *Nothopeus hemipterus.*

Turpinia nepalensis. *Stromatium barbatum.*

Turraeanthus africana. *Coptops aedificator.*

Ulmus americanus. *Batocera lineolata.*

Ulmus oreinum. *?Tetropium oreinum.*

Ulmus wallichiana. *Aeolesthes sarta, Stromatium barbatum.*

Ulmus sp. *Aeolesthes sarta, Batocera horsfieldi, B. lineolata, Glenea relicta, Mesosa myops, Prionus insularis, Stromatium barbatum.*

Uncaria sp. *Ropica honesta, R. illiterata, R. vinacea.*

Vanda sp. *Diaxenes phalaenopsidis.*

Vangueira spinosa. *Clytus minutus, Xylotrechus smei.*

Vateria indica. *Dihammus griseoplagiatus, Massicus venustus, Rhaphipodus subopacus, Serixia vateriae, Zoodes quadridentatus.*

Vatica lanceaefolia. *Glenea sanctaemariae.*

Ventilago calyculata. *Falsomesosella gardneri, Kunbir telephoroides.*

Ventilago sp. *?Ceresium raripilum.*

Viburnum coriaceum. *Stromatium barbatum.*

Viburnum cotinofolium. *Stromatium barbatum.*
Viburnum cylindricum. *Stromatium barbatum.*
Viburnum erubuscens. *Stromatium barbatum.*
Viburnum foetens. *Stromatium barbatum.*
Viburnum grandiflorum. *Stromatium barbatum.*
Viburnum nervosum. *Stromatium barbatum.*
Viburnum odoratissimum. *Xylorhiza adusta.*
Vigna catjang. *Nupserha bicolor.*
Vitex altissima. *Clytus ceylonicus, Xylotrechus smei, X. subscutellatus.*
Vitex lignum-vitae. *Xylotrechus australis.*
Vitex pinnata. *Xylotrechus smei, X. subscutellatus.*
Vitis araneosa. *Pterolophia griseofasciata, P. occidentalis, Ropica signata.*
Vitis coignetiae. *Phymatodes maaki.*
Vitis latifolia. *Pterolophia oculata, Xylotrechus smei.*
Vitis vinifera. *Dere thoracica, Sthenias grisator.*
Vitis sp. *Chlorophorus annularis.*

Wistaria brachybotry. *Mesosa myops.*
Wistaria sp. *Dihammus mixtus, Pterolophia occidentalis.*
Woodfordia floribunda. *Epipedocera affinis, Stromatium barbatum.*
Wrightia tinctoria. *Coptops aedificator, Sthenias grisator, Stromatium barbatum.*

Xanthium indicum. *Nupserha antennata.*
Xanthium pungens. *Nupserha antennata.*
Xanthium strumarium. *Nupserha madurensis, N. malabarensis.*
Xylia dolabriformis, see **X. xylocarpa.**
Xylia xylocarpa. *Aristobia approximator, Ceresium leucosticticum, Chlorophorus quatuordecimmaculatus, Derolus volvulus, Dialeges undulatus, Eunidia xyliae, Noserius indicus, N. tibialis, Pachydissus birmanicus, P. xyliae, Perissus laetus, Xylotrechus smei, Xystrocera globosa.*
Xylosoma longifolium. *Stromatium barbatum.*
Zanthoxylum rhetsa. *Neocallia pubescens.*
Zingiberaceae. *Pterolophia albivenosa.*
Zizyphus jujuba, see **Z. mauritiana.**
Zizyphus mauritiana. *Celosterna scabrator.*
Zizyphus nummularia. *Stromatium barbatum.*
Zizyphus oenoplia. *Clytus balwanti.*
Zizyphus rugosa. *Nothopeus fulvus.*
Zizyphus xylopyrus. *Derolus volvulus, Stromatium barbatum.*

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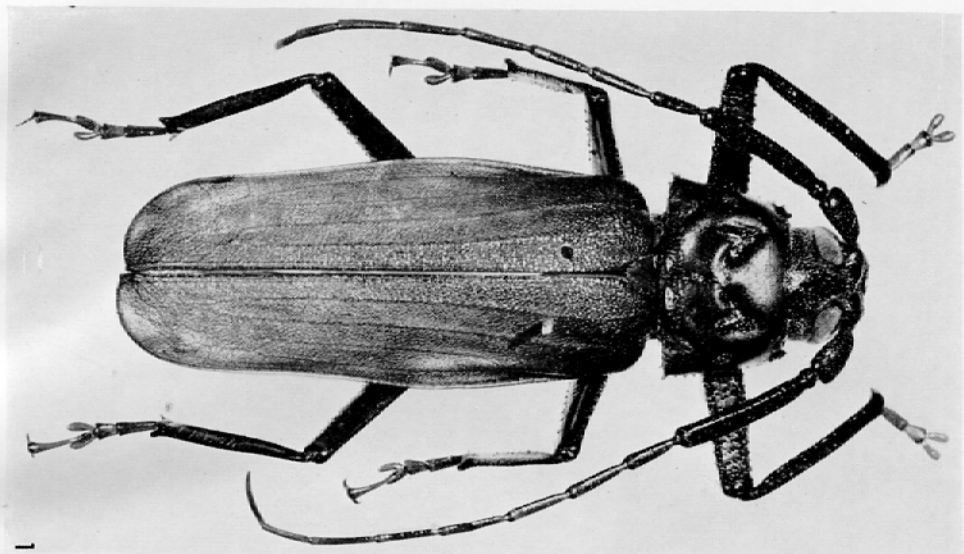
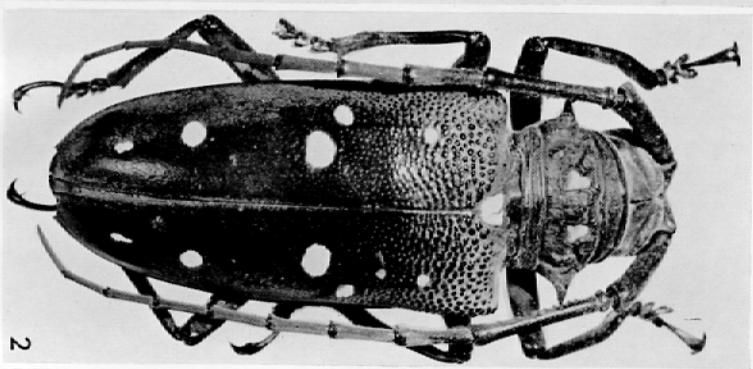
PLATES

PLATE I





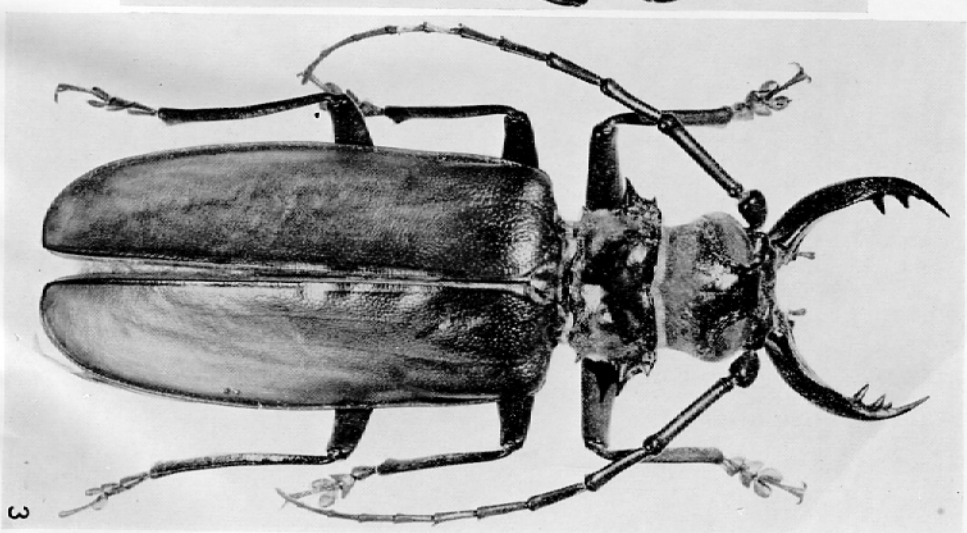


Fig. 1. *Macrotoma crenata* (Fabricius). Adult (× 2).
Fig. 2. *Batocera rubus* (Linnaeus). Adult (× 2).
Fig. 3. *Acanthophorus serraticornis* (Olivier). Adult (natural size).

PLATE II

Rhaphipodus hopei Waterhouse. Cross-section of larval galleries in *Dipterocarpus* (natural size).

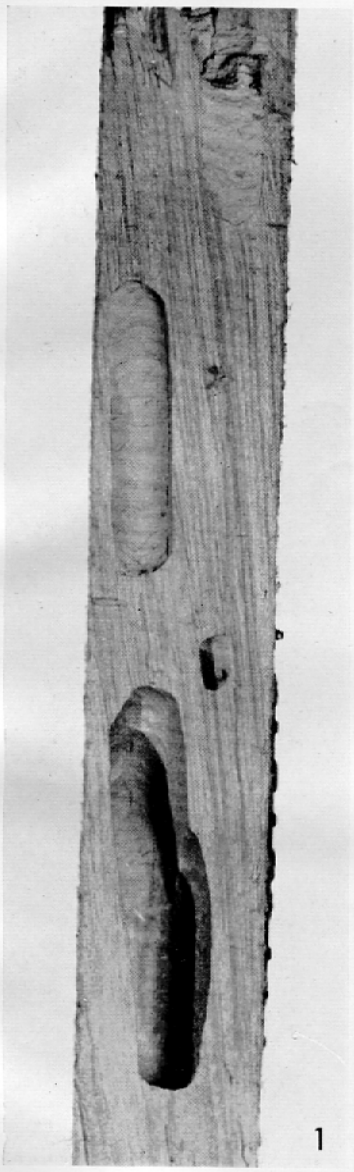
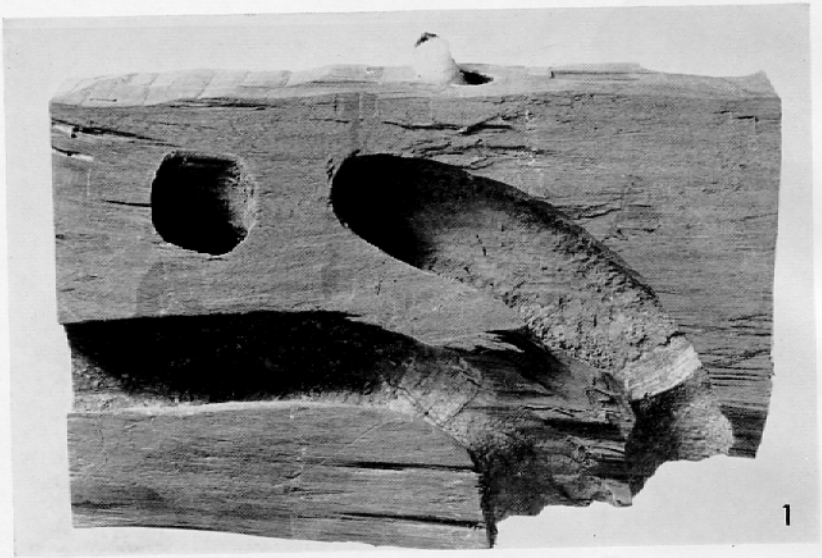
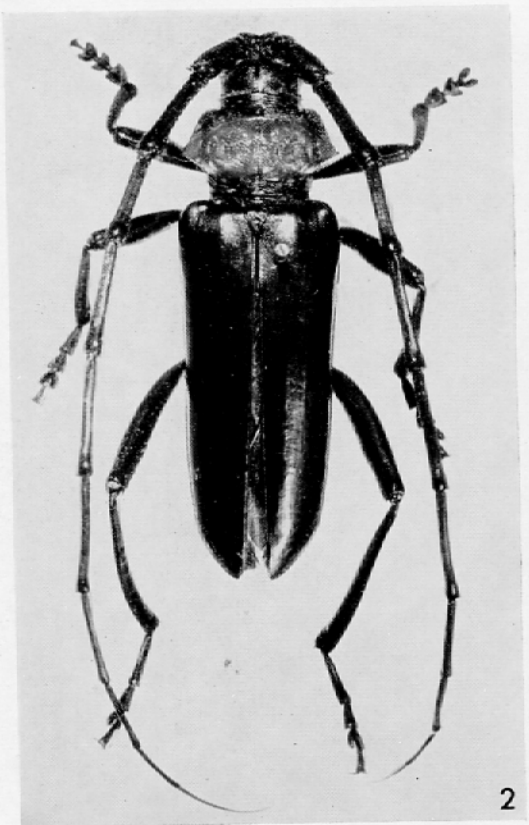


Fig. 1. *Stromatium barbatum* (Fabricius). Pupal cell ($\times$ 1½).
Fig. 2. *Rhaphipodus hopei* Waterhouse. Larval gallery showing compacted frass (⅔ natural size).





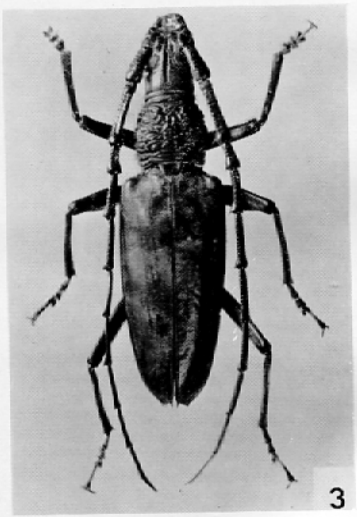
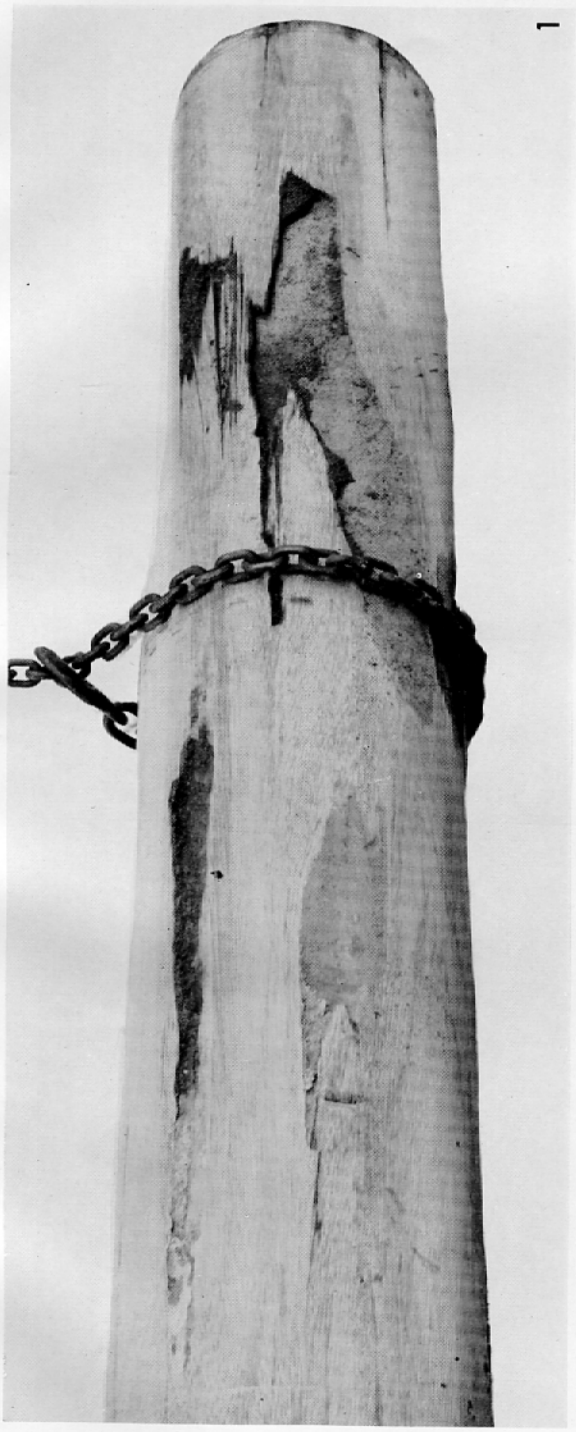


Fig. 1. *Hoplocerambyx spinicornis* (Newman). Larval galleries in *Shorea robusta* (natural size). (Duffy, 1963).

Fig. 2. *Aromia bungii* (Faldermann). Adult (× 2).

Fig. 3. *Hoplocerambyx spinicornis* (Newman). Adult (natural size). (Duffy, 1963).

PLATE V



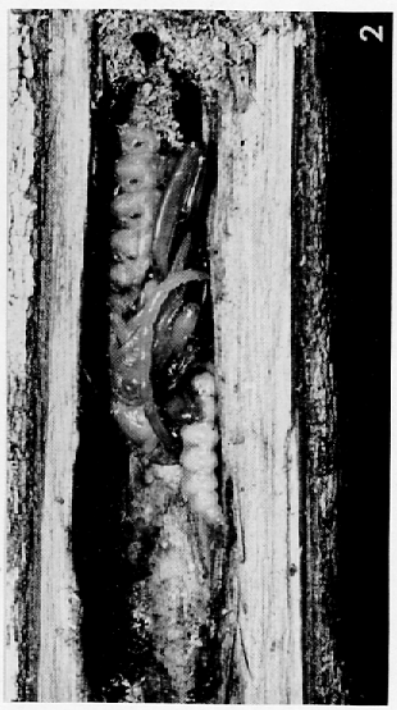


Fig. 1. *Hoplocerambyx spinicornis* (Newman). Larval damage to *Shorea* log (⅓ natural size approx.). (F.P.R.L.).
Fig. 2. *Niraeus tricolor* Newman. Pupa being devoured by a rhysodid larva (× 1½). (H. T. Pagden).
Fig. 3. *Niraeus tricolor* Newman. Pupa being devoured by rhysodid larva (× 1½). (H. T. Pagden).

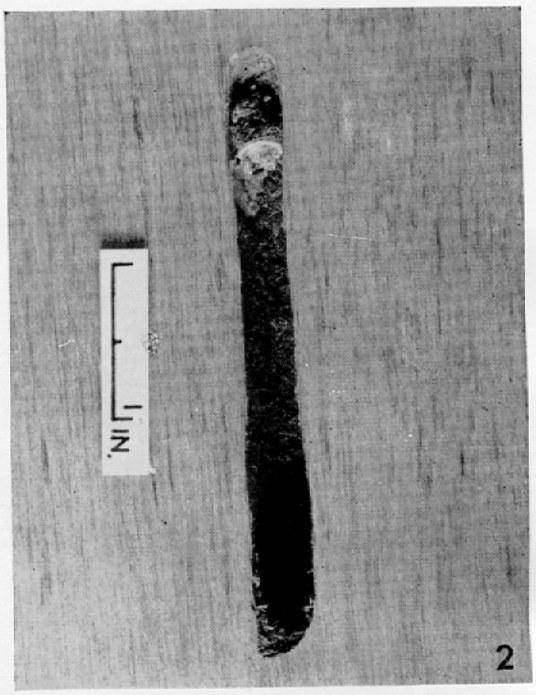
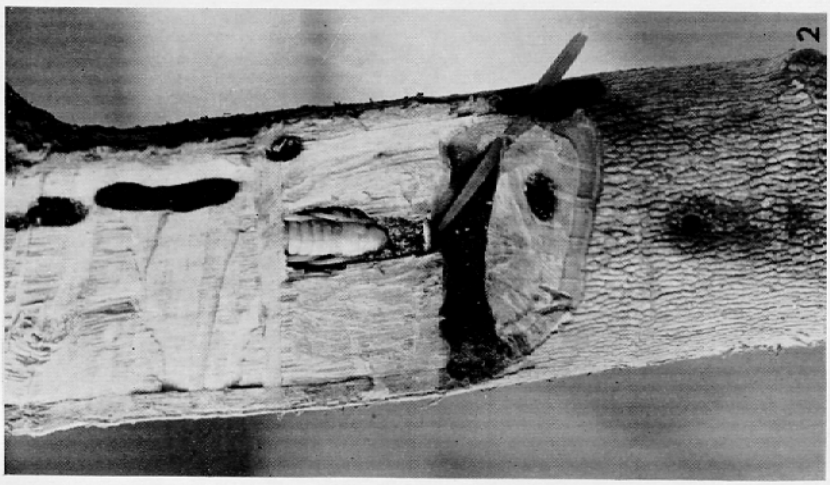


Fig. 1. *Niraeus tricolor* Newman. Larva being devoured by rhysodid larva (note calcium plug closing exit from pupal chamber) (natural size). (H. T. Pagden).
Fig. 2. *Aeolesthes holosericea* (Fabricius). Pupal chamber in *Dipterocarpus* ($\frac{2}{3}$ natural size). (F.P.R.L.).
Fig. 3. *Trinophylum cribratum* Bates. Damage to sawn oak logs ($\frac{1}{4}$ natural size). (Duffy, 1953c).

PLATE VII



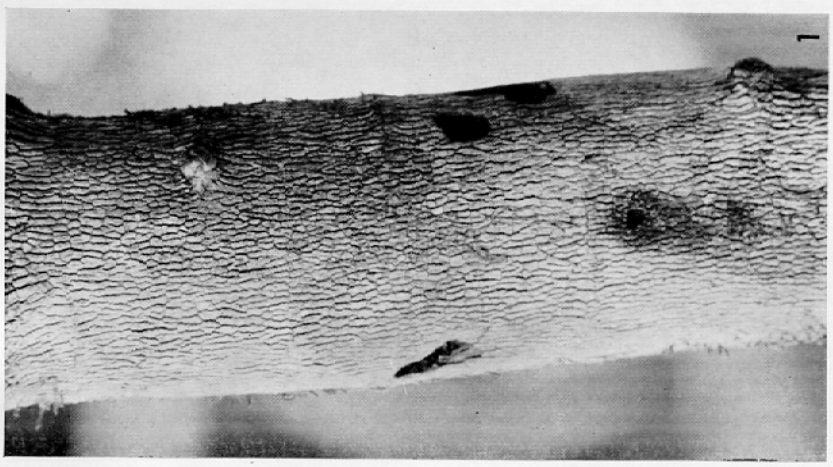


Fig. 1. *Chelidonium brevicorne* Franz. Prepared emergence holes in branch of clove tree ($\frac{2}{3}$ natural size). (H. T. Pagden).
Fig. 2. *Chelidonium brevicorne* Franz. Pupa in chamber (note calcium plug) ($\frac{2}{3}$ natural size). (H. T. Pagden).
Fig. 3. *Stromatium barbatum* (Fabricius). Emergence holes in *Casuarina* pole ($\frac{1}{4}$ natural size). (Duffy, 1957).

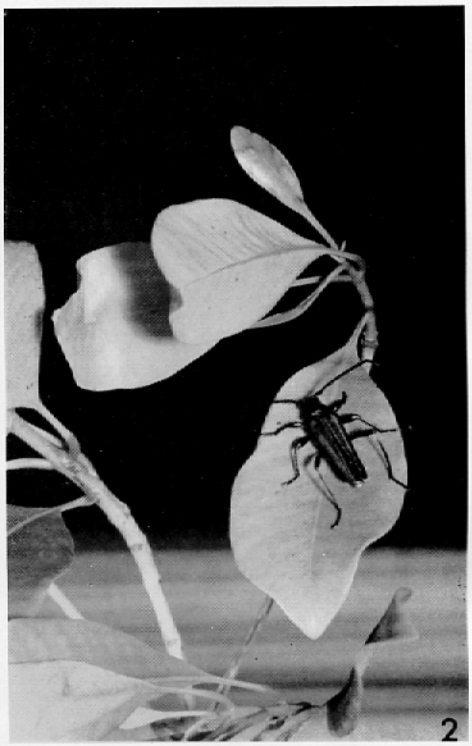
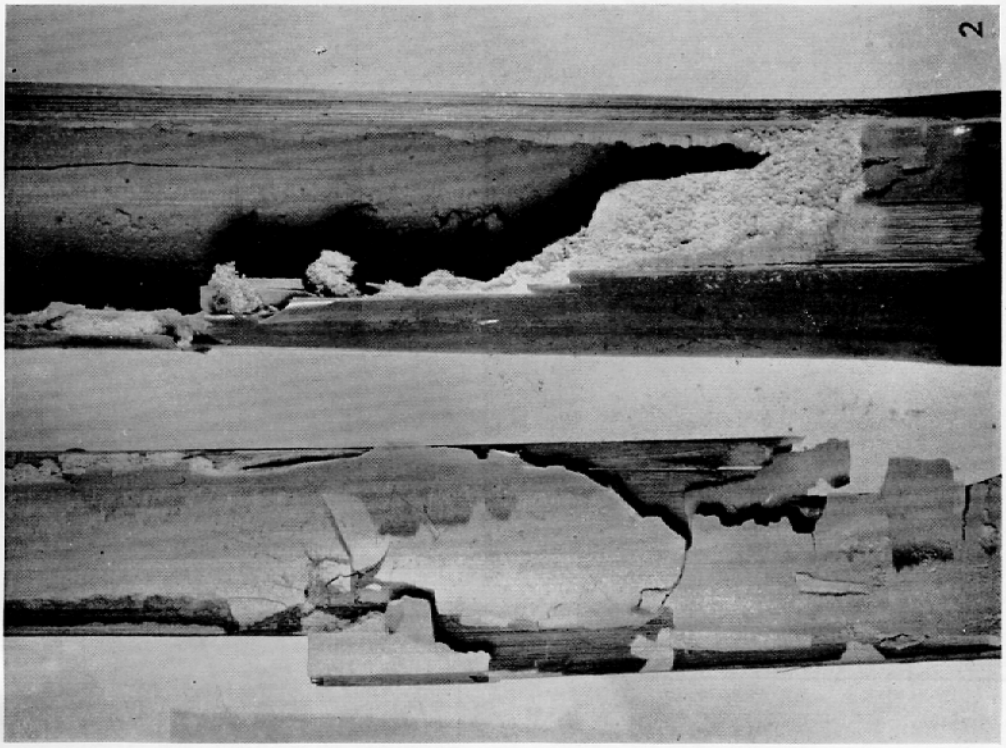


Fig. 1. *Niraeus tricolor* Newman. Adult (♂ natural size). (H. T. Pagden).
Fig. 2. *Chelidonium brevicorne* Franz. Adult (♂ natural size). (H. T. Pagden).
Fig. 3. *Stromatium barbatum* (Fabricius). Larval gallery in *Casuarina*. (Duffy, 1957).

PLATE IX



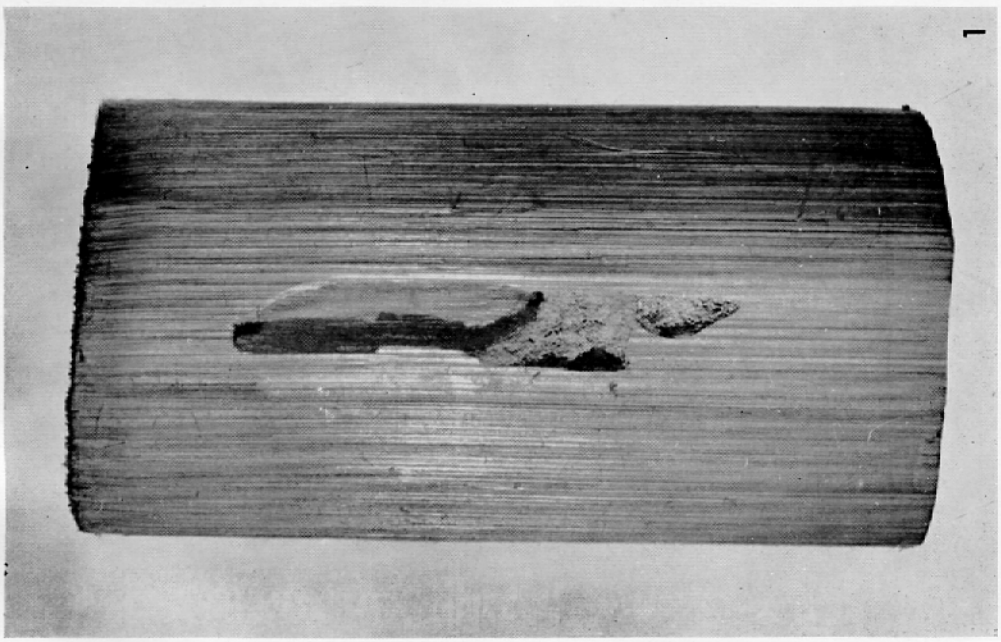
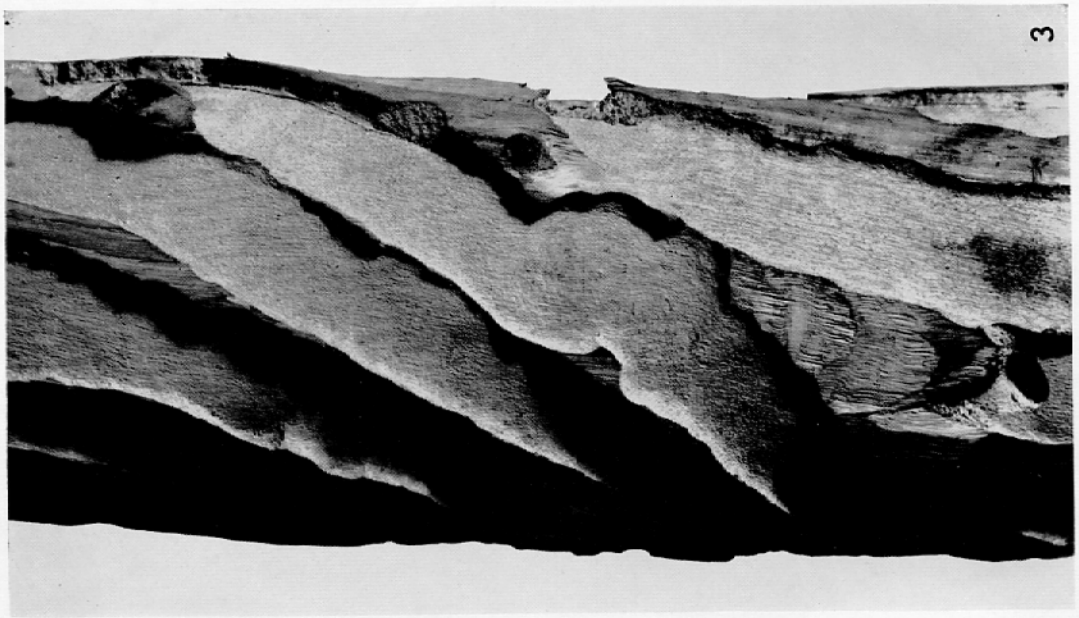
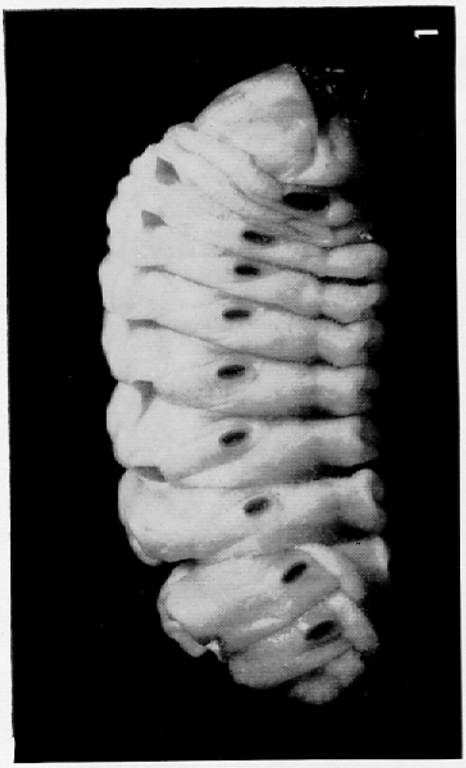


Fig. 1. *Chlorophorus annularis* (Fabricius). Pupal cell in bamboo (× 1½).
Fig. 2. *Chlorophorus annularis* (Fabricius). Larval damage in *Phyllostachys reticulata* (× 1½).





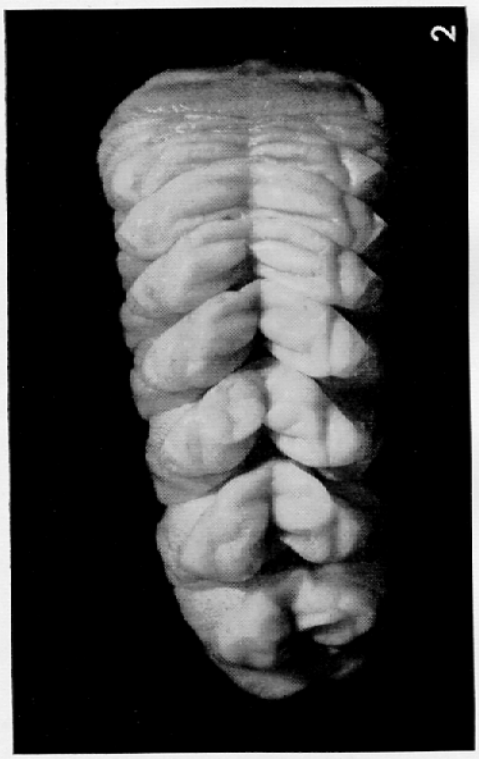
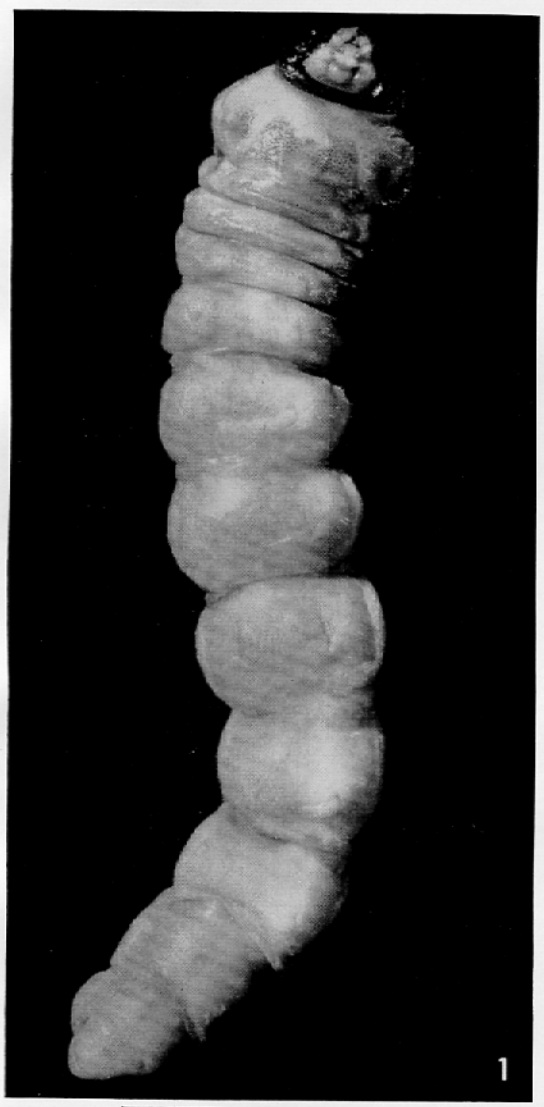
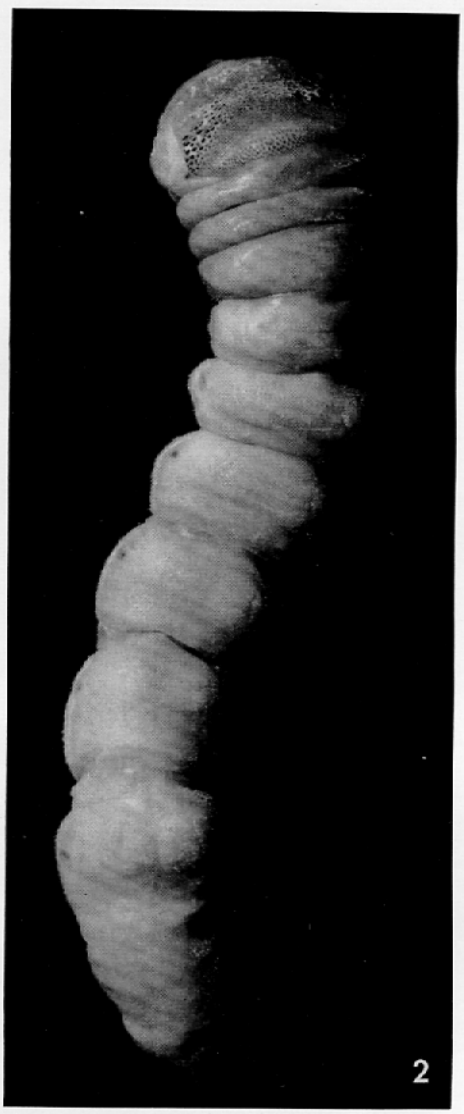


Fig. 1. *Plocaederus obesus* Gahan. Mature larva. Lateral aspect (× 2).
Fig. 2. *Plocaederus obesus* Gahan. Mature larva. Dorsal aspect (× 2).
Fig. 3. *Phoracantha semipunctata* (Fabricius). Radial galleries in branch of *Eucalyptus* (natural size). (Duffy, 1963).





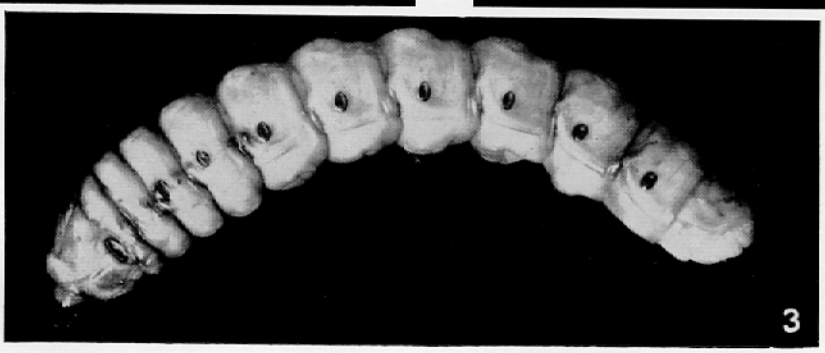
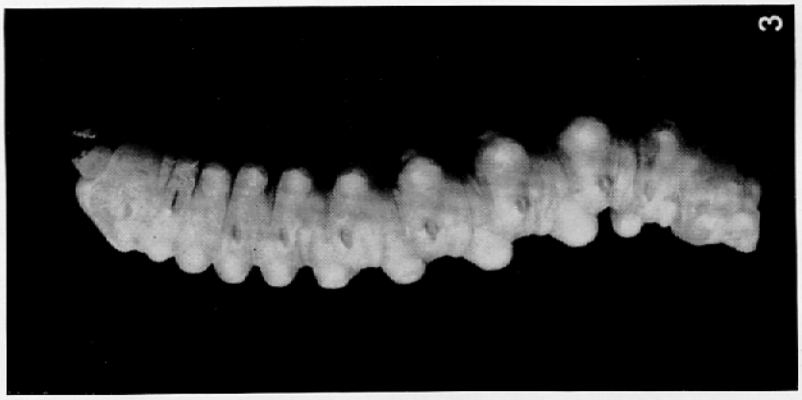


Fig. 1. *Batocera una* White. Mature larva. Ventral aspect (× 1½).
Fig. 2. *Batocera una* White. Mature larva. Dorsal aspect (× 1½).
Fig. 3. *Apriona germari* (Hope). Mature larva. Lateral aspect (× 1½).



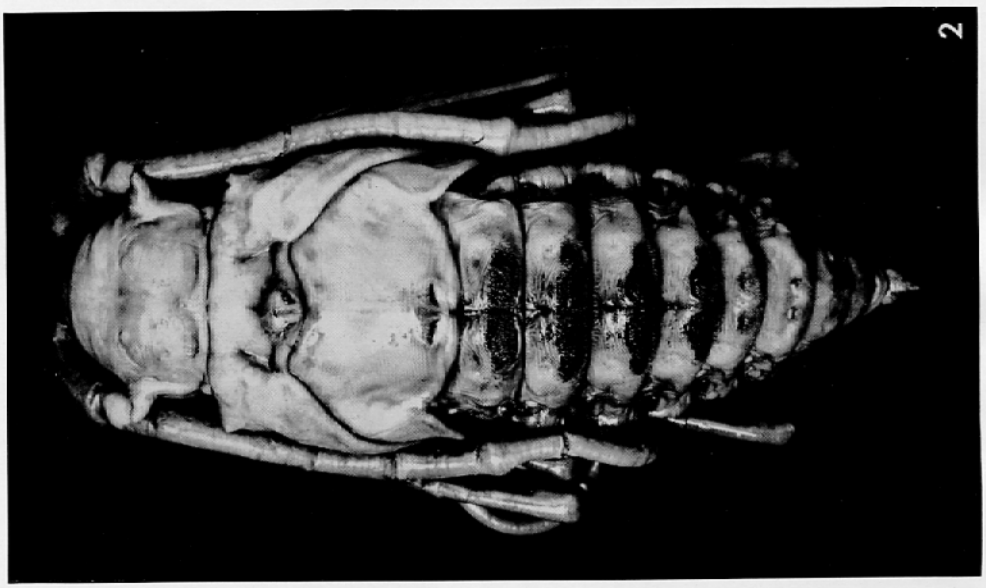
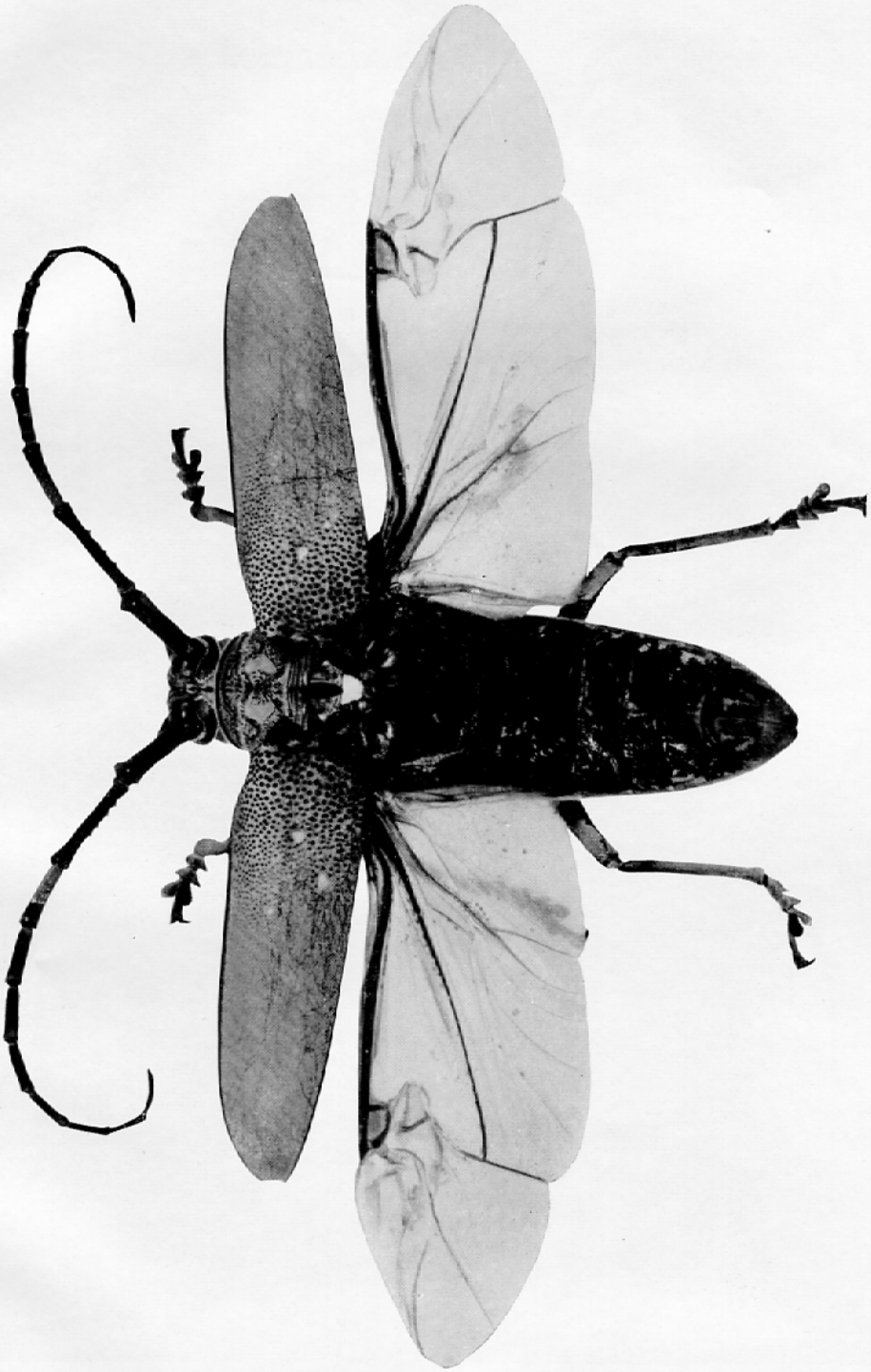
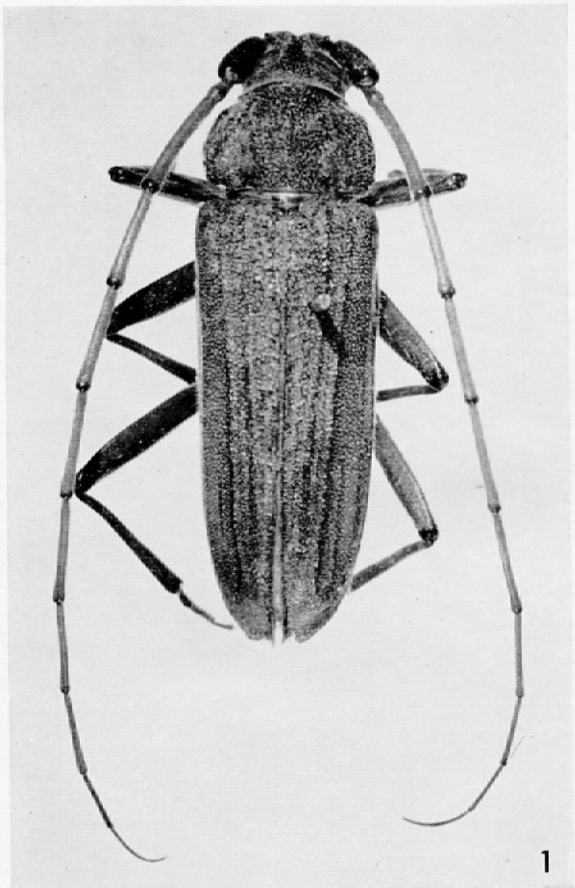


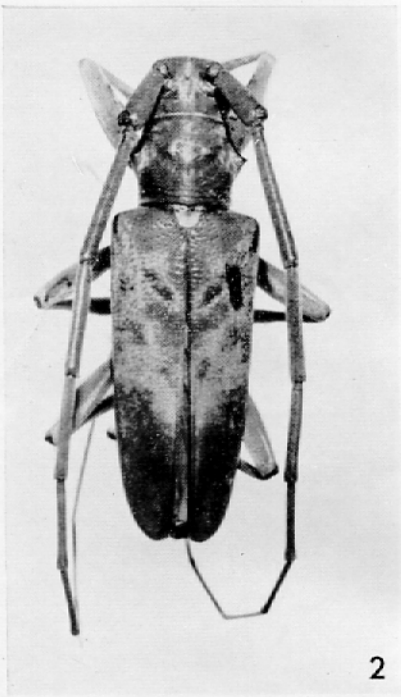
Fig. 1. *Batocera rubus* (Linnaeus). Mature larva. Dorsal aspect (× 1½).
Fig. 2. *Batocera una* White. Pupa. Dorsal aspect (× 1½).
Fig. 3. *Nothopeus fasciatipennis* Waterhouse. Mature larva. Lateral aspect (× 2).

PLATE XIII



Batocera rufomaculata (Degeer). (Adult × 1½)





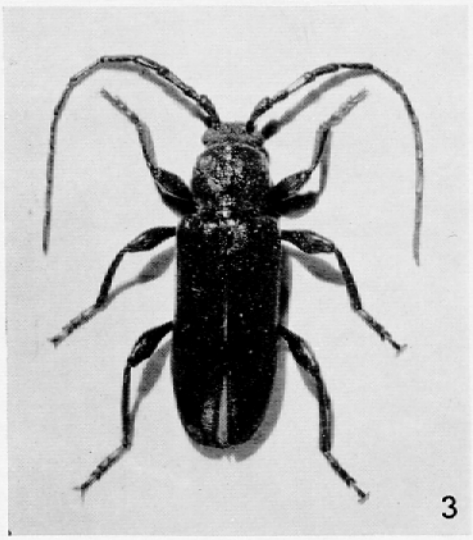
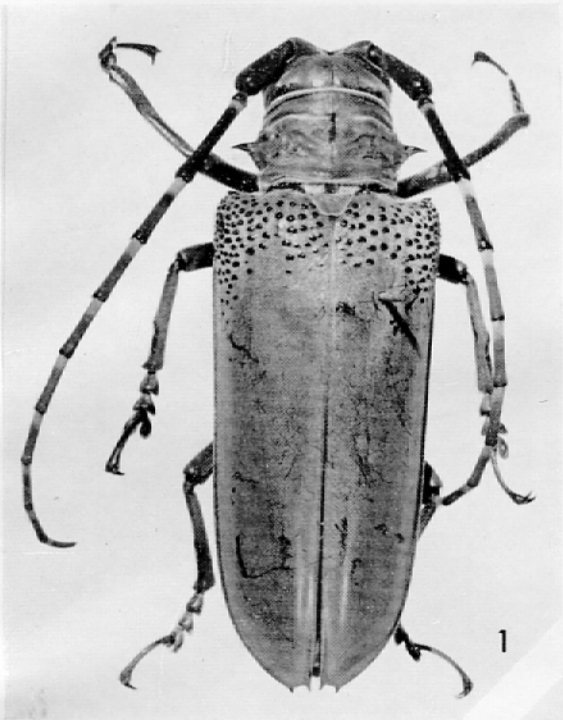
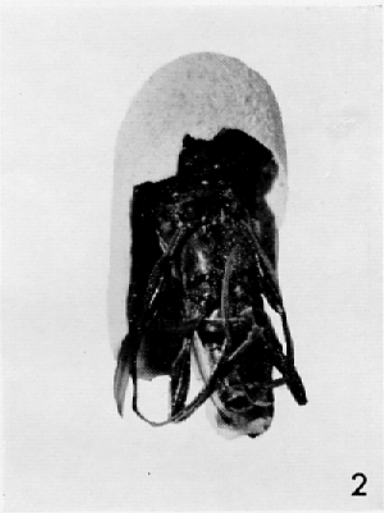


Fig. 1. *Stromatium barbatum* (Fabricius). Adult (× 3).
Fig. 2. *Dihamnus cervinus* (Hope). Adult (× 3).
Fig. 3. *Trinophylum cribratum* Bates. Adult (× 3).
Fig. 4. *Aristobia approximator* (Thomson). Adult (× 3).

PLATE XV





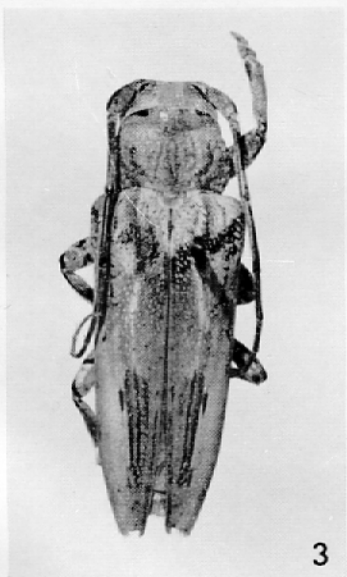
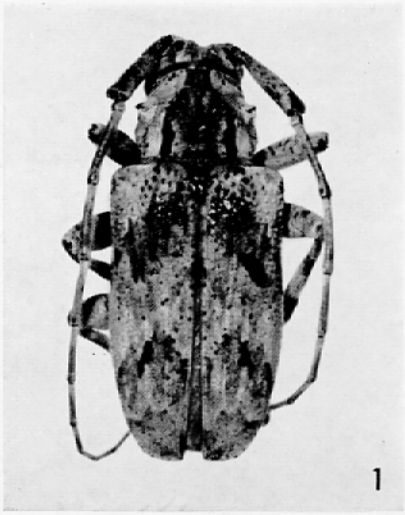
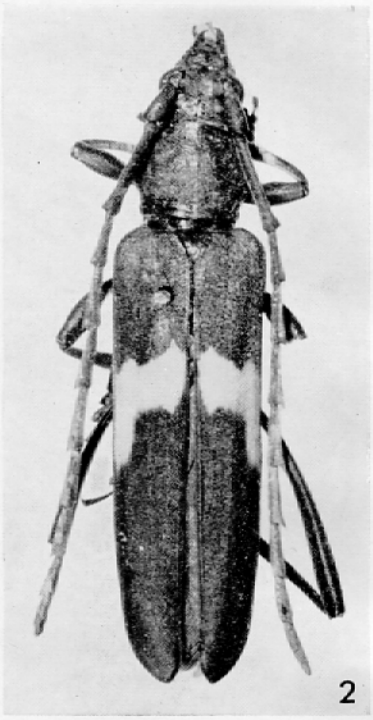
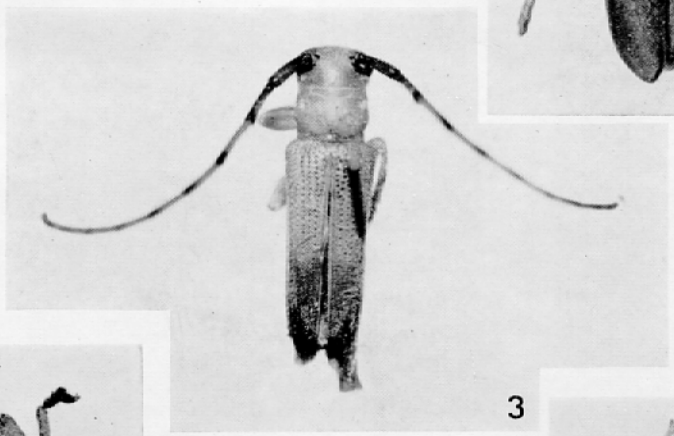
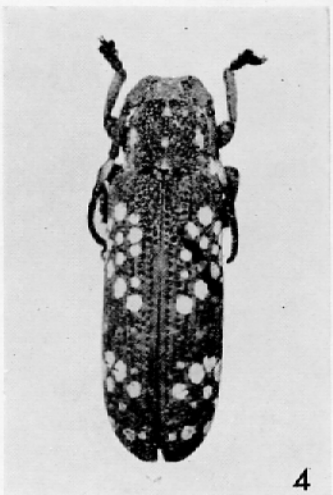


Fig. 1. *Apriona germari* (Hope). Adult (× 1½).
Fig. 2. *Xystrocera globosa* (Olivier). Adult in calcareous cocoon (× 2).
Fig. 3. *Niphona hookeri* Gahan. Adult (× 3).
Fig. 4. *Acolesthes holosericea* (Fabricius). Adult (× 3).









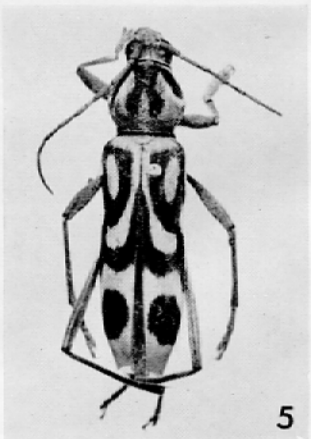
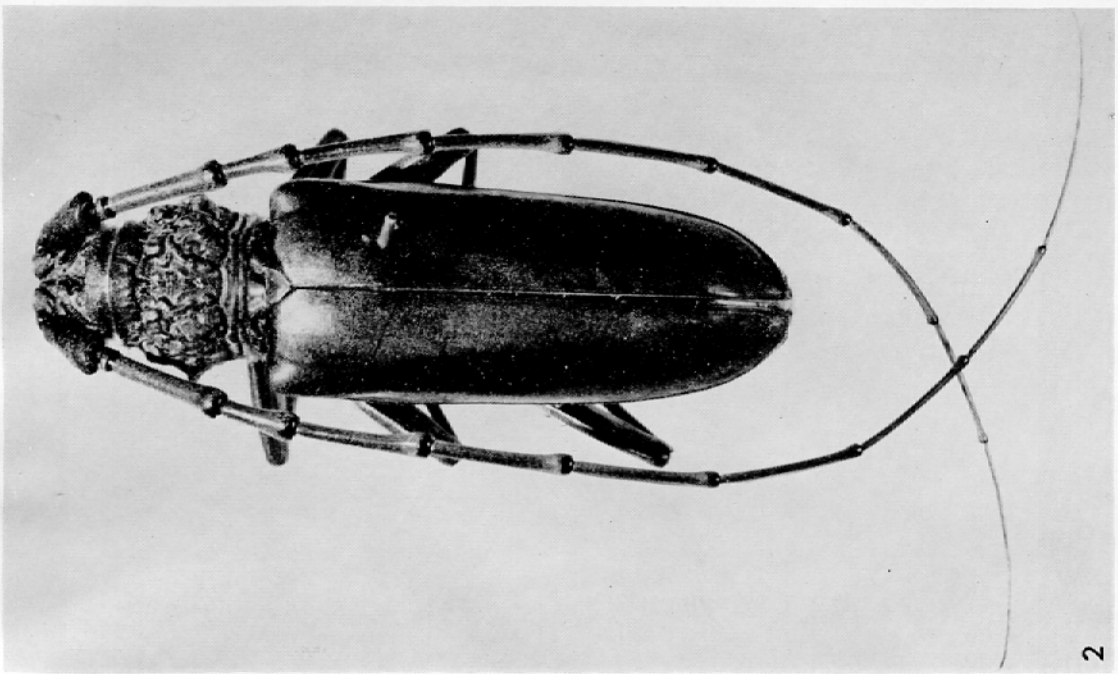


Fig. 1. *Coptops aedificator* (Fabricius). Adult (× 3).
Fig. 2. *Chelidonium cinctum* (Guérin-Méneville). Adult (× 3).
Fig. 3. *Nupserha bicolor* (Thomson). Adult (× 4).
Fig. 4. *Apomecyna albogiittata* (Megerle). Adult (× 3).
Fig. 5. *Chlorophorus annularis* (Fabricius). Adult (× 3).



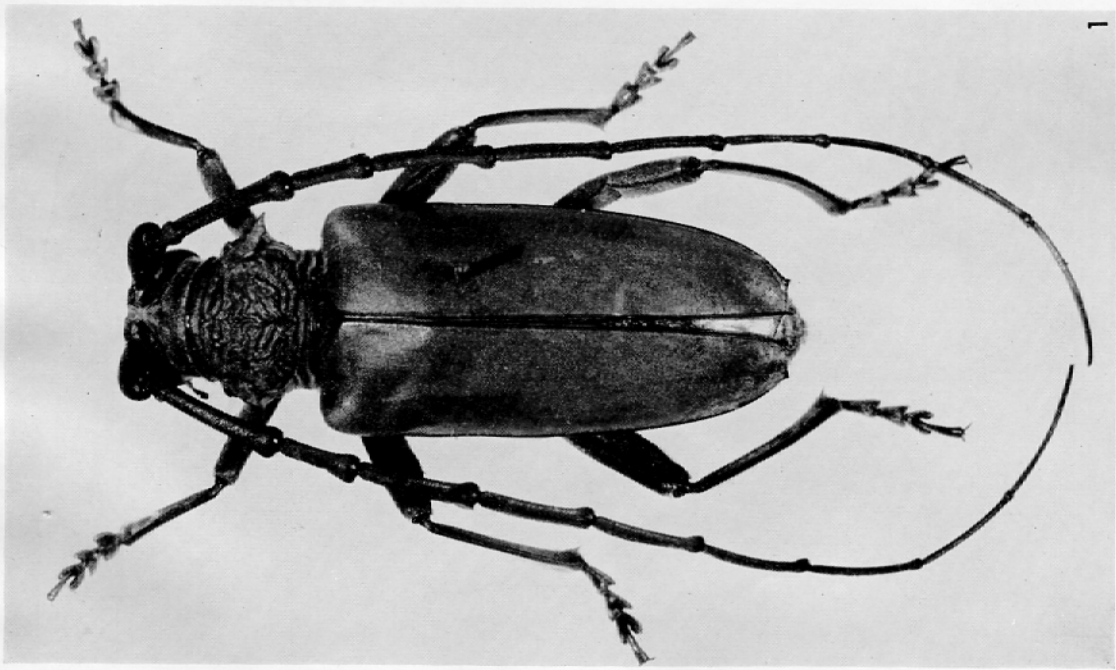


Fig. 1. *Plocaederus obesus* Gahan. Adult (× 2).
Fig. 2. *Nadezhdiella cantori* (Hope). Adult (× 2).

PLATE XVIII

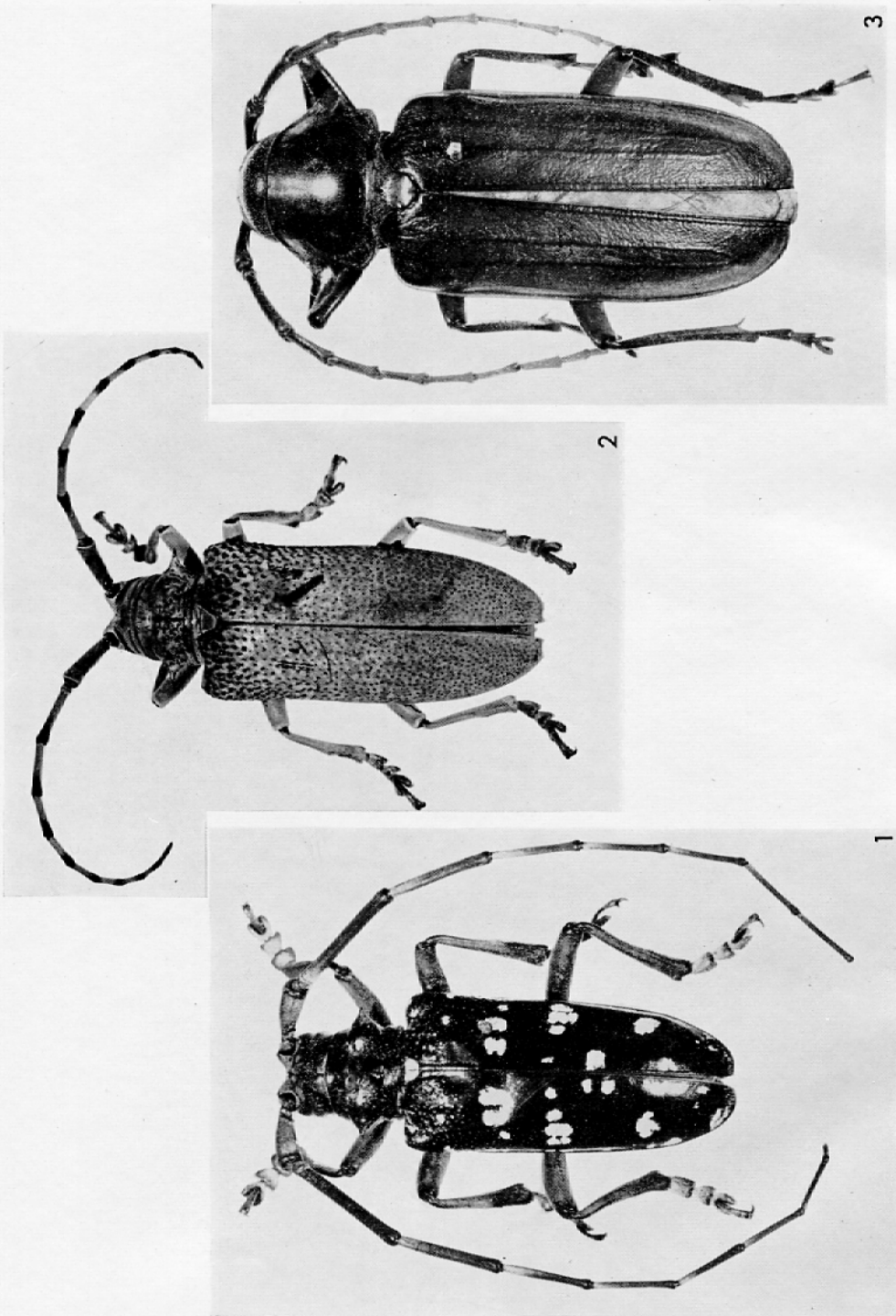


Fig. 1. *Anoplophora chinensis* (Förster). Adult (× 2).
Fig. 2. *Celosterna scabrator* (Fabricius). Adult (× 2).
Fig. 3. *Dorysthenes hugeli* Redtenbacher. Adult (× 2).