

THE BIOLOGY AND EXTERNAL MORPHOLOGY OF THE LARVAE  
OF EPILACHNINAE (COLEOPTERA, COCCINELLIDAE).

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(Plate VI.)

The larvae of the subfamily EPILACHNINAE, like the adults, are herbivorous. They have a porcupine-like general appearance, as the body is usually clothed with long, branched, spinous processes. The larvae, even of those species which are well known pests, have not hitherto been studied in much detail. On account of their rather uniform general appearance and the great complexity of the armature of the body-wall, the various species are not easily distinguished from one another, and the general descriptions that have appeared in papers dealing primarily with their biology and control measures are often insufficient for this purpose. Earlier workers who studied the larvae of Coccinellids were handicapped not only because the number of species of EPILACHNINAE available to them was very limited, but also because of the unsatisfactory state of the classification of the adult beetles and insufficient knowledge of their biology. Redtenbacher (1843) was apparently the first to draw attention to their phytophagous habits. Mulsant (1846), Candèze (1861) and Grandi (1913) each described one or two larvae of this sub-family. Böving (1917), Gage (1921), Strouhal (1927), and a few others who have studied the larvae of Coccinellids in general, have also described the structure of one or two species only, chiefly with a view to defining the larval characters of the subfamily as a whole. Few workers have hitherto attempted to distinguish more than two species or genera. The present study includes descriptions of 14 species belonging to six different genera of the sub-family from various parts of the world. Further, all the larval instars have been studied for three species and biological notes are given where possible.

Of the many points of interest concerning the family COCCINELLIDAE, those relating to their feeding habits have received considerable attention. The question as to whether the herbivorous habit is a primary or a secondary acquisition in the family will remain largely a matter of speculation until palaeontological evidence and greater knowledge of the relationship between the various groups (tribes and genera) of species are available. Observations on the feeding habits and the related structural differences are, however, discussed. The EPILACHNINAE comprise about one-sixth of the known species of the family. The adults present a great uniformity in external structure, with the result that nearly all of the known species have been placed in one genus, *Epilachna*. Of late, there has been a tendency to divide this subfamily into as many natural groups as possible, and for this purpose details of the external structures and of the genitalia are being increasingly employed. A study of the larvae, it is thought, will help not only in the identification of the species and genera but also in evolving a satisfactory and natural classification of the subfamily. In the following pages, the descriptions given are of the final instar larvae except where otherwise stated.

Besides the material in the British Museum (Natural History) and that collected by the author himself, collections of immature stages, as well as the adults in many cases, were received from Mr. J. C. M. Gardner, C.I.E., formerly of the Forest Research Institute, Dehra Dun (India), Mr. G. de Lotto of Eritrea, Mr. W. V. Harris of Uganda, Dr. E. A. Chapin of the U.S. National Museum, Washington, and Dr. F. van Emden,

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### General Description of the Larvae.

*Body* moderately elongate to oval, usually widest on the second or third abdominal segment and more narrowed posteriorly than towards the head; convex on the dorsal and rather flat to moderately convex on the ventral surface (Plate VI *a*).

*Head* relatively well developed, usually subrounded, sometimes slightly wider than long, directed at right angles to the longitudinal axis of the body, connected with the thorax by a moderately long membrane allowing limited movement in all directions; occipital foramen large and subrounded (fig. 15, *a*); vertex and genae convex, the front with an oblong-oval slight depression round a small central area. The epicranial suture, usually indicated by lighter coloration, consists of a coronal and two frontal sutures; the former extends from the base of the vertex to the middle of the distance between the base of the vertex and an imaginary transverse line joining the antennae; the frontal suture runs almost straight from the anterior end of the coronal suture to the base of the antenna; the clypeofrontal suture always present and usually distinctly indicated by strong sclerotisation of the frontal area. Ocelli, three on either side, dark, sub-conical, and arranged triangularly; one of them situated close and external to the base of the antennae, the other two at a little distance away towards the vertex and lying close together, usually of equal size,

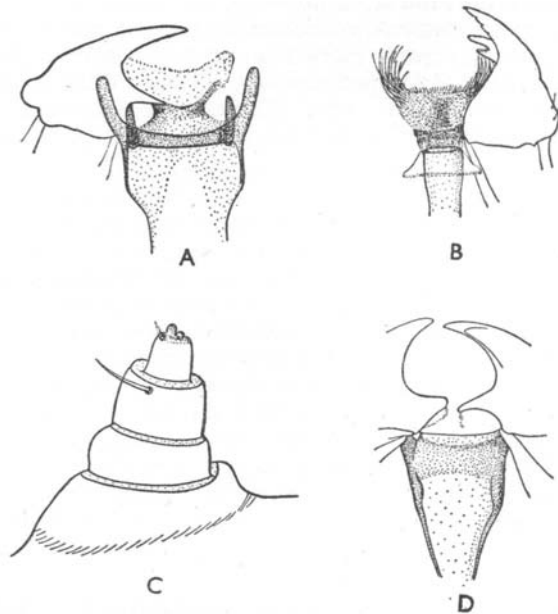


Fig. 1.—(a) *Brumus suturalis*, left mandible and hypopharyngeal sclerome of larva; (b) *Epilachna vigintioctopunctata*, right mandible and hypopharynx of first-instar larva; (c) *Coccidula scutellata*, antenna of larva; and (d) parts of mandibles and hypopharynx.

sometimes the inner one larger. Antennae, two- or three-segmented, usually long (two to three times as long as wide), but sometimes short (one-and-a-half times as long as wide), with the basal antacoria well developed and arising from a slightly elevated, circular part of the cranium forming the antennal socket. Clypeus usually well developed and demarcated by clypeofrontal suture, trapezoidal, narrowing anteriorly and bearing a few setae on the lateral margins. Labrum rectangular or transversely elliptical, variable in size in certain genera. The mandibles, which provide the most characteristic feature of the subfamily, are without basal teeth and have three to seven (or more) major teeth in the distal part; some of these teeth are denticulate on the inner margin. The hypopharyngeal sclerome\* not sclerotised (fig. 1 *b*). The maxillae and labium different in different genera; maxillary palpus characteristically long and three-segmented.

*Thorax* usually increasing in diameter towards the abdomen; less convex on the dorsal surface than the abdomen, with distinct pleurotergal and pleurosternal folds. Prothorax longer than either of the other two thoracic segments; pronotum sclerotised, with usually three, sometimes two, pairs of scoli† along the anterior margin and a few chalazae‡ and setae on the rest of its surface. Mesothorax and metathorax similar in shape and in the armature of the body-wall, each with three pairs of scoli on the dorsolateral surface, the area round the bases of scoli being sclerotised; the scoli differ from those of pronotum in that they are on the transverse median line of the segment. There is a single pair of spiracles on the thorax; each spiracle is situated on the dorsal aspect of the anterolateral part (sometimes called the spiracular area) of the mesothorax, and has a circular opening and is surrounded by a more or less sclerotised or pigmented area; thoracic spiracles usually larger than those on the abdomen. There is considerable uniformity in the arrangement of scoli on the thoracic and abdominal segments. The three pairs of scoli on each segment are arranged symmetrically on either side of the median longitudinal line. The scolus nearest the mid-dorsal line is called dorsal scolus, the next is called the subdorsal scolus, and the third, situated farthest from the mid-dorsal line and usually on the lateral margin or on the dorsal aspect of the pleuron, is called the dorsolateral scolus. On the underside of the segment, when the setae are arranged in groups or strumae§, there are usually three pairs of these called ventral, subventral and ventrolateral. On the underside of the thorax, however, only the ventral groups of setae or strumae are present and in certain species the prosternum has only a single struma instead of one on either side of the median longitudinal line of the segment. The legs are similar in structure on all three segments; the part of the segment immediately surrounding the coxa is sclerotised and bears a few long setae; legs with long and sparse setae, except on the inner side of tibiae where the setae are dense, long and often thickened at the apices, the claw with a quadrate or triangular basal tooth and narrowed, bent moderately to strongly and pointed distally.

*Abdomen* ten segmented; the first eight segments each with three pairs of scoli and a pair of spiracles on the dorsal surface and with one to three pairs of the groups of setae or strumae on the ventral surface (but sometimes there is only a single seta representing each group); some of the strumae fused with one another in certain species. The dorsal scoli much closer to the median longitudinal line than is the case on the mesothorax and metathorax in many species. Each spiracle situated

\*A hypopharyngeal sclerome is also called a hypopharyngeal bridge; a strongly sclerotised transverse part (usually with branches at either end) (fig. 1) at the base of the floor of the hypopharynx and usually present in the carnivorous species of the family (fig. 1 *a*).

†A scolus is a process, usually long and branched, of the body-wall, bearing setae at the apices of the branches; in the EPILACHNINAE it has also been applied to cases where it has become very short or simplified in structure by reduction in the number of branches.

‡A chalaza is a pimple-like swelling of the body-wall bearing a seta at its apex.

§A struma is a moderately convex area of the body-wall bearing a few setae or chalazae or both.

antero-laterally relative to base of subdorsal scolus, but on the first segment the spiracle is a little more dorsal. The ninth segment usually with a semicircular tergum bearing a number of both short and long setae or a pair of strumae; tenth segment short, mostly membranous, sometimes with a few very short setae, usually directed downwards and not visible from above.

#### Relationship with other Coccinellids.

The family COCCINELLIDAE is divided into three subfamilies, EPILACHNINAE, COCCINELLINAE and TETRABRACHINAE (LITHOPHILINAE). The larvae of the last named subfamily are quite unknown although, as far as can be judged from the structure of their mandibles, the adults appear to be carnivorous. The subfamily COCCINELLINAE is about five times as large as the EPILACHNINAE and presents a greater variety of form and structure. With the exception of the tribe Psylloborini, which is fungivorous and is very closely allied to Coccinellini in structure, the larvae and adults of the COCCINELLINAE are carnivorous. Although relatively little is known about the larvae of the Coccinellids as a whole, certain attempts to fix the position of the family in the order Coleoptera and to trace the relationship between the various subfamilies and tribes on the larval characters, have been made by certain workers in the past. While the conclusions presented by Böving (1917) and Böving and Craighead (1931) are in general accord with those of other Coleopterists, such as Ganglbauer (1899), and Sharp and Muir (1912) who studied the adults, Gage (1921) and Strouhal (1927) arrived at quite different results. Böving, and Böving and Craighead, regard the family COCCINELLIDAE as belonging to the Cucujoidea and *Hyperaspis* larvae as representing a more generalised form of the family. Gage and Strouhal consider CHRYSOMELIDAE as the probable progenitors of the family and EPILACHNINAE as the more generalised form. Again, while Böving regards EPILACHNINAE as allied to the tribe Coccinellini, Gage regards it as being close to Chilacorini, Strouhal, however, considers that Chilacorini and Coccinellini have probably originated independently from the EPILACHNINAE.

These differences in conclusions are apparently due to the limited number of the larvae studied so far, and also to the fact that different authors have stressed different characters. Apart from being herbivorous, the larvae of CHRYSOMELIDAE and EPILACHNINAE differ a great deal both in structure and in their mode of feeding. The structural differences have been dealt with by Böving and by Böving and Craighead, and need not be repeated here. Attention may, however, be called to the differences in their feeding habits. The EPILACHNINAE scrape and compress the leaf tissue with their mandibles and imbibe the juices and softer tissues, rejecting the cellulose and other harder tissues of the leaf previous to ingestion. The long and usually dense setae on the galea and neighbouring parts help in holding the juices during the process of scraping. The excrement is passed out in fluid form, unlike that of Chrysomelids and phytophagous caterpillars, which usually ingest leaf tissue in bits and pass the excrement in solid lumps. These and similar observations were made by Howard (1941) for *Epilachna varivestis* larvae, and subsequently by others for several more species of EPILACHNINAE. Regarding the relationship between the latter and the Chilacorini, Gage and Strouhal appear to have laid great emphasis on their common characters in respect of the coronal suture and the scoli of the body wall. The coronal suture, which is always present in the EPILACHNINAE, exists in only three closely related genera—*Chilocorus* Leach, *Orcus* Mulsant and *Egius* Mulsant, in the CHILOCORINI. It is also present, though very much shorter, in *Ceratomegilla maculata* (De Geer) which is a member of the tribe COCCINELLINI. Similarly, there is great variation in the degree of development of scoli on the thorax in the various species and genera of CHILOCORINI, and even in COCCINELLINI the scoli are present in several species though not usually well developed. The 14 species of EPILACHNINAE studied here have shown that the scoli vary a great deal in size and

form in various genera ; in *Chnootriba* Chevrolat and *Merma* Weise, for example, the scoli are even shorter or have more reduced branches than in certain CHILOCORINI and COCCINELLINI. It appears, therefore, that these characters are of little value for tracing the relationships between the various groups. Böving regarded EPILACHNINAE as being allied to COCCINELLINI on account of their similar general appearance, the position of the thoracic spiracles and the shape of the terga and pleurae on the thoracic segments. In the form of the hypopharyngeal sclerome and the structure of the mandibles, he regarded EPILACHNINAE as occupying a unique position in the family. The structure of the clypeofrontal region and of the antennae were also considered by him to be characteristic of the subfamily. The present studies show that while the mandibles and antennae present greater variety of structure than was the case in the four species examined by Böving, the importance of these characters remains undiminished. According to the classification based on the adults, the tribe COCCIDULINI is regarded as more generalised among the subfamily COCCINELLINAE. An examination of the larvae of *Coccidula scutellata* (Herbst), *C. rufa* (Herbst) and *Rhizobius litura* (F.), members of COCCIDULINI, revealed that the hypopharyngeal sclerome was not so strongly sclerotised (fig. 1 *d*) and did not have any branches at either end, unlike the known larvae of most other tribes of the subfamily ; thus, in this respect, the COCCIDULINI are closer to the EPILACHNINAE than to any other tribe. Maxillary palpi in the two are also long. The antennae of *Coccidula* (fig. 1 *c*) and *Rhizobius* are moderately long, narrowed distally, and composed of three clearly defined segments of nearly equal length. They differ from the very short antennae in most other tribes of COCCINELLINAE and from the rather long ones in the EPILACHNINAE. In most other characters of the head and of the armature of the body-wall the larvae of COCCIDULINI resemble the other known larvae of the subfamily. With our limited knowledge of the related forms, the question of the relationship with EPILACHNINAE may not be easily answered. It seems probable, however, that at least among the COCCINELLINAE it represents a more generalised form than either HYPERASPINI or CHILOCORINI.

*Key to the Genera.*

1. Subdorsal scoli absent on pronotum ; scoli\* long, some longer than width of body, with numerous long and short branches interspersed ; mandibles broad at base, with three blunt teeth.....*Afissa* Dieke  
 Subdorsal scoli present on pronotum ; scoli short or long but distinctly shorter than width of body, branches less numerous, the shorter ones being usually near the base ; mandibles broad or narrow at base but with more than three teeth..... 2
2. Claw without a quadrate basal tooth ; scoli very short, with short branches arising like a rosette from a conical base, and bearing equally short setae ; labrum very short, subrectangular ; galea elongate, strongly sclerotised on the inner margin.....*Chnootriba* Chevrolat *in* Dejean  
 Claw with a quadrate basal tooth ; scoli moderately long to long, branches not arising like a rosette ; labrum large, usually subrounded laterally ; galea oval or subrounded, not sclerotised on the inner margin.....3
3. Ocelli of unequal size, the area round them of lighter colour ; scoli moderately long, with short branches bearing very long setae (nearly four times the length of the branch).....4  
 Ocelli of equal size, the area round them relatively dark ; scoli long to moderately long, with long or short branches but with shorter setae.....5

\*Except where otherwise stated, the term "scoli" in the key refers to the dorsal and subdorsal scoli of the abdomen, especially of the first four or five segments.

4. Head with the median anterior part of the front broadly triangular, strongly sclerotised, the part posterior to the sclerotised area with three pairs of rather short setae; mandibles elongate, much narrowed distally, each with one large, apical and three short subapical teeth.....*Cynegetis* Chevrolat in Dejean

Head with the median anterior part of the front not broadly triangular, usually with six pairs of short setae crowded together; mandibles very broad at base, not much elongated or narrowed distally, each with two large apical and three moderately large to small, subapical teeth.....*Subcoccinella* Guérin-Ménéville

5. Mandibles broad at base, not much narrowed distally, with seven teeth, four of which are large and sharp; clypeus mostly membranous, larger than labrum which is expanded laterally at the anterior angles; galea subrounded with very short setae; scoli long with short branches and setae; dorsal scoli on the seventh and eighth abdominal segments equally long.....*Merma* Weise

Mandibles elongate and much narrowed distally, with not more than five teeth, two of which are large; clypeus mostly sclerotised, shorter than labrum which is not expanded distally; galea oval, with long, dense setae; scoli long, with usually long branches bearing much shorter setae; when the branches and setae are equally short, the former arise bilaterally from the main-stem, dorsal abdominal scoli on the eighth segment much shorter than on the seventh.....*Epilachna* Chevrolat in Dejean

#### Genus *EPILACHNA* Chevrolat in Dejean.

The larvae of the genus *Epilachna*, as at present constituted, show a great variety of structure. This is probably due to the fact that earlier workers have been misled into placing all the species concerned into one genus by the uniformity that the adult beetles display in certain external characters, including general appearance. In recent years, however, a more detailed study of their external structure and genitalia has resulted in the species being arranged into new groups, and some being separated into new genera. The present study of the larvae lends some support to this arrangement. The genus *Afissa*, for example, which was separated from *Epilachna* by Dieke in 1947, presents larval characters that are very distinct from those of *E. borealis* (F.), the type of the genus. The genus *Chnootriba* Chevrolat (in Dejean) which was sunk under *Epilachna* by Weise (1898) but has finally been recognised as valid by Mader (1941), also has distinct larval characters. From the accompanying descriptions and key to the species of *Epilachna*, it will be observed that the characters separating the species from one another within a group are much less pronounced than those distinguishing one group of species from another. This is equally true of the adult beetles, provided that the characters employed are more reliable than those, such as coloration and markings, that have been used hitherto.

#### *Key to the fourth-instar larvae of Epilachna described in this paper.*

1. Body yellowish, most of the scoli with the stem and spines piceous and the branches partly or wholly piceous; antenna long, with third segment indistinct; subdorsal scolus on pronotum with two or three very short setae, one of which is borne on a small branch; dorsal and dorsolateral scoli on pronotum not much broader towards the base than most other scoli...(*borealis* group) 2

Body yellowish, brown or piceous with scoli yellowish to dark brown; antenna usually long with the third segment distinct; when short, the third segment indistinct; subdorsal scolus simple or branched, the dorsal and dorsolateral scoli on pronotum much broader towards the base than other scoli.....3

2. Mandibles rather elongate, their length much greater than their width at the base and narrowed distally, the two large subapical teeth united at base ; scoli with the main stem and usually the basal part of branches piceous ; dorsal scoli on first seven abdominal segments with about eight long branches ; ventral strumae each with three or four setae, those on the seventh segment lying close to the subventral strumae, and those on the eighth being confluent with them (America).....*borealis* (F.)  
 Mandibles broad at the base, only a little longer than broad and narrowed distally, the two large subapical teeth separate ; scoli with the main stem and branches piceous, the dorsal scoli on the first seven abdominal segments with about twelve long branches ; ventral strumae each with about six setae, ventral and subventral strumae separate on the seventh segment and close to each other on the eighth (America).....*varivestis* Muls.
3. Head with a few short setae, usually restricted to vertex and anterior part of front, other setae moderately long and sparse ; antennae long, third segment distinct, second segment about twice as long as wide, with the seta below the apical margin .....4  
 Head with numerous short setae, intermixed all over its surface with long setae ; antennae short, third segment indistinct, second segment only slightly longer than wide, with the seta at the apical margin (Europe, N. Africa).....*argus* (Geoffr.)
4. Scoli with the branches arising all round the stem ; abdomen with the dorsal scoli equal in length to or slightly shorter than the subdorsal ones ; ventral surface with the setae arranged in groups or strumae.....5  
 Scoli with branches arising usually bilaterally from the main stem ; abdomen with the dorsal scoli much shorter than the subdorsal ones ; ventral surface without strumae or distinct groups, the setae being irregularly dispersed.....  
*(eusema group)* 8
5. Scoli moderately long, becoming distinctly broader towards the base, branches close, and (except for the apical setae) not bearing short, very thin setae ; meso- and metanotum with the bases of dorsal and subdorsal scoli of the same side not very close together.....6  
 Scoli long, only slightly broader towards the base, branches sparse and each bearing (in addition to the apical setae) two or three short and very thin setae ; meso- and metanotum with the bases of dorsal and subdorsal scoli of the same side very close together.....*(vigintioctopunctata group)*
6. Subdorsal scolus on pronotum usually with two branches ; dorsal surface of body-wall mostly piceous with the scoli and the area round their bases lighter (brownish) ; ventral and subventral strumae separate on the seventh segment and close to each other on the eighth (Africa).....*hirta* (Thnb.)  
 Subdorsal scolus on pronotum unbranched ; body mostly light yellow, with scoli and the area round their bases usually light brown or brown ; ventral and subventral strumae contiguous on both the seventh and eighth segments (Africa, Europe, Asia) .....*chrysomelina* subsp. *orientalis* Zimm.
7. Scoli as long as the width of the head, with twelve rather close branches ; strumae on the underside with the bases not strongly sclerotised or pigmented brown ; prosternum with a single struma in the middle ; ventral and subventral strumae on eighth segment fused (Asia)..... *vigintioctopunctata* (F.)  
 Scoli distinctly longer than the width of the head, with twelve sparse branches ; strumae on the underside strongly sclerotised and pigmented brown ; prosternum with a pair of strumae ; ventral and subventral strumae on eighth abdominal segment separate (Asia).....*dentulata* Dieke

8. Body lightly yellow with the part of the abdominal tergites between the dorsal pair of scoli brown to dark brown ; scoli with short branches bearing short apical setae ..... *eusema* (Ws.)  
 Body dark brown to piceous on the dorsal surface, with the scoli whitish except for the black, short, apical setae borne by the long to moderately long branches ..... *flavofasciata* (Lap.)

***Epilachna borealis*** (Fabricius) (Figs. 2 & 3).

*Epilachna borealis* is of interest from both the economic and the taxonomic point of view ; in Central and North America it is a pest of cucurbitaceous plants. It is also the type of the genus *Epilachna*. A morphological description of the larva was given by Gage (1921) who also generalised the characters of the subfamily EPILACHNINAE.

*Body* (fig. 2) elongate oval, slightly narrower posteriorly, widest at the second abdominal segment. Fourth (last) instar larva 6.5–7.0 mm. long and 2.8–3.0 mm. wide across the second abdominal segment, excluding scoli which are about 1.75 mm. long. General colour of the body light yellow excepting the dark or light brown markings on the head, scoli and legs.

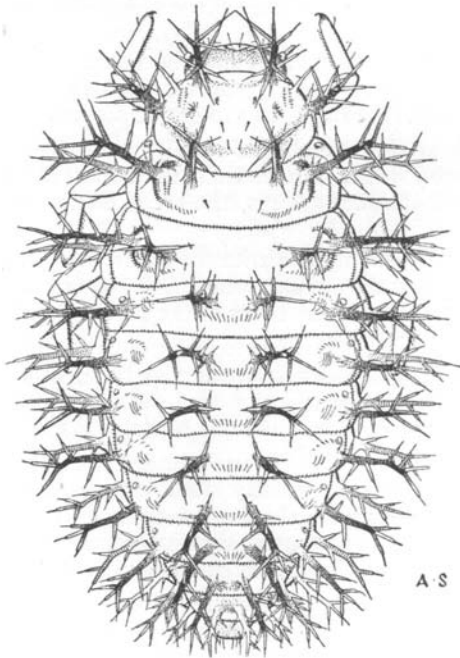


Fig. 2.—Larva of *Epilachna borealis*.

*Head* (fig. 3 *b*) subrounded, a little narrower than prothorax, vertex and genae with brown to dark brown markings ; area round ocelli especially dark ; front rather lightly coloured except in and around a shallow, oval depression between the frontal sutures. Epicranial suture with both the coronal and frontal sutures lighter in colour, antero-clypeal margin distinctly sclerotised and marked dark brown. Setae moderately long, rather sparsely distributed, as shown in fig. 3 *b*. Ocelli, three on either side, conical, piceous, of equal size, arranged triangularly, the two towards vertex much nearer each other than to the third which is situated near the



antennal socket. Antenna (fig. 3 *d*) with first segment slightly broader than long; second a little narrower than the first, slightly narrowing apically, nearly  $2\frac{1}{2}$  times as long as wide, and bearing a long seta at two-thirds its length and a moderately short and conical sensilla near its apex; third segment light, rather indistinct, disc-like, and with a number of very short, conical sensillae. Clypeus (fig. 3 *b*) transverse, slightly narrower anteriorly, nearly four times as long as broad and bearing six or eight, short setae. Labrum slightly narrower at base, a little longer than clypeus; mandible (fig. 3 *e*) a little less than twice as long as wide, basal area plain, distally



Fig. 3.—Larva of *Epilachna borealis*: (a) subdorsal scolus of pronotum; (b) head; (c) subdorsal scolus of second abdominal segment; (d) antenna; (e) mandible; (f) dorsolateral scolus of fifth abdominal segment; (g) maxilla and labium; (h) claw.

with four large and several small teeth, the large ones being weakly denticulate on the inner margin; maxilla (fig. 3 *g*) with galea subtriangular, rounded at apex, with four large and several small teeth, the large ones being weakly denticulate on sparsely placed, short setae; palpus with apical segment filiform, narrower but slightly longer than either of the other two; labium oblong, membranous excepting

the rather weakly sclerotised area near bases of palpi, the latter short, with apical (second) segment elongate, cylindrical; mentum with two or three pairs of short setae in the middle.

*Thorax* gradually increasing in width, metathorax becoming as wide as first abdominal segment. Prothorax transverse, two-thirds as long as wide, pronotum with dorsal scolus arising near anterior margin, directed upwards and slightly forwards, brown to dark brown on main stem and light brown on branches, a little longer than the length of pronotum, and slightly tapering, with about 16 branches arising from all round main stem, but rather irregularly, and varying in length from short tubercles near the base to as long as two-thirds the entire length of main stem; usually three or four of the long branches arising from near the apex, six or seven long to moderately long ones arranged sparsely in the median half of the main stem and the remainder, moderately long to short, arising from near the base; apical seta of a branch usually brown, stout and nearly two-fifths the length of its branch. Subdorsal scolus (fig. 3a), on pronotum lighter, half as long as the latter and comprising a long filiform process with a long apical seta, a short branch, with a short seta, usually situated near middle of the scolus, and one or two short, simple setae situated between middle and the base. Dorsolateral scolus similar to dorsal scolus, arising a short distance from anterolateral margin of pronotum and pointing anterolaterally. Besides a pair of short chalazae situated near centre of pronotum, there are about a dozen similar chalazae arranged almost in a row along its posterior margin. Meso- and metathorax similar to each other, each shorter but wider than prothorax, nearly four times as wide as long, and with scoli on tergum similar to dorsal or dorsolateral scoli on prothorax. Dorsal scolus as far from the median longitudinal line as from lateral margin of tergum and placed very close to subdorsal scolus which is very similar to it. The areas of tergum round the bases of these scoli, and especially that situated laterally and posteriorly to the base of subdorsal scolus, heavily sclerotised and pigmented. Subdorsal scolus directed upwards and slightly laterally; dorsolateral scolus directed laterally. On the underside each struma has two to four short setae; prosternum with a single struma in the middle, meso- and metasternum, each with a pair of strumae. Legs: trochanter and femur together slightly longer than tibia, the latter dark brown on outside towards apex and as usual with dense and long setae on inner side; claw (fig. 3h) with a subquadrate basal tooth, distal part, narrow, pointed and subrounded near its base.

*Abdomen*: Dorsal scoli situated rather close to the median longitudinal line and the pair on each segment having a common, oval, sclerotised area round their bases; on first seven segments equal in size to those on metathorax, each with about twelve, long branches; on eighth segment short and lighter in colour and usually with eight rather short branches. Subdorsal scoli (fig. 3c) in line with the corresponding scoli on metathorax and likewise directed dorso-laterally except on the last three segments, where they tend to point rather posteriorly; on first seven segments, subdorsal scoli similar to those on metathorax in size, branching and coloration; on eighth they are much shorter, about two-thirds the length of dorsal scoli on the same segment, and with fewer setae. Dorsolateral scoli directed laterally, similar in size, general structure and coloration to the other scoli on first four segments but decreasing rapidly in size and number of branches (fig. 3f of fifth segment) on the succeeding four segments until, on the eighth, the dorsolateral scolus is merely a conical process with six to eight short spines, two or three of which are borne on small tubercles; dorsolateral scoli on sixth to eighth segments usually without brown coloration. The tergum of ninth segment semicircular, strongly sclerotised with light brown markings and about ten, short to moderately long, simple setae usually near its external margin. Ventral surface usually with subrounded to oval, rather lightly pigmented strumae. Ventral pair of strumae on first six segments distinct, each comprising 3-4 short setae usually in a transverse row; on the seventh

similar but situated by the side of subventral struma and on the following segment confluent with subventral strumae. The latter on the first two segments similar to ventral strumae of the same segment ; on third to seventh segments, each comprise four or five short to moderately long setae arising from small tubercles ; on eighth segment subventral and ventral strumae contiguous, with a total of six to eight setae. Ventrolateral strumae distinct from the rest on first eight segments ; on first segment similar to the ventral, on second to eighth segments, each comprising five or six setae, two or three of which arise from short, pimple-like projections. On ninth segment setae not arranged in separate groups, rather short, and usually not more than eight in all. Tenth segment membranous, with two or three very short setae on either side.

*Material examined*: Ten larvae (several pupae and adults) lent by Dr. E. A. Chapin of U.S. National Museum, Washington : six from Creton, Connecticut, on squash, 27.viii.43 and four from Quincy, Florida, on cushaws (*Cucurbita moschata*), 9.viii.44 (*L.M. May*).

### **Epilachna varivestis** Mulsant (Fig. 4).

*Epilachna varivestis*, commonly known as the Mexican bean beetle, is a pest of beans in Central America and the United States. The larva is very similar in general appearance to that of *E. borealis* from which it differs in a few structural details only.

*Body* similar in outline and size to that of *E. borealis* ; general colour light yellow, parts of head, tergites, legs and the majority of scoli dark brown to piceous.

*Head* similar to that of *borealis* in general shape ; but with the brown markings on vertex more diffused, genae and neighbouring parts of the front as dark as the area round ocelli. Setae moderately long and sparse and arranged as in *borealis*. Ocelli and antennae (fig. 4 *a, b*) also similar to those in *borealis*. Clypeus very broad at base with the basal angles very acute, the anterior margin being much shorter than the posterior. Mandibles (fig. 4 *c*) different from those of *borealis*, broad at base, slightly longer than broad, much narrowed in the distal half, with three large and two or three small teeth ; apical large teeth denticulate on the inner margin ; other mouth-parts as in *borealis*.

*Thorax* similar to that of *borealis* in general outline and in the arrangement of scoli, the latter, however, differing in the arrangement of branches and coloration. Prothorax with the tergum rather strongly sclerotised, dark brown especially along the posterior margin which bears a row of fairly closely placed chalazae. Dorsal scolus a little longer than the length of the tergum, slightly broader towards the base, with the main stem brown to dark brown, bearing about seventeen long to moderately long branches arising irregularly from all round its surface ; five branches near the apex dark brown, the rest uniformly coloured brown to light brown ; setae varying between two-thirds to two-fifths the length of the branches bearing them. Subdorsal scolus (fig. 4 *e*) variable, a little shorter than the dorsal scolus, with a long seta at the apex, and two or three short ones (sometimes one of them arising from a short branch) at two-thirds to one-third the length of the main stem. Dorsolateral scolus slightly longer than the dorsal scolus, with about eighteen branches, as in the latter. Meso- and metathorax with the arrangement of scoli as in *E. borealis*, but different in coloration, each scolus (fig. 4 *g*) with the main stem and the branches, dark brown except the few towards the base, which are lighter. Dorsolateral scolus with the main stem and branches light brown, but otherwise like those of the other scoli. Differs from *borealis* in structure of strumae on the underside ; prosternum with a pair of ventral strumae, each comprising three very short and closely placed setae on a small sclerotised area near the longitudinal median line ; on meso- and metasternum the strumae are as on the prosternum but with longer setae. Legs

similar to those in *borealis*, but with the distal part of claw (fig. 4 *d*) acutely bent near the basal tooth and not subrounded as in the latter species.

**Abdomen :** Dorsal scoli on first seven segments of almost equal length ; narrower at base than those on metathorax, with the main stem dark brown from a little above the base to the apex, branches and setae throughout of the same colour as the stem or slightly lighter ; usually with a dozen rather long and about four short branches (the latter near the base), each branch bearing at its apex a short, stout seta usually equal to one-fourth the length of the branch, but in the case of short branches the setae not proportionately reduced. Dorsal scolus on eighth segment nearly half the length of that on the first, of light colour, with ten short branches. Subdorsal scoli on the first six segments nearly equal in size to dorsal scoli of the same segment, each with the area round its base heavily sclerotised, dark brown and emarginate on the side towards the centre of the segment, on the seventh and eighth segments shorter, usually lightly coloured, and each with eight to ten branches

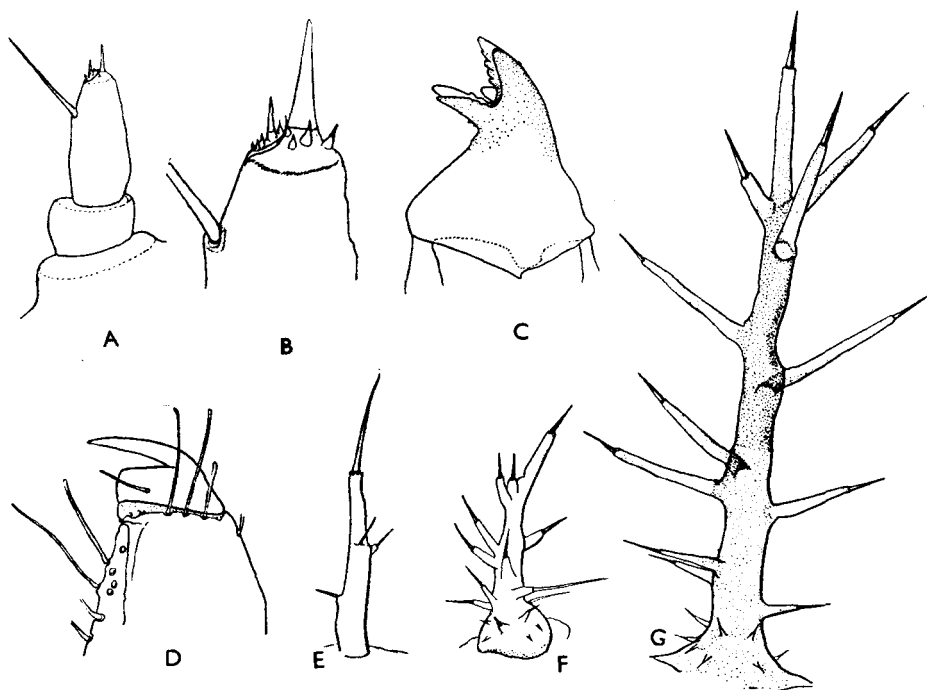


Fig. 4.—Larva of *Epilachna varivestis* : (a) antenna ; (b) apex of antenna much enlarged ; (c) mandible ; (d) claw ; (e) subdorsal scolus of pronotum ; (f) dorsolateral scolus of fifth abdominal segment ; (g) subdorsal scolus of second abdominal segment.

which are much shorter on those of the eighth than on those of the seventh. Dorsolateral scoli directed laterally, similar in size, general structure and coloration to the other scoli on the first four segments but decreasing in length and in the number of branches in each succeeding segment (fig. 4 *f*, of fifth segment), and without heavily sclerotised areas round their bases ; the scolus on the sixth segment with six short branches ; that on the eighth with two short chalazae and four short setae only. The tergum of the ninth segment semicircular, sclerotised, dark brown and with a dozen short setae, mainly along the external margin. The strumae on the ventral surface larger, more distinct and darker, being more strongly sclerotised than

those of *borealis*. Ventral strumae on first segment each represented by two short, rather transversely placed setae, on the second to seventh each ventral struma consisting of about six short setae, rather transverse oval; on the eighth similar to that on the seventh but lying close to the subventral struma. Subventral strumae on the first segment absent, on the second, struma with three short setae, but on the six succeeding segments with the number of setae increasing to about six. Ventrolateral struma on the first segment represented by a single short seta, on the second by one long and three to five short setae, and on the next three segments the strumae similar to those on the second but each with two or three long chalazae; on the sixth to eighth segments similar but smaller. On the ninth segment the setae are not grouped, but are distributed along the posterior margin and are about 18 in number. The tenth segment is devoid of setae ventrally.

*Remarks.*—The branches of scoli are uniformly pigmented either brown or piceous unlike those of *borealis* which are lighter towards the apices. The strumae are more distinct than in the latter species and also differ in their number and position on the prosternum and sternum of the eighth abdominal segment. The mandibles and claws show differences in structure as described above.

*Material examined*: One larva—same as described by Gorham (1898); 12 larvae from Berwyn, Maryland, 4.vii.1928 (*A. B. Gahan*).

***Epilachna argus*** (Geoffroy, in Fourcroy) (Fig. 5).

*Epilachna argus* occurs in Central and Southern Europe and in North Africa. It attacks cucurbitaceous plants but is not reported to do serious damage. Brief descriptions of the larvae have been given by Mulsant (1846), Candèze (in Chapuis & Candèze, 1853) and Doebner (1862) but these are insufficient to distinguish it from other species. Schmidt (1922) also described the larva but this publication has not been available to the writer.

*Body* elongate oval, the final instar larva 10 mm. long, and 3.5 mm. wide; of variable colour, being brown to dark brown on the head, pronotum, the main stem of scoli and all or some of its branches, the openings of spiracles, the area round the bases of scoli, greater part of legs, and the bases of ventral setae; the remainder of the body light yellow.

*Head* (fig. 5*b*) subrounded; brown, with irregular, small darker patches on the vertex and dark brown area around the ocelli, the epicranial suture light brown. Setae very short to long, numerous, crowded, and arranged as shown in the figure; in addition, five or six moderately long setae present on the lower surface of genae. Ocelli, three on either side, of nearly equal size, black and arranged triangularly; the two towards the vertex close to each other and at a little distance from the third which lies close to and outside antennal socket. Antenna (fig. 5*a*) comparatively short, the first segment much broader than long, the second slightly narrower and a little longer than its diameter, with a moderately long seta and an elongate conical sensilla near its apical margin; the third small, indistinct, disc-like, lighter in colour, and bearing a few short sensillae. Clypeus two-and-a-half times as wide as long, with the basal half rather dark brown. Mouth-parts similar to those of *E. chrysomelina*.

*Thorax* distinctly increasing in diameter towards the abdomen. The arrangement of scoli on thorax and abdomen corresponds to that in *E. chrysomelina*. Prothorax half as long as wide, with the pronotum transverse oval, narrower posteriorly, strongly sclerotised and with irregular dark patches and a few shallow depressions on either side. Dorsal scolus (fig. 5*z*) a little shorter than length of pronotum, much broader at the base, with about 15 branches arising irregularly from all round its surface; branches moderately long to long, the apical two or three branches rather dark brown and with the setae dark and nearly as long as their branches; the

remaining branches brown or of very light colour, with the dark apical seta half to one-third as long as the branch bearing it; some branches occasionally with a very short seta in the middle. Subdorsal scolus of one side usually different from the corresponding scolus on the other side in the same example, varying in colour from light to dark brown; the one on the left side (fig. 5 *d*) of the pronotum like a large branch of the dorsal scolus, equal to about two-thirds the length of the latter, bearing an equally long seta at its apex and two or three short setae, arising from short tubercles situated near the base or the middle; that on the right side of the pronotum similar but with an additional (fig. 5 *c*), moderately long branch situated in the middle and bearing a fairly long, apical seta. Dorsolateral scolus similar to dorsal scolus. The centre of the tergum with a pair of moderately long chalazae and the posterior margin with about twelve, rather short chalazae and simple setae and metathorax with dorsal and subdorsal scoli longer than the dorsal ones on prothorax; each scolus with about fifteen long branches bearing short, brown, apical spines, usually not longer than one-third the length of the branches bearing them; the main stem and the apical three or four branches darker in colour. Dorsolateral scolus (fig. 5 *j*) similar to the other scoli on the segment but with a separate dark brown area round its base. Underside with dark brown strumae, the prosternum

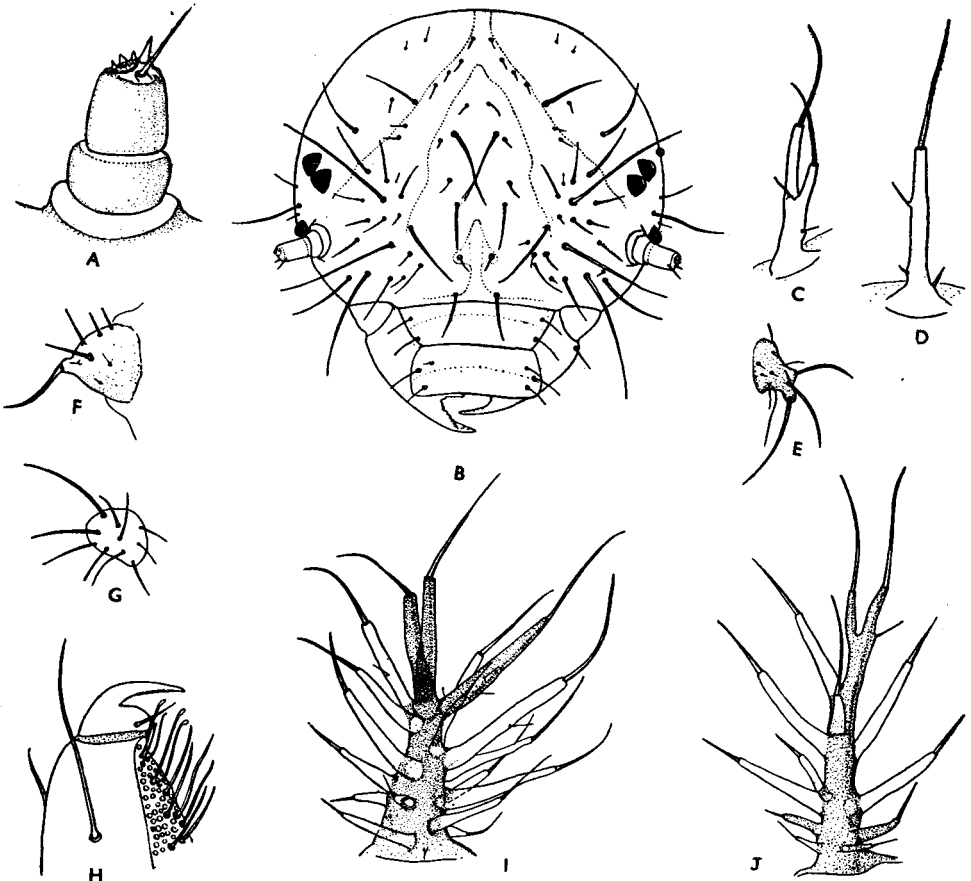


Fig. 5.—Larva of *Epilachna argus*: (a) antenna; (b) head; (c, d) subdorsal scoli of pronotum; (e) dorsolateral scolus of eighth abdominal segment; (f) ventrolateral struma of third abdominal segment; (g) the same of eighth abdominal segment (h) claw; (i) dorsal scolus of pronotum; (j) the same of mesonotum.

having one central struma with eight to ten setae ; on meso- and metasternum the strumae are separated but close together and each has about six short to moderately long setae. Legs as in *E. chrysomelina* but with distal part of claw (fig. 5 h) acutely bent nearer the basal tooth.

*Abdomen* : The pair of dorsal scoli on each segment, surrounded by a common, transverse oval to rectangular, sclerotised and darkly pigmented area ; scoli similar to those on metathorax in coloration and branching but slightly narrower at base, shorter and usually with 12 branches bearing short setae except for those on the eighth segment which have rather short branches but long and very light setae. Subdorsal scoli on the first seven similar to dorsal scoli but with the dark area round the base of each, subquadrate except for a short notch on the margin towards the centre of the segment ; on the eighth segment similar to dorsal scoli of that segment, nearly two-thirds as long and each with about eight branches. Dorsolateral scoli similar to the others on the first four segments but gradually decreasing in size on the next four segments, with apical setae of branches, however, becoming longer and lighter in colour ; on the eighth (fig. 5 e) being only a conical projection with a short branch and a number of moderately long to short setae. Ninth tergite semicircular, sclerotised, brown, with a few short setae in the middle and a row of moderately long ones at the posterior margin. Tenth segment with a small lightly sclerotised, brown area on either side, and bearing four very short setae. Ventral surface with usually dark brown strumae ; ventral strumae on first segment with two or three very short setae, on the second with four, usually subtransversely arranged, on the third to fifth each with eight to ten setae but then decreasing gradually in number to about three on the eighth segment. Subventral strumae usually absent on the first segment ; each consists of one long and two short setae on the second ; of six to ten moderately long and closely placed setae on each segment from the third to sixth, and of about five setae on the seventh and eighth. Unlike those of *E. chrysomelina*, not contiguous with the ventral struma on these two segments. Ventrolateral struma on the first segment represented by a single, usually brown chalaza with a long seta, on the second increases in size and has one chalaza and two short setae ; on the third with three long and usually four moderately long setae ; on the fourth to sixth segments the setae become longer and increase in number to about ten or twelve in each struma ; on the seventh and eighth the number is reduced to seven and five, respectively. Ninth segment with two strumae on either side, each consisting of three to five short, brown setae. No setae present ventrally on the tenth segment.

*Material examined* : Three larvae from Central Europe (*Verhoeff*) and four from North Algeria, 25.v.1913.

*Remarks* : By its head having numerous short setae intermixed all over its surface with long setae and by the short antennae, this species is very distinct from the other species. The structure of the adult beetles, especially of the male genitalia, also supports this.

### ***Epilachna chrysomelina* subsp. *orientalis* Zimm. (Fig. 6).**

*Epilachna chrysomelina* (F.) occurs throughout Africa, southern and middle Europe and central and southern Asia. It is divisible into several subspecies ; according to Zimmermann (1936), the typical form occurs in southern and central Europe, the western Mediterranean and north-west Africa and the subspecies *orientalis* Zimmermann in the eastern Mediterranean, north-east Africa, central Asia and across India, to as far as Indo-China. In India this species has often been erroneously called *E. dodecastigma* Wied.,\* which is a quite distinct species and is

\*Usually misspelled *dodecastigma* and wrongly credited to Mulsant (1850) ; Wiedemann's (1823) reference was omitted by Mulsant who later (1853) corrected this omission.

not related to *chrysomelina*. The larvae and adults of *E. chrysomelina* feed mostly on cucurbitaceous plants. In central Asia and India it is a pest, whereas in southern Europe it is not reported to do serious damage. The morphology of the larvae, although previously dealt with by Grandi (1913) and Klemm (1930), is treated here in greater detail and for all the instars. The examples of the larvae described here are from Eritrea, Palestine and India and belong to the subspecies *orientalis*. Some of the Eritrean specimens have rather dark coloration which is very variable.



Fig. 6.—Larva of *Epilachna chrysomelina* subsp. *orientalis*: (a) antenna; (b) head; (c) mandible; (d) dorsolateral scolus of fifth abdominal segment; (e) subdorsal scolus of pronotum; (f) dorsolateral scolus of eighth abdominal segment; (g) claw; (h) maxilla and labium; (i) dorsal scolus of first abdominal segment; (j) ventrolateral struma of eighth abdominal segment; (k) the same of second abdominal segment; (l) dorsal scolus of pronotum.



*Body* elliptical, twice as long as wide, slightly narrower posteriorly than towards the head; a well grown, final-instar larva is 8 mm. long and 4 mm. wide across the third abdominal segment which is the widest. Colour usually light yellow, brownish in more heavily sclerotised parts; sometimes with dark brown pigmentation, especially at the apices of the scoli.

*Head* (fig. 6 *b*) subrounded, slightly longer than wide, brownish except for the epicranial suture and median part of the front which are lighter; clypeal suture darker; setae mostly long, a few short ones usually at the vertex and near the clypeal margin as shown in the figure; lower surface of the genae with three or four short setae. Ocelli three on either side, black, of equal size, and arranged triangularly; the two towards the vertex close together and situated a little distance away from the third which lies very close to and outside the antennal socket. Antennae (fig. 6 *a*) fairly long; the first segment nearly as wide as long, the second a little narrower than the first and only slightly narrowing anteriorly, nearly twice as long as wide, with a long seta and an elongate, conical sensilla at the apical margin; the third segment small, narrower, much shorter than wide and with a number of sensillae at the broad apex. Clypeus trapezoidal, narrow anteriorly, less than half as long as wide and with three or four moderately long setae at each lateral margin. Labrum nearly twice as long, slightly rounded on the margins and with about six or eight moderately long setae; mandibles (fig. 6 *c*) much narrowed distally, each with four large teeth which are denticulate on the inner margin; maxilla (fig. 6 *h*) with the galea broadly oval, the distal part especially on the oral surface with fairly dense, rather delicate and moderately long setae; maxillary palpus with the apical segment long and narrowed distally; labium for the most part membranous, the small area round the bases of palpi sclerotised; the palpi with the apical segment narrower but a little longer than the basal one.

*Thorax* distinctly increasing in diameter towards the abdomen. Prothorax nearly twice as wide as long, with the pronotum oval, slightly more narrowed posteriorly, sclerotised with four or five shallowly pitted and darker areas situated near and posterior to the bases of scoli. Dorsal scolus (fig. 6 *l*) directed forwards and slightly upwards, its main stem elongate and conical, a little shorter than the length of pronotum with about 16 to 18 moderately long branches arising from all round its surface, and each with an apical brownish seta of varying length, the setae on the apical branches equal to or about two-thirds the length of the branches bearing them, those on the branches near the base proportionately small. Subdorsal scolus (fig. 6 *e*) consists of a single narrow process, which is a little shorter than the main stem of the dorsal scolus, and has the apical seta equal to about half the length of the process itself. Dorsolateral scolus similar to the dorsal scolus in size and structure but directed anterolaterally and a little dorsally. In addition, the pronotum has a pair of chalazae in the middle and about a dozen short chalazae at the posterior margin. Mesothorax shorter but distinctly wider than prothorax; dorsal scolus on each side closer to the subdorsal of the same side than to the middle of the segment, similar to the corresponding scolus on pronotum, directed forward and upward but with the branches reduced to about 12 and with shorter setae, each of the latter, half to one third as long as the branch bearing it; subdorsal scolus similar to the dorsal one with slightly longer setae; directed anterolaterally; the bases of dorsal and subdorsal scoli of the same side surrounded by a common, suboval, sclerotised and rather brownish area. Dorsolateral scolus similar to the subdorsal scolus but slightly narrower at base. Metathorax slightly greater in diameter than the mesothorax to which it is otherwise similar. Prosternum with a median struma consisting of about six moderately long setae; mesosternum and metasternum each with a pair of strumae, each struma situated close to and on either side of the median line and consisting of one long, central seta and five or six shorter ones. Legs with trochanter and femur together equal in length to the tibia; claw (fig. 6 *g*) with a short quadrangular basal tooth and with the distal part moderately bent near the base.

*Abdomen* : dorsal scoli (fig. 6 *i*) closer to the longitudinal median line than the corresponding scoli on the thorax ; the pair on any one segment with a common, transverse oval, sclerotised area round their bases ; on the first segment, vertical, each with 12 moderately long to long branches similar to those in the corresponding scoli on metathorax, on the second segment similar but directed slightly laterally, on the third to seventh segments, similar but directed gradually more posteriorly, and on the eighth, a little shorter with eight short branches bearing relatively longer setae. Subdorsal scoli situated in line with the corresponding ones on the metathorax, similar in structure to the dorsal scoli of the same segment, directed slightly more laterally and each with a sclerotised and sometimes pigmented area round its base, this basal area with a small notch on the side towards the middle of the segment. Dorsolateral scoli on the first segment directed laterally, slightly longer but narrower at the base than subdorsal scoli, each with usually 15 branches ; on the second to sixth segments gradually decreasing in length and in number of branches and directed more posteriorly in each succeeding segment, on the seventh segment reduced to nearly half the length of that on the preceding segment and with about eight setae arising from short tubercles ; on the eighth segment further reduced to a short process (fig. 6 *f*) with about six setae. Setae of dorsolateral scoli on the fifth (fig. 6 *d*) to eighth segments distinctly longer than those of the other scoli. Tergum of the ninth segment semicircular with about 12 short and six long setae, mostly on the external margin. The underside mostly with distinct, sclerotised and usually lightly pigmented strumae. Ventral strumae on the first segment each consisting of three short setae, one of which is longer than the other two, on the second segment consisting of four or five setae, two of which are longer, and on each segment from the third to sixth consisting of eight or nine setae, about four of which are longer ; on the seventh and eighth segments the ventral and subventral strumae of the same side are confluent, a character by which the species can be easily distinguished from others ; the total number of setae in these confluent strumae being usually ten and six in the seventh and eighth segments, respectively. Subventral struma absent on the first and often also on the second and when present on the latter segment it consists of only two short setae ; on the third segment the subventral struma bears four setae one of which is longer than the rest ; on each segment from the fourth to sixth, it consists of three long and six shorter setae. Ventrolateral struma on the first segment consists of a long seta borne on a short tubercle and a short seta close to it, on the second segment it consists of about seven setae, two of which are long and are borne on a short tubercle (fig. 6 *k*), on the third it is similar to that on the second but with the two tubercles sometimes confluent at the base and with the setae usually longer. On the fourth to sixth, its base is more convex and it has about seven setae, on the seventh and eighth it is shorter and has two long and four short setae (fig. 6 *j*). Ninth segment bears a total of 10 moderately long setae, mostly in the median part of the posterior margin, and the tenth has only a few very short setae along the transverse median lines.

The characters of the earlier instars are as follows :—

*First instar* : 0.8–1.25 mm. long and about 0.4–.75 mm. wide in the middle. Head with well defined epicranial and clypeal sutures, setae relatively long, ocelli as in the final instar, the antennae also similar but with the second segment only a little longer than its diameter and with a large sensilla, mouth-parts in general similar to those of the final instar except for the mandibles which have only the apical teeth serrate on the inner margin. Thorax slightly increasing in diameter posteriorly ; prothorax with the dorsal and dorsolateral scoli shorter than the length of the pronotum ; each with eight short branches bearing setae, nearly twice as long, at their apices ; the subdorsal scoli shorter, with the apical seta equal to twice its length. The scoli on the other thoracic segments and on the abdomen, longer, usually narrower at base, and with shorter setae, than the dorsal scoli on the prothorax.

*Second Instar* : 3.5 mm. long and 1.7 mm. wide, with the structure of the head similar to that in the first-instar larva, the scoli on the thorax and abdomen similar to those in the first instar, proportionately larger, with the number of branches usually increased to ten and bearing relatively shorter setae.

*Third Instar* : 4.5 mm. long and 2.25 mm. wide ; closely resembling the final instar, but scoli usually with ten to twelve branches.

*Material examined* : All instars and many examples of each collected and reared on watermelons in Eritrea (*G. de Lotto*). Several larvae collected and reared by the author on pumpkins, melons and watermelon leaves in the Punjab and Delhi, 1935-39. Palestine 1 larva (*Dr. F. S. Bodenheimer*).

*Remarks* : Besides the general structure of the armature of the body-wall, this species is characterised by the confluence of the ventral and subventral strumae on the seventh and eighth segments and can thus be easily separated from *Epilachna argus* (Geoffr.), *E. hirta* (Thnb.) and *E. vigintioctopunctata* (F.).

### ***Epilachna hirta* (Thunberg) (Fig. 7).**

*Epilachna hirta* is widely distributed on the African continent. The present material is from Eritrea.

*Body* oblong oval, much narrowed posteriorly, 6.5 mm. long and 2.25 mm. wide in the middle, coloration very variable, usually the greater part of head, posterior half of pronotum, longitudinal median and marginal part of mesonotum and metanotum, area round bases of abdominal scoli and lateral part of underside of body dark brown.

*Head* subrounded ; vertex and basal half of front with large and irregular, piceous patches except for the very light epicranial suture ; area surrounding ocelli, the antennae, ocelli and maxillary palpi piceous to dark brown ; setae moderately long to long, arranged as in *E. chrysomelina* except that the very short ones are absent ; ocelli also as in the latter species. Antenna (fig. 7a) with first segment slightly wider than long, second slightly narrower, nearly twice as long as wide, with a long seta situated a little below and a conical sensilla at the apical margin, third segment very short, less than half as wide as second and with a number of sensillae at apex. Clypeus trapezoidal, narrower anteriorly, about one-third as long as wide and with three setae on each lateral margin. Mouth-parts very similar to those of *E. chrysomelina*, but mandibles (fig. 7c) much narrowed distally, each with five sharply pointed teeth, two of which are larger ; one of the latter and two shorter teeth usually denticulate on the inner margin.

*Thorax* gradually increasing in diameter posteriorly, moderately convex dorsally. Prothorax nearly twice as broad as long, pronotum oval, sclerotised, dark brown to piceous mostly along the posterior margin and along the basal half of median longitudinal line ; dorsal scoli as long as pronotum, with the main stem conical slightly darker than the branches which arise from all round its surface, the branches being about 20 in number and, with the exception of about six near the base, moderately long and each bearing an equally long or slightly longer apical seta. The subdorsal scolus (fig. 7b) usually about two-thirds as long as the main stem of the dorsal scolus, narrow, divided into three short branches in the distal half ; each branch with relatively longer seta, usually equal to that on a branch of the dorsal scolus. Dorsolateral scolus similar to the dorsal scolus but with the apical setae on some branches much longer. A pair of chalazae with piceous setae present in the middle of the pronotum which has, in addition, a dozen short setae near its posterior margin. Mesothorax with the dorsal scolus arising at a point equidistant from the subdorsal and the median longitudinal line, directed upward, slightly longer but narrower at base than the dorsal scolus on the pronotum, with about 16 branches, similar to those on the latter scolus but with relatively shorter and stouter setae. Subdorsal scolus

similar but slightly longer, directed dorsolaterally and slightly anteriorly. Surrounding the bases of dorsal and subdorsal scoli of the same side is a subrectangular, dark brown to piceous area, with three triangularly placed darker and depressed spots in the middle. Dorsolateral scolus (fig. 7 *f*) similar to the subdorsal, directed anterolaterally and usually of lighter colour except near the base. Metathorax similar to mesothorax in arrangement and structure of the scoli. Underside with the area round the base of setae piceous; prosternum with a pair of moderately long setae in the middle; meso- and metasternum each with a pair of short strumae placed close to the median longitudinal line, each struma usually with four setae. Legs much darker on the outside; the femora nearly as long as the tibiae; claws (fig. 7 *d*) with the basal tooth subquadrate but rounded on the inner margin, the narrow distal part bent near the basal tooth.

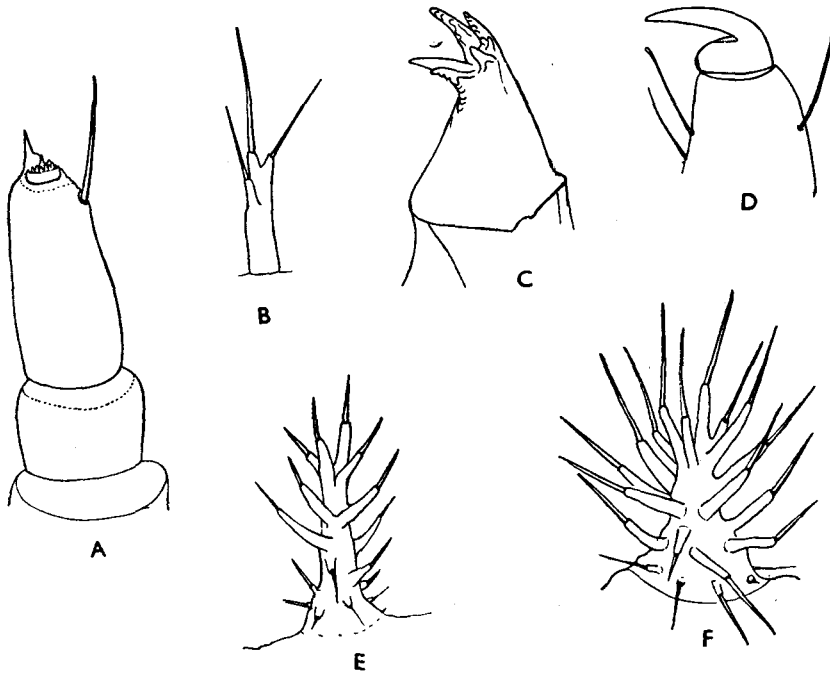


Fig. 7.—Larva of *Epilachna hirta*: (a) antenna; (b) subdorsal scolus of pronotum; (c) mandible; (d) claw; (e) dorsal scolus of second abdominal segment; (f) dorsolateral scolus of pronotum.

*Abdomen* with the first three segments only slightly wider than metathorax, the succeeding ones gradually narrowing; dorsal scoli of each segment placed closer to each other than are the corresponding ones on the meso- and metathorax, similar in structure to the latter on the first six segments (fig. 7 *e*), but with short and very short branches on the seventh and eighth segments, respectively; subdorsal scoli placed in line with the corresponding scoli on the last two thoracic segments and equal to them in length on the first six segments but with fewer (10 or 12) branches, the latter a little shorter on the seventh and eighth segments and with relatively longer setae; dorsolateral scoli on the first three segments similar to the corresponding ones on the meso- and metathorax but decreasing gradually in length and in number of branches from the fourth to the eighth segments, on the latter, present in the form of a conical projection, nearly as wide as long and bearing about six setae.

Tergum of the ninth segment semicircular, sclerotised and partially dark brown with about twelve moderately long setae; the tenth segment with a lightly pigmented area on either side, and bearing four very short setae. Underside mostly with the strumae sclerotised and pigmented; ventral strumae on first segment each consisting of a single short seta, on the second to seventh segment of three or four moderately long setae, on the eighth similar to that on the seventh but closer to the subventral struma of the same side; subventral strumae absent on first segment, represented by a single long seta on second, by one long and two short setae on third, by two long and four short setae on fourth to sixth and by one long and stout and two short setae on the seventh and eighth segments; ventrolateral strumae represented by two short setae on first segment, bearing three to six setae and a well developed chalaza in the centre on the second to fifth segments, similar on the sixth to eighth segments but without the chalaza. Ninth segment with a transverse sclerotised and pigmented area with three long and three short setae on each side. No setae present on the ventral surface of the tenth segment.

*Material examined*: Numerous full grown larvae (and other immature stages and adults) found feeding on *Solanum marginatum* at Asmara (cir. 2350 ft.)—ix.1947, in Eritrea (*G. de Lotto*).

***Epilachna vigintioctopunctata* (F.) (Figs. 8–10).**

*Epilachna vigintioctopunctata* is widely distributed in south-east Asia and Australia and occurs as a pest of solanaceous crops, such as potatoes and brinjals

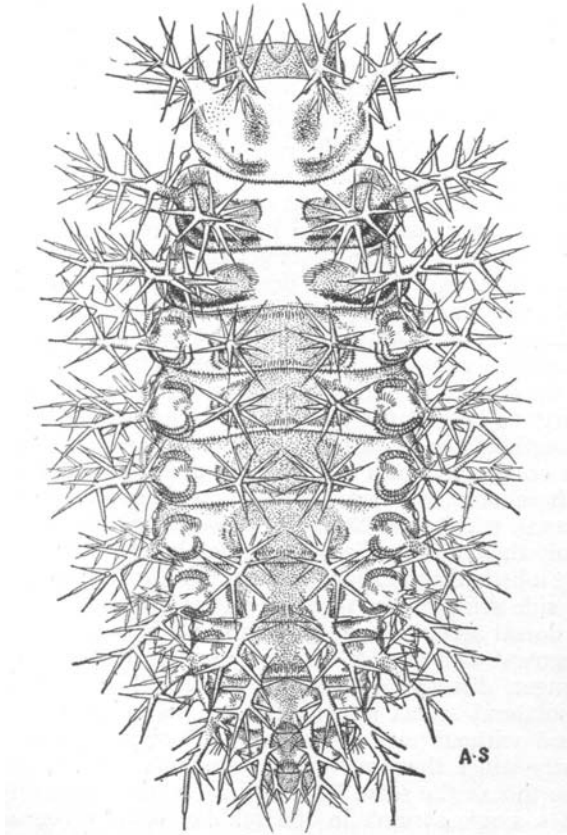


Fig. 8.—Larva of *Epilachna vigintioctopunctata*.

(egg-plant), in India, Ceylon, Malaya, East Indies and China. As in the case of several other species, the descriptions and figures of the larvae given in the works dealing with its biology and control (Lefroy 1909, Krishnamurti 1932 and Chue 1930) do not include details of structure by which it could be distinguished from related species. According to the classification based on the adults, this species is also divisible into several subspecies, but the examples of larvae examined from India (type locality) and Formosa do not show differences in structure except that some of those from Formosa have darker coloration.

*Body* (fig. 8) elongate oval, a little longer than twice its width; final instar larva about 6 mm. long and 2.8 mm. wide across the third abdominal segment; general colour pale yellow except for the more heavily sclerotised parts and areas round bases of scoli which are brown.

*Head* (fig. 9 *d*) subrounded; vertex, genae and greater part of front brown except for the ocelli and a small area round them which is dark brown; epicranial suture light in colour; setae usually moderately long, sparse and arranged as shown in the figure; ocelli three on either side, of equal size, arranged triangularly, the two towards the vertex situated close together and the third close to the base of the antenna; antenna (fig. 9 *c*) with the first segment nearly as long as wide, slightly narrower at base, second a little narrower, less than twice as long as wide, with a long seta and a sensilla situated a little below and at the apical margin, respectively, third segment small, nearly half as wide as second, about half as long as its own width, and with one long and a few short sensillae at apex; clypeus trapezoidal, narrow anteriorly, slightly dark towards base and with two short setae on each lateral margin; labrum nearly twice as wide as long, the upper surface with six or eight setae, the oral surface (fig. 9 *f*) with a row of short setae in the middle; mandibles (fig. 9 *i*) much narrowed distally, with five teeth, the two apical ones large and denticulate on the inner margins, the remaining three smaller and only bluntly denticulate; maxillae and labium as in *E. chrysomelina*.

*Thorax* slightly increasing in width towards the abdomen. Prothorax a little less than twice as wide as long, pronotum oval, sclerotised and light brown on each side of the median longitudinal line and bearing three or four simple setae at the posterior margin; dorsal scolus slightly longer than tergum, directed anterodorsally, fairly wide towards base, with 14 to 18 branches arising from all round its surface, the branches moderately long, except a few shorter ones situated close to the base, each bearing at the apex a brownish, stout, short seta (about half as long as a long branch) and two or three very thin, short, colourless setae which are usually dispersed irregularly in the median part; subdorsal scolus (fig. 10 *e*) like a large branch of the dorsal scolus, nearly as long as the stem of the latter, with the apical seta equal to three-fifths the length of the scolus, and with about five very thin colourless setae like those present on the branches of the dorsal scoli; dorsolateral scolus (fig. 10 *f*) a little long and broader at the base than the dorsal scolus, pointed anterolaterally and slightly upwards, with about 20 to 22 branches mostly as in the dorsal scolus, but some, especially those directed laterally, much longer and with longer but thinner setae. Mesothorax a little shorter than the prothorax, with the dorsal and dorsolateral scoli of the same size arising close together and surrounded by an oval, sclerotised, brown area, the dorsal scolus directed upward, slightly anteriorly and toward the middle of the segment and similar to the dorsal scolus on prothorax; subdorsal scolus slightly longer, directed dorsolaterally, but otherwise similar to the dorsal scolus. The dorsolateral scolus also similar to the subdorsal scolus but directed anterolaterally and without any sclerotised and pigmented area round its base. Metathorax slightly wider than but otherwise similar to the mesothorax. On the ventral side of the thorax the setae form strumae with moderately chitinised bases; prosternum with a single struma in the middle, usually consisting of five short setae, meso- and metasternum each with a pair of similar strumae close to the median

longitudinal line. Legs with the femora as long as the tibiae which are darker towards the apex; claw (fig. 9 *k*) with a subquadrate basal tooth and with the distal part moderately curved.

*Abdomen*: dorsal scoli on first seven segments similar to corresponding ones on metathorax but each with ten or twelve branches and with a shallowly pitted and dark spot on the outer side of the base; dorsal scolus on eighth segment equal to about two-thirds the length of the corresponding one on the preceding segments, narrower and with about eight short branches bearing rather long, thin and

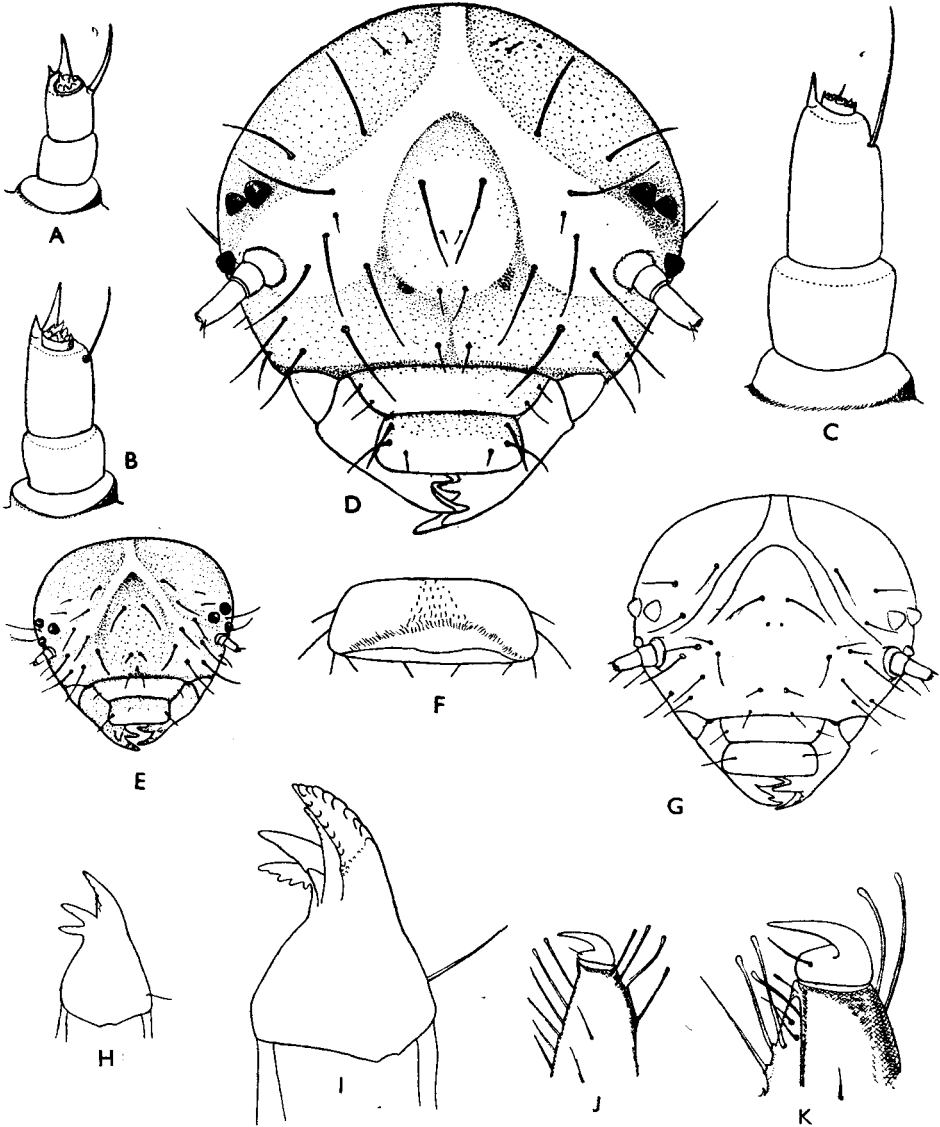


Fig. 9.—Larva of *Epilachna vigintioctopunctata*: Antenna (*a*) first instar; (*b*) second instar; (*c*) fourth instar; Head (*d*) fourth instar; (*e*) first instar; (*g*) third instar; (*f*) underside of labrum of fourth instar; Mandible (*h*) first instar; (*i*) fourth instar; Claw (*j*) first instar; (*k*) fourth instar.

colourless setae; subdorsal scoli (fig. 10 *l*) on first seven segments similar to dorsal ones but each with subrounded, sclerotised and lightly pigmented area round its base; subdorsal scolus on eighth segment equal to about two-thirds the length of the dorsal one of the same segment but otherwise similar; dorsolateral scoli also with distinct sclerotised area round their bases, similar in structure to the subdorsal scoli, or slightly longer on the first three segments, but decreasing in length in each successive segment, on the fourth to sixth segments with the branches gradually becoming shorter and fewer, being eight to ten in each scolus, but with the setae relatively long, thin and colourless, on the seventh segment the number of setae

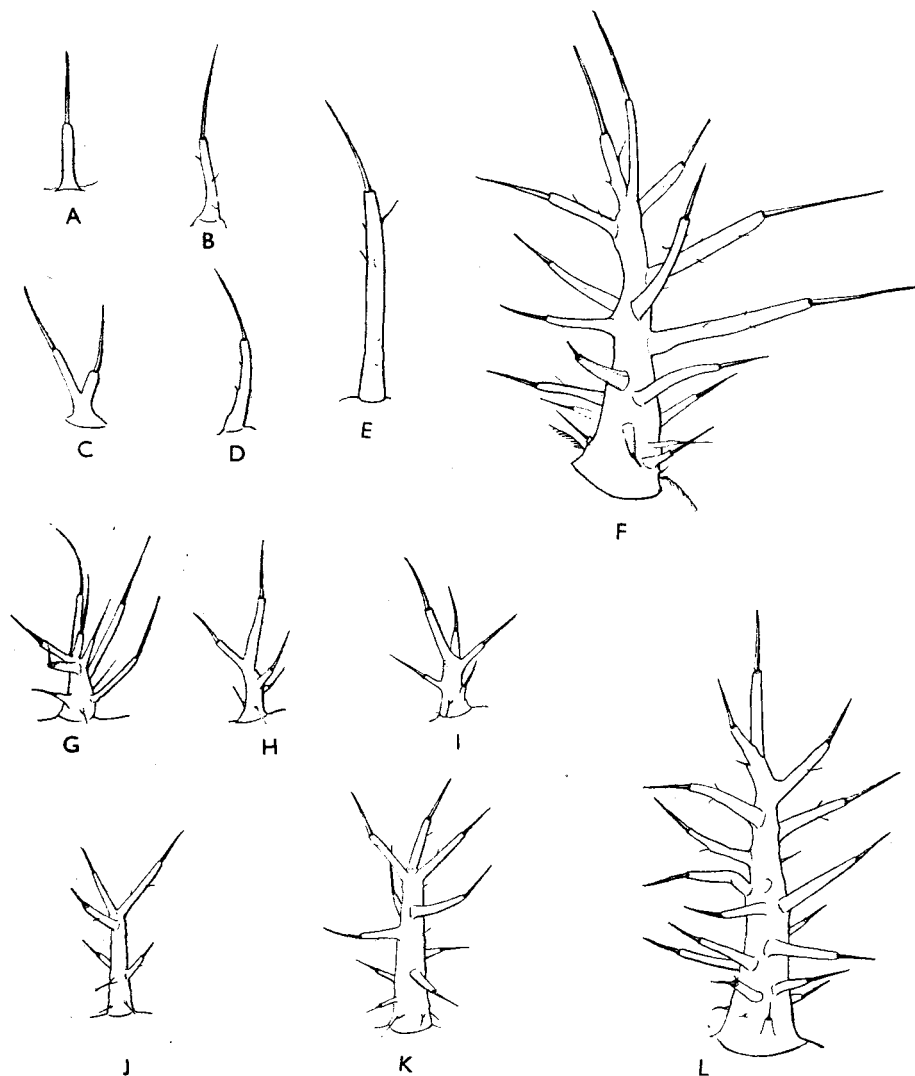


Fig. 10.—Larva of *Epilachna vigintioctopunctata*: Subdorsal scoli (*a*), (*c*) first instar; (*b*) second instar; (*d*) third instar; (*e*) fourth instar; Dorsolateral scolus of pronotum (*f*) fourth instar; (*g*) first instar; (*h*) dorsal scolus of pronotum of first instar; (*i* to *l*) subdorsal scolus of second abdominal segment of first, second, third and fourth instars, respectively.



reduced to about six, three of which are on short tubercles and one on a moderately long branch ; on the eighth segment the dorsolateral scolus reduced to a mere struma with about six setae, three of which are borne on short tubercles. Ninth tergite semicircular, sclerotised, pigmented light brown and with a dozen, rather long, thin and colourless setae situated mostly along the posterior margin. Tenth tergite membranous, except for a small, weakly sclerotised area on either side, and bearing two or three short setae. Ventral surface with chalazae or strumae which are neither sclerotised nor pigmented ; ventral and subventral strumae distinct on the first seven segments but contiguous on the eighth ; ventral strumae on first and second segments each consist of one long and three short setae, on the third to sixth segments the number of setae increases to six or seven, of which three are long and three or four short, and on the seventh and eighth segments the setae are reduced to four in each struma. Subventral struma absent on first segment ; on the second consisting of two setae and on the next six segments being similar to the ventral strumae. Ventrolateral group on the first segment consisting of a single chalaza, and on each of the succeeding segments consisting of a chalaza in addition to a number of short to moderately long setae, the number of setae being two and three on the second and third segments and varying from four to six on the next five. On the ninth segment the setae moderately long, not formed into groups, usually ten in number and arranged in a single row near the posterior margin. The tenth segment mostly membranous, with eight very short setae.

The characteristics of the earlier instars are as follows :

The larvae differ from those of the final or fourth instar in having lighter coloration and simpler armature.

*First instar* : 0.6 mm. long when newly emerged, 1.8 mm. long just before the first moult in the Punjab (which usually occurs four to six days after hatching) and about one-half to one-third as wide as long. Head (fig. 9 *e*) relatively large, like that of the final-instar larvae in general shape, and in the epicranial suture and arrangement of setae and ocelli, but with the antennae (fig. 9 *a*) slightly different in that the second segment is only a little longer than its diameter and has two sensillae at its apical margin. Mandibles (fig. 9 *h*) also differ from those of the final-instar larva, having three large and two very small and inconspicuous teeth, the apical one of the larger teeth being weakly denticulate on the inner margin. Thorax similar in arrangement of scoli to that of the final-instar larva ; the dorsal scolus (fig. 10 *h*) on pronotum with about eight short branches bearing slender setae usually much longer than the branches, subdorsal (fig. 10 *a*) usually comprising a single filiform projection bearing a long seta, though sometimes one of the pair is (fig. 10 *c*) divided in the middle into two branches, each bearing a seta ; dorsolateral (fig. 10 *g*) similar to dorsal but slightly larger and with about twelve branches. Scoli on the other thoracic segments similar in general to the dorsolateral scoli on pronotum. On the underside each segment with a pair of ventral setae, each situated close to and on either side of the median longitudinal line. Legs relatively long, with the basal tooth of the claw (fig. 9 *j*) rather small and triangular, unlike the large, quadrangular one of the final instar. Abdomen with short scoli bearing relatively long setae, each scolus (fig. 10 *i*) on the first few segments having one long apical branch and three or four short branches. On the ventral surface, the ventral, subventral and ventrolateral groups represented by a single seta each.

*Second instar* : 3 mm. long, 1 mm. wide across the middle of the body. Similar to first instar in general structure and antennae (fig. 9 *b*) but easily distinguished from it by the structure of the scoli, the dorsal and dorsolateral scoli on thorax having nine branches and on abdomen seven or eight (fig. 10 *j*) ; further, the small inconspicuous setae that are present on the branches in the final instar first appear in the second instar. On the ventral surface each group comprises three or four setae. Duration usually shorter than that of the first instar, being only two or three days in the Punjab.

*Third Instar.* : 5 mm. long and 2.25 mm. wide. Similar to fourth instar in general structure. Head: (fig. 9 g). Pronotum and parts of the thoracic tergites more conspicuously sclerotised than in the earlier instars. Thoracic scoli usually with about twelve relatively long branches, abdominal scoli (fig. 10 k) on the first few segments each with about twelve branches with relatively short setae; undersurface with the arrangement and number of setae almost the same as in the fourth instar. The duration of the third instar varies from three to six days.

*Material examined*: More than 12 larvae of each instar (and reared pupae and adults) from Formosa, 1937 (*T. Yoshida*) and several larvae in each instar from the Punjab and Delhi (India) reared by the author.

### ***Epilachna dentulata* Dieke (Plate VI, c, d).**

*Epilachna dentulata* is very closely related to *Epilachna vigintioctopunctata*. The adults of both species are similar in general appearance and in elytral spots. The larvae of these two species also agree in many structural details, but show greater differences in general appearance than the adults.

*Body* comparatively dark brown on the sclerotised parts and at the apices of the branches of scoli, on the underside the bases of strumae dark brown.

*Head* similar to *E. vigintioctopunctata* in shape, colour, arrangement of setae and ocelli, and structure of antennae and mouthparts.

*Thorax* differs from that of *E. vigintioctopunctata* mostly in the structure of the scoli which are longer and have more sparsely placed branches, the individual branches long but the apical setae short, as in *E. vigintioctopunctata*. Pronotum with the dorsal scoli each having about 17 branches of which six, placed near the base, are short, the subdorsal scoli nearly four-fifths the length of the main stem of the dorsal one and bearing a long apical seta as in *E. vigintioctopunctata*; the dorsolateral scoli similar to the dorsal in length and number of branches, but slightly broader at base. Mesothorax and metathorax similar as regards the scoli, which are slightly longer than the corresponding ones on the pronotum, each scoli with about 15 branches of which four, situated near the base, are short while the others are long, the apical setae dark-brown, stout, and each equal to one-fourth the length of the branch bearing it. Underside with a pair of strumae on prosternum instead of a single one as in *E. vigintioctopunctata*, each with one long and usually two short setae; mesosternum and metasternum each with a pair of larger strumae with brown coloration, each struma with a centrally placed long seta and four or five shorter ones around it.

*Abdomen* similar in general shape and arrangement of scoli to that of *E. vigintioctopunctata*; the scoli with the main stem and branches relatively long, the latter sparse, each with a short, brown apical seta as in the thoracic scoli. On the underside the strumae more transverse on first three segments and each comprising three rather short setae, those on fourth and fifth similar but each with four short setae, those on sixth to eighth segments rather sub-rounded and each with three moderately long setae; on eighth segment ventral and subventral strumae close to each other but not contiguous as in *E. vigintioctopunctata*. Subventral struma absent on first segment, represented by a single seta on the second, by four to six, short to moderately long, setae on third to sixth segments, and by three and two setae on seventh and eighth segments, respectively. Ventrolateral group consists of a single short seta on first segment, of one short seta and one long chalaza on second, and third segments, of one long chalaza and three or four shorter setae on fourth to eighth segments. Ninth segment with the greater part of sternum sclerotised, brown and with a total of about twelve moderately long setae situated along the posterior margin; tenth segment without setae.

*Material examined*: 16 larvae, some feeding on *Solanum xanthocarpum* and *Solanum* sp., at Dehra Dun, United Provinces, India, collected and some reared to adults by J. C. M. Gardner (July, 1928; 1933), Balwant Singh (August, 1933) and A. K. Sharma (June, 1941).

***Epilachna flavofasciata*** (Laporte) (Pl. VI a, b, text fig. 11).

*Epilachna flavofasciata* is widely distributed in South America from Colombia to Bolivia. The larvae were briefly described by Candèze (1861, as *proteus* Guér.), who regarded it as very similar to the European species *E. argus*.

*Body* (Pl. VI a, b) elongate oval, widest in the middle, more convex on the upper than on the ventral surface; final-instar larva usually 10 mm. long and 3.5 mm. wide in the middle. Upper surface piceous, with a light streak on the thorax along the median longitudinal line and scoli whitish except for the piceous setae at the apices of the branches; underside lighter in colour, with small irregular, lightly piceous patches, near bases of setae; legs mostly dark brown.

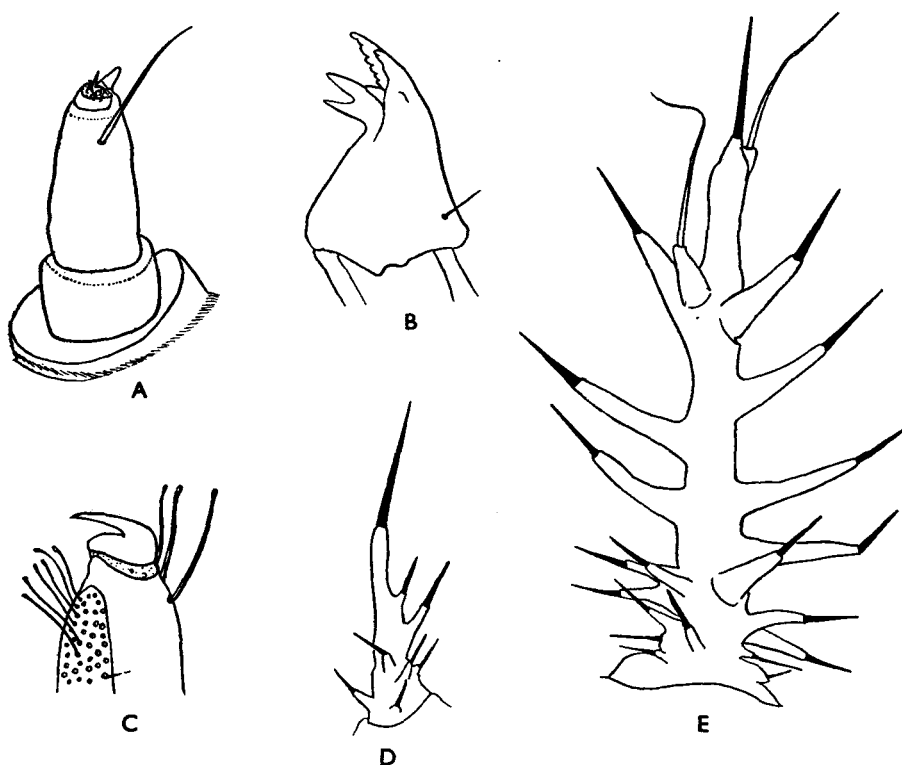


Fig. 11.—Larva of *Epilachna flavofasciata*: (a) antenna; (b) mandible; (c) claw; (d) subdorsal scolus of pronotum; (e) dorsolateral scolus of pronotum.

*Head* dark brown to piceous with the epicranial and frontoclypeal sutures, the lateral part external to the ocelli, the clypeus and labrum paler; setae brownish, short to fairly long, vertex with six, short setae dispersed sparsely on either side; a pair of long setae in the centre of the front, other setae on the front arranged as in *E. borealis*; on the underside of the genae on either side usually six shorter setae. Ocelli three on either side, the two towards the vertex very close together, third situated close

to the antennal socket ; antenna (fig. 11 *a*) dark brown, first segment slightly wider than long, second slightly narrower than first but nearly twice as long as wide, with a long seta near apex, third brownish, very small, much narrower than second, nearly one-third as long as wide, bearing a few sensillae at apex ; clypeus trapezoidal, narrow and membranous anteriorly ; labrum slightly narrower at base, and twice as broad as long ; clypeus and labrum each bearing usually four setae on each lateral margin ; mandibles (fig. 11 *b*) dark brown, distal half narrow with five large teeth, the apical two of which are bluntly denticulate on the inner margin, the subapical teeth sharply pointed and not denticulate ; galea oblong, a little narrowed distally, sclerotised near the base and with long, dense setae ; maxillary palpi long, the apical segment narrow and equal to the total length of the two preceding segments.

*Thorax* gradually increasing in width towards the abdomen. Prothorax transverse, nearly one-and-a-half times as wide as long, its tergum oval, slightly more rounded on posterior margin, dark brown to piceous except, as mentioned above, a narrow paler longitudinal streak in the middle and the whitish scoli. The dorsal scolus as long as tergum, moderately broad at base and gradually tapering, with eleven moderately long and four short branches, each bearing a stout, piceous seta, usually equal to two-thirds the length of the branch itself but, sometimes, especially on the apical branches twice as long as the branch itself and thin and lighter in colour, the branches near the base arising from all round the main stem of the scolus but tending to be arranged rather bilaterally towards the apex ; subdorsal (fig. 11 *d*) scolus about one-third as long as dorsal and narrower, the main stem usually with a long, stout and piceous seta at apex and three or four short branches situated in the basal two-thirds, each bearing a dark seta as long as itself ; dorsolateral scolus (fig. 11 *e*) longer than dorsal arising from anterolateral margin of tergum and pointing anterolaterally and slightly upwards, with ten moderately long and ten rather short branches similar to those on the dorsal scolus ; the rest of the tergum with many short and piceous setae near posterior margin and a pair of chalazae with whitish base on either side. Mesothorax shorter than prothorax ; dorsal scolus similar to that on the latter, pointing in the same direction but short and with fewer, usually eight, branches each bearing a seta as long as itself ; subdorsal scolus longer than dorsal, with 12 to 14 branches, those in the median part tending to be arranged bilaterally, the setae much shorter than the branches ; dorsolateral scolus shorter than subdorsal but with the same number of branches. Metathorax similar to mesothorax in general shape and in arrangement and structure of scoli. On the underside, prosternum with a pair of dark ventral strumae, each consisting of six to eight long, brown setae, the number of setae in a struma increasing to between ten and twelve on the mesosternum and metasternum. Legs with coxae on each segment well separated from each other, femur nearly as long as tibia, claw (fig. 11 *c*) with the basal tooth subtriangular and the distal part sharply bent near the tooth.

*Abdomen* : The pair of dorsal scoli on each segment surrounded at base by a common, large, oval, strongly sclerotised, piceous area ; those on the first four segments equal in length to the corresponding scoli on the metathorax, each with about nine rather short branches, arranged almost bilaterally and bearing slightly shorter, apical setae ; those on the fifth to seventh segments gradually increasing in length and in number of branches until, on the seventh, they are equal to about twice the length of those on the first and bearing about twelve, long to short branches (the shorter ones near the base), with shorter setae ; on the eighth the dorsal scoli about half the length of those on the seventh and with fewer branches. Subdorsal scoli much longer than dorsal ; on the first six segments with about twelve moderately long branches bearing short setae and arranged more sparsely and bilaterally, those on the seventh segment equal to nearly two-thirds the length of the corresponding ones on the sixth and with the branches rather close, those on the eighth equal to half the length of those on the seventh and nearly half as wide at the base, with short

tubercles bearing long setae. Dorsolateral scoli directed laterally except for those on the last three segments which are diverted slightly posteriorly; on the first four segments similar and equal in length to the subdorsal ones of the same segment but decreasing rapidly in length on each segment from the fifth to eighth, becoming merely a rounded slightly convex protuberance bearing about eight to ten moderately long setae. Ninth tergite semicircular, uniformly sclerotised and dark brown, bearing 20 to 30 moderately long setae situated near the external margin. Tenth segment short, mostly membranous except for a dark sclerotised patch bearing a few short setae on each side of the tergum. On the ventral surface, the setae arise from dark spots mostly scattered irregularly but some especially long setae, arising close together and forming small ill-defined strumae; ventral strumae consisting of two to four setae on the first eight segments, subventral absent on the first and consisting of one to three setae on each of the succeeding seven segments, ventrolateral almost alike on all the segments but each with one or sometimes two chalazae bearing very long setae. Ninth segment with about eight or ten long setae arising from a moderately sclerotised brownish area, tenth lightly pigmented with two or three short setae on either side.

*Material examined*: Over 50 larvae (and adults, collected together) feeding on leaves of *Datura* sp., from Colombia, 1916 (*M.T. Dawe*).

***Epilachna eusema*** (Weise) (figs. 12 and 13).

*Epilachna eusema* occurs in Tucumán, Argentina; the larva has not been described before.

*Body* (fig. 12) similar to that of *E. flavofasciata* in general shape but smaller, 6 mm. long, 2 mm. wide across the third abdominal segment. General colour light yellowish, except for a dark brown area between the dorsal abdominal scoli.

*Head* with the vertex (except the epicranial suture) and the proximal part of the front with small brown patches; epicranial suture with a short stem and rather indistinctly defined owing to the generally lighter colour of the head; setae light, moderately long, rather sparse, absent on the vertex, three pairs in the median area, and about sixteen setae on either side, arranged as in *E. flavofasciata*; ocelli three on either side; dark brown, of almost equal size, and placed triangularly, one near base of antenna, and two a little away towards vertex and close together, the outer one being slightly higher; antenna (fig. 13 *a*) three-segmented, with the first segment nearly as long as wide, the second narrower, slightly more so distally, nearly twice as long as wide, with a moderately long seta and a conical sensilla near the apical margin, third segment very small, ring-like, with a few small and one moderately long, sensillae at the apex; clypeus trapezoidal, four times as broad as long, much narrowed distally, the lateral margins each with three short setae; labrum (fig. 13 *d*) a little more than twice as broad as long, slightly rounded at the anterior angles and with a dozen short setae; mandibles (fig. 13 *b*) with three to four large and two short teeth in the distal part, the two large apical teeth denticulate on the inner margin; maxilla (fig. 13 *e*) with the galea elongate oval and bearing rather dense and long setae on its distal part, maxillary palpi long, with the apical segment as long as the two preceding segments together, narrowed distally; mentum with the palpi moderately long, the apical segment being about twice as long as wide.

*Thorax* (fig. 12) only slightly increasing in width towards the abdomen. Prothorax a little less than twice as wide as long, tergum subrounded laterally, sclerotised and having, in addition to the three pairs of scoli, two pairs of chalazae in the middle and a number of smaller chalazae on posterior margin; dorsal scolus one-and-a-half times the length of the tergum, situated a little below the anterior margin, directed upwards and forwards, and with about twelve short branches arranged more or less bilaterally, each branch bearing an apical seta which is slightly shorter than the

branch itself ; subdorsal scolus (fig. 12) about half as long as dorsal, usually situated at anterior margin of tergum but in one example coalescent with the dorsolateral scolus, the main stem narrow, bearing a short apical seta and three or four short branches, each with an apical seta as long as itself ; dorsolateral scolus longer and broader at the base than the dorsal, directed anterolaterally and a little upwards, with about 26 moderately long to short branches, the long ones about 16 in number arranged almost bilaterally in distal half of main stem, the remainder short, close together and arising from all round the proximal part of the main stem. Mesothorax a little shorter than prothorax but slightly wider ; tergum rectangular ; dorsal scoli as long as the tergum, similar to the corresponding ones on pronotum with usually ten short branches arranged bilaterally ; subdorsal scolus situated at a fair distance from the dorsal and rather near the lateral margin of the tergum, directed anterolaterally and slightly upwards, nearly twice as long as the dorsal, narrowing anteriorly and having about 24 rather short to very short branches similar to those on the other scoli, and each bearing a seta as long as itself at its apex ; dorsolateral scolus pointed in the same direction as the subdorsal, narrower at base than the latter and nearly two-thirds as long, with about 12 branches similar to those in the other scoli ; there are also a few setae on short tubercles scattered irregularly on the tergum.

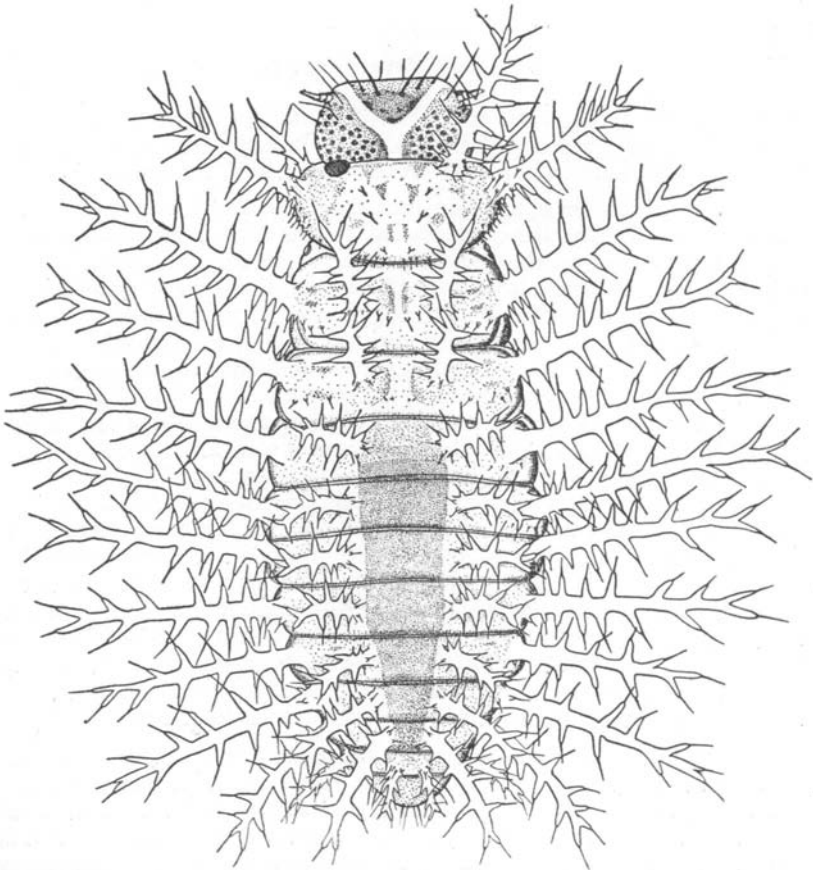


Fig. 12.—Larva of *Epilachna eusema* (left dorsal scolus on pronotum and dorsolateral scoli on other segments not shown).

Metathorax similar to mesothorax, slightly wider. On the underside, each segment with the ventral group represented by three short setae situated close to and on either side of the longitudinal median line. Legs with the coxae on the same segment fairly well separated, claw (fig. 13 *c*) with a subquadrate basal tooth, and with the distal part narrow, pointed, and sharply bent near the tooth.

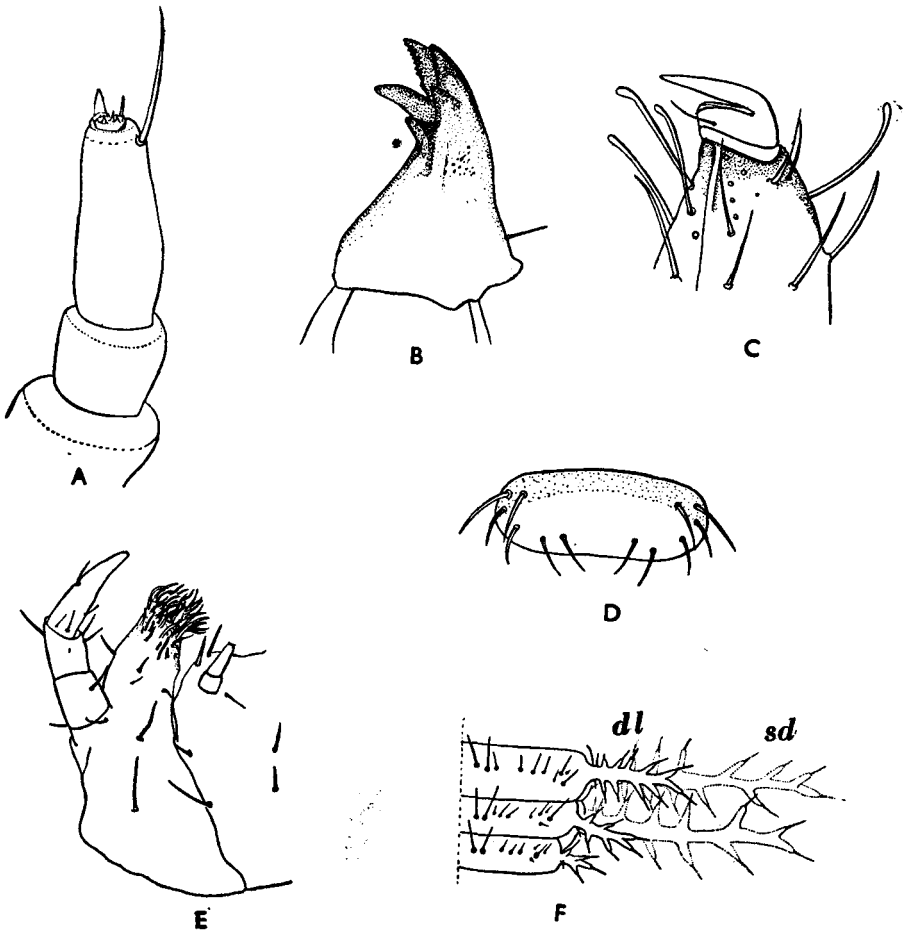


Fig. 13.—Larva of *Epilachna eusema*: (a) antenna; (b) mandible; (c) claw; (d) labrum; (e) maxilla and part labium; (f) ventral half of fifth to seventh abdominal segment (dl=dorsolateral; sd=subdorsal).

*Abdomen*: scoli arranged almost in line with those of the metathorax; dorsal scoli on first segment equal to the corresponding ones on metathorax, directed laterally and a little anteriorly, each with about 12 short, bilaterally arranged branches bearing short apical setae; dorsal scoli on the succeeding six segments with the same number of branches as those on the first, their length gradually increasing on the succeeding six segments. On the eighth segment, they are reduced to two-thirds the length of those on the seventh and have only nine short branches; subdorsal scoli on first six segments similar to those on metathorax, equal to them in length and pointing in about the same direction, each with about 20 branches

bearing short, rather stout, dark setae at their apices ; on the seventh a little shorter ; on the eighth nearly half as long, with short branches which are, however, not arranged bilaterally ; dorsolateral scoli mostly directed laterally, on the first four segments equal to about two-thirds the length of the subdorsal scoli of the same segments, each with about 12 branches ; on the fifth to seventh (fig. 13 *f*, *dl*) segments the dorsolateral scoli markedly decreasing in size in each succeeding segment, while those of the eighth are merely short, conical processes, each with one long and three or four short setae. Ninth tergite semicircular, sclerotised, with about 18 long and 6 short setae situated mainly on the external margin. Tenth segment without setae. On the ventral surface the setae not forming strumae, rather short and sparse on the first three segments ; on the succeeding segments becoming longer and with the decrease in the size of the segments, becoming less sparse ; usually a pair of setae on either side of mid-ventral line longer than the rest (fig. 13 *f*). On the ninth segment about eight short to moderately long setae near the distal margin ; tenth segment without setae.

*Material examined* : 16 larvae of various instars from Tucumán, Argentina (*H. L. Parker*) ; on loan from U.S. National Museum, Washington.

Genera *SUBCOCCINELLA* Guérin-Ménéville and *CYNEGETIS* Chevrolat *in* Dejean.

According to the classification based on the adults, the genera *Subcoccinella* Guér. and *Cynegetis* Chevr. are closely allied. This is supported by the structure of the larvae, which are similar in general shape, and the armature of the body-wall. The two, however, show important differences in the structure of the head as given in the key to the genera and in the description of the larva of *Cynegetis impunctata* (L.). The strongly sclerotised triangular area of the front of cranium, the anteriorly produced lower part of genae, the structure of mouth-parts, especially of the mandibles, are modifications which seem to be related to special feeding habits. In fact, very similar structural modifications occur in *Chmootriba similis* (Thnb.) which feeds mostly on wheat, maize and other Gramineae but is otherwise not related to *Cynegetis*. Very little is known of the food-plants of the latter but wheat (*Triticum repens*) is one of the plants on which it is reported to feed. It is probable that further observations may prove that it feeds mainly on Gramineae or that its food-plants are at least different from those of *Subcoccinella*.

### ***Subcoccinella vigintiquatuorpunctata* (L.) (Figs. 14 & 15).**

*Subcoccinella vigintiquatuorpunctata* is the only phytophagous species of lady-birds occurring in the British Isles. It is distributed all over Europe and the neighbouring countries of Asia and North Africa. The larvae and adults feed mostly on clovers, lucerne, vetches, etc., which, however, are not damaged to any great extent. From a taxonomic point of view, the species is of interest, being the genotype of *Subcoccinella* and resembling fairly closely another European, monotypic genus, *Cynegetis*, from which it may be distinguished by the characters given in the key. Huber (1842) described morphological details of the larvae. Strouhal (1927) described the mandibles and certain scoli. Marriner (1927) gave an account of the life-history in Britain.

*Body* (fig. 14) elongate oval, with the greatest width at the third abdominal segment, slightly narrowing anteriorly, much more so posteriorly, a fully grown larva of the last instar is about 4.4 mm. long and 2 mm. wide. General colour yellowish with certain, very variable, light to dark brown markings on head and tergites ; in the first instar these markings are entirely absent.



*Head* (fig. 15 *a, b*) subrounded, slightly broader than long, vertex and proximal part of the front with small dark brown patches which are usually very variable; epicranial suture consisting of lightly coloured coronal and frontal sutures; the fronto-clypeal margin uniformly light brown and very narrowly produced backwards for a short distance along the median longitudinal line; setae arranged as shown in the figures, usually long except in the median anterior part of the front which has about six pairs of short setae; ocelli three on either side, arranged triangularly, the two towards the vertex not very close to each other, though the distance between them is less than their distance from the third which is situated close to the antennal socket; the median ocellus, situated more towards the centre of the head, slightly larger than the other two; antennae (fig. 15 *f, g*) two-segmented, the first segment

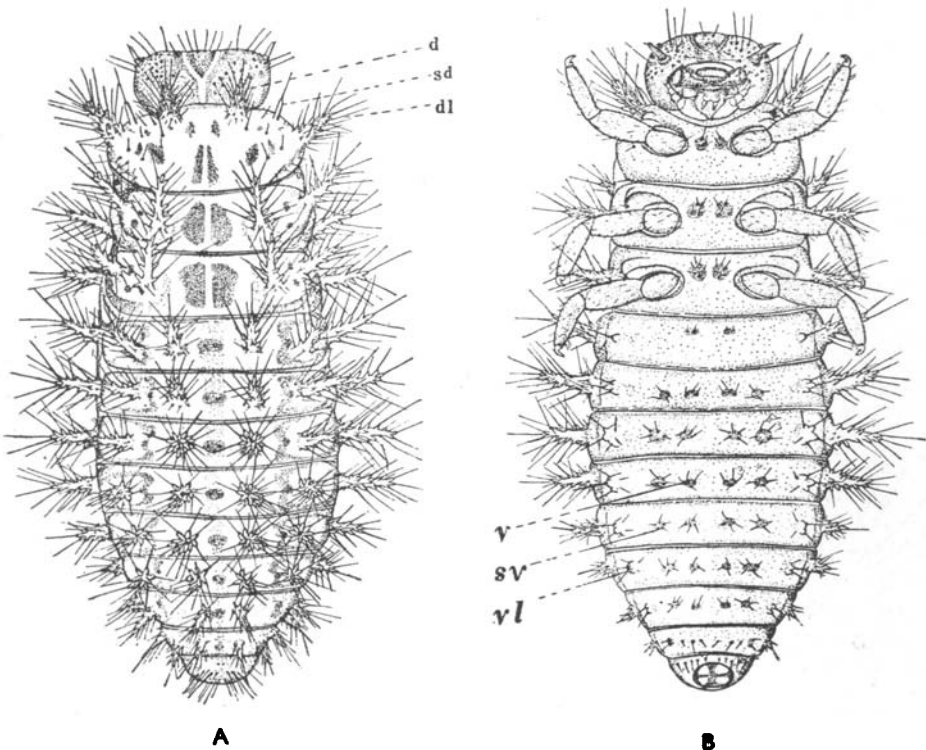


Fig. 14.—Larva of *Subcoccinella vigintiquatuor punctata*: (a) dorsal view; (b) ventral view (d=dorsal scolus; sd=subdorsal scolus; dl=dorsolateral scolus; v=ventral struma; sv=subventral struma; vl=ventrolateral struma).

short, nearly half as long as wide, the second narrower, slightly more so distally, bearing a long seta at two-thirds and a number of sensillae, one of which is longer than the rest, at the apex (fig. 15 *g*); labrum nearly three times as wide as long; mandibles (fig. 15 *h*) very broad at base, slightly narrowed distally, with two large apical teeth weakly denticulate on the inner margin and three subapical ones, two of which are moderately large and blunt, and the third small and conical; maxilla (fig. 15 *a*) with an oblong galea bearing moderately long and dense setae distally; palpus with the apical segment filiform, a little narrower but longer than the preceding segment.

*Thorax* only slightly increasing distally. Prothorax nearly twice as wide as long, pronotum oval, with variable markings and pitted areas; dorsal scolus (fig. 15 *d*) conical, a little shorter than length of pronotum, broad at base, nearly half as long as long, with about 18 to 20 short branches each bearing a very long apical seta which is usually over four times the length of its branch, branches near base of scolus very short or like tubercles; subdorsal scolus (fig. 15 *c*) in the form of a moderately long, filiform process with an equally long seta at apex; dorsolateral scolus similar to the dorsal but situated at anterolateral angle of pronotum; in addition there are a number of simple setae, mostly along posterior margin of pronotum. Meso- and metathorax a little shorter than pronotum, each with the tergum having an elongate

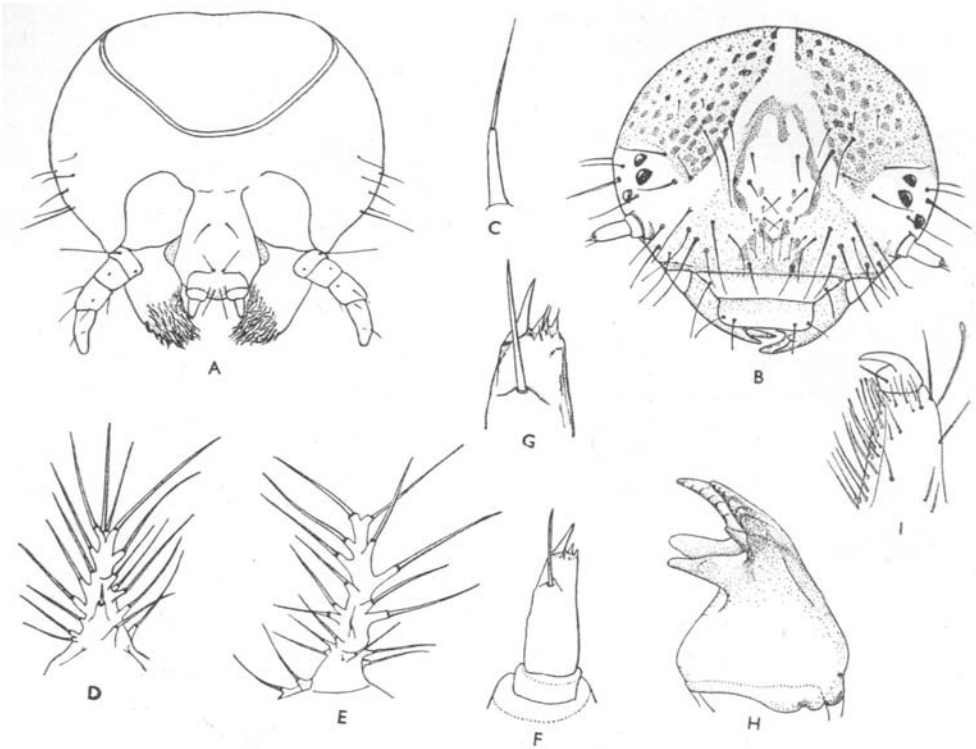


Fig. 15.—Larva of *Subcoccinella vigintiquatuor punctata*: (*a*, *b*) ventral and dorsal view of head; (*c*) subdorsal scolus of pronotum; (*d*) dorsal scolus of pronotum; (*e*) subdorsal scolus of second abdominal segment; (*f*) antenna; (*g*) apex of antenna much enlarged; (*h*) mandible; (*i*) claw.

brown marking on either side of the median longitudinal line and two or three dark patches between the dorsal and subdorsal scoli on either side; dorsal scolus similar to the corresponding one on pronotum but narrower at base and situated a little farther from the median longitudinal line and almost in the centre of the half of the tergum, subdorsal and dorsolateral scoli similar to the dorsal one of the same segment, the dorsolateral directed anterolaterally; on the underside each segment with a pair of ventral strumae situated close together, each with four or five short setae; coxae of any one segment close together, claw (fig. 15 *i*) with a subquadrate basal tooth and moderately bent near it.

*Abdomen*: the first eight segments each with three pairs of scoli and with brown to dark brown, variable markings on the tergum, the markings comprising a pair

situated in the middle of the segment and others between the dorsal and subdorsal scoli; dorsal scoli on first five segments similar to metathorax but gradually decreasing in size, those on the sixth to eighth with fewer branches, those on the eighth having only six or seven, which are directed posteriorly; subdorsal scoli (fig. 15 *e*) similar to the dorsal of the same segment; dorsolateral scoli also similar on the first four segments but decreasing gradually in length and in number of branches and setae on the succeeding segments. Ninth segment with a semicircular, uniformly sclerotised tergum with a dozen moderately long setae situated mostly near the external margin. The ventral surface (fig. 14 *b*) with the strumae rather strongly sclerotised but not deeply pigmented; ventral strumae on first segment each consisting of two transversely-placed, short setae, on the second to sixth segments each struma with about four or five short to moderately long setae, on the seventh and eighth segments each with three setae; subventral strumae on first segment each represented by three or four short setae, on the other segments similar to the ventral strumae of the same segment; ventrolateral strumae on first segment each represented by a single chalaza, on the second by a conical projection bearing three setae, on the third to sixth segments similar to the other strumae of the same segment but usually with an additional chalaza. Ninth segment with about a dozen setae situated close to each other and to the posterior margin; tenth segment without setae.

*Material examined*: Many larvae from England and Wales in the British Museum (Nat. Hist.) collection and others collected and reared by the author; one larva from Denmark, Maglehoi Honkenya, 3.vii.1946 (J. P. Kryger).

### ***Cynegotis impunctata* (L.) (Fig. 16).**

*Cynegotis impunctata* occurs on the continent of Europe and in the western part of Russia. Its feeding habits are inadequately known, the recorded food-plants being wheat (*Triticum repens*), bilberry and *Trifolium*. Böving (1917), while enumerating the general characters of the EPILACHNINAE, pointed out a few structural peculiarities of this species differentiating it from three other species of the subfamily studied by him.

*Body* similar in outline and size to that of *Subcoccinella vigintiquatuor punctata* (L.), but the body, in the examples seen, though pale yellow, has only a few brown markings on the tergites.

*Head* (fig. 16 *c*) subrounded; vertex and median part of front with small, brown, irregular patches which are very rarely coalescent on the vertex but frequently so on the front; frontoclypeal margin strongly sclerotised, brown, and with the median part triangular (fig. 16 *c*, *t*) and pointed towards the centre of the head for a short distance; the lower part of the genae (fig. 16 *c*, *g*) distinctly produced forwards; setae moderately long, less numerous than in *vigintiquatuor punctata* and usually arranged as shown in fig. 16 *c*; ocelli differ in size and arrangement from those in the latter species, three on either side, conical, arranged triangularly, the two towards the vertex closer to each other and larger than the third situated near the antennal socket. Antennae (fig. 16 *a*) two-segmented, with basal segment short, twice as wide as long, the second a little over twice as long as wide and much narrowed towards the apex (fig. 16 *b*), with a long stout seta at two-thirds its length and with three or four long to short, conical, sensillae at the apex; clypeus trapezoidal, much narrowed distally; labrum small and subquadrangular; mandibles (fig. 16 *e*) elongate, much narrowed distally, with a large apical tooth, which is denticulate on the innerside, and three small, subapical teeth which are not denticulate; maxilla and labium rather similar to those of *Subcoccinella*.

*Thorax* similar to that in *S. vigintiquatuor punctata* in general shape and armature of the body-wall, except that the scoli are relatively shorter; pronotum with numerous setae dispersed irregularly, and with a few chalazae on the lateral margins. On the

ventral surface each segment with a pair of long setae, each situated on either side of the median ventral line. The group of setae and chalazae situated on the area external to the first pair of coxae was considered characteristic of the genus by Böving (1917), but seems to be only slightly larger than that present in *Subcoccinella*.

*Abdomen* also similar to that in *S. vigintiquatuor punctata* in general shape and arrangement and structure of scoli, which are, however, relatively shorter. On ventral surface, strumae also similar in arrangement but very weakly sclerotised at base, not pigmented and with fewer setae. The ventral strumae on the first, eighth and

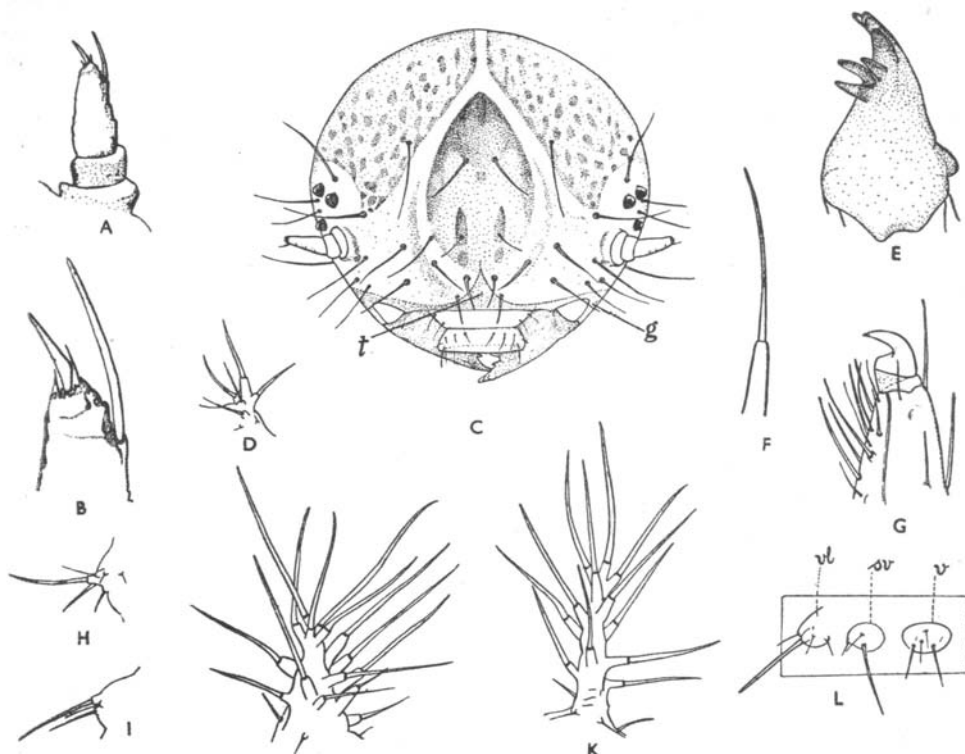


Fig. 16.—Larva of *Cynegetis impunctata*: (a) antenna; (b) apex of antenna much enlarged; (c) head (t, median part of frontoclypeal margin; g, lower part of geneae); (d) dorsolateral scolus of seventh abdominal segment; (e) mandible; (f) subdorsal scolus of pronotum; (g) claw; (h) ventrolateral struma of seventh abdominal segment; (i) same of eighth abdominal segment; (j) dorsolateral scolus of pronotum; (k) subdorsal scolus of second abdominal segment; (l) ventral view of the left half of sixth abdominal segment showing ventral (v), subventral (sv) and ventrolateral (vl) strumae.

ninth segments each represented by two long setae and on the second to seventh segments by three or four setae (fig. 16 l v), the subventral strumae absent on the first segment, and are represented by two or three setae (one of which is longer than the others) on the next seven segments (fig. 16 l, sv); ventrolateral strumae on the first eight segments (fig. 16 h, i) each consisting of two or three setae and about the same number of chalazae, one of which usually has much longer seta than the rest. The subventral strumae on the seventh and eighth segments with the base more convex than on the sixth. The ninth segment with twelve short setae near the posterior margin; the tenth entirely devoid of setae.

*Material examined*: 5 larvae (and a pupa and adult), Berlin, July, 1928 (R. Korschefsky), lent by Dr. F. van Emnden.

Genus *AFISSA* Dieke.

Since the larvae of only a single species of this genus are known, the characters given in the key to the genera (page 165) are only provisional. The absence of the subdorsal scoli on the pronotum, however, may prove characteristic; they are also absent in the larvae of another species of this subfamily which were collected in the Kumaon Hills (c. 4,000 ft.), India, and may well belong to this genus, though they cannot be identified because of lack of adults. In details of the structure of the mandibles, which are very large, and of the armature of the body-wall, the two species are very distinct.

***Afissa dumerili*** (Mulsant) (Figs. 17 and 18).

Originally described from "les Indes orientales" (under which Mulsant frequently included examples from India), this species is recorded by Dieke (1947) from North Bengal and Assam. Examples of it from the Nilgiri Hills (South India), Bombay, Bengal, Assam, Sikkim, the Andaman Islands, Burma and Siam are present in the British Museum (Nat. Hist.). The larvae described here are from North Bengal.

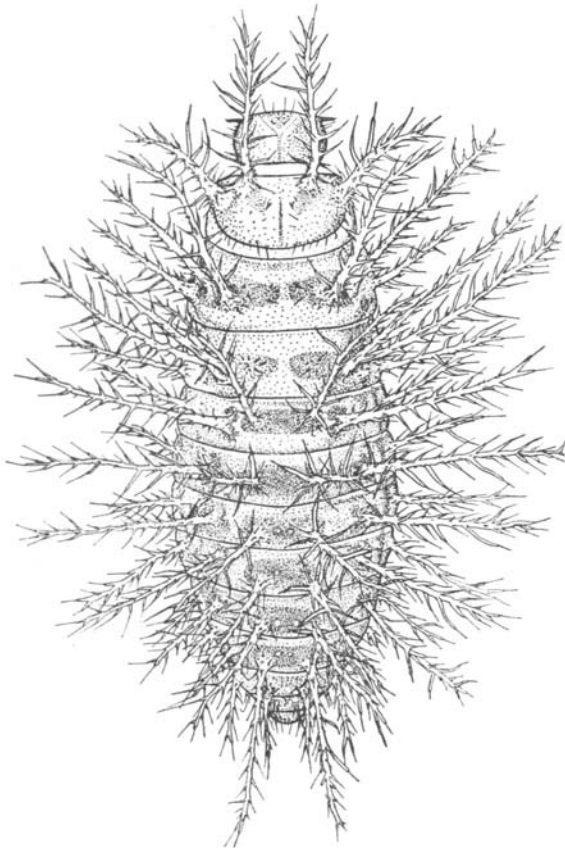


Fig. 17.—Larva of *Afissa dumerili*.

*Body* elongate oval, 7.5–8.0 mm. long and about 2.6 mm. wide in the middle; last two thoracic segments only a little narrower than the first four abdominal ones; normally light yellow with the more heavily sclerotised parts, such as the head, legs and the area round the bases of the scoli, light brown.

*Head* (fig. 18 *d*) rather small relative to size of body, brown, the coronal and frontal sutures lighter; setae short to long, rather sparse, arranged as shown in the figure; ocelli three on either side, of almost equal size arranged triangularly, the two towards the vertex placed obliquely and not very far from the third which is situated near the base of the antenna; antenna (fig. 18 *a, b*) long and narrow,

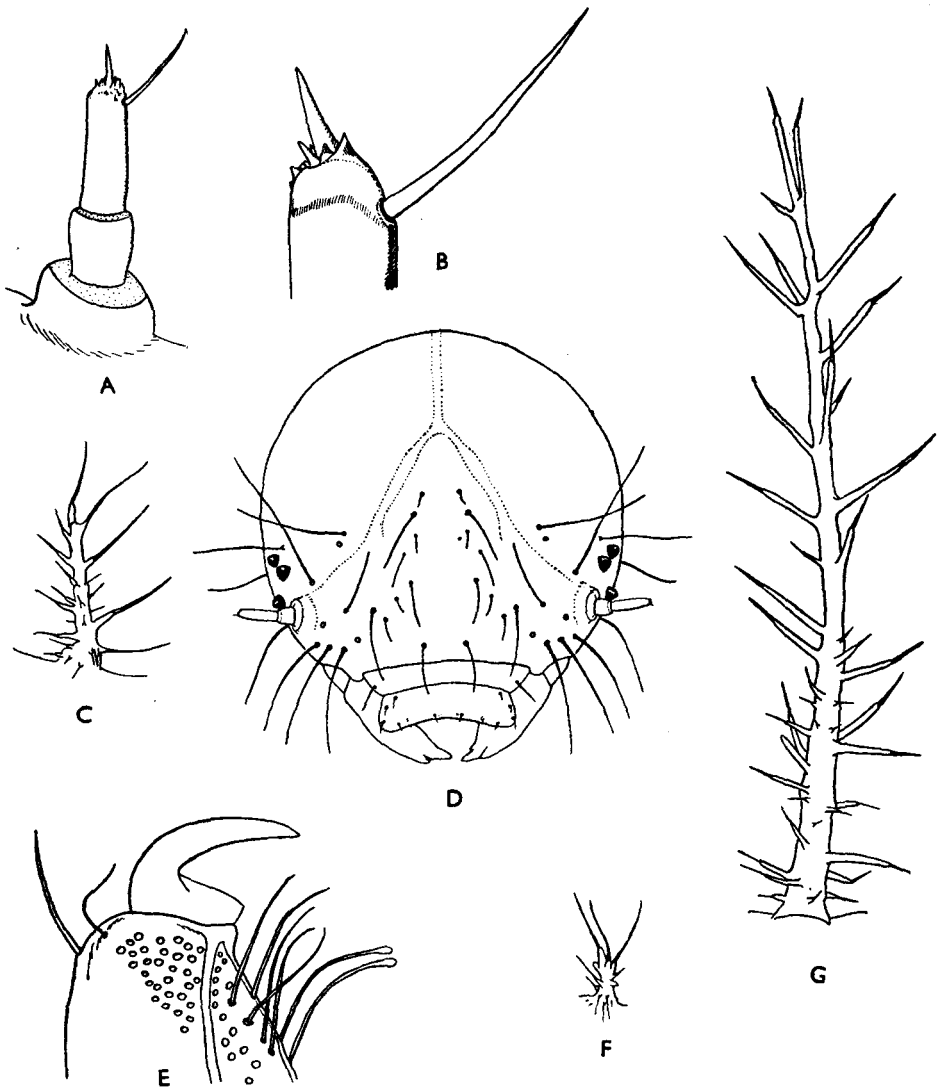


Fig. 18.—Larva of *Afissa dumerili*: (*a*) antenna; (*b*) apex of antenna much enlarged; (*c*) dorsolateral scolus of sixth abdominal segment; (*d*) head; (*e*) claw; (*f*) dorsolateral scolus of seventh abdominal segment; (*g*) subdorsal scolus of metathorax.

two-segmented, the basal segment a little longer than wide, the second a little narrower, about three times as long as wide, with a long seta situated a little below the apex and a small number of sensillae present at the apex, one of which is thinner and longer than the rest; clypeus relatively short, almost four times as wide as long; labrum a little longer than clypeus; mandibles stout, as wide as long not much narrowed distally, each with three rather short and blunt, heavily sclerotised teeth; the other mouth-parts as in most other EPILACHNINAE.

*Thorax* slightly increasing in diameter posteriorly. Prothorax less than twice as wide as long; pronotum almost uniformly sclerotised, rounded posteriorly; dorsal scoli directed anteriorly and a little upwards, nearly twice as long as pronotum, very narrow, each with 30 to 36 very short to rather long irregularly dispersed branches, with moderately long to short setae; subdorsal scoli absent; dorsolateral scoli about two-thirds the length of the dorsal, but with the branches more crowded, a few short chalazae present in the middle and along the posterior margin of the pronotum. Mesothorax a little wider than prothorax but shorter; the area of the tergum round the bases of dorsal and subdorsal scoli on each side and a little towards the middle of the segment sclerotised and provided with a few short chalazae; dorsal and subdorsal scoli of the same side very close together at their bases, diverging distally, directed a little anteriorly and each longer than the dorsal ones on the pronotum; dorsolateral scoli directed anterolaterally, equal to two-thirds the length of the dorsal scoli of the same segment, with about 28 comparatively shorter branches. Metathorax similar to mesothorax (fig. 18 g). On the underside, the ventral group on each thoracic segment consisting of two to four very short setae; coxae of any one segment well separated, femora slightly shorter than tibiae, claw (fig. 18 e) with a rather triangular tooth at base and moderately bent distally.

*Abdomen* with the first four segments nearly equal in width to the metathorax, the rest narrowing gradually posteriorly; dorsal scoli on the first six segments similar in structure to the corresponding scoli on the metathorax but a little shorter, on the seventh equal to nearly half the length of the dorsal scoli on the sixth, with relatively shorter and fewer, usually 16 branches, on the eighth like that on the seventh but half as long; subdorsal scoli on the first five segments equal in length and similar in branching to the dorsal scoli of the same segments, on the sixth (fig. 18 c) and seventh a little shorter, each with about 18 relatively shorter branches, on the eighth similar to the dorsal scoli on the same segment; dorsolateral scoli much shorter than the others of the same segment, usually directed laterally but in the last few segments directed successively more posteriorly, equal to two-thirds the length of the other scoli of the first three segments, and each with about 20 short, seta-bearing branches, but on the fourth to seventh (fig. 18 c, f) segments gradually decreasing in length, and on the eighth present in the form of a conical process bearing a few setae. The ninth segment with tergum short, semicircular, with a small struma on either side and with about eight setae on the posterior margin. On the ventral surface the setae poorly developed, short, almost transversely arranged and not arising from sclerotised areas; ventral group comprising usually three setae (one shorter) on each segment; subventral absent on first segment, consisting of two setae each on the second to fifth and of three on the sixth to eighth; ventrolateral group usually absent on the first, but sometimes comprising a single simple seta like that of the second, on the third and fourth segments consisting of a short chalaza and two short setae, on the fifth to seventh present in the form of strumae, each with about six setae, and on the eighth consisting of three simple setae. Ninth segment with six setae on either side; tenth without any setae.

*Material examined*: 2 larvae from Jalpaiguri, North Bengal, feeding on *Clerodendron infortunatum* (Verbenaceae); February 1931, adults reared.

Genus *CHNOOTRIBA* Chevrolat *in* Dejean.

*Chnootriba* was first defined by Mulsant (1850) who regarded it as very distinct from the rest of the EPILACHNINAE. Weise, in 1898, however, sunk it as a synonym of *Epilachna* and since that time, until recently, the validity of this genus has remained uncertain. In Korschefsky's catalogue (1931), for instance, it was regarded as a subgenus of *Epilachna*. Mader, in 1941, considered it to be a valid genus and the present study of the larvae of the type species, *C. similis* (Thnb.), lends support to this view. The species feed mainly on Gramineae and the structure of the larvae is very distinct from most other members of the subfamily. Some of the differences have been mentioned in the key to the genera, while others are given in the description of the species in the following pages. Since larvae of the other species of the genus are not known, it is not possible to say which of these characters would be of greater value in separating it from the other genera of the subfamily.

***Chnootriba similis* subsp. *tellini* Weise (Figs. 19 and 20).**

*Chnootriba similis* occurs in Africa (except probably the south) and in south-west Arabia. It is divisible into several subspecies; that occurring in Abyssinia, Eritrea and south-west Arabia, being called *tellini* Weise. It is a serious pest of maize,

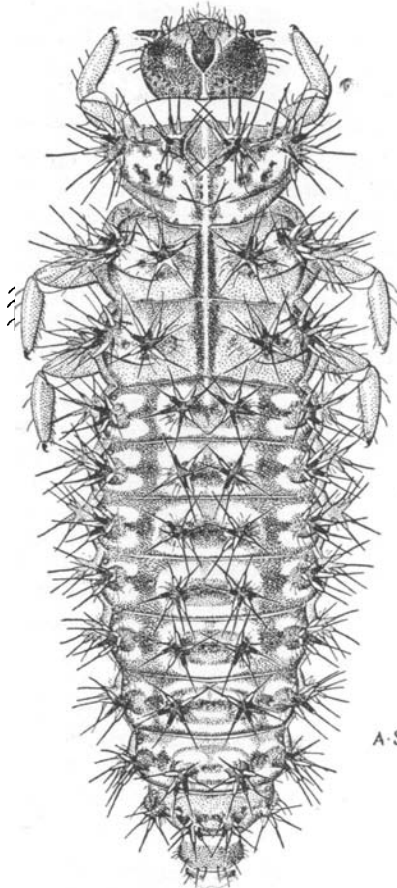


Fig. 19.—Larva of *Chnootriba similis* subsp. *tellini* (relaxed).



sorghum, wheat and other related crops in these countries. Recently Jannone (1941) has given an account of its biology and control in Abyssinia. The larval material described here was reared by Mr. G. de Lotto at Asmara, Eritrea.

*Body* elongate oval, widest in the middle, 5.5–6.5 mm. long and 2.5–2.7 mm. wide; coloration very variable especially on the dorsal surface, head piceous to brown, thorax with elongate piceous markings in the middle and on the lateral parts of the tergites, abdomen piceous but with lighter areas round the bases of the scoli, which are also mostly piceous or brown but sometimes whitish, the underside light brown or

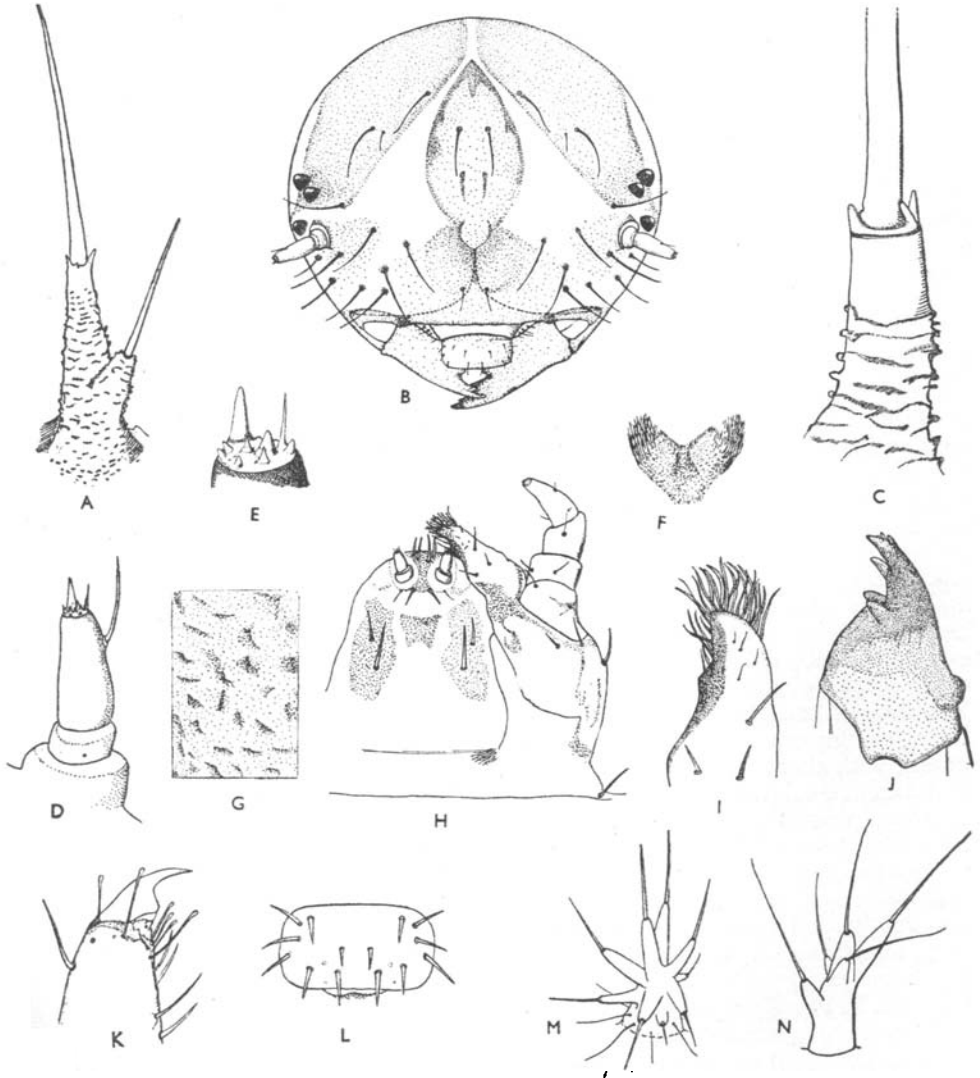


Fig. 20.—Larva of *Chnootriba similis* subsp. *tellini*: (a) branched subdorsal scolus of pronotum; (b) head; (c) unbranched subdorsal scolus of pronotum, much enlarged and with distal part of seta not shown; (d) antenna; (e) apex of antenna, much enlarged; (f) hypopharynx; (g) surface of the body-wall much enlarged; (h) maxilla and labium; (i) galea (ventral view) much enlarged; (j) mandible; (k) claw; (l) labrum; (m) subdorsal scolus of second abdominal segment; (n) dorsal scolus of pronotum of first-instar larva.

greyish in the middle, piceous or slightly paler on the lateral parts and round the bases of the setae in the median part.

*Head* (fig. 20 *b*) subrounded, vertex (except coronal suture), median part of front, the area anterior to the antennal sockets, ocelli and antennal segments piceous, other parts of head brownish; setae mostly long, and usually arranged as shown in the figure; ocelli three on either side and arranged triangularly, the two towards the vertex very close together and further from the third than from one another, the third situated outside and close to the antennal socket; antenna (fig. 20 *d*) two-segmented, long, with the first segment very short and about twice as wide as long, second long, about twice as long as wide, slightly narrowing in distal half, with a long seta at two-thirds and a few sensillae at apex (fig. 20 *e*); median part of clypeofrontal margin formed into a strongly sclerotised, triangular area with the apex towards the centre of the front and bearing a number of short setae; clypeus short and broad, trapezoidal, narrowing anteriorly, the lateral and anterior parts membranous, the former with about three setae on each side; labrum (fig. 20 *l*) rectangular, a little less than twice as wide as long, with very short but stout setae; mandibles (fig. 20 *j*) resembling those in *Cynegetis impunctata*, much longer than broad and narrowed distally, the base oblique on inner side, the condyle situated rather laterally, with four teeth, the apical one being large and bluntly denticulate on the inner margin; hypopharynx (fig. 20 *f*) emarginate in the middle and with moderately long setae on either side; maxilla (fig. 20 *h*) with the galea elongate, strongly sclerotised (rather horny) on the inner margin (fig. 20 *i*) and bearing dense, short setae distally, palpi relatively short, with the apical segment a little longer than the preceding and narrowed distally; labium (fig. 20 *h*) with partially sclerotised mentum and with narrow, moderately long, palpi.

*Thorax* (fig. 19) slightly widening posteriorly. Prothorax nearly twice as broad as long with the pronotum oval and slightly more rounded posteriorly; dorsal scoli very short, equal to half the length of the pronotum, broadly conical, each bearing about a dozen filiform branches arranged in the form of a rosette, each with a rather slender apical seta slightly longer than itself; the surface of these branches and of the body-wall (fig. 20 *g*) wrinkled except where strongly sclerotised; subdorsal scoli (fig. 20 *c*) small, each like a large branch of the other scoli and bearing a long apical seta (sometimes (fig. 20 *a*) there is a small branch in the middle which also bears a small seta at its apex); dorsolateral scoli similar to dorsal, slightly larger, each having about 16 branches. Mesothorax with the spiracles smaller than in most other species of the subfamily; dorsal scoli situated midway between the median longitudinal line of the segment and the subdorsal scoli, a little smaller than the corresponding one on pronotum, usually with eight branches; subdorsal larger than dorsal, with about ten branches similar to those of the dorsal; the area round bases of dorsal and subdorsal scoli of the same side more strongly sclerotised, oval and dark brown to piceous on the margins; dorsolateral scoli conical, directed rather laterally, each with about 12 branches similar to those of the others but usually brownish, seldom piceous. Metathorax with the scoli similar to those of mesothorax. On the underside, each segment with a single lightly piceous, subrounded struma situated in the middle of the sternum, that on the prosternum being small, and with about four, sometimes six, short setae, those on the meso- and metasternum being a little larger and each with six to ten short setae. Legs with tibia a little longer than femur, claw (fig. 20 *k*) without a quadrate basal tooth, rather triangular at base and gradually narrowed and pointed distally.

*Abdomen* with the spiracles relatively smaller than in most other species of the subfamily; dorsal scoli on each segment closer to one another than to the subdorsal, surrounded by a common transverse-oval strongly sclerotised area which is usually dark to piceous, but when lighter has a pair of pitted dark spots in the middle; dorsal scoli on first five segments similar, slightly smaller than the corresponding ones on metathorax, each with seven or eight branches bearing apical setae slightly

longer than themselves, the scoli on the sixth to eighth segments similar but with the base more conical; subdorsal scoli (fig. 20 *m*) situated in line with the corresponding ones on metathorax but a little smaller, each bearing eight or nine branches except on the seventh and eighth segments where it is small and has only five or six branches; dorsolateral scoli smaller than the subdorsal of the same segment and decreasing in size in each succeeding segment after the third; on the first three segments, each with about seven branches, on the fourth to fifth segment with four or five branches and on the seventh and eighth more or less like a struma bearing six setae. Ninth tergite semicircular, sclerotised and pigmented distally, with about eight moderately long setae on either side and on the posterior margin. The ventral surface with the strumae sclerotised and dark, on the first segment the pair of ventral strumae usually absent (sometimes present only as a single, median and small struma, with a pair of setae), on the next five segments the strumae present in pairs, one on either side of the median longitudinal line and each with six to ten rather short setae, the seventh and eighth segments usually with about four setae; subventral struma absent on first segment, on the succeeding segments similar to the ventral strumae of the same segment, on the eighth contiguous with the ventral; ventrolateral strumae absent or represented by a single short seta on each of the first two segments, on the next six segments, each struma with three to five setae. Ninth segment with a total of six to eight setae, present in a transverse median line; tenth with four very short setae on either side.

The characters of the earlier instars are as follows:—

*First instar.*—0.8–1.2 mm. long, 0.6–0.9 mm. wide, with relatively large head and long legs. Head subrounded, slightly broader than long, usually lighter than the rest of the body which is mostly piceous; coronal and frontal sutures distinct, lighter in colour; setae long, usually as in the subsequent instars; of the ocelli the two towards the vertex relatively more distant from each other than in the fourth (final) instar larva; antenna two-segmented as in the latter, with the first segment shorter than broad, the second not much narrower than the first, nearly as broad as long, with the seta and sensillae relatively more prominent; the median triangular part of the antero-clypeal margin relatively smaller than in the final instar. Prothorax as wide as head and half as long; dorsal scoli on pronotum situated more laterally than in the subsequent instars, each with about five short branches arising from a moderately long stem (fig. 20 *n*), each branch with the apical seta equal to about four times its length; subdorsal scoli comprising a single filiform process bearing a long seta; dorsolateral similar to dorsal. The scoli on the rest of the thoracic and on the abdominal segments similar in general arrangement to those described for the final instar but each with usually three branches like those of the dorsal scoli on the pronotum. On the underside the number of setae very small being usually two or three in a struma.

*Second instar.*—3.0 mm. long, 1.3 mm. wide, with the thoracic and first few abdominal segments wider than the head which is similar in structure to that of the final instar larva. Dorsal scoli on pronotum also closer together than in first instar; the number of branches on the dorsal scoli on the pronotum and on the first few abdominal segments usually eight and five, respectively, each branch with the setae relatively shorter than in the first instar.

*Third instar.*—4.5 mm. long, 1.8 mm. wide; like the fourth instar in general coloration and structure of the body; the dark stripe on either side of the mid dorsal line on the thorax becoming distinct for the first time in this instar; the scoli relatively shorter but with the number of branches equal to that in the fourth-instar larva.

*Material examined*: Many larvae of each instar (also eggs, pupae and adults) from Asmara, Eritrea, 1947 (*G. de Lotto*), damaging leaves of maize, sorghum, and wheat, and also attacking *Medicago sativa*.

***Merma mediata* Kapur (Figs. 21 and 22).**

The larvae of the genus *Merma* Weise have not been described before. The present material from Kawanda, Uganda (East Africa) was collected by Mr. W. V. Harris.

*Body* (fig. 21) elongate oval, slightly more tapering posteriorly, 5.0 mm. long and 1.7 mm. wide in the middle, uniformly and moderately convex on the upper surface; greater part of head and pronotum, most of the dorsal and subdorsal scoli and the areas of the tergite around their bases, brown to dark brown in colour, underside usually much lighter but with the legs and strumae brownish.

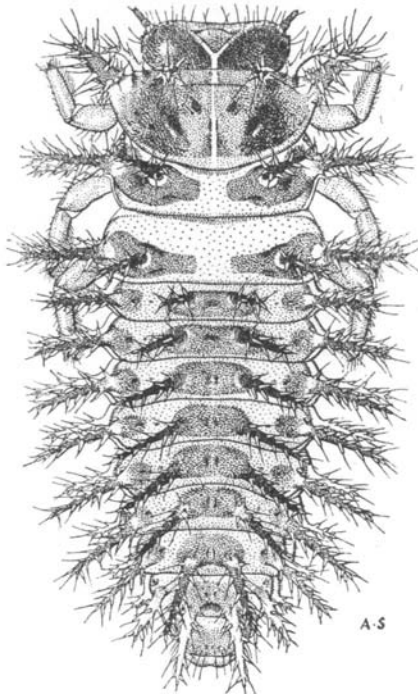


Fig. 21.—Larva of *Merma mediata*.

*Head* (fig. 22 *a*) larger in proportion to size of body than in other known genera, slightly broader than long, vertex and front dark brown except for the lighter epicranial suture comprising as usual a narrow coronal suture and a pair of frontal sutures, genae also lighter except for a dark area round the ocelli; setae moderately long to rather short, usually greyish and arranged as shown in the figure, ocelli three on each side, piceous, of equal size and placed triangularly as in most other species of the subfamily; antenna (fig. 22 *c*) long, two-segmented, dark brown, first segment slightly wider than long, second a little narrower and slightly tapering, twice as long as wide, with a moderately long seta situated a little below the apex and two longer and several short sensillae at the apex. Anterior margin of front with a small triangular, strongly sclerotised area in the middle; clypeus relatively large,

rather weakly sclerotised, trapezoidal, nearly twice as wide as long and with three setae on each lateral margin, labrum as wide as anterior margin of clypeus but slightly shorter, more strongly sclerotised at base and with about a dozen short setae; mandibles (fig. 22 *d*) only slightly longer than broad at base, the distal half with about seven teeth, the apical one largest and usually not denticulate on inner margin, three of the remaining six slightly larger than the other three and denticulate on the inner margin, hypopharynx with long and dense setae on the anterolateral angles; maxillae with the galeae subrounded, expanded, relatively large and with short setae instead of the usually long and dense ones present in most other EPILACHNINAE studied, maxillary palpus moderately long, with the apical segment much narrowed distally.

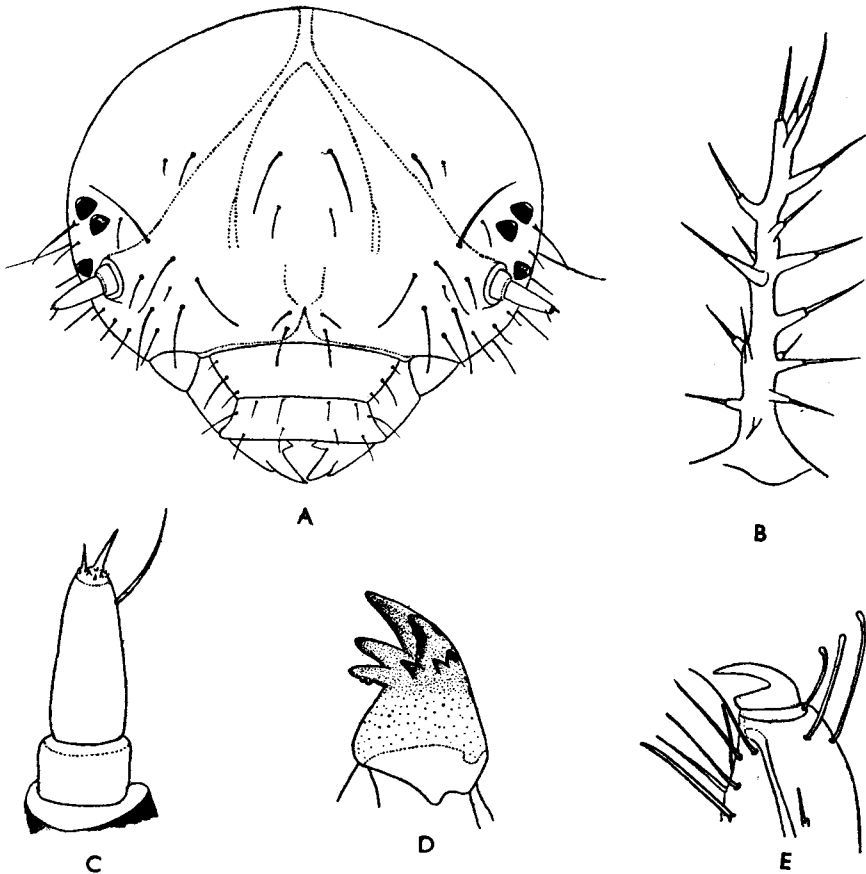


Fig. 22.—Larva of *Merma mediata*: (a) head; (b) subdorsal sclerite of second abdominal segment; (c) antenna; (d) mandible; (e) claw.

*Thorax* slightly widening towards abdomen, slightly convex dorsally. Prothorax about twice as wide as long, pronotum oval, slightly more narrowed posteriorly, strongly sclerotised and pigmented irregularly brown to dark brown except for a very light and narrow longitudinal median line and four or five piceous patches on either side of it, dorsal scoli nearly as long as pronotum, the main stem usually piceous with about 20 branches arising from all over its surface, the branches usually lighter, short (equal to diameter of main stem), each with a thin apical seta usually

little longer than the branch bearing it, subdorsal scoli lighter in colour, sometimes asymmetrical, usually with a narrow main stem, equal in length to two-thirds the length of the dorsal scolus, and bearing four to six short branches similar to those on the latter but arising only on one side, dorsolateral scoli similar to dorsal but relatively broader at base and directed anterolaterally; there are also about a dozen short setae and chazae on the rest of the surface of the pronotum. Mesothorax with the dorsal and subdorsal scoli of the same side with their bases near together and distinctly away from centre of segment, surrounded by a common strongly sclerotised brown to dark brown, subrectangular area; dorsal scolus slightly shorter and narrower at base than the corresponding scolus on pronotum, darker except at base, with about fourteen short branches bearing setae equal in length to themselves; subdorsal scolus (fig. 22 *b*) similar to dorsal but slightly longer and with about seventeen branches; dorsolateral scolus similar to dorsal except for its very light colour. Metathorax similar to mesothorax in general shape and armature. On the underside, each thoracic sternum with a pair of strumae, each bearing four to six moderately long setae. Legs dark brown for the most part, femora nearly as long as the tibiae, claw (fig. 22 *e*) with a subquadrate basal tooth, distal part moderately bent and sharply pointed.

*Abdomen* with the first three segments slightly wider than metathorax, the succeeding segments gradually narrowing posteriorly; the pair of dorsal scoli on each segment surrounded by an oval, sclerotised and brownish area; dorsal scoli on first five segments similar in coloration and size to those on metathorax but usually with the number of branches reduced to ten, on the sixth and seventh segment lighter, longer and each with 12 branches bearing setae as long as or slightly longer than themselves, setae on the eighth similar but much lighter in colour; subdorsal scoli each with a brown sclerotised area round the base, similar in structure to the dorsal ones of the same segment but shorter on the eighth; dorsolateral scoli without coloration except for a light brown area round the base of each, on the first four segments equal in length to one another and slightly shorter than the subdorsal ones of the same segments and each with about 15 shorter but more crowded branches, on the fifth to eighth segments decreasing rapidly in size, being only a conical projection bearing a chazaa and four short setae on the eighth. Ninth tergite relatively larger in size than in the other known larvae of the subfamily, subquadrate, the posterior margin slightly rounded, with a struma bearing about six short setae near each lateral margin and with about eight rather long setae on the posterior margin; tenth tergite slightly sclerotised distally, brownish and with a few very short setae. The ventral surface usually with small, light brown, rather ill-defined strumae with the setae becoming relatively longer in the last few segments; ventral strumae on the first eight segments each with usually three setae; subventral strumae absent on first segment and like the ventral strumae on the others; ventrolateral strumae with two short setae on first segment and four or five each on the succeeding seven segments, one of these setae borne on a pimple-like process. On the ninth segment, ten moderately long setae situated in a row in the posterior half of the segment; tenth with a few very short setae on either side.

*Material examined*: 5 larvae (several pupae and adults reared) 21.iii.1947, at Kawanda, Uganda (*W. V. Harris*).

### Summary.

The EPILACHNINAE constitute one-sixth of the known species of the family COCCINELLIDAE. They are herbivorous and include a number of well known pests of cultivated plants in different parts of the world. Their adults present a great uniformity of external structure, with the result that nearly all the known species have been placed in one genus, *Epilachna* Hope. Their identification is made more

difficult by the employment of characters such as the elytral markings and spots which may vary a great deal in one species or be almost identical in two quite unrelated species. Lately, there has been a tendency to split the genus by employing more reliable morphological characters, including genitalia. A greater knowledge of the biology and morphology, including that of the immature stages, particularly the larvae, is necessary to evolve a natural classification. Relatively little was known of the larvae. This paper deals with 14 species belonging to six different genera.

In addition to discussion of the relationship of this subfamily with other COCCINELLIDAE in the light of the extensive larval material examined, it is observed that larvae belonging to different genera, including those recently erected or revived, show considerable morphological differences that support a division of *Epilachna* (*s.l.*) based on adult characters. A study of the larvae of nine species that are still retained in the genus *Epilachna* shows that they are separable into several groups, which may well indicate where further division of the genus may be made.

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