COMPARATIVE MORPHOLOGICAL STUDIES OF THE LARVAE OF SOME QUEENSLAND DACINAE (*TRYPETIDAE, DIPTERA*).

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SUMMARY.

A description of the morphology of larvae of Trypetidae and techniques for studying their more important diagnostic characters are given.

Nineteen species of the Dacinae in Queensland are described and figured in detail, and a key by which 16 of these may be separated on larval characters is presented.

I. INTRODUCTION.

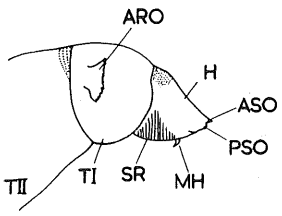
The extensive literature on the Trypetidae is concerned mostly with the adults, although in recent years some attention has been paid to larval forms.

Banks (1912), using external characters only, gave the first detailed comparative description of Dipterous larvae. Snodgrass (1924), dealing with *Rhagoletis pomonella* Walsh, Benjamin (1934) with American Trypetidae, Thomsen (1935) with species of the Stomoxydinae, and Varley (1937) with some English Trypetidae, were among those who paved the way for a paper by Phillips (1946). This contains descriptions and a key for separating the larvae of 45 species of American Trypetidae, only a few of which cannot be differentiated adequately. Hardy (1949) described all the instars of the 3 species (2 genera) of Trypetidae of economic importance in the Hawaiian Islands, and presented a key based on larval characters.

There has been little published on the larval forms of Australian Trypetidae, and nothing at all on their comparative morphology. Such information would be of value to systematists, other biological workers and quarantine officers. In Queensland, the Dacinae contains nearly all the Trypetid species of economic importance. Accordingly, a study of the larvae of this sub-family was initiated several years ago at the University of Queensland. Before specialising, however, as many representatives as possible of other sub-families were studied. This basic work was carried out during 1952-53 at the University of London.

II. MATERIAL.

May (1953) considered that the 39 species of Dacinae in Queensland can be grouped into 13 genera; Hardy (1951, 1954), however, treated most of these genera as sub-genera of *Dacus*. Throughout this work the generic classification proposed by Perkins (1937) and followed by May (1953) has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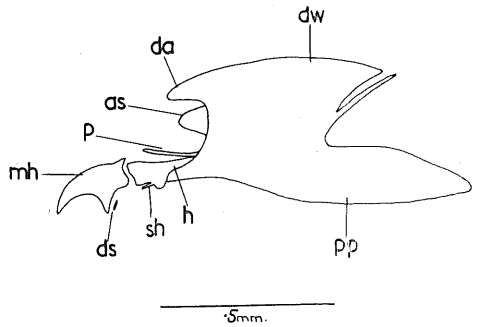
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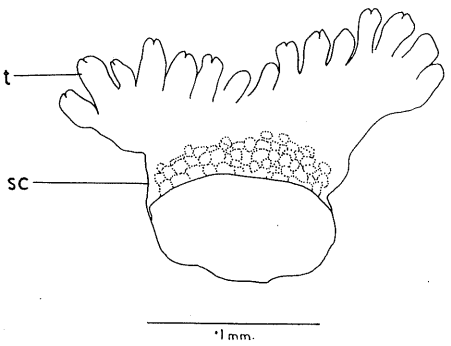
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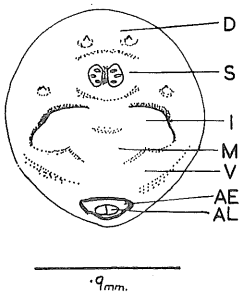
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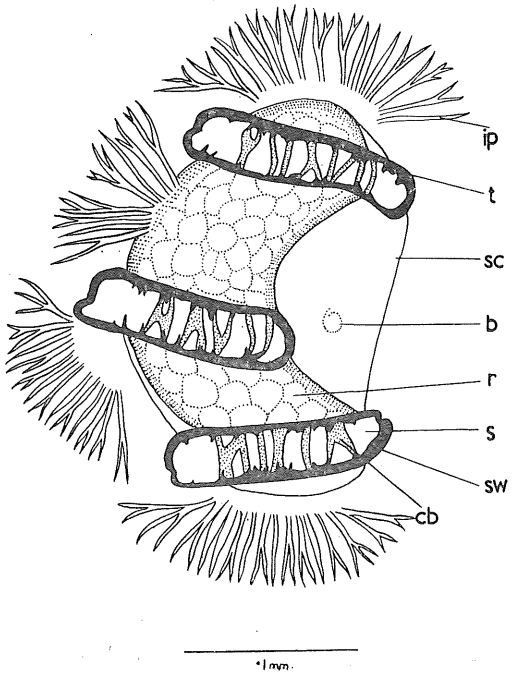
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been used. The 19 species described include those of economic importance and others which were also plentifully available. In all instances, larvae were bred in the laboratory from pure adult colonies or were taken from a host proved to support only one species. To reduce errors in comparison and because second stage larvae tend to shrivel when removed from preservative, only mature third stage larvae were studied in detail. These can be readily distinguished from the first and second instars by their large size (length and breadth) and by the longer and thinner slits of the posterior spiracles.

III. MORPHOLOGY.

The typical Trypetid larva is an elongate whitish maggot with two minute black dots, the heavily sclerotised mouth hooks, at the tapered anterior end. The body consists of a reduced cone-shaped head, three thoracic segments and eight abdominal segments.

At the apex of the head (Fig. 1, A) are two pairs of minute sensory papillae. In Trypetidae, the anterior pair may each be composed of one to three segments (Phillips 1946). In all the Dacinae studied, however, there are only two segments in these *anterior sense organs,* although at first glance there seem to be three. The first segment appears to be divided, the narrower distal portion forming a collar at the junction with the second segment.

The *posterior sense organs* lie below the anterior pair. Each is composed of one segment flattened on its distal surface and bearing a number of minute sensillae.

The semi-circular oral lobes are situated one on each side of the mouth, which lies in the middle of the ventral surface of the head. These bear *stomal ridges,* which flare fanwise from the mouth cavity and may vary in number on each lobe and for different species.

Snodgrass (1924) and Phillips (1946) stated that a third pair of sensory organs, the *stomal sense papillae,* are present at the side of each mouth hook. Extensions of the stomal ridges in these regions in *Austrodacus cucumis* (French) are the only indications of these papillae in the species studied.

Fig. 1.

MORPHOLOGY OF DACINID LARVA.

A.—*Lateral view of anterior end*: ARO, anterior respiratory organ; H, head; ASO, anterior sensory organ; PSO, posterior sensory organ; MH, mouth hook; SR, stomal ridges; TI, first thoracic segment; TII, second thoracic segment.

B.—*Cephalo-pharyngeal skeleton:* mh, mouth hook; p, parastomal sclerite; as, anterior sclerite; da, dorsal arch; dw, dorsal wing; ds, dental sclerite; sh, subhypostome; h, hypostome; pp, pharyngeal plate.

C.—*Anterior respiratory organ*: t, tubercle; sc, stigmatic chamber.

D.—*Posterior respiratory organ*: ip, interspiracular processes; t, teeth; sc, stigmatic chamber; b, button; r, reticulum; s, slit; sw, slit wall; cb, crossbar.

E.—*Posterior view of caudal segment*: D, dorsal area; S, stigmatic area; I, intermediate area; M, median area; V, ventral area; AE, anal elevation; AL, anal lobe.

Minute spines or *spinules* may be scattered indiscriminately on the integument but are more usually arranged in groups or in rows especially near the junction of segments. These help larval movement by anchoring the body to the sides of the tunnels. In the Dacinae, spinules are concentrated on the ventral surface in spindle-shaped areas, known as *fusiform areas*. Unless otherwise stated in the descriptions, these fusiform areas occur on the last eight intersegmental areas; seven are clearly visible to the naked eye.

The *cephalo-pharyngeal skeleton* (Fig. 1, B) is the heavily sclerotised framework in the anterior part of the body. It includes the mouth hooks, continues posteriorly to surround and support the mouth cavity and pharynx, and provides attachments for the muscles which govern the vertical motions of the mouth hooks.

The *mouth hooks* are paired symmetrical structures, curved at the tip. In some species extra teeth are present along the ventral margins. Posteriorly the hooks deepen and articulate with the *hypostome*. This consists of two elongate arms connected by a bar in the floor of the mouth. Its curious shape prompted Keilin (1915) to use the term "H-shaped piece," but this is not at all descriptive when the structure is viewed laterally. Sometimes, when seen from this angle, it is definitely triangular; hence the "triangular piece" of Snodgrass (1924). The term used in this work follows Efflatoun (1927), Thomsen (1935) and Phillips (1946), who used hypostome, hypostomium, or hypostomal piece.

A pair of long, rod-shaped sclerites, the *parastomal pieces* or *parastomals*, lie dorsally parallel to the hypostome, being attached near its dorso-caudal end, and probably give some rigidity to the roof of the mouth. Other authors mention an unpaired sclerite, anterior to the parastomals, giving support to the roof of the mouth. In the Stomoxydinae, Thomsen (1935) figured this "epistomal sclerite" as a large, heavy cap-like structure; in *Rhagoletis pomonella* (Walsh), Snodgrass (1924) figured a narrow rod, deeper than long, lying embedded in the roof but without articulation with other parts of the skeleton. According to Phillips (1946), in some Trypetidae it bears prolongations which are attached to the internal surface of the hypostome. No trace of this epistomium is present in the Dacinae.

Two rod-like sclerites joined in the shape of a V lie in the floor of the mouth between the crossbar of the hypostome and the mouth hooks. The apex of the V is between the mouth hooks, and each arm articulates with a lateral piece of the hypostome. The term *subhypostome* is used here for this pair of sclerites, which, unfortunately, is often obscured in preparations. Snodgrass (1924) figured these structures but without a name. Phillips (1946) thought that "subhypostome" must be synonymous with the "irregular sclerites" of Thomsen (1935), but by their position and shape, that author's "antler-like structures" seem to correspond more closely.

There is another pair of sclerites lying close to the mouth hooks along the ventro-caudal edges. Hewitt (1914) labelled these structures "*dental sclerites,*" but Thomsen (1935) considered this term unsuitable and proposed "ectostomal sclerites." Hardy (1949) figured these structures as dental sclerites, but made no mention of them in his text. In this study Hewitt's term has been used. Phillips (1946) did not mention these sclerites, but they appear to be present in some species of the Dacinae, although not always visible in preparations.

The side walls of the pharynx are supported by long, broad, sclerotised pieces, the *posterior pharyngeal plates.* The dorsal pouch is an extension from the dorsal side of the pharynx, which divides into two lobes and passes backwards along the body. The outer walls of these lobes are sclerotised and are called the *dorsal wing plates.* Each pharyngeal plate and dorsal wing plate may be cleft, so when viewed from the side the pharyngeal skeleton may possess four posterior prolongations. When there is no cleft, there is usually a line of heavy sclerotisation along the ventral edge of the dorsal wing and along the dorsal edge of the pharyngeal plate. The dorsal wing plates are joined anteriorly by the *dorsal arch.* In many specimens this is perforated by irregular holes, which give it the appearance of an open network often differently coloured from the rest of the pharyngeal skeleton. In the Stomoxydinae the dorsal arch is a separate sclerite (Thomsen 1935), but in the Trypetidae it seems to be merely a connecting bridge.

The term *anterior sclerite* has been coined for the rather diffuse mass of darkened material which projects anteriorly from the archway joining the dorsal wing and pharyngeal plate of each side. It is attached to the inside of the pharyngeal skeleton and differs in texture from the other parts of the cephalo-pharyngeal skeleton. No reference to any similar structure has been found in the literature, though in the majority of Dacinae examined it is most conspicuous. Hardy (1949), without explanation, figured what might be anterior sclerites.

The *anterior respiratory organs* (Fig. 1, C) are borne on the first thoracic segment and project externally from the surface. Each main trachea ends in a broad area, the stigmatic chamber, which extends to the body wall and there flares outwards to form the projecting respiratory organ. This bears many processes or tubules, usually in a row along the outer edge; the actual number varies within a species and even on the two sides of a specimen, but in general the shape, size and number are fairly constant for the species. The interior of the stigmatic chamber is filled with a reticulum of variously shaped meshes which probably acts as a filter to prevent foreign particles entering the trachea (Phillips 1946).

The walls of the external part of the anterior respiratory organs present a regular granular appearance. In the distal part of the tubules, however, the granulations are usually coarse. A clear area on the tip of each tubule marks the position of the opening through which air enters.

The *caudal segment* (Fig. 1, E) bears many structures of use in classification, the most conspicuous being the posterior respiratory organs set above the mid-line. The *anus* is usually almost on the ventral edge and is flanked by a pair of *anal lobes*. The surface of the caudal segment is divided into several well-defined areas: the *anal elevation* surrounding the anal lobes; the *ventral area* dorsal to this; and two *intermediate areas* separated by a *median area* above the ventral area. Above and to the side of the posterior spiracles are the *dorsal* and *lateral areas*. The dorsal, lateral, intermediate, and ventral areas may bear *tubercles*. In 1929 Greene described 10 species of Trypetid larvae and compiled a key which depended almost entirely on the presence or absence of tubercles on the caudal segment.

The *posterior respiratory organs* may occupy any position from high up on the dorsal edge to well down towards the middle of the posterior surface. Their detailed structure (Fig. 1, D) has proved useful in classification. Efflatoun (1927) was among the first to use these microscopic structures, and Butt (1937) gave a very good description of the posterior stigmatic apparatus within the Trypetidae. Varley (1937) and Phillips (1946) have added to the picture.

Each dorsal trachea opens into a broadened stigmatic chamber which is filled with a reticulum composed of variously sized meshes. Distally, this stigmatic chamber branches into three lobes which meet the surface of the body at the so-called *slits*. The walls of these slits are heavily sclerotised and may bear many teeth and crossbars. In the Dacinae examined, the teeth were always distal to the crossbars. The structure of the spiracle as described by Varley (1937) was seen in some specimens—i.e., the true spiracular opening is a narrow aperture in a transparent membrane which covers each slit.

Translucent structures known as *interspiracular processes* are attached to the integument at the sides of the outer ends of the slits. There are thus four sets, which vary greatly in number, length and general character in different species. Because of their translucency, these processes are not easily seen at first glance except in well prepared slides. Their function is unknown. When the lobes of the stigmatic chamber are large, they often bulge around the slits, which when viewed from the surface then appear to have borders—the *spindles*. The *button* marks the external opening of the previous instar.

IV. TECHNIQUE.

The mature larva was killed by immersion in hot water, and transferred to cold water for immediate examination, or to 70 per cent. alcohol for preservation.

The general shape and size were always taken after killing. The numbers of stomal ridges and fusiform areas, and the characters of the caudal segment, were noted before the slide was made.

Manual manipulation was found to be the surest and quickest method of studying the caudal segment. The larva was held between the first finger and thumb of the left hand, and viewed though a binocular microscope. This allowed twisting and turning to catch the best light. When drawings were made the specimen was embedded head downwards in plasticine, and a spotlight focussed on the posterior end. The amount of moisture present was regulated carefully to avoid glare and to prevent the formation of unnatural wrinkles.

Slide preparation was as follows:—Firstly the caudal segment was partly severed with a fine pair of scissors, and the larva was then placed in 10 per cent. caustic potash solution; freshly killed material was boiled until the internal parts became soft. Preserved material became hard and leathery if heated, so was soaked in cold potash overnight. As soon as the internal organs were soft, the specimen was removed from the potash, placed in a drop of water on a slide, and the cephalic end held down with a needle. By rolling another needle along the body from the head backwards the internal parts were squeezed out at the posterior cut. The skin and attached cephalo-pharyngeal skeleton, after washing, was soaked from one-half to two hours in water to which a few drops of glacial acetic acid had been added.

The most satisfactory staining technique was Britten's 'three-solution' method (Eltringham 1930). Solution I consisted of glacial acetic acid to which two or three drops of acid fuchsin had been added; Solution II of one part clove oil and two parts glacial acetic acid; and Solution III of equal parts of clove oil and glacial acetic acid. The 'skins' were removed from water, placed in Solution I for 10 minutes, transferred to Solutions II and III for five minutes each; then into clove oil and finally into xylol for a few minutes before being mounted in Canada balsam. Britten (quoted by Eltringham 1930) suggested mounting direct from Solution III into Euparal. Under Queensland conditions Euparal did not set hard. When the specimen was on the slide, the caudal segment was completely severed with a sharp blade and placed with its external surface upward near the rest of the skin. One cover glass was used to cover both pieces.

Drawings were made from entire specimens and slides of larval 'skins' to the scales drawn under the appropriate diagrammatic figures of Fig. 1; accordingly, illustrations of the different species are directly comparable in size. In drawing the posterior respiratory organs, care was taken that each spiracle was at the proper angle to the vertical so that the true relation to the other spiracle of the pair is given.

For the species *Strumeta tryoni* (Frogg.), *S. kraussi* Hardy and *S. halfordiae* (Tryon), a series of counts of measurable characters was compiled for statistical analyses. Those used were: number of stomal ridges on each side of the head, number of tubules in each anterior respiratory organ, and total body length.

V. DESCRIPTIONS.

Afrodacus jarvisi (Tryon).

(Fig. 2).

Described from 9 larvae from a pure culture established in Toowoomba by A. W. S. May, Nov. 1952, and 110 larvae collected from the fruit of *Planchonia careya* (F. Muell.) R. Knuth at Cairns by N. L. H. Krauss, Dec. 1949.

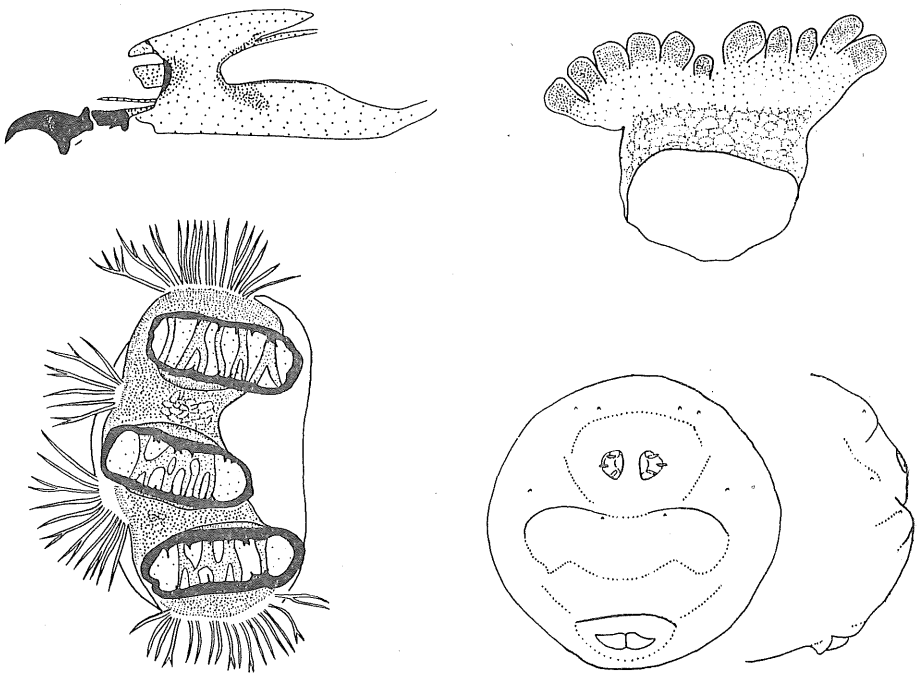


Fig. 2.

Afrodacus jarvisi (Tryon).

Larvae medium sized, length 8·5-10 mm., diameter 1-2 mm. *Anterior sense organs* with second segment cone-shaped or rounded, wider than long. *Posterior sense organs* cylindrical, slightly higher than wide, with at least four sensillae. *Stomal ridges* 11-16. *Spinules* on all fusiform areas, thorn-like, arranged in parallel rows; forming complete bands around the body in the cephalic region, and behind the first and second thoracic segments; anus surrounded by spines. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* one-and-a-half times as long as deep, prominent projection on dorso-caudal corner, deep arch; *hypostome* twice as long as deep, two-thirds length of mouth hooks; *parastomals* present, lightly sclerotised, about equal in length to hypostome; *subhypostome* present; *dental sclerites* small; *dorsal wing plates* cleft, *pharyngeal plates* broad, heavily sclerotised ventral edge of dorsal wings about two-thirds length of the heavily sclerotised dorsal edge of the pharyngeal plates; *anterior sclerite* present. Each *anterior respiratory organ* large, external part flared, tubules 11-14, bulbous and well separated, tips of tubules with heavy granular appearance; reticulum of numerous, irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line, about the length of one slit apart; anal lobes semicircular with a few fine surface grooves; *intermediate area* prominent; two dorsal tubercles, one lateral and one intermediate tubercle present on each

side, all minute. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of medium-sized irregular meshes which are difficult to distinguish; *slits* nearly three times as long as wide, walls thick, teeth numerous, slender, jagged and needlelike; crossbars numerous, thick, interlocking freely; *interspiracular processes* branched, 4-12 trunks, length of fingers greater than half the length of one slit; *spindles* small.

Afrodacus mesoniger May.

(Fig. 3).

Described from 14 larvae found in *Neolitsea involucrata* (Lam.) Alston on Acacia Plateau, southern Queensland by A. W. S. May, Mar. 1953, and 6 larvae in *Litsea reticulata* (Meissn.) Benth. at Mt. Glorious, southern Queensland, by A. W. S. May, Dec. 1952.

Larvae medium sized, length 7-9 mm., diameter about 1·5 mm. *Anterior sense organs* with second segment circular. *Posterior sense organs* cylindrical, of greater diameter than the anterior sense organs, with three sensillae. *Stomal ridges* 9-13, narrow, close together, difficult to count. *Spinules* small, on all fusiform areas as thorn-like and straight spines, minute straight spines forming complete bands between the cephalic and first

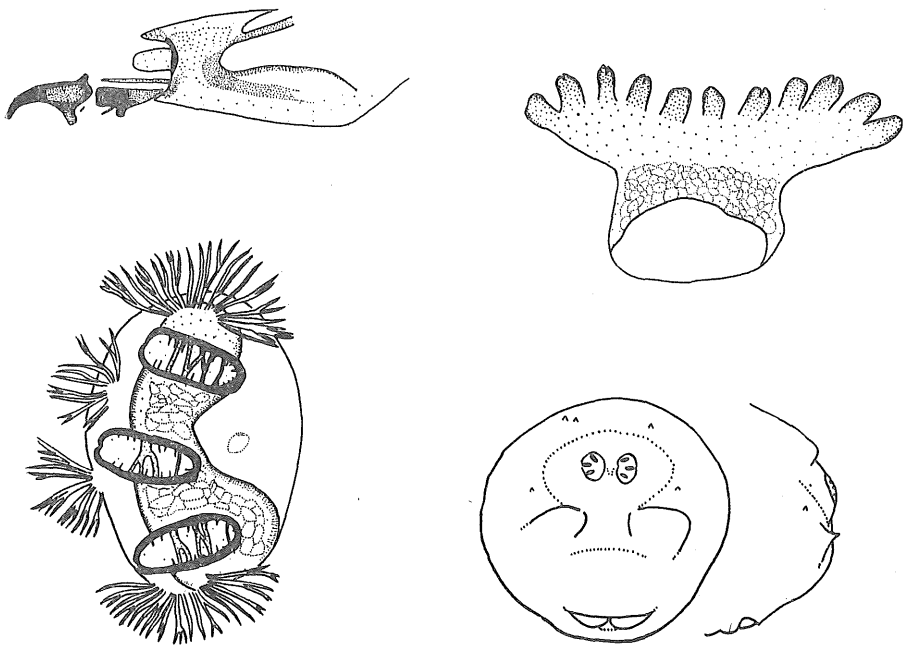


Fig. 3.
Afrodacus mesoniger May.

thoracic segments, the first and second thoracic segments and the second and third thoracic segments, and in some an incomplete band between the third thoracic segment and the first abdominal segment; large and small spines, all slightly curved, around anus. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* slender, about twice as long as deep, gape wide, posterior part lightly sclerotised; *hypostome* not as long as mouth hooks, anterior part rectangular and heavily sclerotised, posterior part lightly sclerotised and tapering to a point; *parastomals* not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* with a dark band

across the dorsal border, otherwise wings and plates not heavily sclerotised, *dorsal arch* recurved over hypostome, dark band along anterior border of archway; *anterior sclerite* present. Each *anterior respiratory organ* small, external part flared; tubules 9-13, small, with heavier granulation; stigmatic chamber about four times as wide as deep, reticulum of three or four rows of irregular meshes; spiracular openings obvious in some preparations. Posterior view of *caudal segment* shows the posterior spiracles on a raised spiracular plate well above the mid-line, about the length of a slit apart with a furrow between them; *anal lobes* retracted, bean shaped, directed downwards; *intermediate areas* prominent, *anal elevation* inconspicuous; one (sometimes two) dorsal tubercles, one lateral and one intermediate tubercle present on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of large meshes; *slits* nearly two-and-a-half times as long as wide, walls thick, teeth long and needlelike; crossbars few, fine, difficult to see; *interspiracular processes* long, fine; *spindles* not evident.

Asiadacus calophylli Perk. and May.

(Fig. 4).

Described from 70 larvae collected from the fruit of *Calophyllum inophyllum* L. in North Queensland by N. L. H. Krauss, June 1949, and W. A. Smith, Aug. 1954.

Larvae medium sized, length 7-10 mm., diameter 1-2 mm. *Anterior sense organs* with second segment cone-shaped, one-quarter the length of the whole organ. *Posterior sense organs* cylindrical, three-fourths as high as wide, three sensillae clearly seen. *Stomal ridges* numerous, 12-16, placed close together and covering a long, large triangular area.

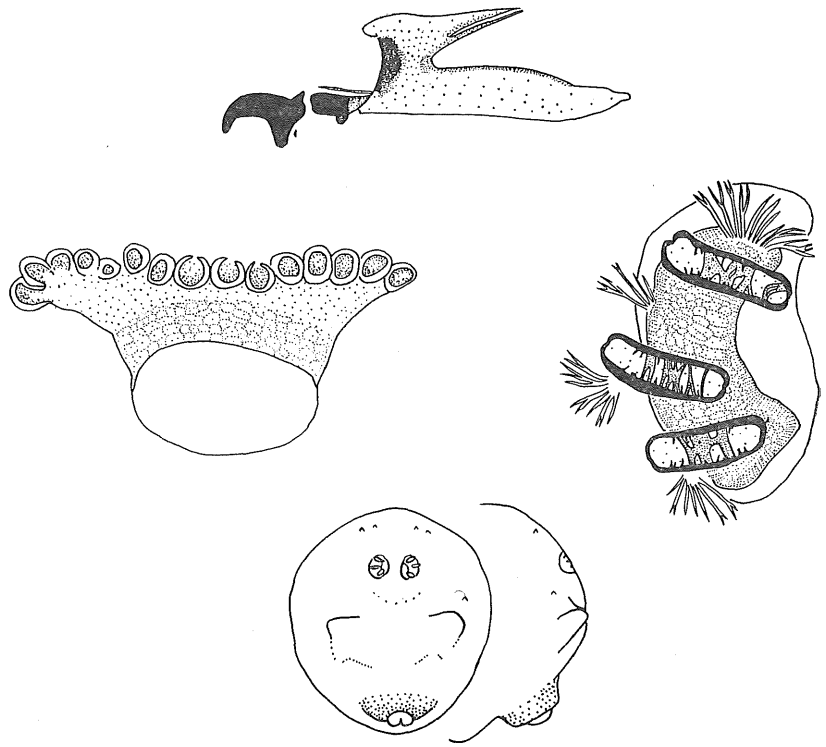


Fig. 4.
Asiadacus calophylli Perk. and May.

Spinules thorn-like on all fusiform areas, rows of minute, backwardly-directed straight spines encircling the body between the cephalic and first thoracic segments, and between the first and second thoracic segments, this latter band incomplete in some specimens; both curved and straight spines around anus. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* large, solid, strongly curved, nearly twice as long as broad, prominent projection on dorso-caudal corner; *hypostome* heavy, anterior part rectangular, heavily sclerotised, posterior part short, triangular; *parastomals* not quite as long as hypostome; *subhypostome* thick, lightly sclerotised; *dental sclerites* small; *dorsal wing plates* cleft, *pharyngeal plates* cleft with dark bands along the dorsal edges; anterior border of archway with a dark sclerotisation diffusing posteriorly; *anterior sclerite* small, dark. Each *anterior respiratory organ* wider than average, external part flared but not deep, tubules 12-17, covered with thick cuticle, clear breaks at apices of the tubules of some specimens for the spiracular openings; stigmatic chamber nearly four times as wide as deep, reticulum of fairly large meshes which are not clearly visible. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line and slightly more than the length of a slit apart with a shallow depression between them; *anal lobes* small, facing almost ventrally, with distal edges rounded but a triangular piece inserted between the rounded edge and the corner of the anal elevation; prominent *intermediate areas* separated by a slightly raised *median area; anal elevaton* prominent; one, or sometimes two, small inconspicuous dorsal tubercles and one small lateral tubercle on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of irregular meshes some of which are very large; *slits* not quite three times as long as wide, walls thick, teeth small, jagged; crossbars freely interlocked; *interspiracular processes* few, fingers fine, about half the length of one slit with tips frequently divided; *spindles* not clearly visible.

Austrodacus cucumis (French).

(Fig. 5).

Described from about 60 larvae from a pure culture established in Toowoomba by A. W. S. May, July 1954.

Larvae large, length 9-11 mm., diameter 1·5-2 mm. *Anterior sense organs* with second segment cone-shaped and one-third the length of the basal segment. *Posterior sense organs* much wider than high, with at least four large sensillae. *Stomal ridges* 12-17, close together, covering a large area and extending well in front of mouth hooks. A wide band of minute *spinules* encircling cephalic segment, complete bands around the anterior borders of the second and third thoracic segments, minute spines present on the ventral edge only of the first abdominal segment, both large, curved, thorn-like spines, and small, straight spines present on the ventral border of all other segments; rings of large and small spines around anus. *Fusiform areas* present on the ventral region of the last seven segments. *Cephalo-pharyngeal* skeleton larger than average; *mouth hooks* well curved with a tooth about midway along the ventral border, a non-sclerotised band circling the hooks at mid-length, dorso-caudal projection prominent; *hypostome* about the length of the mouth hooks, anterior part only heavily sclerotised and twice as wide as posterior part; *parastomals* nearly as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* not cleft but with a darker ventral border, *pharyngeal plates* broad; *anterior sclerites* present. Each *anterior respiratory organ* large, external part flared into two slight lobes, tubules 12-19, coarsely granulated; stigmatic chamber between three and four times as wide as deep, reticulum of small, irregular meshes. Posterior view of *caudal segment* shows posterior spiracles well above the mid-line on a slightly raised

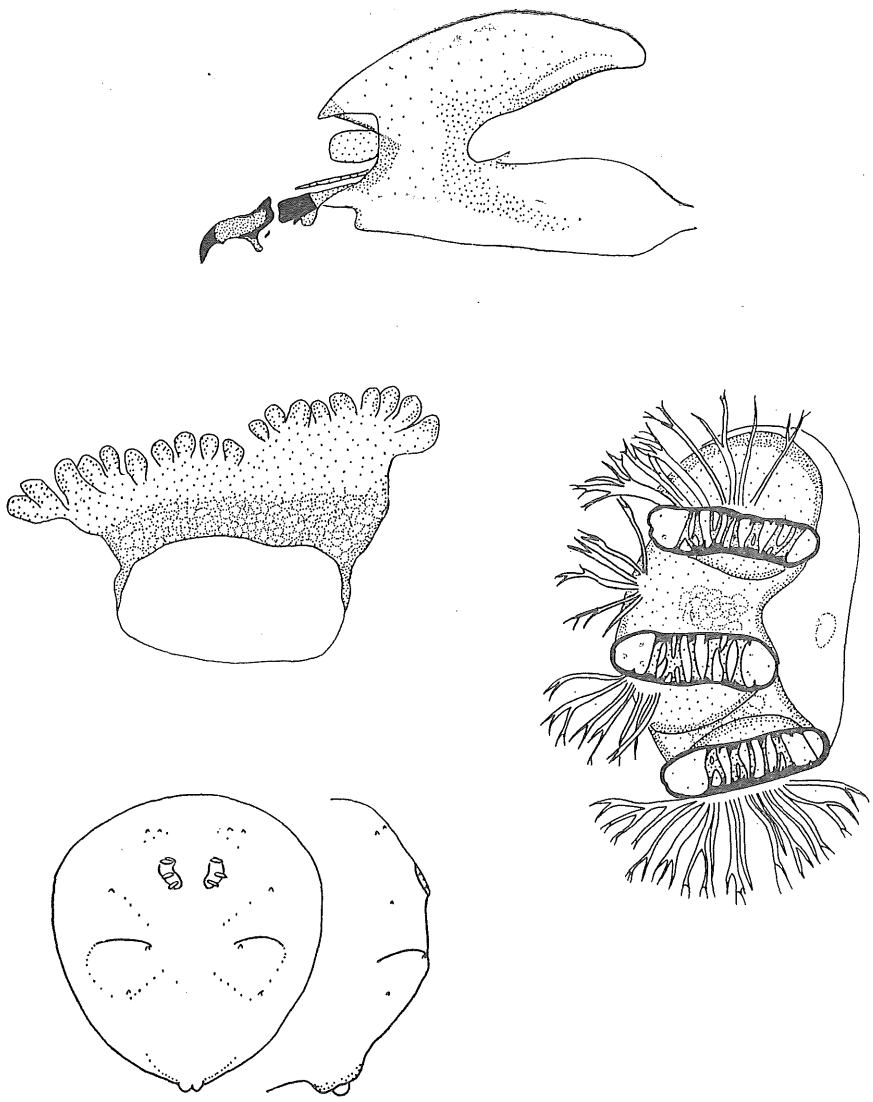


Fig. 5.
Austrodacus cucumis (French).

stigmatic area, more than the length of a slit apart; *anal lobes* facing ventrally; *intedmediate areas* prominent, *anal elevation* fairly prominent; tubercles small, two dorsal, one lateral, one intermediate and one ventral on each side. Each *posterior respiratory organ* medium size; stigmatic chamber heavily granulated with a reticulum of crowded irregular meshes; *slits* about three-and-a-half times as long as wide, walls thick, teeth needle-like, crossbars numerous, freely interlocked; *interspiracular processes* with thick bases and divided tips, about the length of three-quarters of one slit; *spindles* present.

Daculus murrayi Perk.

(Fig. 6).

Described from 10 larvae from the fruit of *Semecarpus australiensis* Engl. at Cairns by N. L. H. Krauss, Dec. 1949.

Larvae medium sized, length 7-9·5 mm.; diameter 1·5 mm. *Anterior sense organs* with second segment rounded and three-quarters the width of the basal segment, basal segment higher than wide. *Posterior sense organs* cylindrical, wider than deep. *Stomal ridges* 10-12, close together. *Spinules* minute, present on all fusiform areas as fairly straight spines; bands composed of rows of minute, backwardly-pointing spines completely encircle the body between the cephalic segment and the first thoracic segment, and between the first and second and second and third thoracic segments. *Cephalo-pharyngeal skeleton* large, *mouth hooks* about twice as long as deep, anterior part slender, prominent projection on dorso-caudal corner; *hypostome* two-thirds length of mouth hooks, anterior part only heavily sclerotised; *parastomals* present, not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, wide, *pharyngeal plates* wide; band along anterior border of archway heavily sclerotised; *anterior sclerite* dark. Each *anterior respiratory organ* large, external part flared with the outer edge curved inwards, tubules 12-20, large, heavily granulated, crowded and sometimes out of line; stigmatic chamber over twice as wide as deep, reticulum of large irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line less than the length of one slit apart; *anal lobes* retracted, triangular; *intermediate areas* prominent, *anal elevation* prominent; tubercles inconspicuous, one dorsal, one lateral and one intermediate on each side. *Posterior respiratory organ* large, stigmatic chamber large with reticulum of medium sized meshes, *slits* large, three-and-a-half times as long as wide, walls thick, teeth numerous and needle-like; crossbars numerous and freely interlocked; *interspiracular processes* few, 3-6 trunks, fingers fine, freely branched, length less than half the length of one slit; *spindles* evident.

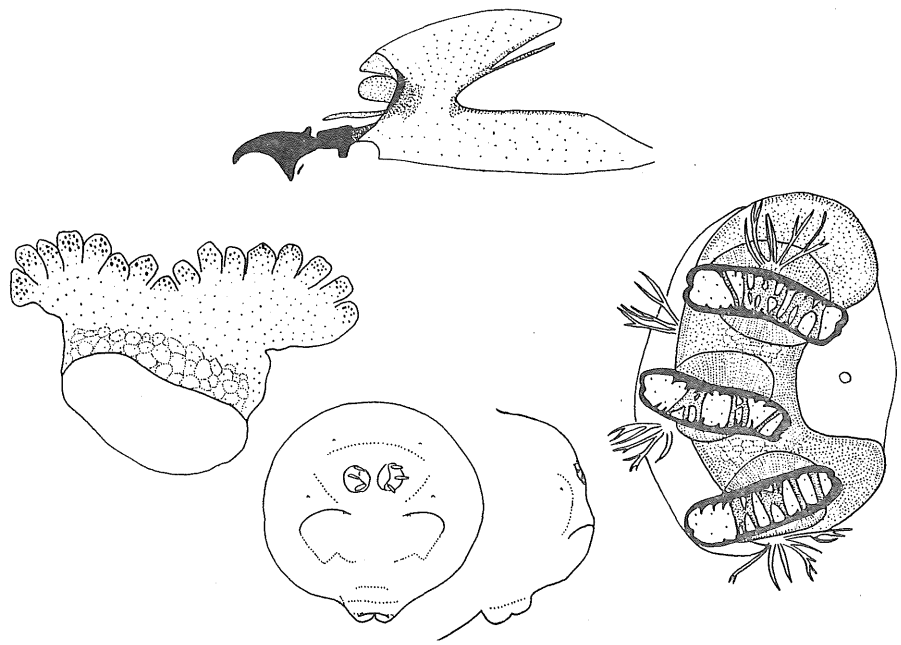


Fig. 6.
Daculus murrayi Perk.

Paratridacus expandens (Walk.).

(Fig. 7).

Described from 21 larvae taken from the fruit of *Garcinia tinctoria* (DC.) W. F. Wight at Cairns by N. L. H. Krauss, July 1949.

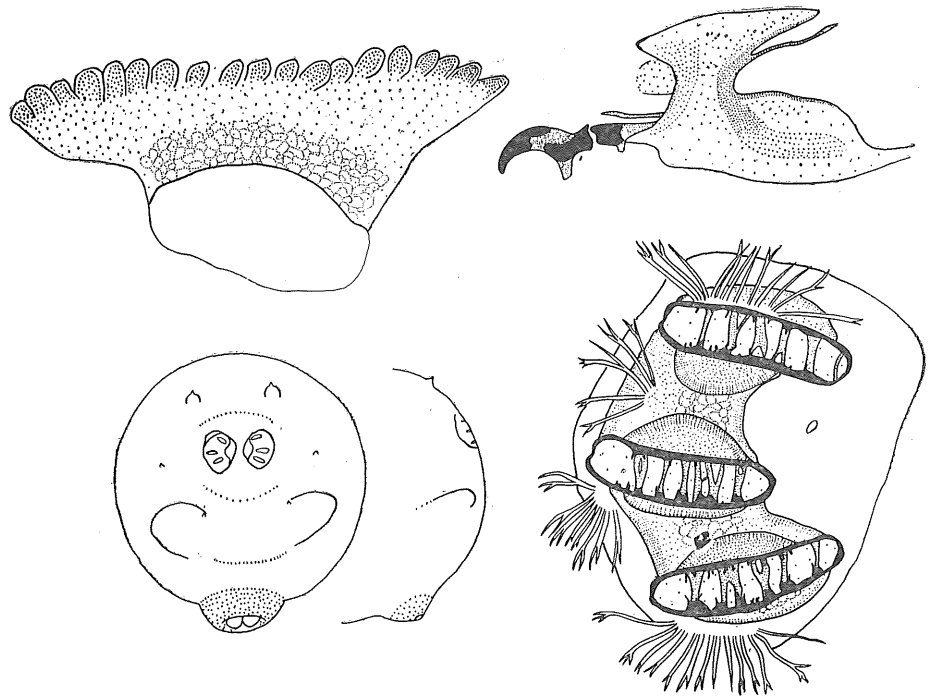


Fig. 7.
Paratridacus expandens (Walk.).

Larvae large, length 9-11 mm., diameter 1·5-2 mm. *Anterior sense organs* with second segment conical, about one-quarter length of whole organ. *Posterior sense organs* cylindrical, much wider than deep. *Stomal ridges* 8-9, wide, close together. *Spinules* on all fusiform areas as large, slightly curved or small, straight spines; complete bands of very small spines around the body between the cephalic segment and the first thoracic segment, the first and second thoracic segments, and the second and third thoracic segments; rings of large, curved spines around the anus. *Cephalo-pharyngeal skeleton* large, *mouth hooks* slender, greatly curved, prominent projection on dorso-caudal corner, anterior part of mouth hooks heavily sclerotised in all specimens, posterior part also heavily sclerotised in some; *hypostome* about three times as long as broad, posterior part narrow, lightly sclerotised and fitting into the pharyngeal skeleton in a gradual dorsal slant; *parastomals* almost as long as the hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* and *pharyngeal plates* very large, dorsal wing plates cleft; *anterior sclerite* large, diffuse. Each *anterior respiratory organ* large, flared externally, tubules 15-20, well separated, heavily granulated; stigmatic chamber about four times as long as deep, five or six rows of small irregular meshes. Posterior view of *caudal segment* shows posterior spiracles above the mid-line, only half the length of a slit apart, separated by a furrow; *anal lobes* protruded, small, with curved distal border; *intermediate areas* prominent, connected by a slightly raised *median area,*

anal elevation prominent; one exceedingly prominent dorsal tubercle on a prominent raised area, one prominent lateral and one minute intermediate tubercle present on each side. Each *posterior respiratory organ* large; stigmatic chamber with reticulum of irregular meshes that tend to be obscured by heavy granulations; *slits* three-and-a-half times as long as wide, walls thick; teeth needle-like, in some specimens situated on raised thickenings of the slit wall; crossbars thick, fairly straight, not greatly interlocked; *interspiracular processes* inconspicuous, fingers in most less than half the length of one slit, fine, freely divided; *spindles* not obvious in most preparations.

Strumeta bancroftii (Tryon).

(Fig. 8).

Described from 31 larvae taken from the fruit of *Cudrania javanensis* Trécul by A. W. S. May, 1953.

Larvae medium sized, length 7-9·5 mm., diameter 1-1·5 mm. *Anterior sense organs* with second segment cone-shaped, as high as wide, one-third the height of whole organ. *Posterior sense organs* cylindrical, slightly wider than high. *Stomal ridges* large, 9-12. *Spinules* on all fusiform areas as hooked and straight spines; complete bands of sharp, straight, backwardly pointing spines encircling the cephalic segment and the areas between the first and second thoracic segments and the second and third thoracic segments; rows

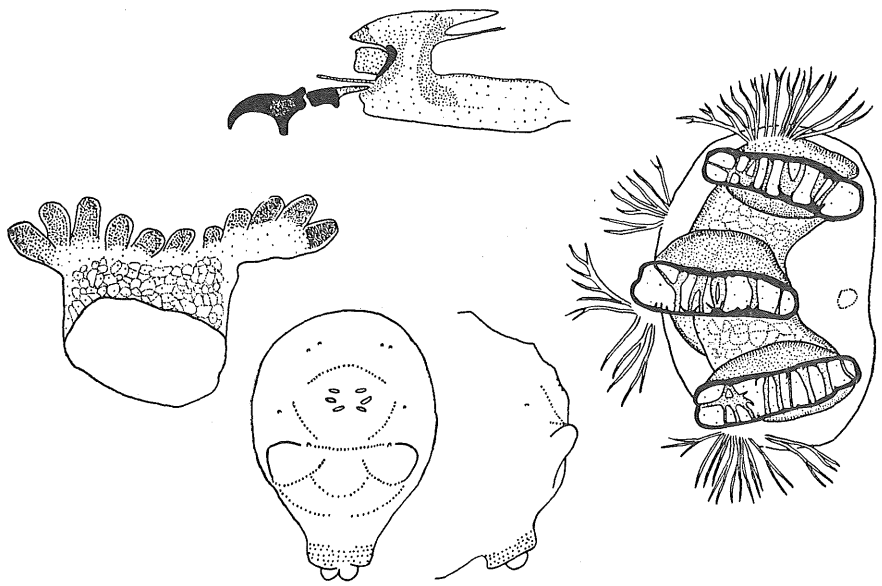


Fig. 8.

Strumeta bancroftii (Tryon).

of long, curved and straight spines on exceedingly prominent anal elevation. *Cephalopharyngeal skeleton* medium size; *mouth hooks* well curved, slender, not quite twice as long as broad, with prominent dorso-caudal projection; *hypostome* not as long as mouth hooks, anterior part twice as wide as posterior part and heavily sclerotised; *parastomals* present, not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* broad; anterior archway very black; *anterior sclerite* present. Each *anterior respiratory organ* varying in size, external part flared slightly, tubules 8-18, spiracular

openings seen in some, tips of tubules with heavy granulation; stigmatic chamber with reticulum of 3-6 rows of large meshes. Posterior view of *caudal segment* shows the posterior spiracles well above the mid-line on slightly raised spiracular areas; *anal lobes* curved on their outer edges; *anal elevation* exceedingly prominent; two dorsal, one lateral and one intermediate tubercle present on each side. Each *posterior respiratory organ* large; stigmatic chamber with reticulum of large meshes which are clearly visible; *slits* nearly four times as long as wide; teeth thick, jagged; crossbars thick, interlocking freely; *interspiracular processes* about half the length of one slit, fine, freely branched; *spindles* present.

Strumeta barringtoniae (Tryon).

(Fig. 9).

Described from about 100 larvae taken from the fruit of *Barringtonia calyptrata* R.Br. at Cairns, by N. L. H. Krauss, Dec. 1949.

Larvae medium sized, length 7-9 mm., diameter 1-1·5 mm. *Anterior sense organs* with second segment rounded, one-quarter the length of the whole structure. *Posterior sense organs* cylindrical, wider than deep, with two large sensillae. *Stomal ridges* 7-9. *Spinules* on all fusiform areas, curved, thorn-like; complete bands of backwardly pointing straight spines between the cephalic segment and first thoracic segment and between the first and second thoracic segments; and an almost complete band between the second and third thoracic segments; anus surrounded by both straight and curved spines. *Cephalo-pharyngeal skeleton* large, *mouth hooks* solid, not quite twice as long as deep, gape wide, in most specimens only the anterior and posterior ends heavily sclerotised; *hypostome* not as long as mouth hooks, anterior end heavily sclerotised, posterior end tapering to a point; *parastomals* lightly sclerotised; *subhypostome, dental sclerites* present; *dorsal wing plates*

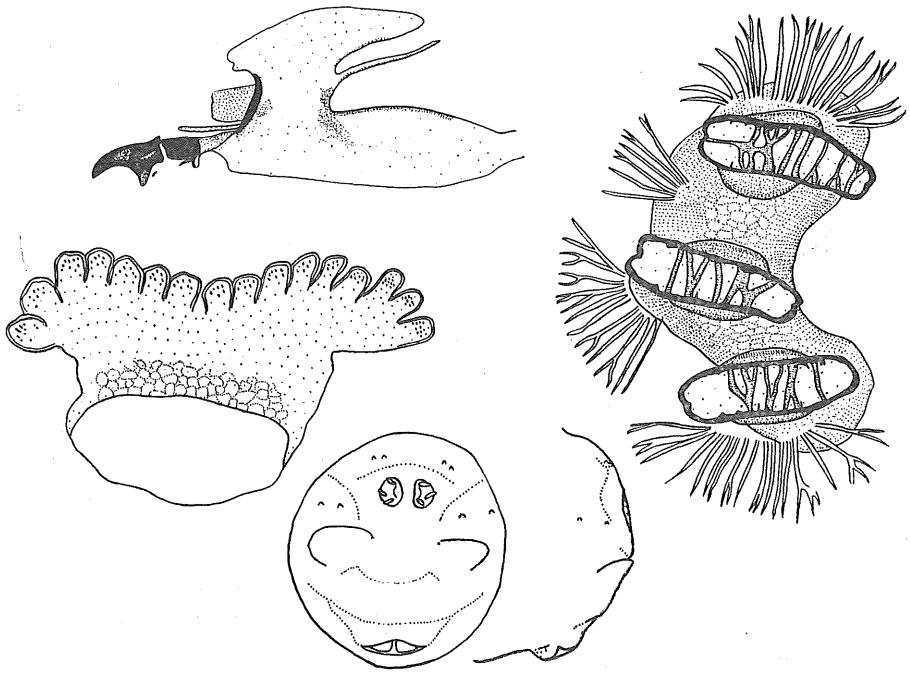


Fig. 9.

Strumeta barringtoniae (Tryon).

deeply cleft, *pharyngeal plates* long and deep; band along anterior border of archway heavily sclerotised; *anterior sclerite* present. Each *anterior respiratory organ* large, external part flared into two lobes, tubules large, 15-19, sometimes crowded out of line, heavily granulated but with a clear layer of chitin bordering each; stigmatic chamber not quite half the depth of the organ, reticulum of three or four rows of irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line, separated by a deep depression and about three-quarters the length of one slit apart; *anal lobes* facing ventrally, small, with distal edges rounded; very prominent *intermediate areas* separated by a raised ventral portion of the *median area; anal elevation* prominent; two dorsal, two lateral and a small intermediate tubercle present on each side. Each *posterior respiratory organ* large; stigmatic chamber with reticulum of large irregular meshes; *slits* large, three times as long as wide, walls thick, teeth not very numerous; crossbars numerous, freely interlocking; *interspiracular processes* very numerous, fingers about half the length of one slit, freely divided; small *spindles* present.

Strumeta bryoniae (Tryon).

(Fig. 10).

Described from 22 larvae taken from the fruit of *Bryonopsis laciniosa* (L.) Naud. in North Queensland by N. L. H. Krauss in June 1949 and A. W. S. May in Mar. 1953.

Larvae large, length 9-11 mm., widest diameter 1½-2 mm. *Anterior sense organs* with second segment about as high as wide. *Posterior sense organs* larger in diameter than the base of the anterior sense organs, sensillae difficult to count. *Stomal ridges* large, 6-8.

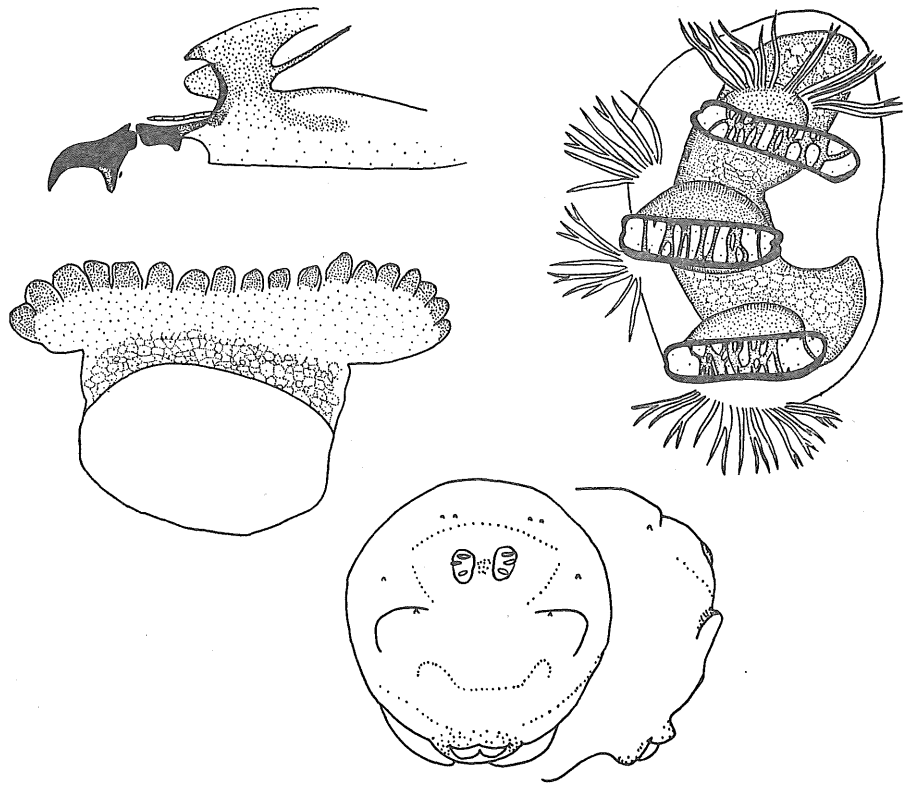


Fig. 10.
Strumeta bryoniae (Tryon).

Spinules on all fusiform areas small, hooked; minute straight spinules forming complete bands around the body between the first and second thoracic segments and between the second and third thoracic segments; and forming a dorsal band between the cephalic region and the first thoracic segment, and a much less concentrated dorsal band between the third thoracic segment and the first abdominal segment; both hooked and straight spines around the anus. Only a few spines visible on one specimen examined. *Cephalo-pharyngeal skeleton* large; *mouth hooks* large, slender, one-and-a-half times as long as greatest depth, arch deep, prominent projection at dorso-caudal corner; *hypostome* not as long as mouth hooks, about two-and-a-half times as long as its widest part, posterior end tapers and is less than half diameter of anterior part; only anterior part heavily sclerotised; *parastomals* present, not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* with dark bands along dorsal edges; anterior border of archway heavily sclerotised; *anterior sclerite* clearly visible. Each *anterior respiratory organ* large, external part flared, slightly deeper than the chamber, outer edge curved inwards, tubules 14-19, each with a narrow clear portion on outer edge; stigmatic chamber about five times as broad as deep, filled with reticulum of irregular meshes four or five rows deep. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line and a little less than the length of one slit apart; *anal lobes* triangular; very prominent *intermediate areas, median area* fairly prominent, *anal elevation* protruding; no obvious tubercles. Each *posterior respiratory organ* large; stigmatic chamber with reticulum packed with irregular meshes; *slits* almost four times as long as wide, teeth fairly numerous, needle-like; crossbars interlocking freely; *interspiracular processes* almost half the length of one slit, freely branched, base of each finger large, about as thick as the slit wall; *spindles* present.

Strumeta cacuminata Hering.

(Fig. 11).

Described from 7 larvae taken from the fruit of *Solanum auriculatum* Ait. on the Atherton Tableland, North Queensland, by N. L. H. Krauss, June 1949, and from 3 larvae from the fruit of *Solanum verbascifolium* L.

Larvae medium sized, length 7-9 mm., diameter 1-2 mm. *Anterior sense organs* with second segment rounded, one-third the length of the whole structure. *Posterior sense organs* cylindrical, slightly wider than deep. *Stomal ridges* 8-9. *Spinules* on all fusiform

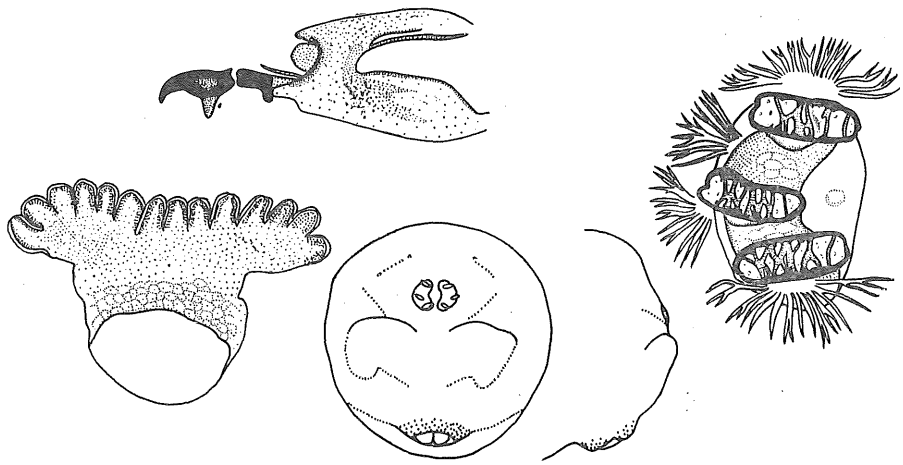


Fig. 11.
Strumeta cacuminata Hering.

areas minute, curved and straight; complete bands of straight spines between the cephalic and first thoracic segments, the first and second thoracic segments, and an almost complete band between the second and third thoracic segments; a ring of curved and straight spines around anus. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* well curved, one-and-a-half times as long as wide, anterior and extreme posterior parts only heavily sclerotised; *hypostome* not as long as mouth hooks with anterior portion twice as wide as posterior part and heavily sclerotised; *parastomals* not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, incompletely in some, shorter than the broad pharyngeal plates, dark band along dorsal border of *pharyngeal plates* which in some specimens gives the impression of a cleft; narrow band along anterior border of archway heavily sclerotised; *anterior sclerite* present. Each *anterior respiratory organ* medium sized, external part flared into two slight lobes, tubules 11-14, twice as long as wide, tips of tubules with heavy granular appearance, in some a thick layer of cuticle on each tubule; stigmatic chamber with reticulum of four rows of irregular meshes; whole organ wider than the depth at its shallowest part. Posterior view of *caudal segment* smooth, with posterior spiracles well above the mid-line on a smooth, slightly raised area, not quite the length of one slit apart; *anal lobes* almost ventral; *intermediate areas* prominent, joined by a ventral ridge; *anal elevation* not prominent; no tubercles present. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of irregular, large meshes which are not clearly visible; *slits* nearly three times as long as wide, walls thick, teeth broad, sharp; crossbars freely interlocking; *interspiracular processes* freely branched, length of fingers about half the length of one slit; *spindles* not conspicuous.

Strumeta endiandrae Perk. and May.

(Fig. 12).

Described from about 50 larvae taken from the fruit of *Endiandra discolor* Benth. near Deeral, North Queensland, by N. L. H. Krauss, June 1949.

Larvae medium sized, length 8-9 mm., diameter 1-1·5 mm. at the widest part. *Anterior sense organs* with second segment rounded, not as high as wide. *Posterior sense organs* as wide but not as high as the basal segment of the anterior sense organs, with at least three large sensillae. *Stomal ridges* large, 5-8. *Spinules* on all fusiform areas, the larger ones hooked, the smaller straight; minute straight spinules forming a complete band around the body between the first and second thoracic segments and dorsal bands between the cephalic region and first thoracic segment, and between the second and third thoracic segments; both hooked and straight spines around anus. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* slender, nearly twice as long as deep, prominent projection at dorso-caudal corner, posterior part not heavily sclerotised; *hypostome* four times as long as deep, not as long as mouth hooks, anterior part twice the diameter of the posterior portion which fits into the pharyngeal skeleton in a long, gradual dorsal slant, only anterior part heavily sclerotised; *parastomals* not as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, about as long as the mouth hooks and hypostome together, *dorsal arch* curved and overhanging posterior part of hypostome; *pharyngeal plates* broad, with dark bands along dorsal borders; band along anterior border of archway of equal blackness; *anterior sclerite* clearly visible except in one preparation. Each *anterior respiratory organ* medium size; external part slightly deeper than the chamber, flared, outer edge curved inwards; tubules 10-13, heavily granulated; stigmatic chamber about five times as broad as deep, reticulum with two or three rows of large, squarish meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line, about the length of one slit apart; *anal lobes* large, with angled or rounded lateral edges; prominent

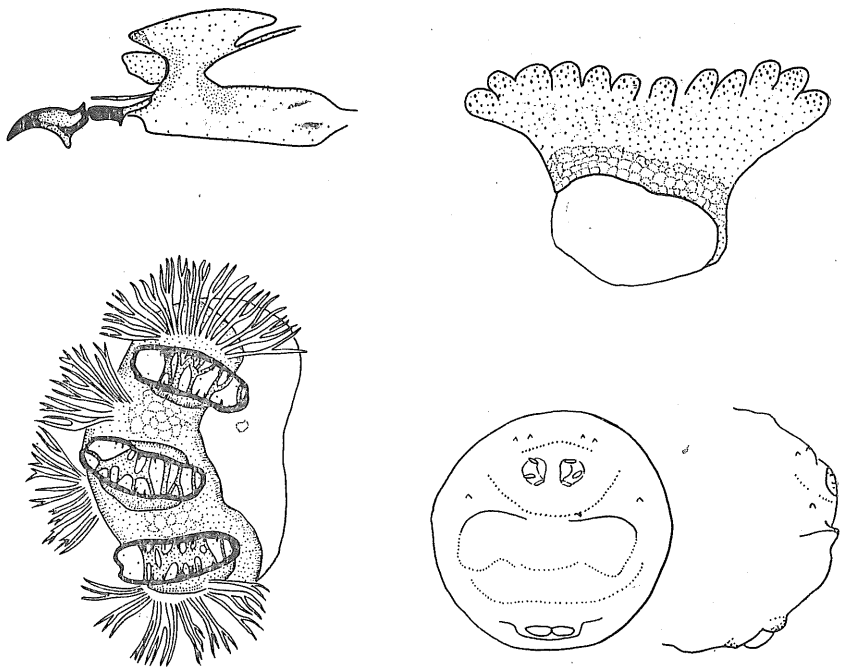


Fig. 12.
Strumeta endiandrae Perk. and May.

intermediate areas joined by a slightly raised ventral band of the *median area, anal elevation* prominent; two dorsal, one lateral and one intermediate tubercle on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of large meshes which are difficult to distinguish, *slits* three times as long as wide, walls thick, teeth needle-like; crossbars numerous, interlocking freely; *interspiracular processes* numerous, spread in fanwise fashion around organ, each finger almost equal to the length of one slit, tips of fingers freely divided; *spindles* present.

Strumeta fagraea (Tryon).

(Fig. 13).

Described from about 18 larvae from the fruit of *Fagraea cambageana* Domin near Deeral, North Queensland, by N. L. H. Krauss, Sept. 1949.

Larvae medium size, length 7-9 mm., diameter 1-1·5 mm. *Anterior sense organs* with second segment rounded, two-thirds the length of the first segment. *Posterior sense organs* cylindrical, as wide as long. *Stomal ridges* 9-11. *Spinules* on all fusiform areas, those on the areas at the posterior end of the body more curved and larger; forming complete bands encircling the body between the cephalic region and first thoracic segment and between the first and second thoracic segments; anus surrounded by straight spinules. *Cephalo-pharyngeal skeleton* large, *mouth hooks* twice as long as deep, darkly sclerotised, place of articulation with hypostome drawn out into narrow neck; *hypostome* not as long as mouth hooks, posterior part not heavily sclerotised, narrow, about one-quarter diameter of anterior part; *parastomals* present; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* with dark dorsal borders, heavy patches of sclerotisation

between the dorsal wing and pharyngeal plate of each side anteriorly and posteriorly; *anterior sclerite* dark. Each *anterior respiratory organ* medium size, external part slightly deeper than the chamber, flared; tubules 10-13, tips with heavier granulation; stigmatic chamber about five times as broad as deep, reticulum with three rows of large irregular meshes. Posterior view of *caudal segment* shows posterior spiracles above the mid-line,

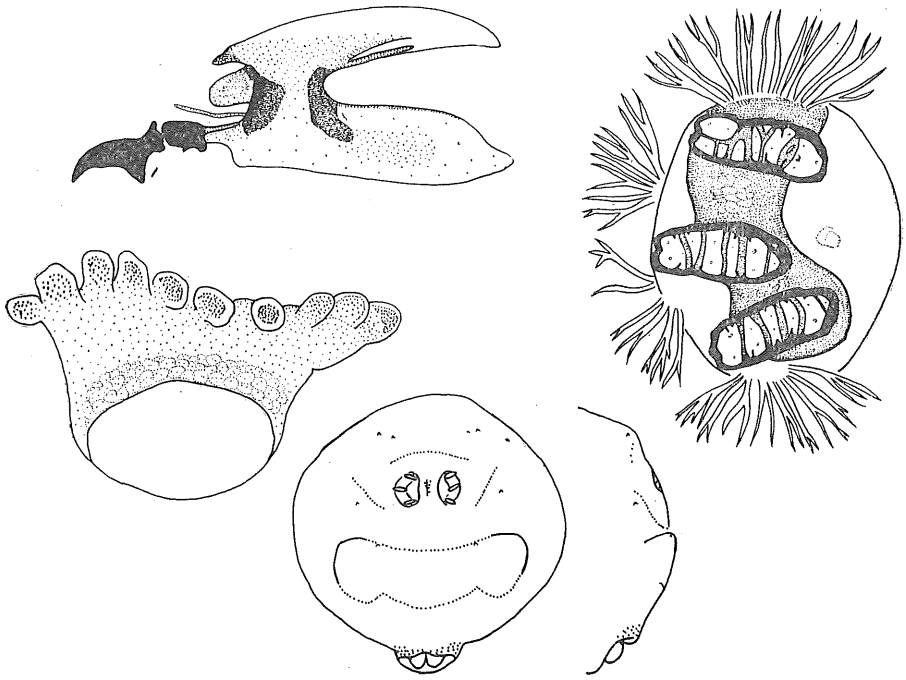


Fig. 13.
Strumeta fagraea (Tryon).

about the length of one slit apart; *anal lobes* prominent, somewhat drawn out into a triangular shape on the lateral edges; two dorsal, one lateral and one intermediate tubercle present on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of inconspicuous irregular meshes; *slits* between two and three times as long as wide, walls thick; teeth short, thornlike, some needle-like; crossbars thick, most freely branched; *interspiracular processes* numerous, almost every finger branched, about two-thirds length of one slit; *spindles* not clearly visible.

Strumeta fuscatus Perk. and May.

(Fig. 14).

Described from 17 larvae taken from the fruit of *Planchonella obovata* (R.Br.) H. J. Lam., near Deeral, North Queensland, by N. L. H. Krauss, June 1949.

Larvae medium sized, length 7-8·5 mm., diameter 1·5 mm. *Anterior sense organs* with second segment half the length of the first, narrowed and rounded distally. *Posterior sense organs* cylindrical, about the size of the basal portion of the anterior sense organs, with at least three sensillae. *Stomal ridges* close together, 8-12. *Spinules* on all fusiform areas,

some hooked, most small and straight; small straight spines present on the dorsal and ventral surfaces between the cephalic and first thoracic segments; complete bands of spines between the first and second thoracic segments and between the second and third thoracic segments; anus surrounded by both hooked and straight spines. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* not quite twice as long as deep, with a wide gape, a central lightly sclerotised area, a prominent projection in the dorso-caudal corner; *hypostome* three-fourths the length of the mouth hooks, anterior part heavily sclerotised and twice the width of the posterior part; *parastomals* three-fourths the length of the hypostome;

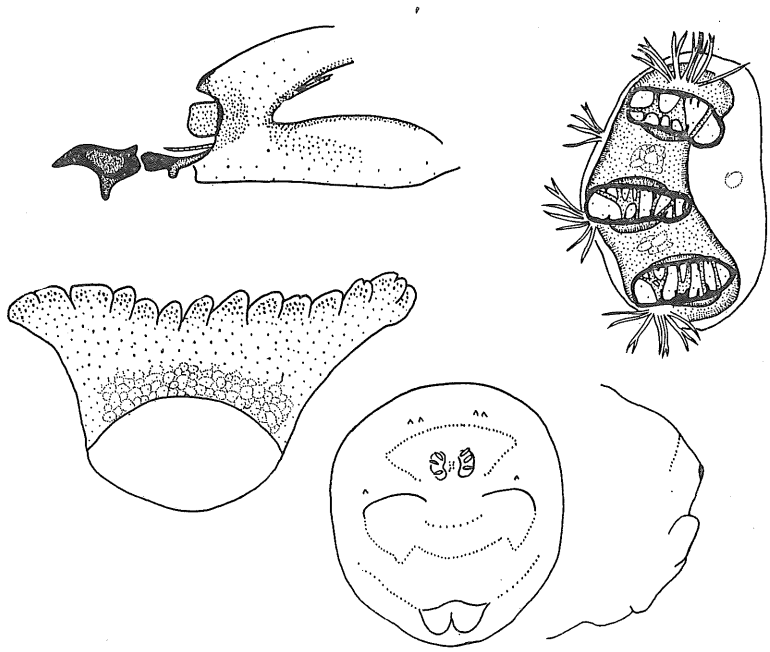


Fig. 14.

Strumeta fuscatus Perk. and May.

subhypostome, dental sclerites present; *dorsal wing plates* cleft, *pharyngeal plates* broad with a dark band along each dorsal border; archway bordered anteriorly with a black band; *anterior sclerite* clearly visible. Each *anterior respiratory organ* medium size, external part flared and slightly deeper than the stigmatic chamber; tubules 14-21, some showing spiracular openings; stigmatic chamber nearly five times as broad as deep, reticulum of three or four rows of irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line, separated by a deep furrow, about the length of one slit apart; *anal lobes* triangular; *intermediate areas* prominent, joined by a raised *median area* (in some specimens only the ventral portion of the median area prominent); *anal elevation* not prominent; two dorsal and one lateral tubercle on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of faint large meshes visible in some specimens, but with a granular appearance only in most; *slits* vary from barely three to four-and-a-half times as long as wide, walls thick, teeth long; crossbars interlocking freely; *interspiracular processes* few, fingers short, not more than half the length of one slit, rarely branched.

Strumeta halfordiae (Tryon).

(Fig. 15).

Described from 11 larvae taken from *Rauwenhoffia leichhardtii* (F. Muell.) Diels, and about 70 larvae from the fruit of *Niemeyera chartacea* (F. M. Bail.) C. T. White collected at Mt. Glorious by A. W. S. May, Dec. 1954.

Larvae small, length 5-8 mm., diameter 1-1·5 mm. *Anterior sense organs* with second segment cone-like, half the length of the first segment. *Posterior sense organs* cylindrical, wider than high, with three sensillae. *Stomal ridges* 7-11, not crowded. *Spinules* on all fusiform areas, curved; bands of minute backwardly directed straight spines forming complete rings between the first and second thoracic segments and between the cephalic segment and the first thoracic segment; and a dorsal band between the second and third thoracic segments; minute straight and curved spines around anus. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* long, slender, nearly twice as long as deep, gape wide, prominent, projection on dorso-caudal corner, heavy sclerotisation in hooks only; *hypostome* not as long as mouth hooks, only anterior part heavily sclerotised, twice as wide as

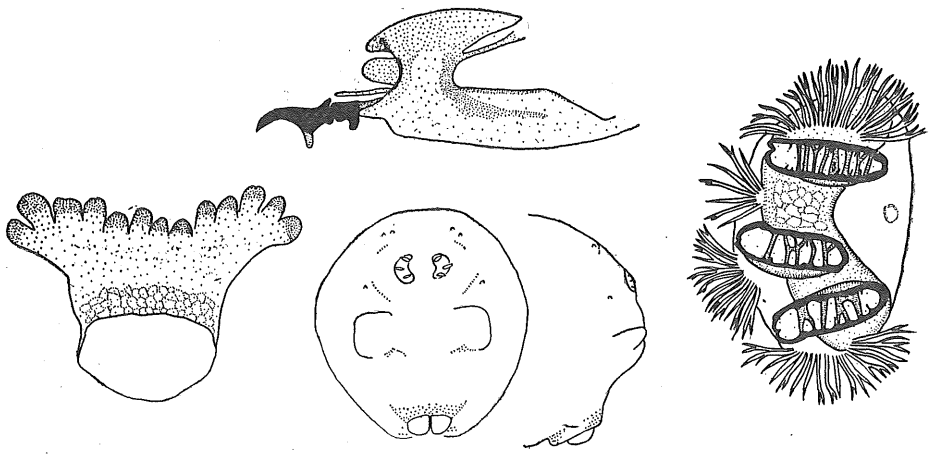


Fig. 15.
Strumeta halfordiae (Tryon).

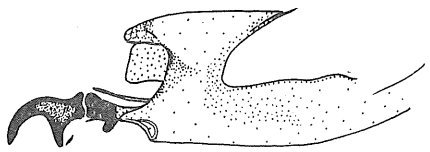
posterior part; *parastomals* nearly as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* broad, *anterior sclerite* present. Each *anterior respiratory organ* medium size, flared externally with a slight dip in outside edge; tubules 10-14, well separated, heavily granulated, with spiracular openings visible in many; stigmatic chamber five times as wide as deep, reticulum of irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line on a raised stigmatic area, less than the length of one slit apart; *anal lobes* triangular; *intermediate areas* prominent, *anal elevation* prominent. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of large irregular meshes; *slits* about three times as long as wide, walls thick, teeth long, needle-like; crossbars numerous, freely interlocked; *interspiracular processes* numerous, fingers longer than half the length of one slit, freely divided, small *spindles* evident.

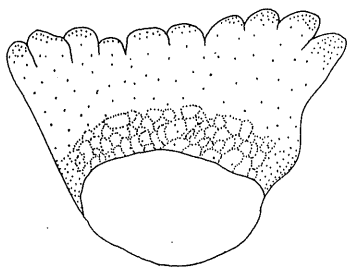
Strumeta humeralis (Perk.).

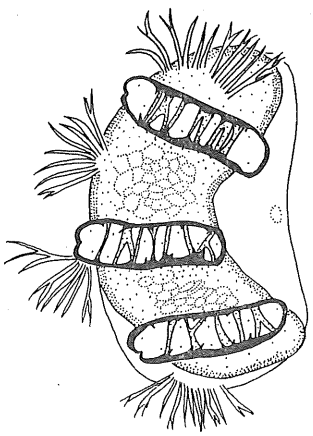
(Fig. 16).

Described from 6 larvae from a pure culture established in Toowoomba by A. W. S. May, Nov. 1954.

Larvae medium sized, length 7-9·3 mm., diameter 1-2 mm. *Anterior sense organs* with second segment cone-shaped and half the length of the first segment. *Posterior sense organs* cylindrical, twice as wide as high, with at least four sensillae. *Stomal ridges* 8-11. *Spinules* on all fusiform areas as large, thorn-like or small straight spines; forming complete bands around the cephalic segment, between the first and second thoracic segments and







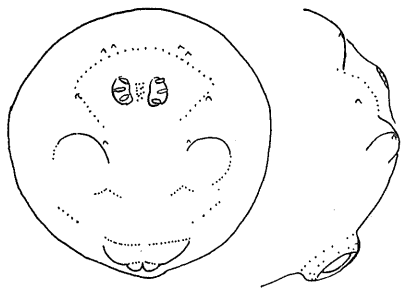


Fig. 16.
Strumeta humeralis (Perk.).

the second and third thoracic segments; anus surrounded by rings of large and small spines. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* heavily sclerotised, slender, well-curved, arch deep, prominent dorso-caudal projection; *hypostome* four-fifths the length of the mouth hooks, only anterior part heavily sclerotised and twice as wide as the posterior part; *parastomals* not as long as hypostome, lightly sclerotised; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* broad; *anterior sclerite* present. Each *anterior respiratory organ* medium size, tubules 9-12, tips of tubules with heavy granular appearance; stigmatic chamber with reticulum of irregular, large meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line on a slightly raised stigmatic area, about the length of one slit apart; *anal lobes* triangular, *anal elevation* prominent; two dorsal, one lateral and one intermediate tubercle on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of fairly large irregular meshes; *slits* three-and-a-half times as long as wide, walls thick, teeth numerous; crossbars interlocking freely; *interspiracular processes* divided, fingers less than half the length of one slit; *spindles* present.

Strumeta kraussi Hardy.

(Fig. 17).

Described from 10 larvae taken from the fruit of *Acmena macrocarpa* C. T. White near Deeral, North Queensland, by N. L. H. Krauss, June 1949.

Larvae small, length 6·5-7·5 mm., diameter 1-1·5 mm. *Anterior sense organs* with second segment rounded, one-third the length of the basal segment. *Posterior sense organs* cylindrical, as deep as broad, with at least four sensillae. *Stomal ridges* 7-10, distinctly separate. *Spinules* on all fusiform areas as straight or slightly curved spines; complete bands of minute, backwardly projecting, saw-like teeth between the cephalic and first thoracic segments, and between the first and second thoracic segments; both large hooked and small straight spines around anus. *Cephalo-pharyngeal skeleton* medium size, *mouth hooks* heavy, not quite twice as long as broad, arch wide with the posterior boundary

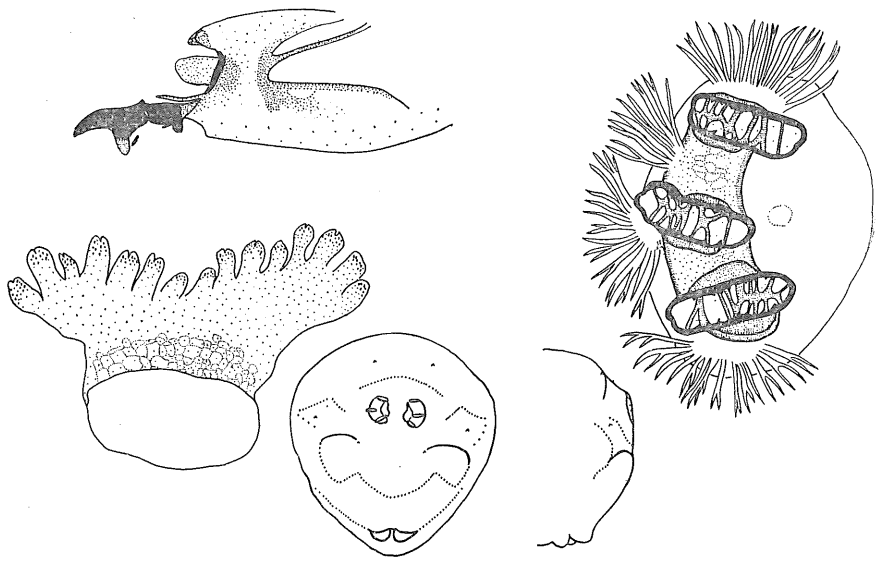


Fig. 17.

Strumeta kraussi Hardy.

directed backwards, this part and the middle of the hooks not heavily sclerotised; dorso-caudal projection well developed; *hypostome* not as long as mouth hooks, anterior half heavily sclerotised and nearly twice the diameter of the posterior half; *parastomals* present, not as long as hypostome, lightly sclerotised; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* broad, *dorsal arch* high and recurved over hypostome, heavily sclerotised band along anterior border of archway; *anterior sclerite* present. Each *anterior respiratory organ* medium size, external part flared into two lobes; tubules 12-16, large, twice as long as wide, apical spiracular openings clearly visible, granules in the tips of tubules slightly larger than elsewhere; stigmatic chamber occupies half the depth at the narrowest part; reticulum of five or six rows of irregular meshes. Posterior view of *caudal segment* shows posterior spiracles well above the mid-line, separated by a deep cleft and about the length of a slit apart, *anal lobes* small, triangular, not prominent, almost completely ventral; *intermediate areas* prominent, joined by a raised *median area, anal elevation* not prominent, almost completely ventral; two small dorsal, one lateral and one small intermediate tubercle present on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of large irregular meshes that are not clearly seen; *slits* about three times as long as wide, walls thick, teeth mostly small and blunt; crossbars freely interlocked; *interspiracular processes* with fingers more than half the length of one slit, base of each finger thick, tips freely divided; *spindles* present.

Strumeta musae (Tryon).

(Fig. 18).

Described from 13 larvae taken from the fruits of *Musa* sp. at Cairns, Queensland, by N. L. H. Krauss, July 1949.

Larvae medium sized, length 8-9 mm., diameter 1·5 mm. *Anterior sense organs* with second segment rounded, one-third the length of the first segment. *Posterior sense organs* cylindrical, broader than long, less than two-thirds the length of the anterior sense organs. *Stomal ridges* close together, 10-14. *Spinules* minute, on all fusiform areas as curved and straight spines; rows of saw-like, backwardly directed straight spines forming complete bands between the cephalic region and the first thoracic region, and between the first and second thoracic regions, and an almost complete band between the second and third thoracic segments; curved and straight spines around anus. *Cephalo-pharyngeal skeleton* large; *mouth hooks* slender, not quite twice as long as broad, gape wide with posterior part directed backwards, heaviest sclerotisation at the anterior and posterior parts of mouth hooks; *hypostome* three-quarters the length of mouth hooks, anterior half rectangular and heavily sclerotised, posterior part narrowed to a point and not heavily sclerotised; *parastomals* almost as long as hypostome; *dental sclerites* present; *dorsal wing plates* cleft, *pharyngeal plates* broad, anterior edge of archway bordered by narrow black band; *anterior sclerite* present. Each *anterior respiratory organ* medium size, external part flared into two lobes; tubules 13-17, large, well-spaced; stigmatic chamber about four times as wide as deep with reticulum of four or five rows of irregular angular meshes. Posterior view of *caudal segment* shows the posterior spiracles well above the mid-line, about the length of one slit apart; *anal lobes* large, with curved distal edges and surface covered by shallow grooves running outwards from the median edges; *intermediate areas* prominent, joined by a raised *median area, anal elevation* prominent; two dorsal, one lateral and one intermediate tubercle present on each side. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of irregular meshes; *slits* three to four times as long as wide, walls thick, particularly on the longer sides; teeth numerous, jagged or needle-like; crossbars freely interlocked, narrower than slit walls; *interspiracular processes* large, numerous, fingers longer than half the length of one slit, tips freely divided, base of each finger thick; small *spindles* visible.

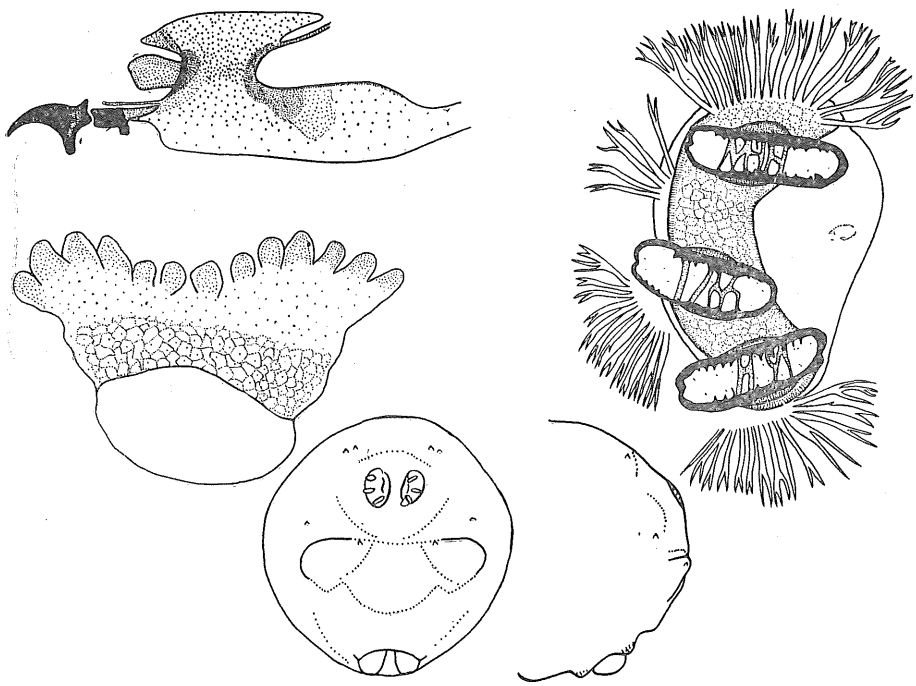


Fig. 18.
Strumeta musae (Tryon).

Strumeta pallidus Perk. and May.

(Fig. 19).

Described from 32 larvae taken from the fruit of *Nauclea orientalis* L. at Cairns, by N. L. H. Krauss, Mar. 1950.

Larvae medium sized, length 7-9·3 mm., diameter 1-2 mm. *Anterior sense organs* with second segment long, cone-shaped, one-third the length of the whole organ. *Posterior sense organs* cylindrical, base wide. *Stomal ridges* widely apart, 5-8. *Spinules* as minute, curved spines on all fusiform areas; rows of minute straight spines forming a band between the first and second thoracic segments; in some specimens a similar band between the second and third thoracic segments; and a complete or incomplete band between the cephalic and first thoracic segments; anus surrounded by curved spines. *Cephalo-pharyngeal skeleton* large; *mouth hooks* long, slender, two-thirds as deep as long, posterior part elongate, gape wide, sclerotisation weak in a band around the hooks; *hypostome* not as long as mouth hooks, anterior part only deeply sclerotised, posterior part half the diameter of anterior part; *parastomals* almost as long as hypostome; *subhypostome, dental sclerites* present; *dorsal wing plates* cleft at posterior end, dorsal edges of *pharyngeal plates* heavily sclerotised, strip joining the two plates narrow; *anterior sclerite* present in some specimens but not in others. Each *anterior respiratory organ* medium size, external part flared, tubules 11-17, tips heavily granulated; stigmatic chamber four times as long as deep, reticulum of large irregular meshes. Posterior view of *caudal segment* shows the posterior spiracles above the mid-line, about the length of one slit apart; *anal lobes* large, prominent,

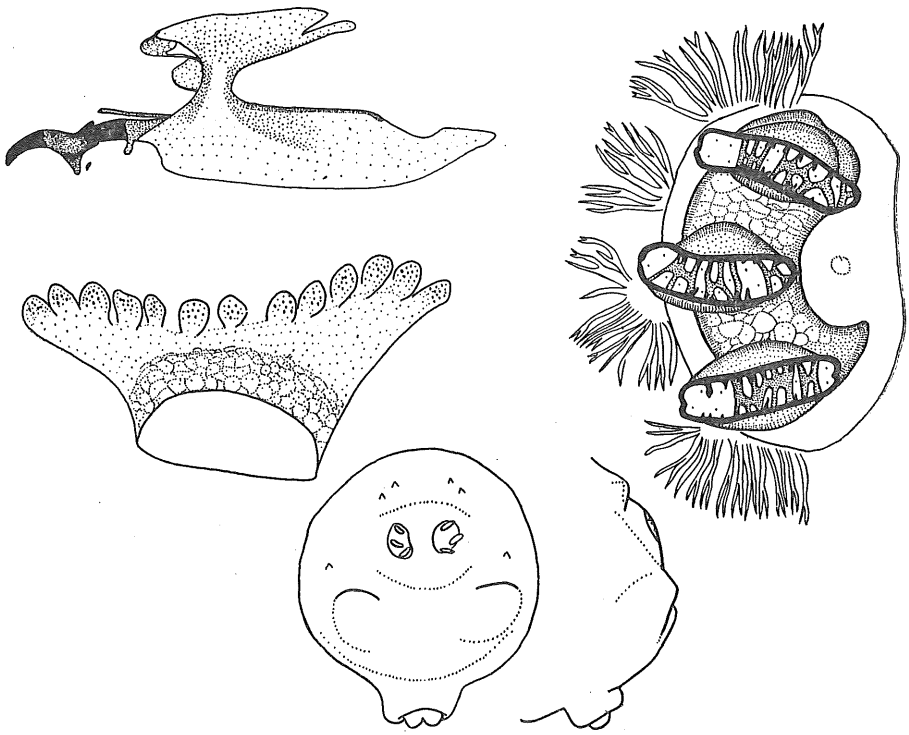


Fig. 19.
Strumeta pallidus Perk. and May.

with distal edges rounded; *intermediate areas* prominent, *anal elevation* prominent; two dorsal and one lateral tubercle on each side. Each *posterior respiratory organ* large; stigmatic chamber with reticulum of large, irregular meshes; *slits* four times as long as wide; teeth long, blunt; crossbars numerous, freely interlocked; *interspiracular processes* numerous, each finger longer than half one slit, freely branched; *spindles* present.

Strumeta tryoni (Frogg.).

(Fig. 20).

Described from a large series of specimens collected over several years from a variety of Queensland fruits.

Larvae medium sized, length 8-10 mm., diameter 1-2 mm. *Anterior sense organs* with second segment cone-shaped. *Posterior sense organs* with four or five sensillae. *Stomal ridges* 7-12, mostly 9. *Spinules* minute, straight or slightly curved, arranged in rows on all fusiform areas; forming a band around the posterior part of the cephalic segment and the region between the first and second thoracic segments; present on anal elevation. *Cephalo-pharyngeal skeleton* medium size; *mouth hooks* slender, one-and-a-half times as long as deep, prominent projection on dorso-caudal corner, deep arch; *hypostome* twice as long as deep, almost as long as mouth hooks; *parastomals* lightly sclerotised, about equal in length to hypostome; *subhypostome* present, *dental sclerites* small; *dorsal wing plates* cleft, *pharyngeal plates* broad, deeply sclerotised ventral edges of dorsal wings about two-thirds the length of the deeply sclerotised dorsal edges of the pharyngeal

plate; heavily sclerotised double band on the anterior edge of archway; *anterior sclerite* large. Each *anterior respiratory organ* medium size, external part flared, tubules 9-12, bulbous and well separated, tips of tubules with heavy granular appearance; spiracular openings clearly visible through the wide layer of chitin; stigmatic chamber with reticulum of numerous irregular medium sized meshes. Posterior view of *caudal segment* shows the

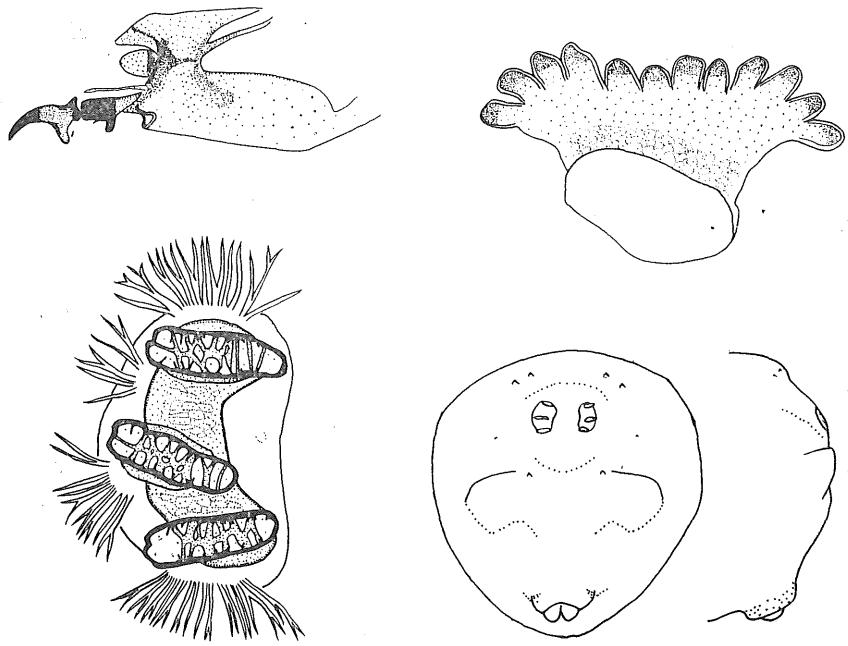


Fig. 20.

Strumeta tryoni (Frogg.).

posterior spiracles above the mid-line situated on a slightly raised stigmatic area, about half the length of one slit apart; *anal lobes* semi-circular; *intermediate areas* prominent, *anal elevation* prominent; two dorsal, one intermediate and one small lateral tubercle on each side; general appearance smooth. Each *posterior respiratory organ* medium size; stigmatic chamber with reticulum of uniform granulation overlying fairly large irregular meshes; *slits* nearly three times as long as wide, walls thick, teeth numerous; crossbars interlocking freely; *interspiracular processes* much branched, 6-16 trunks, length of fingers about half the length of one slit; *spindles* not conspicuous.

VI. KEY TO THE COMMON SPECIES OF DACINAE IN QUEENSLAND.

1. Tooth on ventral border of mouth hook ..... *Austrodacus cucumis*
   No tooth on ventral border of mouth hook 2

2. Ring of spines on cephalic segment complete 7
   Ring of spines on cephalic segment incomplete 3

3. Length over 9 mm. 4
   Length under 9 mm. 5

4. Dorsal band of spines between third thoracic and first abdominal segments ..... *Strumeta bryoniae*

No dorsal band of spines between third thoracic and first abdominal segments ..... *Strumeta pallidus*

5. Interspiracular processes few, fingers short ..... *Strumeta fuscatus*
Interspiracular processes numerous 6

6. Slits four times as long as wide ..... *Strumeta pallidus*
Slits three times as long as wide ..... *Strumeta endiandrae*

7. Caudal tubercles absent ..... *Strumeta cacuminata*
Caudal tubercles present 8

8. One dorsal tubercle on each side 9
Two dorsal tubercles on each side 12

9. Larvae large, dorsal tubercles on prominent raised areas ..... *Paratridacus expandens*
Larvae medium size, dorsal tubercles not on prominent raised areas 10

10. Slits less than $2\frac{1}{2}$ times as long as wide ..... *Afrodacus mesoniger*
Slits more than $2\frac{1}{2}$ times as long as wide 11

11. Slits nearly 3 times as long as wide ..... *Asiadacus calophylli*
Slits $3\frac{1}{2}$ times as long as wide ..... *Daculus murrayi*

12. Slits less than $2\frac{1}{2}$ times as long as wide 13
Slits more than $2\frac{1}{2}$ times as long as wide 14

13. Dorsal wings and pharyngeal plates heavily sclerotised, mouth hooks with a long posterior neck ..... *Strumeta fagraea*

Dorsal wings and pharyngeal plates not heavily sclerotised, mouth hooks without a long posterior neck ..... *Afrodacus mesoniger*

14. Slits about 4 times as long as wide 15
Slits about 3 times as long as wide 17

15. Stomal ridges less than 9 ..... *Strumeta pallidus*
Stomal ridges more than 9 16

16. Anal elevation exceedingly prominent ..... *Strumeta bancroftii*
Anal elevation not exceedingly prominent ..... *Strumeta musae*

17. Mouth hooks with long, drawn-out posterior neck ..... *Strumeta fagraea*
Mouth hooks without long, drawn-out posterior neck 18

18. Two lateral tubercules present on each side of caudal segment ..... *Strumeta barringtoniae*
One lateral tubercle present on each side of caudal segment 19

19. Stomal ridges 11 or more 20
Stomal ridges less than 11 23

20. Interspiracular processes few ..... *Asiadacus calophylli*
Interspiracular processes numerous 21

21. Ring of spines between second and third thoracic segments complete ..... *Afrodacus jarvisi*
Ring of spines between second and third thoracic segments incomplete 22

22. Anterior respiratory organ with 13 or more tubules ..... *Strumeta musae*
Anterior respiratory organ with less than 13 tubules ..... *Strumeta tryoni*

23. Anterior respiratory organ with 13 or more tubules 24
Anterior respiratory organ with less than 13 tubules 26

24. Band of spines between second and third thoracic segments almost complete ..... *Strumeta musae*
Band of spines between second and third thoracic segments dorsal only, or absent 25

25. Anterior sense organs rounded; mouth hooks heavy; teeth of posterior respiratory organs small, blunt ..... *Strumeta kraussi*
Anterior sense organs cone-like; mouth hooks slender; teeth of posterior respiratory organs long, needle-like ..... *Strumeta halfordiae*

26. Slits $3\frac{1}{2}$ times as long as wide ..... *Strumeta humeralis*
Slits not more than 3 times as long as wide ..... *Strumeta tryoni*
Strumeta halfordiae
Strumeta kraussi

VII. DISCUSSION.

Of the 13 genera of Dacinae listed by May (1953) 9 are either monotypical or represented each by a single species in Queensland. This work covers 4 of these genera, 2 of the 4 species of *Afrodacus,* and 13 of 22 species of *Strumeta.* With this limited coverage, *Daculus, Paratridacus* and *Austrodacus,* all represented by a single species each, are distinct and separate from the other genera studied, but it was not possible to distinguish between *Strumeta, Afrodacus* and *Asiadacus.*

The key to the common Dacinae in Queensland, with three exceptions, works well at the species level, although the large amount of overlap in the characters used can be appreciated when it is realised that eight species key out in at least two places. No satisfactory larval characters were found for separating *Strumeta tryoni, S. halfordiae* and *S. kraussi* and the statistical analyses of selected measurements (see page 125) did not yield significant differences between these species. May (1953), from studies of hosts, suggested a close relationship between *halfordiae,* which is found only in southern Queensland, and *kraussi* from North Queensland: and on adult characters Hardy (1951) considered that *kraussi* is also closely related to *tryoni.*

May (1953) discussed the considerable variation in the adults of *S. tryoni* when a large series is examined. Similar differences exist in the mature larvae of this species.

Both Hardy (1951) and May (1953) have suggested that *Strumeta humeralis* may well be a variety of *S. tryoni.* The larvae of these species are readily separated.

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REFERENCES.

BANKS, NATHAN. 1912. The structure of certain Dipterous larvae with particular reference to those in human foods. Ent. Tech. Ser. U.S. Dep. Agric. 22.

BENJAMIN, FOSTER H. 1934. Descriptions of some native Trypetid flies with notes on their habits. Tech. Bull. U.S. Dep. Agric. 401.

BUTT, F. H. 1937. The posterior stigmatic apparatus of Trypetid larvae. Ann. Ent. Soc. Amer. 30: 487-91.

EFFLATOUN, H. C. 1927. On the morphology of some Egyptian Trypaneid larvae (Diptera) with descriptions of some hitherto unknown forms. Bull. Soc. Roy. Ent. Egypte 1: 17-50.

ELTRINGHAM, H. 1930. Histological and illustrative methods for entomologists. Oxford University Press: Oxford. 140 pp.

GREENE, C. T. 1929. Characters of the larvae and pupae of certain fruit flies. J. Agric. Res. 38: 489-504.

HARDY, D. ELMO. 1949. Studies in Hawaiian fruit flies. Proc. Ent. Soc. Wash. 51: 181-205.

HARDY, D. ELMO. 1951. The Krauss collection of Australian fruit flies (Tephritidae-Diptera). Pacif. Sci. 5: 115-89.

HARDY, D. ELMO, and ADACHI, MARIAN S. 1954. Studies on the fruit flies of the Philippine Islands, Indonesia and Malaya. Part 1. Dacini (Tephritidae-Diptera). Pacif. Sci. 8: 147-204.

HEWITT, C. G. 1914. The house fly, *Musca domestica* Linn., its structure, habits, development, relation to disease and control. Cambridge University Press: Cambridge.

KEILIN, D. 1915. Recherches sur les larves de Dipteres Cycloraphes. Bull. Sci. Fr. Belg. 49: 15-198.

MAY, A. W. S. 1953. Queensland host records for the Dacinae (fam. Trypetidae). Qd J. Agric. Sci. 10: 1-44.

PERKINS, F. A. 1937. Studies in Australian and Oriental Trypaneidae. Part 1. New Genera of Dacinae. Proc. Roy. Soc. Qd 48: 51-60.

PHILLIPS, V. T. 1946. The biology and identification of Trypetid larvae. Mem. Amer. Ent. Soc. 12: 1-161.

SNODGRASS, R. E. 1924. Anatomy and metamorphosis of the apple maggot. J. Agric. Res. 28: 1-36.

THOMSEN, MATHIAS. 1935. A comparative study of the development of the Stomoxydinae (esp. *Haematobia stimulans* Meigen) with remarks on other coprophagous muscids. Proc. Zool. Soc. Lond.: 531-50.

VARLEY, G. C. 1937. The life-history of some Trypetid flies with descriptions of the early stages (Diptera). Proc. Roy. Ent. Soc. Lond. (A) 12: 109-22.

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