

# Descriptive terminology of the phasmid egg capsule, with an extended key to the phasmid genera based on egg structure

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**Abstract.** An attempt is made to standardize further the descriptive terminology of the phasmid egg capsule by introducing stricter definitions and standard abbreviations. In addition, the various forms of the internal micropylar plate are categorized. *Eophasma* Sellick is replaced by *Eophasmodes* **nov.n.** A key to 131 generic forms of these eggs is provided. Where more than one egg form is associated with a genus, a diagnosis of the subgroups is provided.

## Introduction

When I first standardized the terms used in the descriptive morphology of this order of insects (Clark, 1976a) the eggs of some 108 species had been figured. Today the number of species whose eggs have been figured exceeds 400. The earlier eggs had a fairly common morphology so that a simple set of nine basic descriptive terms sufficed. Those more recently described have shown structures not denoted by these terms and also raised a few problems of the exact definitions of the original terms. In addition, since Sellick (1980), terms have been developed to describe the structures visible internally in the capsule.

The idea put forward by Kaup (1871), and restated by me (Clark, 1976a; Sellick, 1980), that egg morphology in this order is an essential aid to its subclassification, has become increasingly accepted, and the problems raised by the appearance of different egg types within a single 'genus' have been discussed by a number of authors (e.g. Carlberg, 1983; Clark, 1976a; Hausleithner, 1986, 1988; and Sellick, 1993 for *Baculum* Saussure; Hausleithner, 1989b for *Dimorphodes* Westw.; Hausleithner, 1989a for *Lonchodes* Gray; Clark, 1978 for *Phyllium* Illiger; Scali *et al.*, 1990; and Brock & Schlagman, 1994 for *Ramulus* Saussure [= *Gratidia* Stål]). At the same time some recent authors have made a point of giving a detailed egg description when describing species of this order (e.g. Bragg, 1992a,b, 1993, 1994, 1995a,b,d; Brock & Schlagman, 1994; Salmon, 1991). It therefore seems appropriate to establish a more detailed descriptive terminology than that of 1976.

In my 1980 thesis I proposed that the structure of the phasmid egg be used as an ordinal criterion, all known phasmid eggs having a distinct operculum and micropylar plate, a combination of features absent from other insect groups. At that time I had considered the eggs of 153 species, a total now far more than doubled and each new sample confirms the ordinal characteristics, even the eggs of the aberrant *Timema* Scudder, which differs significantly in its adult structure and

details of egg structure from those of all other phasmids and is now placed in its own suborder Timematodea (Kevan, 1982). It has since been shown that this combination of characters is also present in fossil eggs from the Eocene (Sellick, 1994).

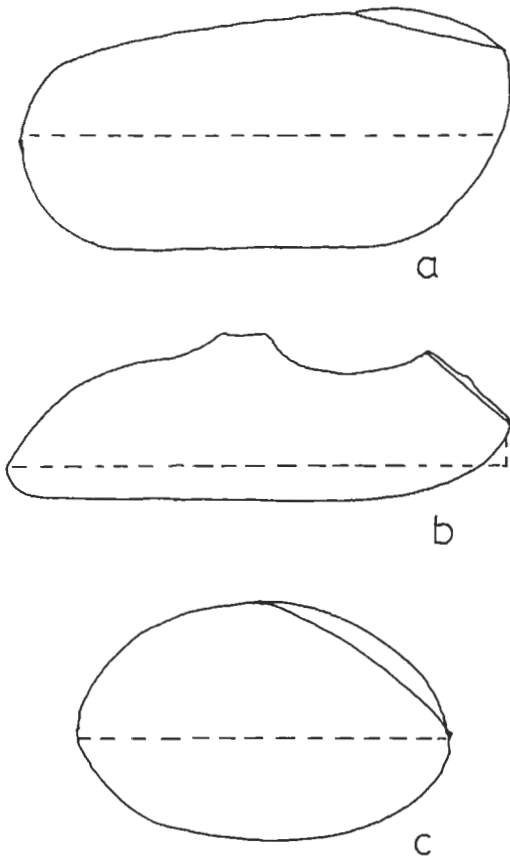
## Descriptive terminology

### *Capsule*

This describes the egg shell – all those structures exterior to the embryonic membranes. In some cases it is extremely delicate, thin and fragile, but in many cases thickened and sculptured in various ways. These latter capsules can take on shapes which diverge significantly from the ellipsoid of the contained egg. Examples are shown in Fig. 1. The main capsule axis is significant in defining various descriptive measurements. The mid dorso-ventral plane presents no problems, as all except abnormal eggs (see below) are bilateral.

Along this plane in most eggs, the main axis runs to the centre of the operculum, but in some cases (particularly in adhesive eggs) the operculum is displaced and may be out of the midline altogether. In these cases the main axis is obtained by viewing the egg laterally and taking the line which best bisects the egg horizontally (Fig. 2).

A capsule may be **adhesive** if it is glued to a substrate. Usually this is by the ventral surface and in some cases also by the anterior and posterior surfaces to adjacent eggs. Eggs of a few genera of Necrosiidae are glued by the flattened posterior pole and, in addition, have a surface layer which splits to produce fibres radiating from the opercular collar. In a number of subgroups the material of the capsule is thick and cork-like in texture due to the presence of many large hollow cellular structures. Such a capsule is **alveolar**. Alveolar capsules are often elaborately sculptured. There may be a series of



**Fig. 2.** Estimation of main axis in eggs with opercula displaced from the midline. (a) *Marmessoidea*; (b) *Palophus*; (c) *Dinophasma*. To different scales. All viewed laterally, dorsal to the top. Only the egg outline and the operculum are shown.

but may bear various extensions. I originally defined the **capitulum** (Clark, 1976) as a structure borne on the operculum which, unlike the main capsule, softens in warm sodium hydroxide solution. More recent authors have not kept to this restriction and some have used the term to refer to any structure rising above the operculum surface. There has also been a misuse of the term **pseudocapitulum**, which I defined as a structure produced by the evagination of the operculum surface, known to me only from a few species of *Baculum* Saussure (Hausleithner's type II, see Fig. 8b) (Hausleithner, 1986, 1988). Some authors use this term for any structure which appears capitular, but which cannot be confirmed as a capitulum. There is no reason not to retain the term pseudocapitulum in its original defined form, and I suggest using the term capitulum to include any structures on the operculum which appear to be different in nature from the general material of the capsule wall. This would allow the small structures of *Bacillus* to be described as capitular. However, the opercular extensions of *Baculum* (Hausleithner's type III), most Acanthoxylini and Phylliidae, which are of the same structure as extensions of the capsule elsewhere on the egg, cannot be termed capitula, but are simply raised opercula. Some of these raised opercula are solid cones, others are hollow cylinders. Surrounding the

operculum on the main capsule is often to be found a distinctive raised or decorated ring, for which Salmon introduced the term **collar** (Salmon, 1991). Care must be taken to distinguish between structures on the opercular rim, i.e. those which come away with the operculum, and those on the collar, which remain as part of the capsule.

#### Capitulum types

I have previously considered the distribution of capitulum types within the order (Clark, 1976b; Sellick, 1988). Open capitula have perforations leading into the hollow interior and closed capitula have an intact surface, within which the capitulum maybe hollow or fibrous, although these latter distinctions are irrelevant to general examination of egg. Figure 4 shows the basic types.

#### Dimension measures

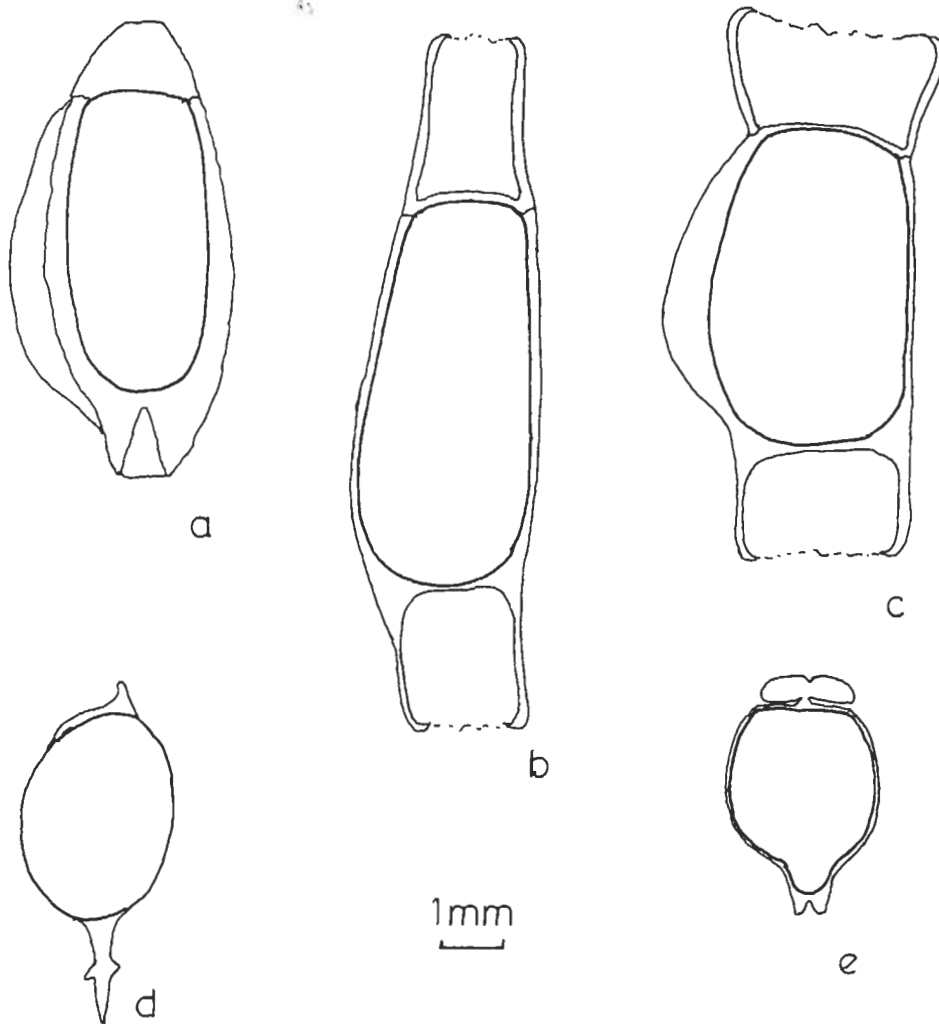
**Length (l).** I originally defined this as the distance from the centre of the operculum to the mid-posterior point. This must now be modified to be the distance along the main capsule axis from the posterior tip of the capsule to either the opercular rim (if the operculum lies on the axis) or to the anterior tip of the capsule. The length never includes the operculum and its structures, in spite of the fact that Salmon (1991) redefined the term length to include capitular structures, since otherwise 'length' cannot be cited for an eclosed egg.

**Height (h).** This is the distance from the middle of the micropylar plate to the ventral surface at right angles to the main axis. In some eggs the micropylar plate is lower than some of the capsule extensions; if necessary a **maximum height (h<sub>max</sub>)** can be quoted to include this extra measurement.

**Width (w).** This is the distance at right angles to the previous two, as seen in dorsal view, even if the capsule narrows laterally between ribs.

The ratios of these dimensions are useful summaries of the overall shape of eggs and conveniently expressed as percentages. The **h/l%** is an indication of the elongation of the egg, known values ranging from 12 (maximum elongation) to 115. The **w/h%** is a measure of the lateral flattening of the egg, known values ranging from 18 (maximum flattening) to 140. Values of **w/h%** above 100 are often associated with ventrally adhesive eggs.

**Capitulum or operculum length (cap/opl).** There is a temptation to describe this as 'height' as it stands up from a detached operculum, but the term length should be retained for consistency of terms throughout the egg. However, this is not measured parallel to the capsule length, but at right angles to the detached operculum as it lays flat. Capitulum and operculum height and width are taken dorso-ventrally across the structure, and at right angles to this, again as the operculum lies flat.



**Fig. 1.** Examples of divergent form in phasmid eggs. Each is shown as a vertical section, dorsal to the left. The egg membrane region is shown by the thicker line. (a) *Phyllium giganteum* (Phylliidae); (b) *Pterinoxylus spinulosus* (Bacteriidae); (c) *Achrioptera* sp. (Phasmatidae); (d) *Asceles margaritatus* (Necrosciidae); (e) *Lonchodes everetti* (Lonchodidae).

anterio-posterior **ribs** (Clark, 1978), ranging from 1 to 5 and symmetrically arranged about the middle plane. Salmon (1991) introduced the term **keel** to refer to the single dorsal rib characteristic of many New Zealand species. A few species, within different families (Bacteriidae, Phasmatidae), have hollow extensions posteriorly, the width of the capsule, superficially resembling their own opercular structures. These I term **polar extensions**. Some non-alveolar species have distinct **polar mounds**, significantly narrower than the capsule. Some species are marked with a distinct **polar spot**, different in colour from the rest of the main capsule surface. One group of species in the Necrosciidae has piercing **rimmed spines** with which the eggs are fixed to leaves. Another group in the same family has a flat **dorsal flange** delimited by two dorso-lateral ridges which run from the micropylar area posteriorly and there is a central median ridge.

The significant feature of the capsule is the **micropylar plate**. This is usually a clearly marked area, the centre of

which marks the dorsal surface of the egg. While in some cases it is strikingly differentiated from the rest of the capsule surface, there are a few examples where even careful examination under magnification fails to show clearly the limits of a plate which is identical in texture and coloration to the rest of the capsule surface. In these cases the nature and location of the plate can only be determined from internal examination (see below). Toward the posterior end of the plate is the location of the micropyles, sometimes indicated by a clear **micropylar cup**. In about half of the known species the micropylar plate has a distinct **median line** running posteriorly in the mid-dorsal line. Like the plate, a median line is confirmable from internal examination.

#### *Operculum*

This, the detachable 'lid' of the capsule, is unmistakable (and an ordinal criterion). It is essentially a flat disc or ellipse,

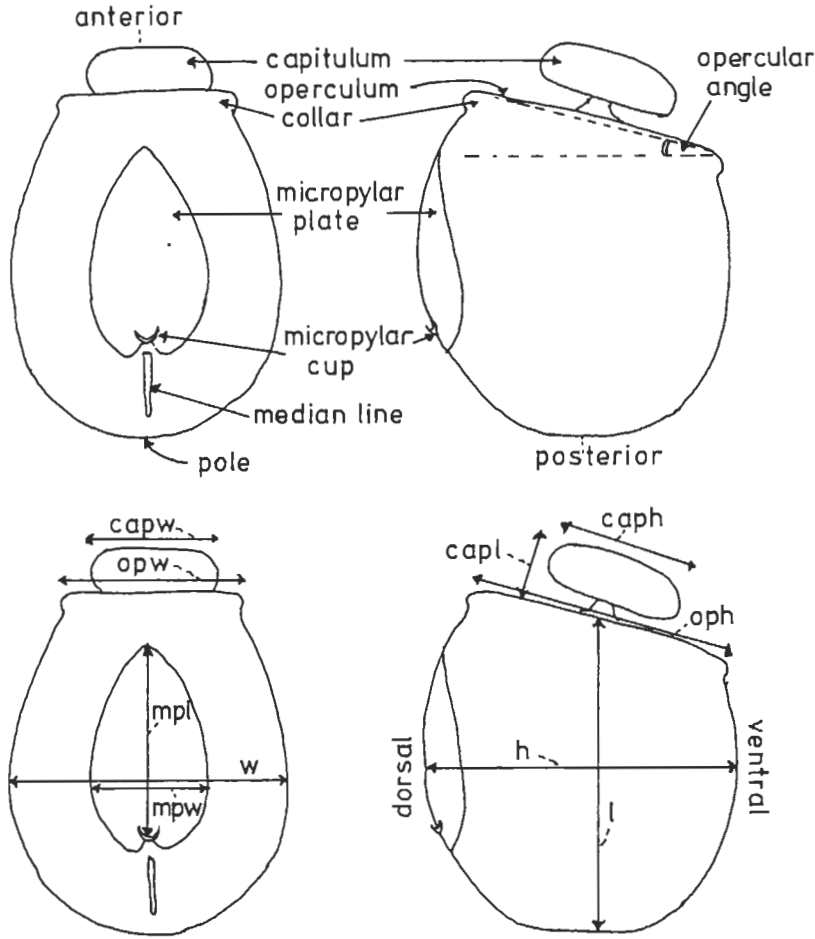


Fig. 3. The descriptive terms and standard measurement abbreviations of the phasmid egg.

**Capitulum height and capitulum width (caph/capw).** Used where the capitulum does not cover the entire surface of the operculum.

**Operculum height and operculum width (oph/opw).** These are best determined from detached opercula. They are not the dimensions of the capsule at the collar.

**Micropylar plate width (mpw).** This is the maximum width of the plate. It is measured as seen from the dorsal view (i.e. in projection if it covers a significant part of the capsule surface – in some cases it even extends ventrally – in which cases the measurement given is that of the capsule width at the level where it crosses).

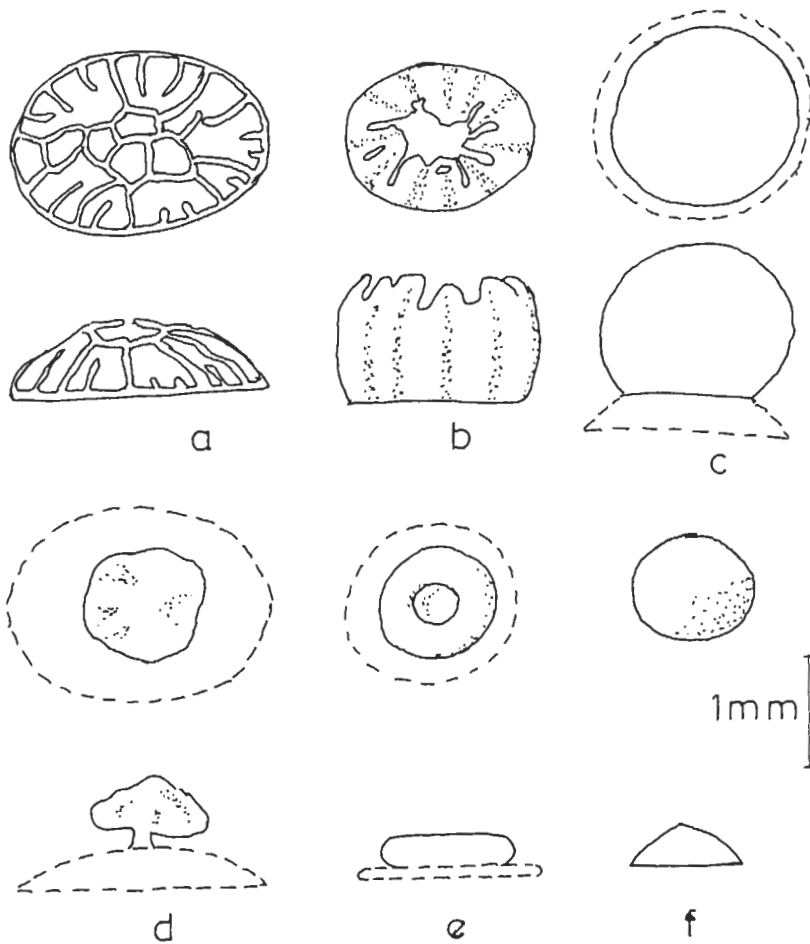
**Micropylar plate length (mpl).** This is the distance along the midline. It does not include median line structures. If the plate should extend laterally beyond the posterior midline point, a **maximum plate length (mplmax)** can be cited. Like the width the distance is cited as seen from the dorsal view (even though a few plates girdle the entire egg).

#### *The internal micropylar plate*

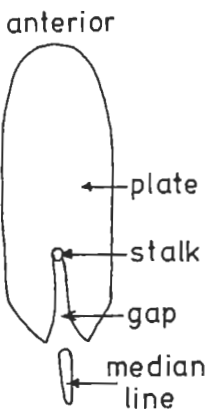
This was first described in Sellick (1980) and elaborated in Sellick (1987) (Fig. 5). It is the true micropylar plate, being an area of air-filled areolar tissue on the inner surface of the capsule connected by the **micropylar stalk** to the inner egg membranes. It is nearly always visible as a glistening white area against the darker capsule material. The external plate follows its outline in general but, whereas sometimes the limits of the external plate are uncertain, those of the internal plate are clear-cut.

The internal plate has rarely been considered by other authors (Carlberg, 1989; Camousseight & Busamente, 1991; Bragg, 1995b,e), possibly because its examination involves destruction of the egg capsule and also because it is invisible under scanning electron microscope examination because it is covered with a fine membrane which obscures its outline. It is best examined under a stereo binocular microscope by reflection.

The internal plate extends from its anterior rim to the micropylar stalk and then parts to either side. These two sides may stay distinctly separated (an **open plate**) or reunite to leave a small gap in the plate posterior to the stalk (a **closed**



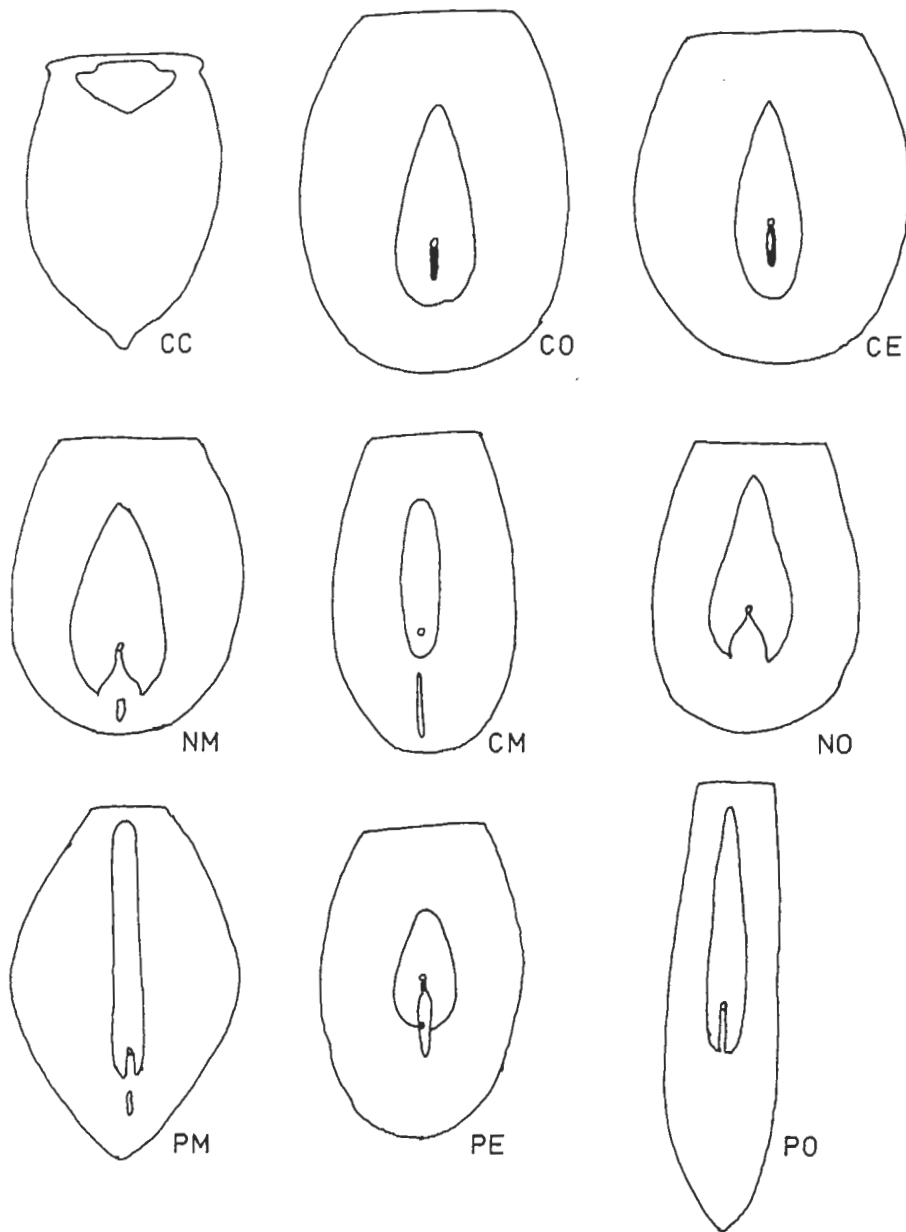
**Fig. 4.** Main capitulum types. All shown in anterior and lateral views. Where the operculum is distinct from the capitulum the former is shown by a broken line. (a) Open network *Phibalosoma*; (b) ribbed and open at top *Calynda*; (c) closed spherical *Eurycnema*; (d) closed stalked *Tirachoidea*; (e) closed button *Hermarchus*; (f) closed conical *Clitarchus*.



**Fig. 5.** The components and orientation of the internal micropylar plate.

plate). Those types with an open plate may or may not also have a true **median line**, a distinct strip of white material isolated from the main plate. The single exception is the aberrant *Timema* Scudder in which the triangular plate has no apparent stalk and therefore no gap. It is connected to a thickening of the opercular rim by a strip of material. I have provisionally divided internal plate types into eight, with appropriate abbreviations (see Fig. 6). Open plates are described as notched (N) if the sides continue to diverge and parallel (P) if the two are separated only by the width of the micropylar stalk. Notched plates may have a median line (NM) or lack such a line (NO). Parallel plates as well as having a line or not (PM, PO), may have the line enclosed between the two arms of the plate (PE). Closed plates (C) usually have no median line (CO), but a few do enclose such a line (CE) and *Timema* has no plate gap (CC).

The internal plate can be used to confirm the orientation of those eggs where the plate girdles the egg and the micropyle is brought to the posterior pole (Sellick, 1994). Because the



**Fig. 6.** The nine forms of internal micropylar plate: CC, *Timema*; CO, *Paramenexenus*; CE, *Paramyronides*; NM, *Lonchodes*; CM, *Calynda*; NO, *Aplopus*; PM, *Oreophetes*; PE, *Eurycantha*; PO, *Gratidia*.

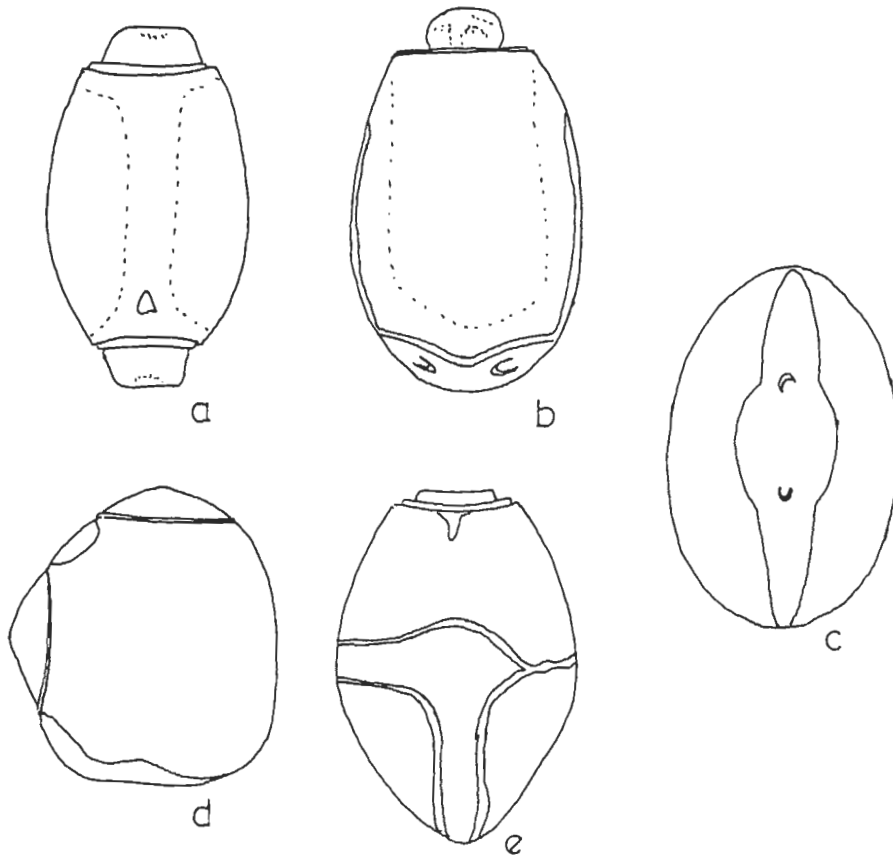
micropylar stalk always has the gap in the plate posterior to itself (i.e. in these circumstances pointing away from the dorsal rim of the operculum), the side of the plate without the gap lies towards the dorsal surface.

### Key to phasid eggs

I have previously published a key to sixty generic forms of phasid eggs (Clark, 1979). It is now possible to extend this to 131 generic forms. I have also included the three fossil species in two genera (Sellick, 1995). I have since discovered

that one of these genus names is pre-occupied by a nematode (Arduini *et al.*, 1983), so I am replacing *Eophasma* Sellick with *Eophasmodes* **nov.n.** I have included for the first time the nature of the internal micropylar plate. Occasionally abnormal egg forms are encountered, most of which are easily distinguished from the normal egg produced by that species. Sometimes a single female will lay a series of abnormal eggs, differing in the degree of their abnormalities. Abnormal eggs are either:

- 1 asymmetrical, either by displacement of structures or duplication of the opercular region, or
- 2 if symmetrical they show either axial or lateral duplication.



**Fig. 7.** Some types of abnormal eggs. (a) Duplicated opercula/pseudocapitula in *Baculum extradentatum*; (b) duplicated and deformed micropylar plate in *Ctenomorphodes tessulatus*; (c) duplicated posterior end in *Phoenopharos* sp.; (d) duplicated opercula and deformed plate in *Extatosoma tiaratum*; (e) asymmetrically deformed plate in *Bacillus lynceorum*. To various scales.

In axial duplication either anterior (opercular) or posterior (polar) structures appear at both ends, with the suppression of the opposing normal structures. In lateral duplication the micropylar region is duplicated.

Figure 7 shows a few types of abnormal eggs. In general, the genera of abnormal eggs cannot be identified from this key.

In this key a 'generic form' is a distinct form, usually associated with a single phasmid genus. Where it has proved necessary to subdivide genera on the basis of egg form, diagnoses of the subgrouping are given below. The PSG numbers are those of cultures held by members of the Phasmid Study Group. There are some 180 different species in culture, many of which have not yet been identified to species level, in most cases because it is likely that they are undescribed species. For these, localities are given.

*Baculum* Saussure. There are around 100 described species of this genus. I first indicated that there were two egg forms within this genus (Clark, 1979), based on *B. extradentatum* and a culture species (PSG 22) that was later to be named *B. thaii*. These I designated groups (i) and (ii), respectively. Hausleithner's (1986) study established three groups, renumbering my two groups as (II) and (I), respectively, and

adding a group (III) based on *B. hypereon*. Lateral views of typical forms of these four groups are shown in Fig. 8. Hausleithner's diagnoses of the three groups were very brief and I give extended diagnoses here, keeping to his numbering. I give his diagnosis first.

Group (i) (Figs 1; 8a,e): **flach, länglich und mehr oder weniger schmal** [flat, oblong and more or less slender]. Typical form *B. thaii*. Other forms I have examined: PSG 144, PSG 153, PSG 157, PSG 158 (all Vietnam), all with distinct egg forms. Hausleithner (1986, 1988) included sixteen other species. Many were based on studies of immature eggs, and it is not clear how many other species really belong here. Among the species he listed was *B. impigrum*, which does not appear from either description or illustration to belong here. I will use this to form the basis of a fourth group (q.v.).

Eggs of this group appear markedly flattened, although their *w/h%* ratios are quite high (50–65). This is because they are more or less rectangular in cross-section (Fig. 8e) with the lateral surfaces flat while the dorsal/ventral surfaces are convex, and so they lie naturally on their sides. In the grooves on either side of the dorsal and ventral bulges lie strips of material of texture and colour which contrasts with the rest of the capsule surface. These run the full length of the ventral surface, but

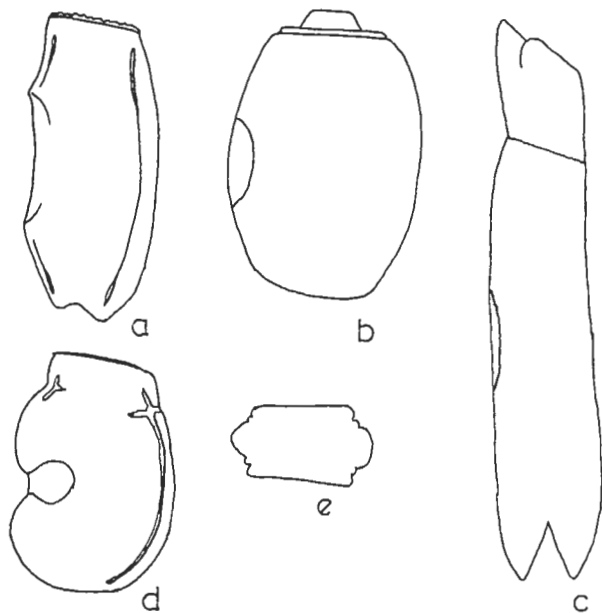


Fig. 8. (a–d) Lateral views of groups (i)–(iv) of *Baculum*; (e) transverse section of group (i) taken in front of the micropylar plate. To various scales. In each figure dorsal is to the left.

are interrupted by the micropylar plate on the dorsal surface. This short plate is pointed anteriorly. The short median line can often only be discerned on the interior plate. The operculum is flat or even concave, with a rough surface and often with a slightly raised toothed rim. Viewed from the side of the pole is slightly indented.

Group (ii) (Figs 8b, 92): **tönnchenförmig, Oberfläche strukturiert** [cask-shaped, surface structured]. Typical form *B. extradentatum*. Hausleithner synonymized *B. annamense* with this species, and also the culture PSG 24 long referred to as *B. impigrum* or *Cuniculina impigra* (having established by egg extraction from genuine *B. impigrum* material that it was not this species). While PSG 24 certainly has eggs very similar to *B. extradentatum* I was able to show in my 1980 thesis that they differed in detail using scanning electron microscopy. Similarly, Hausleithner acknowledges small differences between the eggs of *B. extradentatum* and *B. annamense*. It is possible that there are three species here, for it is not unknown for distinct species in other genera to have almost indistinguishable eggs.

Hausleithner included *B. trilineatum* as the only other species in this group, but from description and figure this does not seem to belong.

Eggs of this group have a so far unique form of operculum, in which the centre is evaginated into a black pseudocapitulum. The capsule is ovoid and variously patterned but with no raised structures. The micropylar plate is almost circular with a posterior notch from which runs a clear median line as far as the pole.

Group (iii) (Figs 8c, 42): **länglich, charakteristischer Eideckelrand und eingekerbte Eibasis** [oblong, characteristic operculum margin and grooved egg base]. Typical form

*B. hypereon*. It also includes *B. cuniculum*, *B. insignis* and *B. insuetum*. Hausleithner placed *B. insuetum* in his group (I) and put *B. attigens*, *B. inversecornutum*, *B. regina* and *B. rivale* in this group. Eggs of this group have a deeply indented pole when viewed laterally. The operculum is expanded and is some 25% of the capsule length.

Group (iv) (Figs 8e, 114). Typical form *B. frustrans*. This also includes PSG 158 (Vietnam), and would appear to include *B. impigrum* as described and figured by Hausleithner. The main characteristic of eggs of this group is a wide bilobed micropylar plate sunk in so that the dorsal surface bulges significantly both anterior and posterior to it. Posteriorly there is a constriction close to the collar, within which may run a strip which branches into two parallel lines running ventrally, somewhat reminiscent of the strips of group (i). The operculum is flat.

#### *Bacteria* Latreille.

Group (i) (Fig. 62). The capitulum is tall, open at the top and supported by thickened struts, micropylar plate expanded at the base, capsule surface pitted. This group contains *B. bicornis*, *B. ferula*, PSG 47 (Costa Rica) and a species from Trinidad.

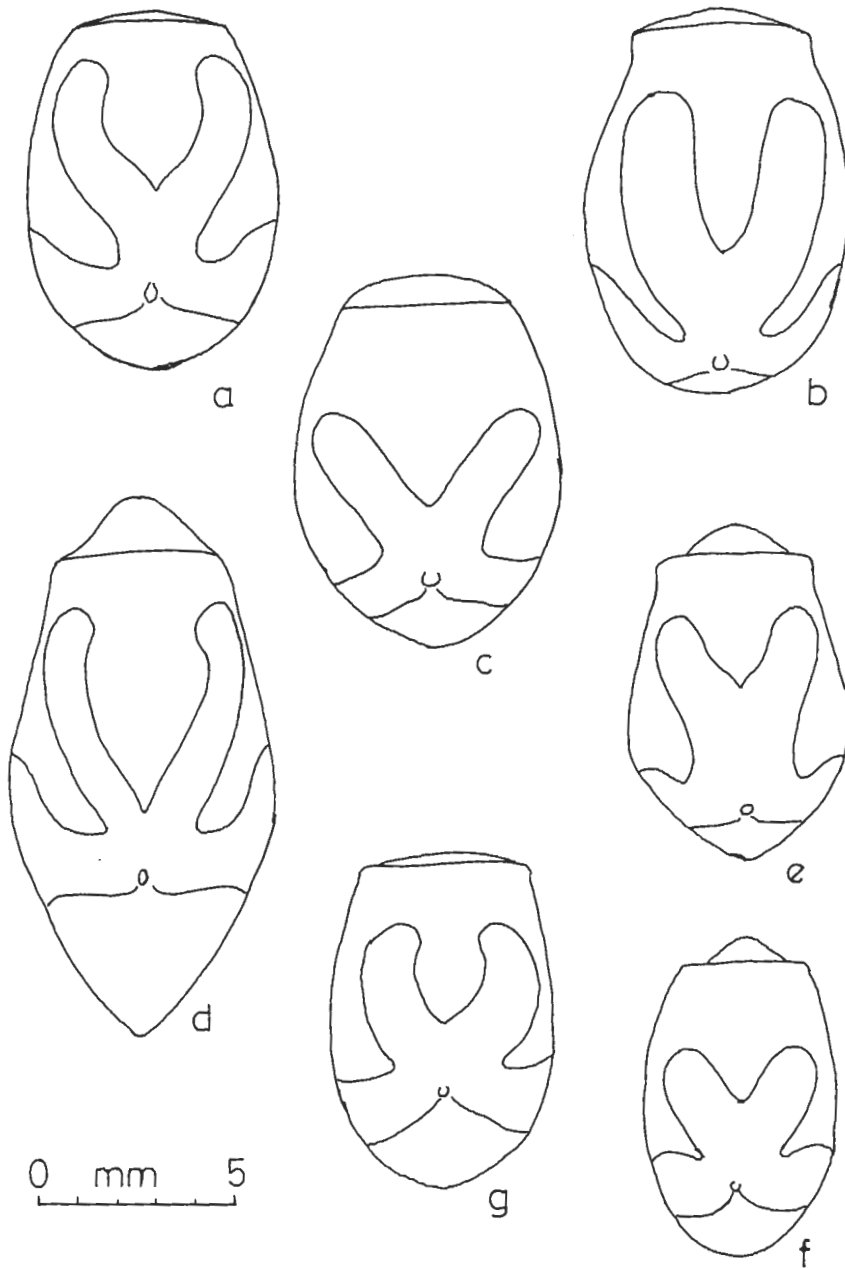
Group (ii) (Fig. 94). The capitulum is roughly dome-shaped, studded with small perforations, micropylar plate parallel-sided surrounded by a raised fringe. This group contains PSG 152 (Venezuela) and another species from Venezuela.

*The Carausius complex* (see Fig. 10). Within the Lonchodinae the genus *Carausius* has eggs which share many features with *Leprocaulus* and with parts of two other closely related genera, *Lonchodes* (see below) and *Phenacephorus* (see below). The *Carausius* eggs I have examined are *C. abbreviatus*, *C. alluaudi*, *C. chani*, *C. cristatus*, *C. mirabilis*, *C. morosus*, *C. sanguineoligatus* and *C. sechellensis*. All these eggs have simple plate shapes, stalked capitula with central pits, notched internal plates with median lines and (unlike the rest of *Lonchodes* and *Phenacephorus*) they lack polar mounds. I am keying eggs of all four genera and part genera together.

*Dimorphodes* Westwood. Hausleithner (1989b) described the eggs of eight species, extracted from the bodies of females. These he divided into four groups. He did not specify what his criteria for group membership was, other than listing similar species. All *Dimorphodes* eggs are similar in overall form, with a convex operculum which carries a small capitulum, and a micropylar plate notched at the base. For this key I have used a grouping divided into two.

Group (i) (Fig. 54). Eggs lacking a median line. Micropylar plate more or less parallel-sided. This group includes *D. asper*, *D. miles*, *D. prosthesis*, *D. serripes*. This is equivalent to Hausleithner's groups 1 and 4.

Group (ii) (Fig. 105). Eggs with a clear median line. Micropylar plate more or less a narrow inverted heart-shape. This group includes *D. catenulus*, *D. celebensis*, *D. sarracini*, *D. mancus*. This is equivalent to Hausleithner's groups 2 and 3. He suggests that the first three might be conspecific. He does not mention the median line in his descriptions though this is clearly visible in each of his figures.



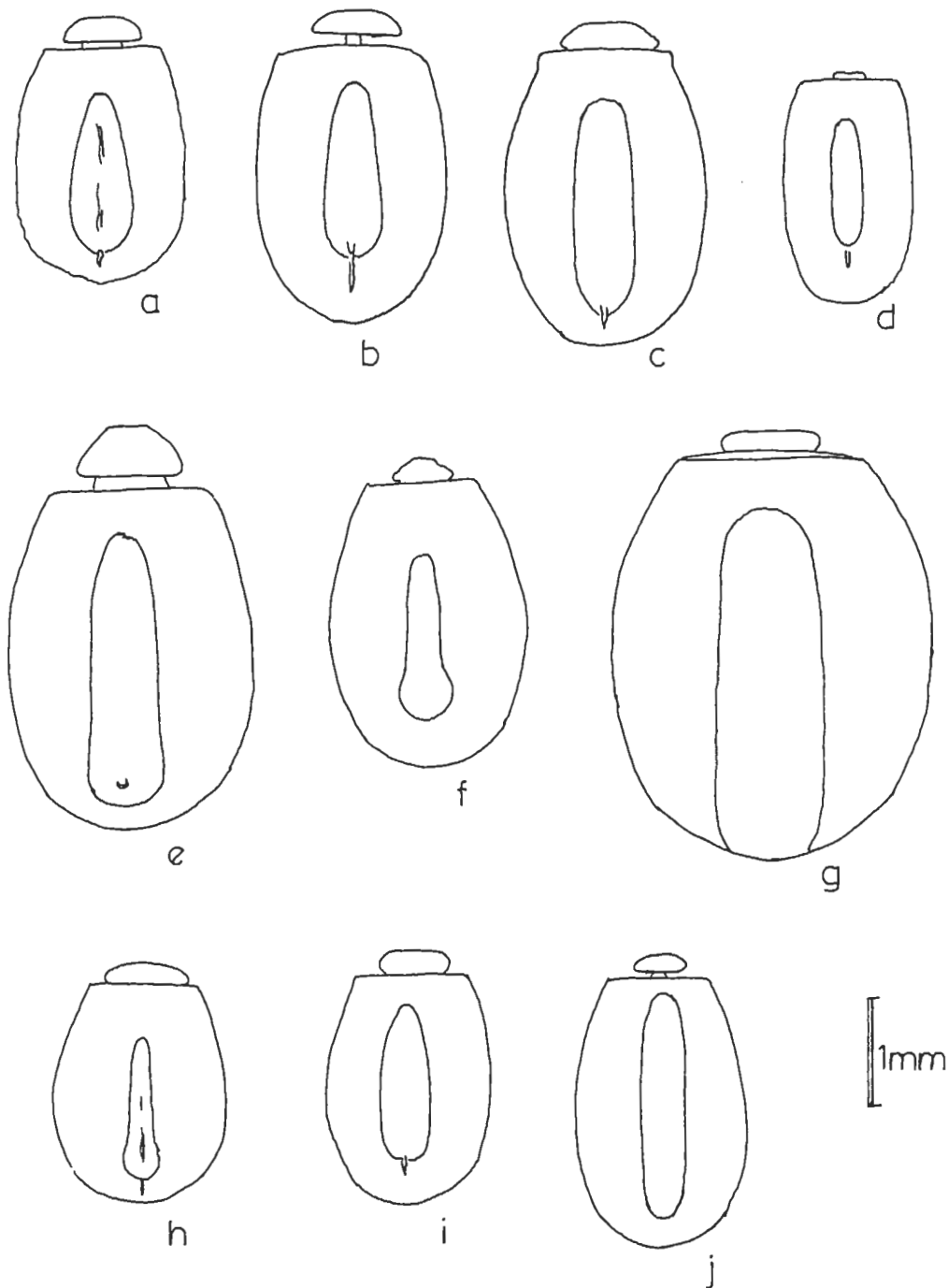
**Fig. 9.** Eggs of the *Haaniella/Heteropteryx* complex. *Haaniella*: (a) *H.dehaani*; (b) *H.echinata*; (c) *H.greyi*; (d) *H.saussurei*; (e) *H.muelleri*; (f) *H.scabra*; (g) *Heteropteryx dilatata*.

*Libethra* Stål. This genus contains some forty species. Of the four whose eggs are known to me, only one has been identified to species level.

Group (i) (Fig. 101). Micropylar plate roughly elliptical; very short median line separate from the plate; operculum almost smooth. This group contains *Libethra regularis* and a species from Ecuador.

Group (ii) (Fig. 88). Micropylar plate parallel-sided; short median line attached to the plate; operculum with a raised ring set in from the edge. This group contains PSG 51 and PSG 87 (both Peru).

*Lonchodes* Gray. Some forty species of this genus have been described under various generic names. Eggs of fourteen species were described by Hausleithner (1989a). Eight of these were extracted from museum specimens. He divided them into four groups on the basis of their egg structure. He also noted the existence of a fifth type in *L.taprobanae*, which he concluded confirmed Günther's suggestion that it was not a true *Lonchodes*. From his figure and description it seems more likely to be an abnormal egg. His group IV contained two species whose eggs in his opinion combined features from the three other groups. Unfortunately he did not give any reason



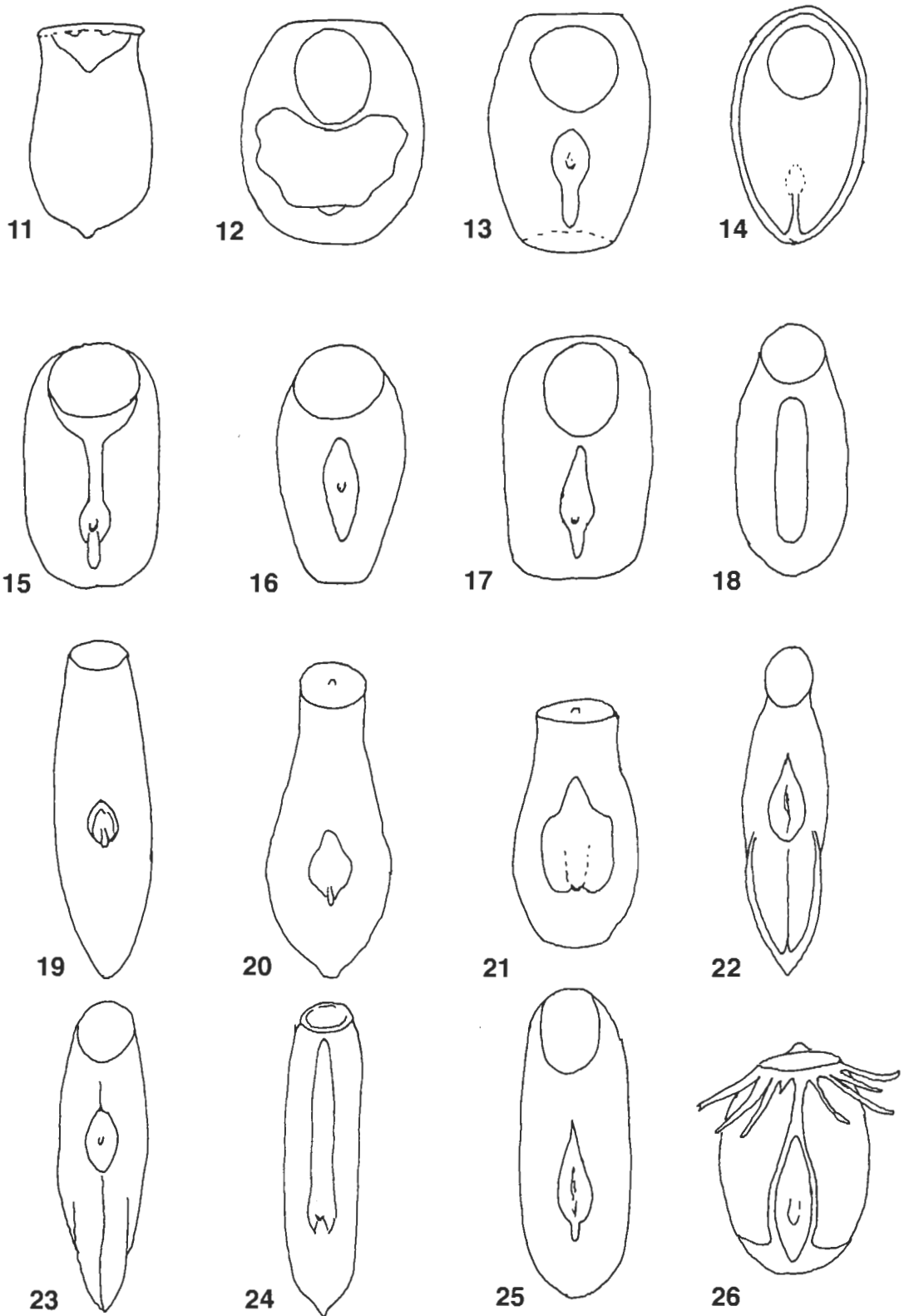
**Fig. 10.** Some of the *Carausius* complex. *Carausius*: (a) *C. abbreviatus*; (b) *C. cristatus*; (c) *C. mirabilis*; (d) *C. sanguineoligatus*. *Lonchodes*: (e) *L. haematopus*; (f) *L. jejunos*; (g) *L. strumosus*. *Phenacephorus*: (h) *P. pauciculatus*; (i) *P. spinulosus*; (j) *Leprocaulus rudis*. Only egg and plate outlines are shown; surface decoration has been omitted. Although median lines are not always obvious all have clear internal median lines.

for his grouping of egg forms, and I cannot deduce what his reasoning was. I have reduced the number of *Lonchodes* groups to three, keeping as far as possible to Hausleithner's numbering.

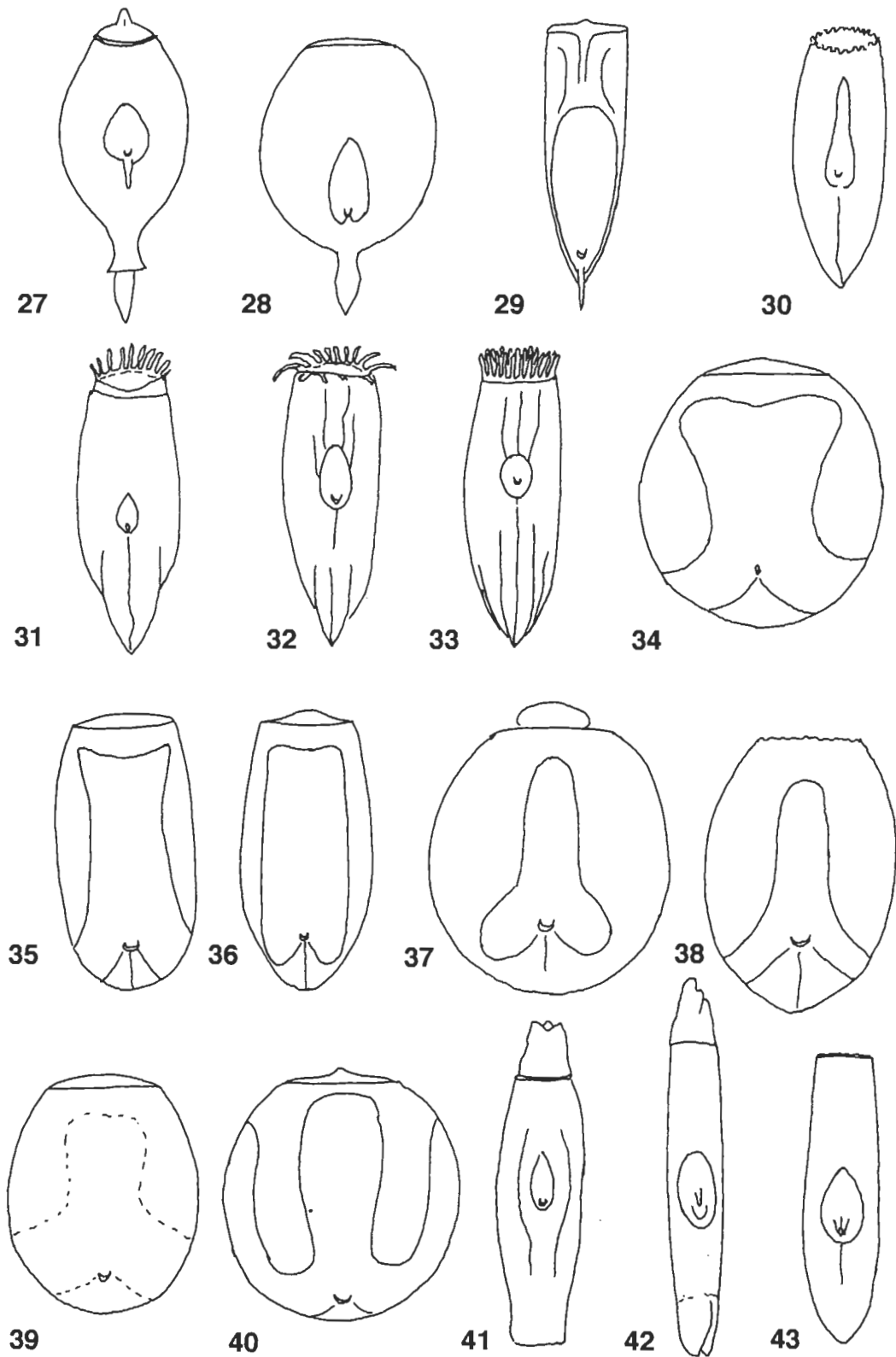
Group (i) (Fig. 47). Eggs with a polar mound, and with the micropylar plate set on the smooth curve of the dorsal surface. This group includes *L. brevipes*, *L. haematopus*,

*L. jejunos*, *L. mindannense*, *L. strumosus*, *L. uniformis*, *L. validior*. Hausleithner considered *L. uniformis*, *L. validior* and *L. everetti* to be subspecies of *L. brevipes*. He placed *L. haematopus* in his group II. *Lonchodes jejunos* is a junior synonym of *L. cator* (Brock, 1996).

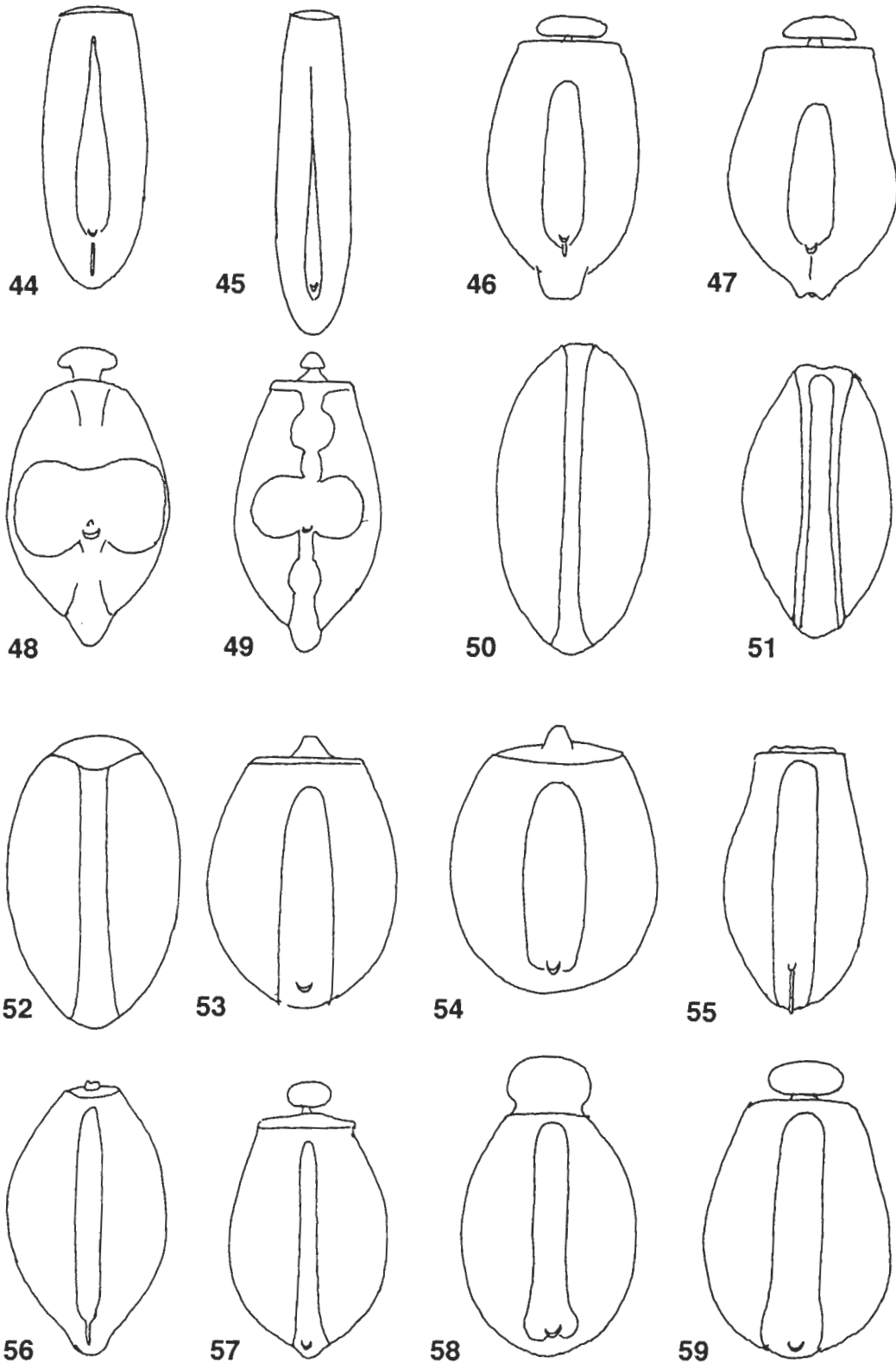
Group (ii) (Fig. 10). Eggs lacking a polar mound. This group



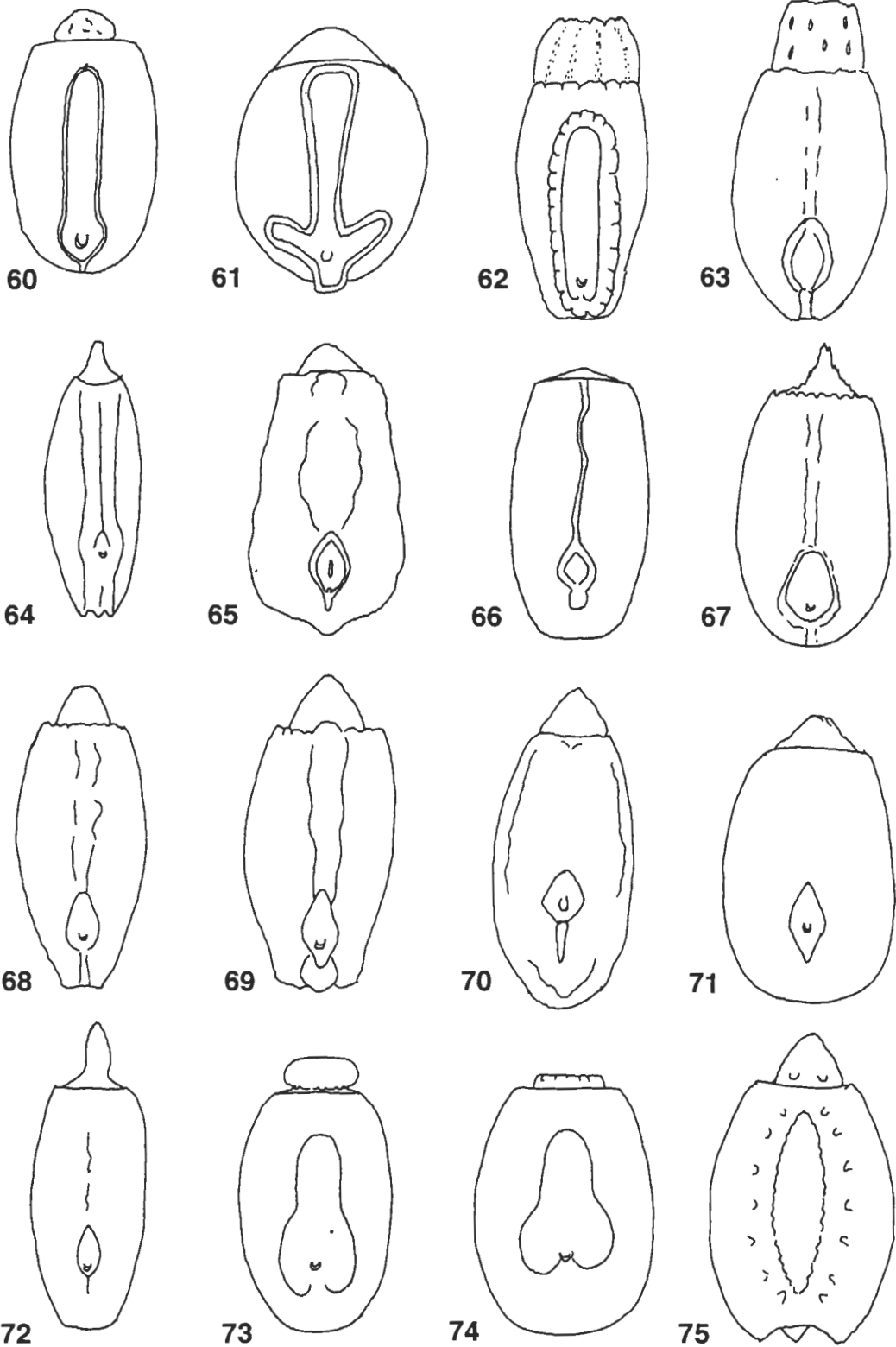
**Figs 11–26.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 11, *Timema*; 12, *Prisopus*; 13, *Calvisia*; 14, *Kalokorinnis*; 15, *Marmessoidea*; 16, *Parasosobia*; 17, *Paraprisopus*; 18, *Pseudosermyle*; 19, *Ischnophasma*; 20, *Palophus*; 21, *Bactrododema*; 22, *Aruanoidea*; 23, *Orthonecrosia*; 24, *Gratidia*; 25, *Sipylodea* (i); 26, *Trachythorax*.



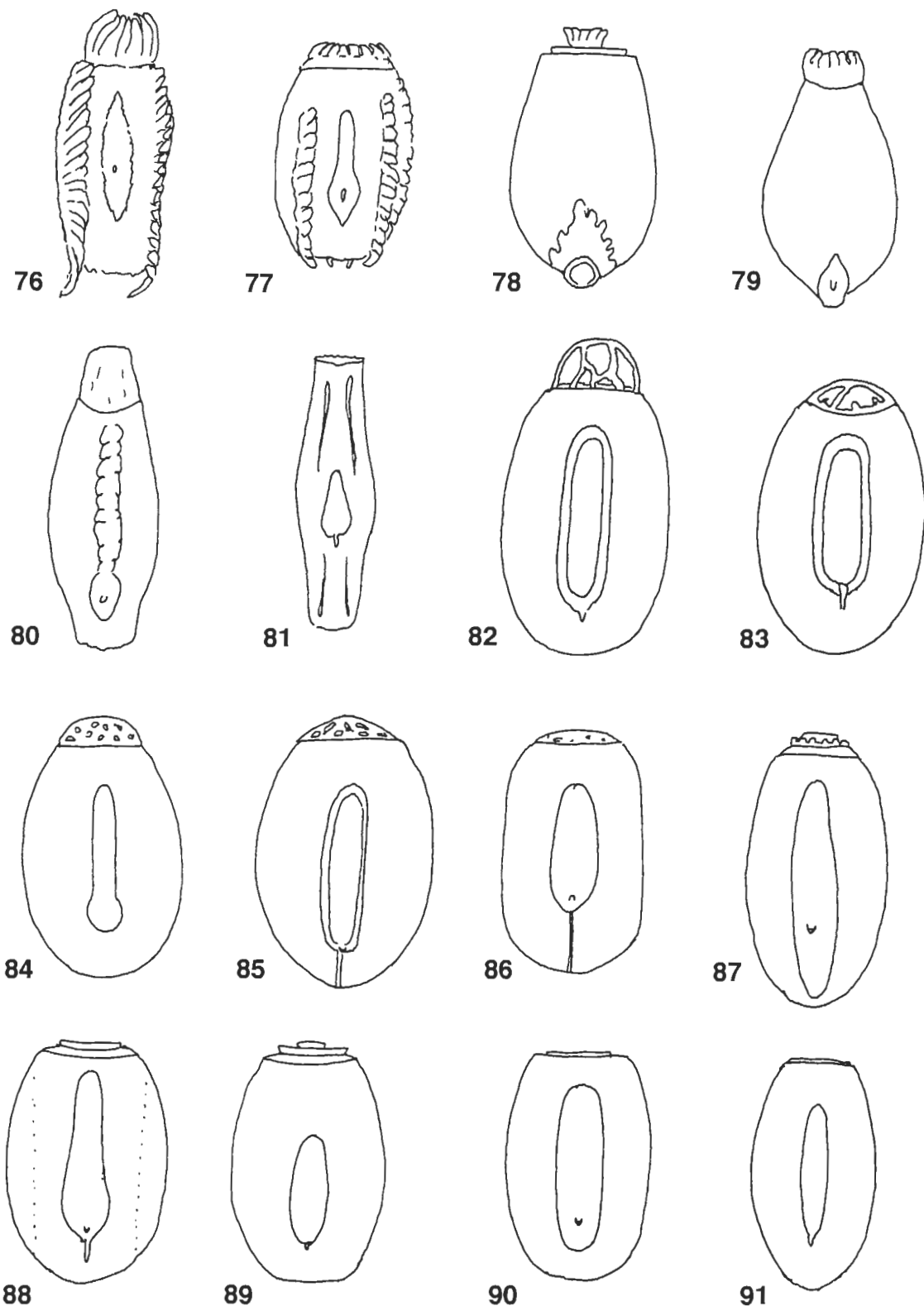
**Figs 27–43.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. Where the external micropylar plate is very obscure its outline is dotted. To various scales. 27, *Asceles*; 28, *Loxopsis*; 29, *Prisomera*; 30, *Orxines*; 31, *Acacus*; 32, *Centema*; 33, *Diesbachia*; 34, *Dares*; 35, *Aretaon*; 36, *Ebulides*; 37, *Tirachoidea*; 38, *Hoploconia*; 39, *Epidares*; 40, *Datames*; 41, *Pterinoxylus*; 42, *Baculum* (iii); 43, *Entoria*.



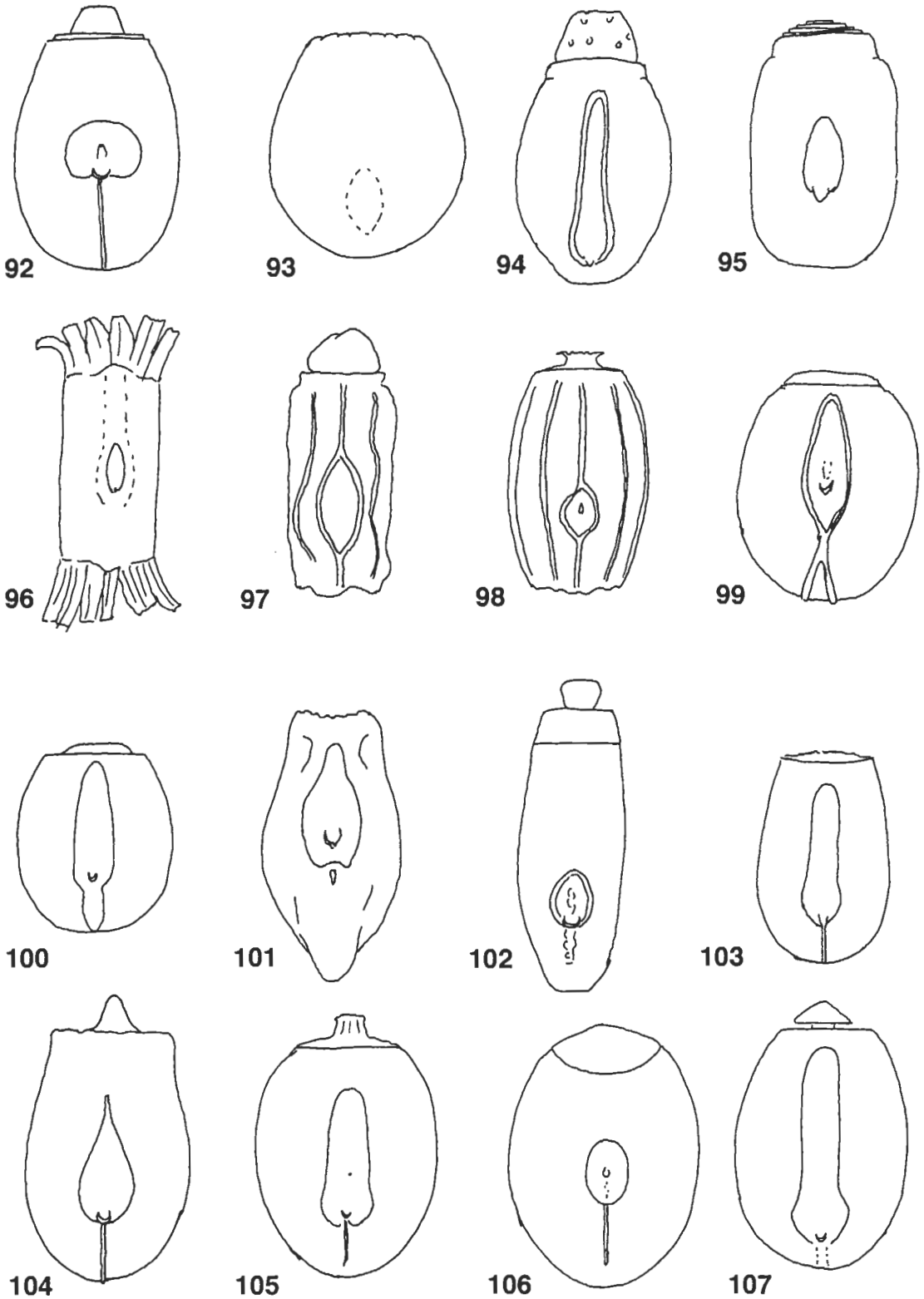
**Figs 44–59.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 44, *Leptynia/Burria*; 45, *Brachyrtacus*; 46, *Lonchodes* (iii); 47, *Lonchodes* (i); 48, *Pharnacia*; 49, *Nearchus*; 50, *Dinophasma*; 51, *Orthomeria*; 52, *Aschiphasma*; 53, *Paramenexenus*; 54, *Dimorphodes* (i); 55, *Bacillus*; 56, *Oreophoetes*; 57, *Anchiale*; 58, *Vetilia*; 59, *Phasma*.



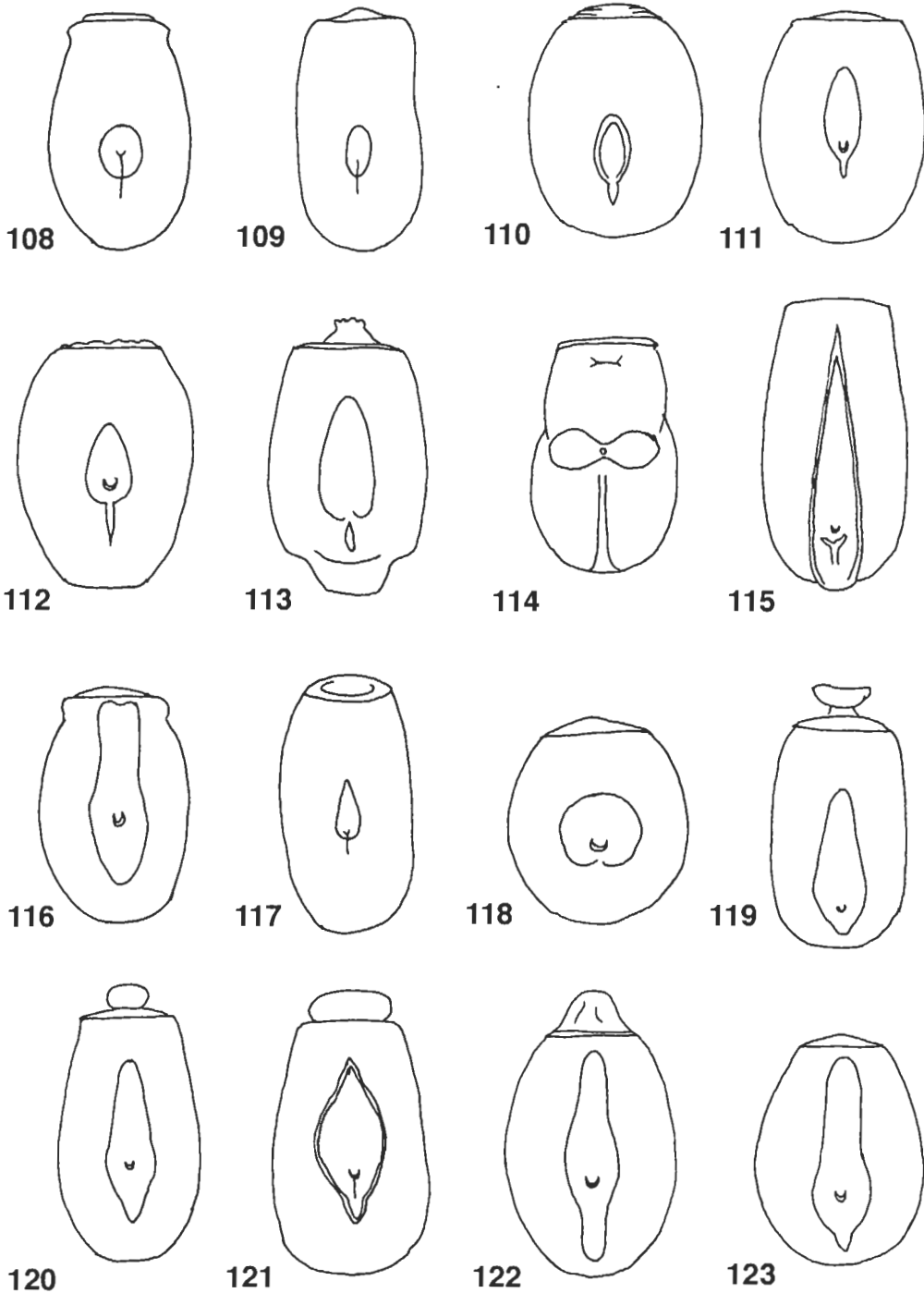
**Figs 60–75.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 60, *Ctenomorphodes*; 61, *Extatosoma*; 62, *Bacteria* (i); 63, *Tectarchus*; 64, *Acanthograeffea*; 65, *Argosarchus*; 66, *Pachymorpha*; 67, *Spinotectarchus*; 68, *Mimarchus*; 69, *Acanthoxyla*; 70, *Graeffea*; 71, *Megacrania*; 72, *Ophicrania*; 73, *Aplopus*; 74, *Diapherodes*; 75, *Phyllium* (ii).



**Figs 76–91.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 76, *Phyllium* (i); 77, *Chitoniscus*; 78, *Bacunculus*; 79, *Xeropsis*; 80, *Achrioptera*; 81, *Baculum* (i); 82, *Megaphasma*; 83, *Diapheromera*; 84, *Calynda*; 85, *Phibalosoma*; 86, *Clonistria*; 87, *Xylica*; 88, *Libethra* (i); 89, *Oncotopasma*; 90, *Bostra*; 91, *Hemipachymorpha*.



**Figs 92–107.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. Where the external micropylar plate is very obscure its outline is dotted. To various scales. 92, *Baculum* (ii); 93, *Cotylosoma*; 94, *Bacteria* (ii); 95, *Cladoxerus*; 96, *Lopaphus* (i); 97, *Podacanthus*; 98, *Sipylloidea* (ii); 99, *Orobia*; 100, *Necroscia*; 101, *Libethra* (ii); 102, *Tropidoderus*; 103, *Clonopsis*; 104, *Raphiderus*; 105, *Dimorphodes* (ii); 106, *Neohirasea*; 107, *Myronides*.

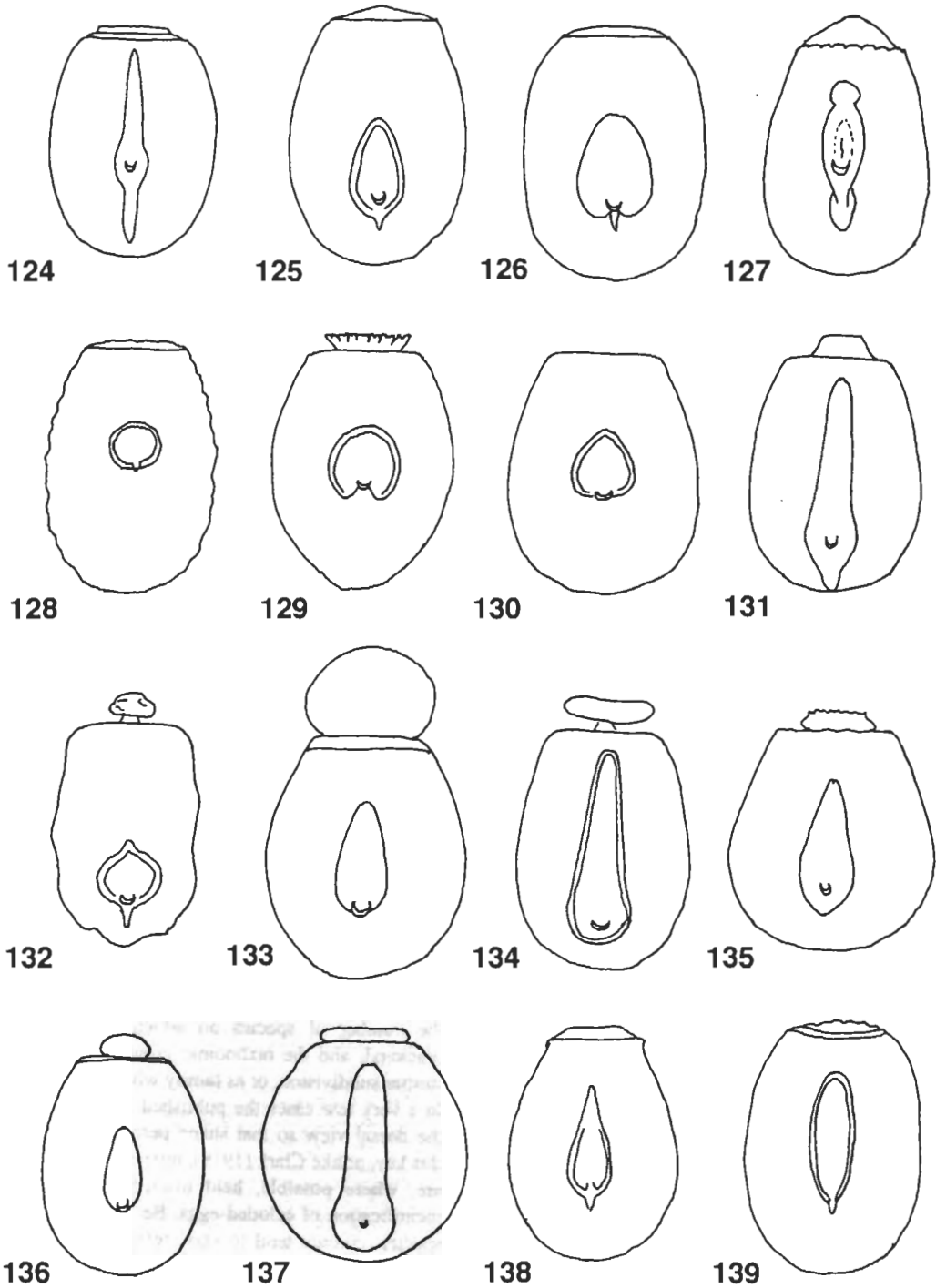


**Figs 108–123.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 108, *Olciphides*; 109, *Eophasmina*; 110, *Eophasmodes* **gen.n.**; 111, *Autolyca*; 112, *Anisomorpha*; 113, *Phenacephorus* (i); 114, *Baculum* (iv); 115, *Agathamera*; 116, *Hyrtacus*; 117, *Parahyrtacus*; 118, *Menexenus*; 119, *Didymuria*; 120, *Phraortes*; 121, *Hermarchus*; 122, *Phaenopharos*; 123, *Sipyloidea* (iii).

contains *L.haematomus*, *L.jejunus*, *L.strumosus* and *L.validior*. I can find no significant difference between this group and the eggs of *Carausius*, of *Phenacephorus* (ii) and of *Leprocaulus*

*rudis*, so I am here keying them all out as one united group. See *Carausius* above.

Group (iii) (Fig. 46). Eggs with a polar mound, but with the



**Figs 124–139.** Dorsal views of generic forms. Surface decoration is omitted, even in cases where such decoration forms part of the key diagnosis. To various scales. 124, *Parapachymorpha*; 125, *Karabidion*; 126, *Eurycantha*; 127, *Clitarchus/Pseudoclitarchus*; 128, *Paraphasma*; 129, *Lamponius*; 130, *Creoxylus*; 131, *Gigantophasma*; 132, *Ctenomorpha*; 133, *Eurycnema*; 134, *Acrophylla*; 135, *Paramyronides*; 136, *Staelonchodes*; 137, *Lopaphus* (ii); 138, *Micadina*; 139, *Dyme*.

micropylar plate having a constriction anterior to it so that seen laterally it stands away from the general curve of the surface. This group includes *L.amaurops*, *L.everetti*, *L.hosei*,

*L.modestus*. From Hausleithner's descriptions, *L.rusticus* belongs to this group as well. He placed *L.everetti* in his group I.

*Lopaphus* Westwood. Eggs of three species are known, all vastly different.

Group (i) (Fig. 96). This is the very distinctive *L.borneensis* egg which is cylindrical with prominent anterior and posterior fibres.

Group (ii) (Fig. 137). This is *L.caesius* which is quite unlike the former in being almost spherical, lacking any fibres, and having a capitulum. It resembles more a lonchodid than a necrosiid.

There is also reference in the literature to the egg of *L.brachypterus* (Bragg, 1995d), although this is not illustrated. This latter egg differs from both of the previous two, resembling *L.caesius* in shape, and *L.borneensis* in the possession of some fibres.

*Phenacephorus* Brunner. There are two very distinct egg types associated with this small genus, which has only seven species.

Group (i) (Fig. 113). Based on *P.cornucervi* and *P.sepilokensis*. These have a very distinct outline when seen laterally with a conspicuous polar mound, the micropylar plate standing out from the dorsal surface, and a capitulum resembling a truncated wrinkled cone. *Phenacephorus nieuwenhuisi* also conforms to this type, though more ovoid than the other two species.

Group (ii) (Fig. 10). Based on *P.auriculatus* and *P.spinulosus*. This group has eggs which form part of the *Carausius* complex (see above). Bragg (1995e) groups *P.verrucosus* and *P.spinulosus* close to *Lonchodes* and distinct from the three species which form my group (i). I do not yet know the egg of *P.verrucosus*.

*Phyllium* Illiger. I published a study of the eggs of this genus (Clark, 1978) in which I grouped material into four sections. Three of these are very similar, so that in the key these are reduced to two groups.

Group (i) (Fig. 76). The entire egg surface is covered with feathery pinnae, which are longest along the ribs and the operculum rim. The operculum itself is flat. Only *P.siccifolium* is included.

Group (ii) (Fig. 75). There are no pinnae. The shape of the egg surface is clearly visible as 5-ribbed, and is covered with pits. The operculum is expanded into a cone (not a capitulum) and is also pitted. This group includes *P.bioculatum*, *P.celebicum*, *P.gelonus*, *P.giganteum*, *P.pulchrifolium* and *P.scythe*.

*Sipyloidea* Brunner. Some seventy-five species have been described, but very few of these have had their eggs described or figured.

Group (i) (Fig. 25). Containing at the moment only PSG 4 (Madagascar) (for years this culture species was thought to be *S.sipylus*, but this identification is now in doubt). This differs strikingly from others in the genus by being ventrally adhesive, with the operculum displaced by some 45° towards the dorsal surface. There is a short true median line. There are no capitular structures. It is also significantly elongated ( $h/l\%$  40). The PSG

4 has a marked surface decoration of hairs, but this may not be typical of the group as a whole.

Group (ii) (Fig. 98). Non-adhesive eggs. The capsule surface is raised in a series of prominent lines, which typically run longitudinally. One such line runs from the small elliptical micropylar plate to the collar and also backwards to the pole, resembling a median line, but no median line has been found internally. The capsule has a flat pole. The operculum has a central capitulum-like mound. This group contains *S.panaetius*, PSG 103 (Thailand) and PSG 143 (Bali).

Group (iii) (Fig. 123). Non-adhesive eggs. The capsule surface is not strongly ridged. The capsule is smoothly rounded. The micropylar plate is elongated. The operculum is slightly domed but has no capitular structure. This group contains *S.filiformis*, *S.truncata* and PSG 163 (Australia).

In a few cases I have been unable from egg structure to differentiate between closely related genera and they are keyed together. These are the *Carausius* complex (see above), *Haaniella/Heteropteryx*, *Leptynia/Burria* and *Clitarchus/Pseudoclitarchus*. In the two latter cases egg morphology is very similar throughout the pairs of genera. In *Haaniella/Heteropteryx* there is considerable variation in morphology between species (see Fig. 9).

## The key

There are forty-three taxonomic groups, ranging from suborder (Timematodea) to tribe (Acanthoxylini) depending on the level to which subdivision has so far been carried (Kevan, 1982 to subfamily level; tribes added from Bradley & Galil, 1977). I have replaced the tribal name Ramulini by Gratidiini, following Bragg (1995c).

This key includes genera from thirty-nine of these groups. 'Mp' signifies micropylar plate. Following the identification of each genus form I have indicated the basic shape as indicated by the range of  $h/l\%$  (elongation) and  $w/h\%$  (flattening), the symbol indicating internal micropylar type where it is known, the number of species on which this is based [in square brackets], and the taxonomic group (as family if there is no further subdivision, or as family with subdivision if one exists). In a very few cases the published illustration has shown only the dorsal view so that shape percentage cannot be given. In this key, unlike Clark (1979), opercular and capitular structures are, where possible, held toward the end to facilitate the identification of ecdode eggs. Because, even within the same species, colours tend to vary, reference to colour is as far as possible avoided.

Figures 11–139 show outlines of the various egg forms. They should be used only to supplement the key, because (as in the *Hanniella/Heteropteryx* complex, Fig. 9) there may be a variety of detail of shape within one key definition.

1. Capsule soft, translucent, easily collapses, very small posterior mound, mp a small triangle at the opercular rim; internal plate lacks stalk and gap.  $h/l\%$  60–65,  $w/h\%$  85–90, CC [1] (Timematidae) (Fig. 11) ..... *Timema*

- Capsule rigid, mp usually separate from opercular rim, or if not so extending at least halfway along the mid-line; internal plate always with a micropylar stalk and gap .....2
- 2(1). Operculum displaced towards or completely on the dorsal surface; opercular angle at least 45°; no capitulum; generally ventrally adhesive .....3
- Operculum on the horizontal mid-capsule line, even if off centre; opercular angle less than 45°; a few are adhesive, but generally not .....16
- 3(2). Operculum displaced to dorsal surface, relatively smooth surface .....4
- Operculum still anterior, surface may be otherwise .....9
- 4(3). Adhesive to adjacent eggs anteriorly and posteriorly .....5
- Separate eggs .....6
- 5(4). Mp much wider than operculum, meeting it,  $h/l\%$  55–60,  $w/h\%$  135–140 [2] (Bacunculidae, Prisopodini) (Fig. 12)..... *Prisopus*
- Mp much narrower than operculum, not touching it,  $h/l\%$  45–50,  $w/h\%$  100–105 [1] (Necroschiidae) (Fig. 13)..... *Calvisia*
- 6(4). Strong lateral ridge encircles the capsule; obscure mp with raised line running from mp cup posteriorly;  $h/l\%$  40,  $w/h\%$  135, NO [1] (Bacunculidae, Korinninae) (Fig. 14)..... *Kulokorinnis*
- No ridges; obvious mp along most of dorsal mid-line, which is narrow except at opercular rim .....7
- 7(6). Mp wide anteriorly, contacting opercular rim, >5 times longer than wide; operculum almost flat and circular in outline,  $h/l\%$  50,  $w/h\%$  95, PE [2] (Necroschiidae) Fig. 15)..... *Marmessoidea*
- Mp narrow anteriorly, <3 times longer than wide 8
- 8(7). Operculum almost flat and circular in outline; ventral surface angled at about 60° as it turns anteriorly towards opercular rim,  $h/l\%$  50,  $w/h\%$  95–100 [1] (Necroschiidae) (Fig. 16)..... *Parasosibia*
- Operculum dome-shaped and elliptical in outline; ventral surface angled at nearly 90° as it turns towards opercular rim;  $h/l\%$  55,  $w/h\%$  90 [1] (Bacunculidae, Prisopodini) (Fig. 17). *Paraprisopus*
- 9(3). Mp raised above dorsal service .....10
- Mp not raised.....13
- 10(9). Mp elongate, more than half capsule length [1] (Necroschiidae) (Fig. 18)..... *Pseudosermyle*
- Mp small, roughly lozenge-shaped .....11
- 11(10). Capsule surface smooth,  $h/l\%$  20,  $w/h\%$  110–125 [3] (Palophidae) (Fig. 19)..... *Ischnophasma*
- Capsule surface corrugated,  $h/l\%$  above 20 .....12
- 12(11). Capsule length greater than 6 mm; mp pointed posteriorly,  $h/l\%$  35–40,  $w/h\%$  115–125, PO [4] (Palophidae) (Fig. 20)..... *Palophus*
- Capsule less than 5.5 mm, mp notched posteriorly,  $h/l\%$  45–50,  $w/h\%$  95–100 [2] (Palophidae) (Fig. 21) ..... *Bactrododema*
- 13(9). Obvious flanges extend laterally either side of pole, from mp backwards.....14
- No such flanges .....15
- 14(13). Constricted below operculum,  $h/l\%$  20–25,  $w/h\%$  100 [1] (Necroschiidae) (Fig. 22)..... *Aruanoidea*
- Operculum rim runs smoothly into main capsule,  $h/l\%$  20–25,  $w/h\%$  95–105 [2] (Necroschiidae) (Fig. 23) ..... *Orthonecroschia*
- 15(13). Mp extending to opercular rim, which is slightly raised;  $h/l\%$  18–21,  $w/h\%$  95–100, PO [6] (Pachymorphidae, Gratidiini) (Fig. 24)..... *Gratidia* (= *Ramulus*)
- Mp shorter; operculum and capsule with fine spines;  $h/l\%$  35–40,  $w/h\%$  95–100, PE [1] (Necroschiidae) (Fig. 25)..... *Sipylodea* (i)
- 16(2). Adhesive in clusters; adhesive at posterior poles; surface layer peels back except for mp region to form a star of fibres radiating from the opercular collar,  $h/l\%$  65–70,  $w/h\%$  95–100, NM [1] (Necroschiidae) (Fig. 26)..... *Trachythorax*
- No set of fibres formed from surface layer.....17
- 17(16). Capsule with a distinct polar rimmed spine.....18
- No spine at posterior of capsule .....19
- 18(17). Rim surrounds the spine, mp with distinct median line, opercular structures off-centre ventrally,  $h/l\%$  45–55,  $w/h\%$  85–95, NM [3] (Necroschiidae) (Fig. 27)..... *Asceles*
- Rim at ventral side of spine, mp lacks median line, no opercular structures,  $h/l\%$  85–90,  $w/h\%$  95, CO [1] (Necroschiidae) (Fig. 28)..... *Loxopsis*
- 19(17). Capsule tapering to a point posteriorly as seen in dorsal view, barely wider at equator than opercular rim .....20
- Capsule not pointed posteriorly, or if pointed then capsule much wider at equator than opercular rim.....24
- 20(19). Capsule wedge-shaped, very broad in lateral view, deeply indented below opercular rim,  $h/l\%$  48,  $w/h\%$  41 [1] (Lonchodidae, Lonchodini) (Fig. 29)..... *Prisomera*
- Capsule tapering in lateral view, no indentations, operculum surrounded by raised fringed rim .....21
- 21(20). Opercular fringe short <0.2 mm, mp nearly half capsule length,  $h/l\%$  40–45,  $w/h\%$  100, PM [2] (Necroschiidae) (Fig. 30)..... *Orxines*
- Opercular fringe longer, >0.5 mm, mp less than quarter capsule length.....22
- 22(21). Dorsal and ventral surfaces with similar curvature, conspicuous dorsal flange c. 1 mm wide, opercular fringe much stronger ventrally (almost absent dorsally),  $h/l\%$  35–38,  $w/h\%$  95, PM [1] (Necroschiidae) (Fig. 31)..... *Acacus*
- Surfaces with dissimilar curvature, dorsal flange c. 0.5 mm and inconspicuous, opercular fringe even .. .....23
- 23(22). Dorsal surface flatter than ventral,  $h/l\%$  30–35,  $w/h\%$  95–100, NM [1] (Necroschiidae) (Fig. 32)..... *Centema*
- Ventral surface flatter than dorsal,  $h/l\%$  40,  $w/h\%$  90–95 [1] (Necroschiidae) (Fig. 33) ..... *Diesbachia*

- 24(19). Mp extended at anterior and posterior corners into a saltire-like form, or at least notched anteriorly and posteriorly .....25
- Mp not saltire-shaped .....28
- 25(24). Mp shallowly notched between arms anteriorly, posterior arms may encircle egg or remain distinct. ....26
- Mp deeply notched between arms anteriorly, posterior arms may extend ventrally, very large eggs, length >7.5 mm, *h/l%* 70–90, *w/h%* 85–105, NO [7,2] (Bacillidae, Heteropterygini) (Fig. 8).....
- 26(25). Almost spherical, median line weak or absent, *h/l%* 100–115, *w/h%* 90–95, NO or NM [4] (Bacillidae, Datamini) (Fig. 34).....*Dares*
- Elongated, *h/l%* <60, distinct median line .....27
- 27(26). Relatively small, length 2.5–3.0 mm, posterior arms diverge widely, *h/l%* 50–55, *w/h%* 90–95, NM [1] (Bacillidae, Obrimini) (Fig. 35).....*Aretaon*
- Larger, length *c.* 5 mm, posterior arms almost parallel, *h/l%* 40–45, *w/h%* 90 [1] (Bacillidae, Obrimini) (Fig. 36).....*Ebulides*
- 28(24). Mp Y-shaped, the arms extending posteriorly and ventrally, outline often obscure externally ..... 29
- Mp not extended into arms .....32
- 29(28). Stalked capitulum, conspicuous micropylar cup, obvious median line, *h/l%* 90–95, *w/h%* 80–95, NM [1] (Phasmatidae, Pharnaciini) (Fig. 37).....*Tirachoidea*
- No structures arising from operculum .....30
- 30(29). Mp with conspicuous median line, capsule not approximately spherical, *h/l%* 70–75, *w/h%* 90–95, M [1] (Bacillidae, Obrimini) (Fig. 38) ..*Hoploconia*
- Mp without obvious median line, arms may encircle egg or remain distinct, capsule approximately spherical .....31
- 31(30). Capsule surface covered with long hooked hairs making the egg burr-like, *h/l%* 85–90, *w/h%* 90–95, NM [1] (Bacillidae, Datamini) (Fig. 39).....*Epidares*
- Surface not covered in burr-like hairs, *h/l%* 110–115, *w/h%* 90–95, NO [2] (Bacillidae, Datamini) (Fig. 40).....*Datames*
- 32(28). Markedly elongated eggs, *h/l%* <40 .....33
- Not so elongated .....37
- 33(32). Alveolar texture with a pale/medium brown capsule; polar extension, short mp .....34
- Capsule not alveolar; no polar extension .....35
- 34(33). Open cylindrical polar extension, mimicking operculum extension, finely pitted, *h/l%* 35, *w/h%* 95–100, length 9–10 mm, NO [1] (Bacteriidae, Bacteriini) (Fig. 41).....*Pterinoxylus*
- Polar extension deeply notched, operculum extension irregular or notched, *h/l%* 30–35, *w/h%* 60–85, NK [3] (Phasmatidae, Baculini) (Fig. 42)....*Baculum* (iii)
- 35(33). Long thin mp tapering to anterior point .....36
- Short lenticular mp with short median line; opercular fringe of spines, *h/l%* 30–40, *w/h%* 60–65 [2] (Phasmatidae, Baculini) (Fig. 43).....*Entoria*
- 36(34). Prominent median line to or almost to pole, *h/l%* 20–35, *w/h%* 90–100, PE [4,1] (Pachymorphidae, Gratiidiini) (Fig. 44).....*Leptynia/Burria*
- No median line, *h/l%* 20–25, *w/h%* 80–85 [1] (Lonchodidae, Menexeninae) (Fig. 45).....*Brachyrtacus*
- 37(32). Distinct polar mound with central pit; stalked capitulum; capsule surface pitted .....38
- No distinct polar mound .....39
- 38(37). Mp raised on expansion of dorsal surface, giving a distinct notch anterior to mp when viewed from side; *h/l%* 75–80, *w/h%* 65–85, NM [4] (Lonchodidae, Lonchodinae) (Fig. 46).....*Lonchodes* (iii)
- Mp area merges smoothly into rest of capsule; *h/l%* 70–85, *w/h%* 80–85, NM [3] (Lonchodidae, Lonchodinae) (Fig. 47).....*Lonchodes* (i)
- 39(37). Mp with two lateral lobes, rib running from at least pole ventrally to operculum, stalked capitulum...40
- Mp not this shape .....41
- 40(39). Ribs without marked depression on either side, *h/l%* 70–90, *w/h%* 75–80, NM [3] (Phasmatidae, Pharnaciini) (Fig. 48).....*Pharnacia*
- Ribs with one pair of marked depressions anteriorly and one pair posteriorly, *h/l%* 80, *w/h%* 65 [1] (Phasmatidae, Pharnaciini) (Fig. 49).....*Nearchus*
- 41(39). Mp completely encircles capsule, micropyle near to pole, distinct median dark stripe along middle of ventral part of mp, no opercular structures .....42
- Mp does not encircle capsule, micropyle clearly dorsal .....44
- 42(41). Capsule and operculum covered with hairs, negative opercular angle >45°, *h/l%* 60–65, *w/h%* 75–80, CO [1] (Bacunculidae, Aschiphasmatini) (Fig. 50).....*Dinophasma*
- Capsule without obvious hairs, opercular angle <30° .....43
- 43(42). Marked negative opercular angle; operculum does not fit smoothly into the curve of the capsule, *h/l%* 90–100, *w/h%* 55–70, CO [2] (Bacunculidae, Aschiphasmatini) (Fig. 51).....*Orthomeria*
- Opercular angle close to zero; operculum continues the curve of the capsule, *h/l%* 95, *w/h%* 70, CO [1] (Bacunculidae, Aschiphasmatini) (Fig. 52).....*Aschiphasma*
- 44(41). Mp almost parallel-sided except possibly in region of mp cup, extends almost from pole to operculum, at least 80% of capsule length .....45
- Mp not both long and parallel-sided .....52
- 45(44). Mp well clear of opercular rim, capitular structure a short cone .....46
- Mp extends almost from operculum to pole .....47
- 46(45). Mp reaches the pole, micropylar cup well clear of end of mp; *h/l%* 97, *w/h%* 85 [1] (Lonchodidae, Menexeninae) (Fig. 53).....*Paramenexenus*
- Mp clear of pole, micropylar cup at end of mp, *h/l%* 80–85, *w/h%* 83–91 [5] (Phasmatidae, Xeroderinae)

- (Fig. 54).....*Dimorphodes* (i) 56(55). Structure running anterior to mp, often in form of a keel.....57
- 47(45). Mp may connect to operculum ventrally by fine rib, short black variable reticulate capitular structures on operculum, *h/l%* 65–80, *w/h%* 80–90, PE [7] (Bacillidae, Bacillini) (Fig. 55)..... *Bacillus* — No structure running anteriorly from mp.....62
- No ventral rib, either no obvious capitulum or a distinct raised capitulum.....48 57(56). Median keel anterior and posterior of mp, flanked by pair of dorsolateral ribs; *h/l%* 65–70, *w/h%* 45 [1] (Phasmatidae, Platycraninae) (Fig. 64).....
- 48(47). No raised capitulum, but small raised orange markings on operculum; capsule almost biconvex lenticular when viewed dorsally; short median line; glossy, *h/l%* 88–90, *w/h%* 70–75, NM [1] (Heteronemiidae, Heteronemiinae) (Fig. 56)..... *Acanthograeffea* — No dorsolateral ribs.....58
- Distinct raised capitulum; capsule does not narrow anteriorly to give biconvex appearance.....49 58(57). Keel anterior to mp bulging 0.5–1 mm; granular and punctured surface; conical capitular structure; *h/l%* 60–75, *w/h%* 80–100 [2] (Phasmatidae, Acanthoxylini) (Fig. 65)..... *Argosarchus*
- 49(48). Viewed laterally, capsule seen to be notched dorsally and/or ventrally close to operculum and often near posterior pole as well, *h/l%* 85–95, *w/h%* 65–85, PO [4] (Phasmatidae, Phasmatini) (Fig. 57)..... *Oreophoetes* — No large bulge in anterior keel.....59
- No obvious notching, outline smooth viewed laterally.....50 59(58). Anterior keel marked by a narrow line.....60
- 50(49). Capitulum not stalked, broad connection with operculum, *h/l%* 60–90, *w/h%* 75–95 [2] (Phasmatidae, Phasmatini) (Fig. 58)..... *Vetilia* — Anterior keel wider.....61
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