THE STRUCTURE OF THE OVIPOSITOR AND THE MECHANICS OF OVIPOSITION IN THE ORIBATID MITE *MACHADOBELBA SYMMETRICA* BAL. (ACARI : CRYPTOSTIGMATA)

BY

John A. Wallwork

(Department of Zoology, Westfield College, University of London)

Introduction

In 1956, F. Grandjean published the first detailed description of the structure of the ovipositor in oribatid mites. This work was an excellent example of the careful attention to detail which characterized all of Grandjean's studies. Previously, Michael (1883) had featured the gross appearance of the ovipositor of several oribatid mites, but it was Grandjean who first provided a detailed account of the component parts of the ovipositor, their chaetotaxy and their function.

During a systematic investigation of collections of oribatid mites from West Africa, several specimens of the species *Machadobelba symmetrica* Bal. were obtained which showed the ovipositor in various stages of extrusion. This material allowed a detailed study to be made of the structure of the ovipositor of this species, using Grandjean's description as a model. The collection also included one specimen which had died as an egg was passing down the extruded ovipositor. This egg, which had been retained in the tube, could be manipulated up and down the ovipositor by the use of fine needles, and this provided a unique opportunity to observe the events that occur when an egg is being deposited. Celloidin sections of whole animals were also cut to study the configuration of the ovipositor when fully retracted within the hysterosoma. These sections were stained with haematoxylin, photographed, and drawings were made from the photographs. The findings of these investigations are presented below.

Structure of the ovipositor

General description.

The ovipositor of *Machadobelba symmetrica* has the same general structural plan as that of *Nothrus silvestris*, *Heminothrus targionii* and *Eremaeus hepaticus*, described by Grandjean (1956). It is a contractile tube, with strongly pleated walls, which is capable of great elongation and distention. When fully extruded (Fig. 1A), it can be seen to consist of proximal and distal portions, separated by a circular constriction. The three pairs of *k* setae, which GRANDJEAN (1956) found inserted on this constriction, are entirely lacking in *M. symmetrica*. WOODRING and COOK (1962) also noted the absence of *k* setae in *Ceratozetes cisalpinus*. The distal portion of the ovipositor, which is only about half the length of the proximal part, terminates in three eugenital lobes which surround the terminal aperture. In the retracted condition, the distal part is withdrawn into the proximal portion by invagination. The base of the proximal part appears to be attached around the internal rim of the genital aperture, and this part folds in on itself as it retreats into the interior of the hysterosoma.

The position of the ovipositor within the hysterosoma is rather variable, although it is usually located mid-ventrally, with the apex directed anteriorly so that the eugenital lobes are level with, or just posterior to, the genital aperture. In the extended condition, it is directed anteroventrally between the first pair of legs.

Structure of the eugenital lobes

There is a pair of latero-dorsal lobes and an unpaired ventral lobe and, in *M. symmetrica*, these lobes are rather long and narrow. The chaetotaxy is normal, and setae in the τ series on the latero-dorsal lobes are arranged in a triangular pattern (Fig. 1B). The distal setae (ψ_1 on the ventral lobe, and τ_1 on the latero-dorsal lobes) are rather longer than the proximal setae. As GRANDJEAN (1956) noted, these setae are inserted on the non-sclerotized exterior surface of the lobes. The sclerotized inner face of each lobe is glabrous. When the ovipositor is " at rest ", the inner faces of the three lobes fit closely together, so that the aperture of the ovipositor is effectively closed, and is reduced to a triradiate fissure.

Further investigation into the structure of these eugenital lobes, by means of serial sections, has revealed that both internal and external faces of these lobes are fully sclerotized in the basal region. Furthermore, these sections have shown that the ventral lobe interlocks with both of the latero-dorsal lobes (Fig. 2B), before the three merge, at a deeper level, into a single triradiate canal (Fig. 2C).

MECHANICS OF OVIPOSITION

Method of erection

The ovipositor is probably extruded by the hydrostatic pressure of the haemolymph or a gonadial fluid. Extended ovipositors filled with a fluid were noted in the present work (Fig. 1A). This fluid may also serve to lubricate the egg in its passage down the ovipositor. After egg-laying has been completed, the ovipositor is withdrawn, probably by the contraction of muscles inserted on its pleated wall.

Passage of the egg down the ovipositor

The egg of *Machadobelba symmetrica* is ovoid in shape, and its shortest diameter is almost twice as large as the diameter of the genital aperture. It is slightly more pointed at one end than than the other.

The egg passes through the genital aperture with the more pointed end first. The passage of the egg through this aperture was not observed, but it is evident that the egg must be capable of deformation to pass through this restricted space. The presence of the egg in the ovipositor

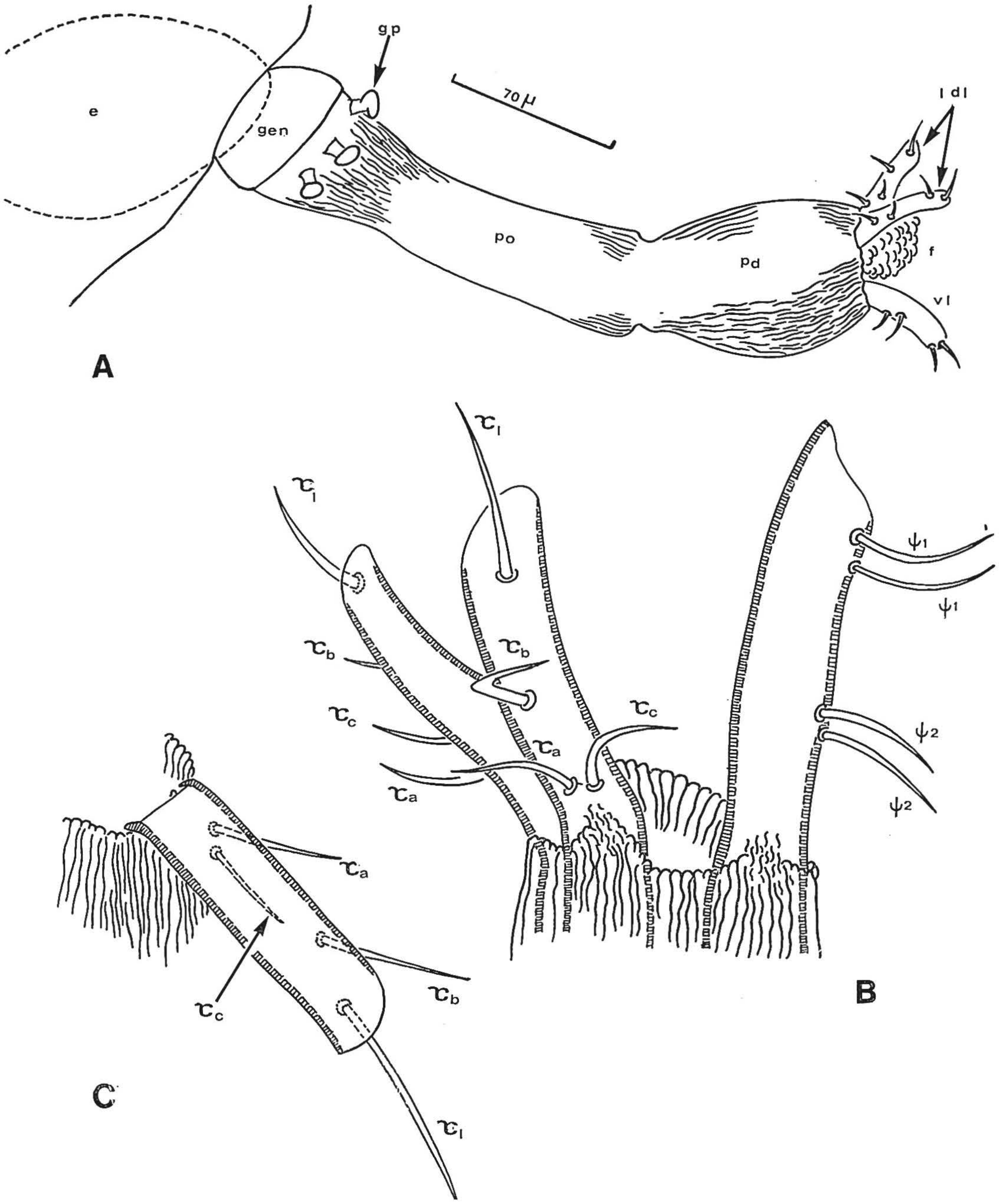

FIG. 1 : The ovipositor of *Machadobelba symmetrica* Bal. — A) Extruded condition immediately after egg deposition ; B) Eugenital lobes, slightly separated ; C) Latero-dorsal lobe in reflexed condition.

e : egg entering ovipositor ; *f* : ovipositor fluid ; *gen* : genital plate ; *gp* : genital papilla ; *ldl* : latero dorsal eugenital lobes ; *pd* : distal part of ovipositor ; *po* : proximal part of ovipositor ; *vl* : ventral eugenital lobe ; setal notations after Grandjean (1956).

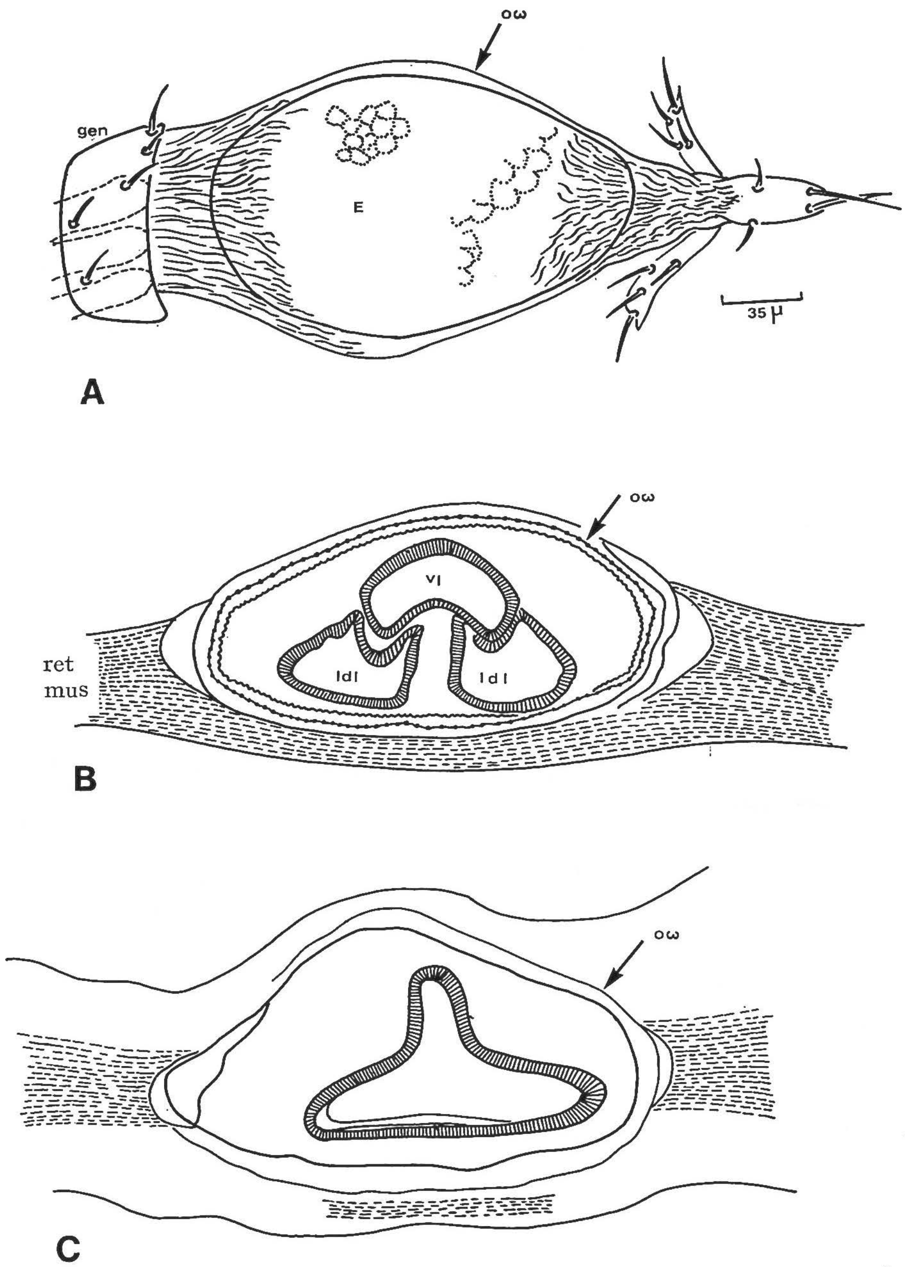

FIG. 2 : The ovipositor of *Machadobelda symmetrica* Bal. — A) Egg passing down the ovipositor ; B) Cross-section of eugenital lobes within retracted ovipositor (redrawn from photograph); C) As (B) but at a deeper level.

e : egg in ovipositor ; *gen* : genital plate ; *ldl* : latero-dorsal eugenital lobes ; *ow* : wall of ovipositor; *ret mus* : retractor muscle ; *vl* : ventral eugenital lobe.

causes considerable distention of the wall of this structure, which becomes stretched to a very thin membrane (Fig. 2A). Waves of muscular contraction probably carry the egg down the tube to the distal portion, where the consequent enlargement of the tube forces the three terminal lobes apart. The two latero-dorsal lobes are hinged near their bases (Fig. 1C), and as the egg passes through the distal part of the ovipositor, these lobes are reflexed sharply, outwards and backwards, thus opening up the distal aperture of the tube through which the egg is deposited. This flexure of the latero-dorsal lobes was clearly evident when an egg, contained within the ovipositor, was manipulated forwards and backwards along this tube. In contrast, the ventral eugenital lobe, although movable, did not appear to be hinged at the base, and was not reflexed to the same extent as the latero-dorsal lobes.

In *Machadobelba symmetrica* eggs are apparently laid in batches, since Figure 1A shows that one egg is in the process of entering the ovipositor immediately after another has been deposited This phenomenon is not unusual among oribatid mites.

Concluding remarks

In its general form and structure, the ovipositor of *Machadobelba symmetrica* conforms to the general picture described by Grandjean (1956). The absence of *k* setae between the proximal and distal parts of the ovipositor contrasts with Grandjean's observation on *Nothrus silvestris, Heminothrus targionii* and *Eremaeus hepaticus*, although he noted the tendency for one of these pairs of setae to be lacking in *Nothrus silvestris*.

One point of information which the present study has brought to light is the presence of a hinge at the base of each of the latero-dorsal eugenital lobes. This hinge allows the lobe to be reflexed outwards and backwards through an arc of approximately 135° when an egg is passing through the distal part of the ovipositor. Grandjean (1956) suggested that the extremities of the eugenital lobes, and their setae, had a tactile function, or a sensitive role in exploring the substratum prior to egg deposition. The fact that the two latero-dorsal lobes can be sharply reflexed also suggests that these lobes may be important in pushing aside particles of organic debris. This could lead to the creation of a micro-cavity into which the egg could be deposited.

Summary

A description is given of the structure of the ovipositor, and the mechanism of egg-lying in the oribatid mite *Machadobelba symmetrica* Bal. In general, Grandjean's (1956) observations are confirmed. The absence of *k* setae and the triangular configuration of setae on the latero-dorsal lobes are features associated with the " higher " oribatids. The passage of the egg along the ovipositor is described, and it is suggested that the eugenital lobes play a part in creating micro-cavities in which the eggs are deposited.

Résumé

L'auteur fait la description de la structure de l'ovipositeur et du mécanisme de la ponte chez l'Oribate *Machadobelba symmetrica* Bal. De façon générale, les observations de Grandjean (1956) ont été confirmées. L'absence des poils *k* et la chaetotaxie triangulaire des poils τ sur les lobes latérodorsaux se retrouvent chez beaucoup d'Oribates supérieurs. Le passage de l'œuf le long de l'ovipositeur est décrit, et il est suggéré que les lobes eugénitaux jouent un rôle dans la formation des microcavités où les œufs sont déposés.

REFERENCES

GRANDJEAN (F.), 1956. — Caractères chitineux de l'ovipositeur en structure normale chez les Oribates (Acariens). — Arch. Zool. Gén. et Exptl., **93** (Notes et Rev.) : 96-106.

MICHAEL (A. D.), 1883. — British Oribatidae, Vol. **1**. — The Ray Society London, 336 p.

WOODRING (J. P.) & COOK (E. F.), 1962. — The internal anatomy, reproductive physiology, and moulting process of *Ceratozetes cisalpinus* (Acarina : Oribatei). — Ann. Ent. Soc. Amer., **55** : 164-181.

Paru en Septembre 1977.