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OBSERVATIONS ON THE PLASTRON MECHANISM
OF HYDROZETES SP.
(ACARI : ORIBATIDA : HYDROZETIDAE)\(^1,2\)

BY G. W. KRANTZ and G. T. BAKER\(^3\)

**ULTRASTRUCTURE PLASTRON**

**ABSTRACT**: The fine structure and configuration of the plastron mechanism of an aquatic oribatid mite, *Hydrozetes* sp., are described. Comparisons are made with the peritrematic plastron mechanisms of two gamasid mite species that also have invaded aquatic habitats.

**ULTRASTRUCTURE PLASTRON**

**RÉSUMÉ**: La fine structure et la configuration du mécanisme du plastron d' *Hydrozetes* sp. sont décrites. Les comparaisons entre un mécanisme de plastron de deux gamasides aquatiques et d' *Hydrozetes* sp. sont faites.

**INTRODUCTION**

The genus *Hydrozetes* comprises 17 described species of oribatid mites which are found throughout the world in aquatic situations, generally in association with plants. Individuals may commonly be encountered on and beneath the water surface on various plant parts, and have even been observed within subsurface roots of anchored aquatic plants. Since *Hydrozetes* is derived from terrestrial stock, invasion of the aquatic milieu has necessitated development of a special strategy for procuring a dependable and uninterrupted oxygen supply. A plastron mechanism, which allows for gas interchange across an air-water interface (THORPE, 1950), has been found in adults of a species of *Hydrozetes* presently in culture at Oregon State University. A complex system of cuticular microextrusions on the body surface traps and holds a thin layer of air, or plastron, which resists wetting when the mite is submerged. The plastron enables *Hydrozetes* sp. to obtain needed oxygen directly from the surrounding water by means of diffusion, and permits the mite to remain submerged for extended periods of time. References in the literature to plastron-like structures in other *Hydrozetes* species (see below) suggest that the plastron is a regular feature of the genus.

Plastrons are well known in the Insecta and have also been described in certain secondarily aquatic gamasid mite species (HINTON 1967, 1971; KRANTZ 1974), but no direct reference has

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FIG. 1-3: *Hydrozetes* sp., female. Configuration of the plastron bed (stippled portions).
heretofore been made to the existence of a plastron mechanism in the Oribatida. NEWELL (1945) described what must have been the plastron in Hydrozetes petrunkevitchi Newell as silvery excrescences on the hysterosoma, “with silvery patches occurring on portions of the propodosoma also, and occasionally on the venter”. Similar silvery areas have been noted on submerged specimens of H. thienemanni and on Hygroribates marinus Banks, a littoral amenophonothroid oribatid species (J. P. WOODRING, personal communication). GRANDJEAN (1948) illustrated the plastron beds of H. thienemanni (= H. incisus Gr.) and H. parisiensis Gr., but did not refer to them in his descriptions. In her diagnosis of H. mollicomma, HAMMER (1958) made reference to the presence of “small chitinous tubercles, especially on the lateral part of the hysterosoma... and along the border of the hysterosoma there is an undulating veil from a secretion layer”. She noted also that “Between the lamellae something like a veil is seen, which proceeds forwards almost to the tip of the rostrum...” It seems likely that Hammer was observing portions of a plastron mechanism. The presence of a plastron mechanism in the Hydrozetes species presently under study was briefly noted by KRANTZ (1978).

Some years ago, a population of Hydrozetes sp. (near lemmiae Coggi) was discovered in a culture of the aquatic weed, Salvinia rotundifolia Willd., collected in central Florida and maintained in the Department of Plant Sciences, Indiana University, Bloomington. A number of live specimens of Hydrozetes sp. were procured from the Indiana culture in 1974 and cultured on Lemna and Cryptocoryne in an aquarium in the acarology laboratory at Oregon State University. Observations on the fine structure and configuration of the plastron mechanism of Hydrozetes reported below are based on specimens from this culture.

Materials and methods.

Live mites were observed on plant material in petri dishes in order to map the location of the plastron. The silvery air layer is clearly seen on the background of heavy, dark brown cuticle that covers the adult mite. Mapping of the plastron is further simplified by the fact that Hydrozetes sp. moves slowly even under strong light, and may be observed over long periods of time with little difficulty. Examination of the microprojections comprising the plastron bed was carried out on a Zeiss phase contrast microscope using permanent mounts and temporary well slide preparations, and on a scanning electron microscope using the following techniques: mites were fixed in 5 % glutaraldehyde in cacodylate buffer at 4°C for 24 hours and post-fixed in 2 % osmium tetroxide in cacodylate buffer for 2 hours. They were then placed in an ultrasonic cleaner for 30 seconds to remove any surface debris, dehydrated in 2,2-dimethoxypropane, and air- or critical point-dried. Silver paint was used to glue the specimens to aluminium stubs, after which they were carbon- and gold-coated. The coated specimens were examined on a AMR1000 S.E.M. at an accelerating voltage of 20kV. Images were recorded on Polaroid P/52 film.

RESULTS AND DISCUSSION

The cuticular extrusions comprising the plastron bed of adult Hydrozetes sp. differ both in structure and location from those of the gamsaid mites Platyselus italicus (Berlese) and Phaulodinychus mitis (Leonardi) (HINTON 1971, KRANTZ 1974). The plastron mechanisms of the latter two species are confined to the peritrematic grooves and consist of modified papillate microtrichiae that serve

4. A strategy for air conservation in an aquatic habitat is seen in the amenophonothroid family Fortuyniidae, in which paired chitinous tubes above trochanters III are thought to serve as air reservoirs during periods of submersion (VAN DER HAMMEN, 1963).

5. In his description of Hygroribates marinus, SCHUBART (1975) illustrates a tuberculate pattern on the dorsolateral aspect of the adult notogaster that is virtually identical in position to the plastron bed of Hydrozetes sp.
4. — Dorsum; 5. — Detail of prodorsum and adjacent notogastric region, showing texture and configuration of portions of the plastron bed; 6. — Lateral aspect; 7. — Detail of anterolateral aspect, showing portion of dorsolateral and intertrochanteral plastron bed; 8. — Plastron bed microextrusions; 9. — Detail of plastron bed adjacent to legs II-III (anterodorsal), showing the irregular patchy pattern of microextrusions. Elliptical entities seen in center of micrograph are diatoms.
as a hydrofuge bed for an overlying film of air. The plastron bed network of adult *Hydrozetes* sp. is considerably more extensive, and is comprised of folded, vertically flattened and jagged microextrusions in shallow grooves (Fig. 8), often arranged in irregular patchy patterns as seen in Fig. 9. The bed is more or less covered by what appears to be a tectostracal film which follows the fine contours of the plastron bed and, consequently, closely reflects its ornamentation. Apparently the plastron is carried on the tectostracal film rather than on the plastron bed itself. HAMMER's (1958) description of an "undulating veil" on the hysterosomatic border of *H. mollicoma* (see Introduction) may have referred to a partially detached tectostracal film.

Dorsally, the plastron bed appears in the interlamellar region of the prodorsum as an anteriorly directed tripartite extension (Figs. 4 and 5), with a separate island of extrusions occurring medially in the rostral area and a papillate crescent lying between setae ro. The adhering air layer, which is clearly seen only on live adult mites, may extend anteriorly from the interlamellar region to include these rostral islands. The plastron bed branches laterally to the lenticulus (Fig. 5, ln) at the lamellar bases, with one division forming two narrow strips of extrusions that extend posterolaterally along the dorsal border of the notogaster (Figs. 6 and 7) and terminate at the level of setae ps, (Fig. 1). The other divisions extend anteroventrally around pedotecta 1, joining a complex ventral pattern as illustrated in Fig. 2. An intertrochanteral pattern of extrusions extends medially to form a crenulated frame for the genital valves. A pair of narrow strips runs from trochanters IV posteriorly to the anal valves, bordering the valve complex on its lateral and posterior margins (Figs. 2 and 3). The entire plastron bed network forms a continuous system that terminates at paired sejugal stigmata between trochanters II-III on either side of the idiosoma (Fig. 3, st).

Plastrons have not been observed in immature *Hydrozetes*, although immatures share the underwater habitat of the adults. It is assumed that immatures respire directly through the cuticle. The development of plastron mechanisms in gamasid and oribatid mites presents an interesting evolutionary convergence. The gamasid plastron beds in *Platyseius italicus* and *Phaulodinychus mitis* are derived directly from preexisting peritremes, which are contiguous with the internal respiratory system. Oribatids have no external peritrematic grooves, but the plastron bed of *Hydrozetes* sp. is, in effect, a greatly extended "peritreme" that contains extrusions similar to those found in *P. italicus* and *Ph. mitis*. Finally, as in these aquatic gamasid species, the plastron bed of *Hydrozetes* sp. is contiguous with the internal respiratory system via paired lateral stigmata.

**REFERENCES**


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