

## Cleavage of a Jumping Bristletail, *Pedetontus unimaculatus* Machida (Hexapoda, Microcoryphia, Machilidae)

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The cleavage of Microcoryphia was reported by Heymons and Heymons (1905) for *Trigoniophthalmus alternatus* (Machilinae) and by Larink (1969) for *Petrobius brevistylis* (Petrobiinae). Those observations are all coincident in that the cleavage is of the typical superficial type as those of the other Thysanura s. lat. (Microcoryphia + Thysanura s. str.) and the Pterygota. On the basis of the cleavage type insect comparative embryologists have conceived a closer affinity between the Microcoryphia and Thysanura s. str., and they have taken it for granted the unity of the Thysanura s. lat. and further of the Euentomata (Thysanura s. lat. + Pterygota) (Sharov, 1966 ; Jura, 1972).

We have been studying the early embryogenesis of a microcoryphian, *Pedetontus unimaculatus* Machida (Petrobiinae) in detail, with employing Karnovsky's fixative and metacrylate or epoxy resins as an embedding medium, and we came to a conclusion that the cleavage of this insect is, at least in earlier stages, holoblastic. Here we briefly report our observations.

First six or seven nuclear divisions are performed radially, with the centrifugal migration of cleavage nuclei. First at the third division, furrows appear between adjacent nuclei on the egg surface. In the following divisions the furrows gradually deepen to divide the yolk mass completely into yolk blocks or blastomeres. The third to eighth nuclear divisions are accompanied by cytoplasmic division. Each resulting blastomere contains a single nucleus. Figure 1 a and b are

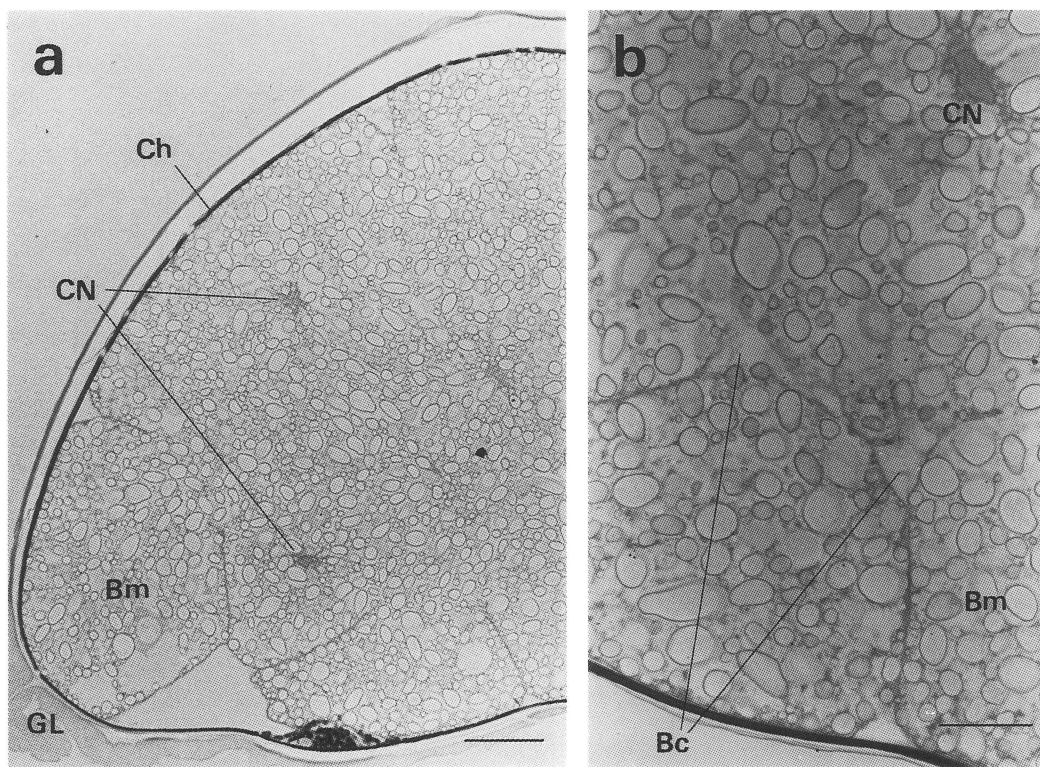


Fig. 1 Egg of *Pedetontus unimaculatus* with 32 nuclei (30hr after laying). a. Cytoplasmic division is in progress after fifth nuclear division. Two cleavage nuclei can be seen. Scale = 100  $\mu$  m. b. Constrained blastocoels are found between adjacent blastomeres. Scale = 50  $\mu$  m. Bc:blastocoel, Bm:blastomere, Ch:chorion, GL:gelatinous layer, CN:cleavage nucleus.

photographs of a 32-nucleus embryo, in which the cytoplasmic division is in half the way of the process, and constrained blastocoels are found between adjacent blastomeres. From the seventh to eighth divisions, tangential divisions take place, although radial ones are predominant, resulting in the formation of blastomeres localizing away from egg surface. The nuclei of these off-surfaced blastomeres are future primary yolk nuclei.

After the eighth or ninth nuclear division no cytoplasmic division was observed except in the periplasm. In *ca.* 250-cell embryos, the nuclei other than the yolk nuclei have settled in the periplasm. The peripheral nuclei proliferate to form blastoderm. A part of their daughter nuclei are liberated into yolk to become secondary yolk nuclei. Both the primary and secondary yolk nuclei undergo mitoses to increase in number up to *ca.* 1000 are counted, when 2000-3000 nuclei are in the just completed blastoderm. With the proceeding of blastoderm formation, boundaries of blastomeres gradually fade out to vanish.

As mentioned above, in *P. unimaculatus* the embryonic development starts with the total cleavage, and then comes to the superficial one, with the restriction of cytoplasmic division to the egg periphery. Similar cleavage pattern is observed in *Haslundichilis* sp. (Machilinae) (unpublished). Here, we conclude that the cleavage is, at least in earlier stages, holoblastic in two subfamilies of the Machilidae, Microcoryphia. Our observataion makes a clear contrast with Heymons and Heymons' (1905) and Larink's (1969) observation for the species of the same two subfamilies that the cleavage is of typical superficial type. Cleavage of *T. alternatus* and *P. brevistylis* should be reexamined by a method we used.

The cleavage of *P. unimaculatus*, and also of *Haslundichilis* sp., resembles those of the Collembola (Jura, 1965) and some myriapods (Tiegs, 1940, 1947; Dohle, 1964), and it is fairly different from the superficial cleavage of the *Thysanura s. str.* (Heymons, 1897; Sharov, 1953; Wellhouse, 1954; Woodland, 1957) and Pterygota. The phylogenetic rearrangement of the lower hexapods may be desired through the consideration on the type of cleavage. Further phylogenetic discussion and details of early embryogenesis including the cleavage of *P. unimaculatus* will be published near future.

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