A Commensal Sea Cucumber

Although echinoderms may serve as hosts to commensals and parasites (*1*), no parasitic or commensal echinoderms have been reported to date. On 12 September 1968 the R.V. *Velero* made a net haul between 500 and 1050 fathoms, 19.5 miles southeast of Head Light on San Clemente Island off the coast of southern California. In this haul was an angler fish, *Gigantactis macronema* Regan, that had four small, cylindrical, gray organisms attached to one side of its body. Whole mounts were made of three of these, and the fourth was serially sectioned. Whole mounts were stained with Mayer's paracarmine, but sections were stained with Mallory's triple. Lengths and maximum widths in millimeters of the three whole mounts are—1.75 by 7.14; 2.52 by 5.71; and 2.24 by 5.18. The anatomy is unquestionably holothurian.

The cucumbers were firmly attached to the fish host, but there appeared to be no invasion of host tissue. These few small individuals probably did not interfere with the host's movement. The cucumbers would benefit by being transported about, increasing their range and providing new feeding areas. They appear to be commensals.

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References and Notes

1. L. Hyman, *The Invertebrates, Echinodermata* (McGraw-Hill, New York, 1955); R. P. Dales, in *Symbiosis*, I. M. Henry, Ed. (Academic Press, New York, 1966), vol. 1; D. Davenport, *ibid.*
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Gnathostomulida: Is There a Fossil Record?

Current investigation (*1*) on the new phylum Gnathostomulida injects a new choice into the paleontological controversy surrounding conodonts. Most specialists (*2*) have favored association of conodonts with fish or primitive vertebrates. Affinity with worms has been proposed (*3*) but questioned (*4*), and similarity to the copulatory apparatus of some Turbellaria has been suggested (*5*). Comparison has been made with molluscan radular teeth (*6*) and I had supposed conodonts to be proventricular teeth of trilobites on the basis of similar chemical analyses published for conodonts and phacopid exoskeleton. Hass (*7*) suggested that they might be internal supports for tissues located in regions of stress, either external or internal, but did not guess affinity of the group.

Microconodonts (*8*) from Baltic Cretaceous chert, characterized by conodont-like form and much smaller size, have been considered to be worm jaws (*9*).

Conodont structure restricts the choice of groups for potential association. Fibrous conodonts (Neurodontiformes) found crushed and frayed, but not broken, were probably endoskeletal in muscular tissue as Hass (*7*) suggested. Laminated conodonts (Conodontiformes), with layers of close packed fibrous crystals perpendicular to laminar interfaces and arranged cone-in-cone, must have been apically accretionary. Thus these also are endoskeletal, probably deposited between dermal membrane and conodont in rigid oral papillae. Occasional finds of broken conodont teeth, repaired by apical overgrowth, support this interpretation. Organisms bearing exoskeletal deposits or ecdysial elements (Trilobites, Crustacea and other arthropods, annelid worms) may be ruled out. Nor could conodonts be close to Onychophora or Tardigrada for the jaws of the former and the claws of both are formed by internal periodic deposition of new layers under a wearing outer surface. Tardigrad stylets are possibly of intramuscular origin. The association of slender and often abruptly curved teeth, long multidentate rami, with plates, found in Conodontophoridia, Gastropoda, Amphineura, and Gnathostomulida suggests similarity of function. Riedl (*1*) reports preferential feeding of gnathostomulids on fungi and blue-green algae. Gastropods with conodont-shaped radular teeth and chitons are generally algal feeders. Hence it is suggested that conodonts were the cores of endosclerotized circumoral papillae, used to tear up and ingest fungal hyphae and algal mats, by probably benthonic "worms." Scalelike objects of conodont-like composition, found in association with conodonts (*10*) in the Ordovician, often with parallel rows of nodular bosses (unpublished), from the Silurian, may be interpreted as basal plates comparable to those of the gnathostomulids. Small spheroidal bodies of similar material may be statocysts similar to those of the gnathostomulidan foregut.

On the basis of size, microconodonts are probably fossil Gnathostomulida closely related to the living fauna. Conodonts belonged to larger organisms which are probably best considered as the class Conodontophorida within the phylum Gnathostomulida, filling in part, the niche constellation of benthonic browsing organisms now occupied by chitons and snails.

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References

1. R. J. Riedl, *Science* **163**, 445 (1969).
2. C. H. Pander, *Monographie der fossilen Fische des silurischen Systems der russisch—baltischen Gouvernements*, St. Petersburg, (1856); E. O. Ulrich and R. S. Bassler, *Proc. U.S. Nat. Mus.* **68**, article 12 (1926); H. Schmidt, *Paleontol. Z.* **16**, 76 (1934); E. B. Branson and M. G. Mehl, *Index Fossils of North America*, H. W. Shimer and R. R. Shrock, Eds. (Wiley, New York, 1944), pp. 235–246; S. P. Ellison, Jr., *Nat. Res. Council, Rep. Comm. Marine Biol. as Related to Paleontology* (1943–1944), pp. 1–4; gives bibliography.
3. H. W. Scott, *J. Paleontol.* **8**, 448 (1934).
4. ———, *ibid.* **16**, 293 (1942).
5. R. L. Denham, *ibid.* **18**, 216 (1944).
6. U. P. James, *J. Cincinnati Soc. Nat. Hist.* **7**, 143 (1884). F. B. Loomis, *J. Paleontol.* **10**, 663 (1936).
7. W. H. Hass, *ibid.* **15**, 71 (1941).
8. O. Wetzel, *Palaeontogr. Abt. A Paleozool.-Stratigr.* **78**, 1 (1933).
9. M. F. Glaessner, *Principles of Micropalaeontology* (Wiley, New York, 1947).
10. C. R. Stauffer, *J. Paleontol.* **4**, 121 (1930).

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Riedl's description (*1*) suggests that members of the new phylum Gnathostomulida are survivors of the group represented by the conodonts (*2–4*), minute toothlike fossils known from the Late Cambrian or Early Ordovician at least to the Late Triassic (very roughly, from 5 to 2×10^8 years ago). Some of the similarities are striking. Riedl states that "The mouth . . . is hardened by thin cuticularized basal plates, sometimes with a 'jugum' in the upper lip, mostly with a 'basal plate' in the lower lip area. The latter always bear lamellae, teeth, or a distinct tiny comb in its center. . . . a pair of lateral jaws in the mouth cavity . . . vary from simple pincer and forceps types to complicated lamellar snap-jaws with three pairs of comblike rows bearing up to 60 teeth," a fair description of conodont morphology. The jaws and basal plates shown in his Fig. 3 compare favorably with figures of individual toothed plates of conodonts (*2*), of assemblages of such plates (*3*), and of basal plates (*4*). Furthermore, gnathostomulids are reported to prefer fine sediment and to be very tolerant, if not fond, of relatively anaerobic conditions; it is well known that conodonts are common in black silty shale deposited under anaerobic condi-