The function of conodonts

SIR,—The biological affinities of the small tooth-like fossils known as conodonts, found in Palaeozoic and Mesozoic sediments, remain unknown. A number of bilaterally symmetrical natural assemblages have been described (reviewed by Rhodes, 1954; Lindström, 1964) and recently Melton & Scott (1972) have discovered some fossils containing such assemblages, although whether these represent the 'conodont-bearing animal' is uncertain. A new hypothesis is presented to explain the symmetry of the assemblages by analogy with the eversible tongue of the Myxinoidea.

Recent histological work now conclusively shows that conodonts were borne internally, i.e. surrounded by tissue. Müller & Nogami (1971) illustrate an *Acodina* element which has fractured, but the broken portion and a small splinter have both been retained and re-cemented. Microsculpture of the conodont surface, revealed using the Scanning Electron Microscope (Müller & Nogami, 1971; Lindström & Ziegler, 1971; Lindström, McTavish & Ziegler, 1972), consists of pits and striae and is strikingly similar to the surface of unworn mammalian enamel (Boyde, 1967, 1969; Boyde & Lester, 1967). The form of the latter is caused by the Tomes' processes of the ameloblasts, the cells responsible for the secretion of the enamel.

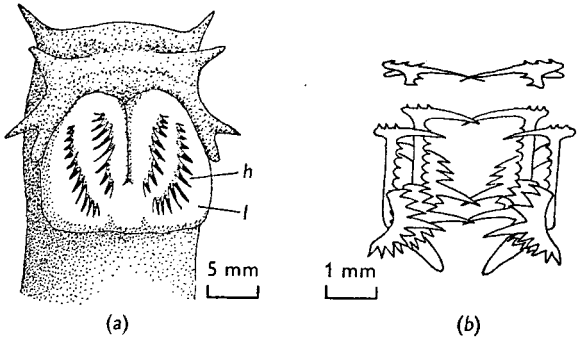

Figure 1. (*a*), The hagfish *Epatretus*, ventral view of the anterior end with the 'tongue' everted (based on a photograph); *h*, horny cusp; *l*, tongue. (*b*), The conodont assemblage *Duboisella typica* Rhodes (after Rhodes, 1954). Note the similarity of the arrays, although the individual elements differ in form.

Several hypotheses have been advanced to explain the function of conodonts (Rhodes, 1954; Lindström, 1964). Of these, only 3 take into account that conodonts were internal (which, incidentally, would appear to make affinities with the Annelida unlikely). Lindström (1964, 1972) proposed a role as a support for a tentacular, lophophore-like filtering organ. Halstead (1969), reversing the current system postulated by Lindström, suggested the conodont assemblages were the internal supports of the branchial basket of a planktonic, filter-feeding 'protovertebrate'. Schmidt (1934, 1964) put forward a similar model, but related the assemblages to jawed fishes, the platform elements functioning as a mandibular skeleton. Schmidt also suggested (Schmidt, 1964) that individual conodont elements bore horny cusps, thus resolving the problem of their tooth-like form whilst being within tissue.

One hypothesis not previously advanced is that the conodont assemblages could have functioned as the skeletal elements of horny cusps borne on an eversible lingual structure. A Recent example of such a feeding organ is the 'tongue' of the Myxinoidea (hagfishes) – see, for example, Jensen (1966) – (to which Ulrich & Bassler (1927) casually referred

certain conodonts). This 'tongue' is armed with a bilaterally symmetrical array of horny cusps (Fig. 1), although these have no individual skeletal supports. The other group of present-day Agnatha, the Petromyozontia (lampreys), provides an example of teeth with such a structure: each cusp has underneath it a cartilage pad. Affinities between the Conodontophorida and the Petromyozontia are, however, rejected on the grounds of the radial symmetry of the tooth array of the latter.

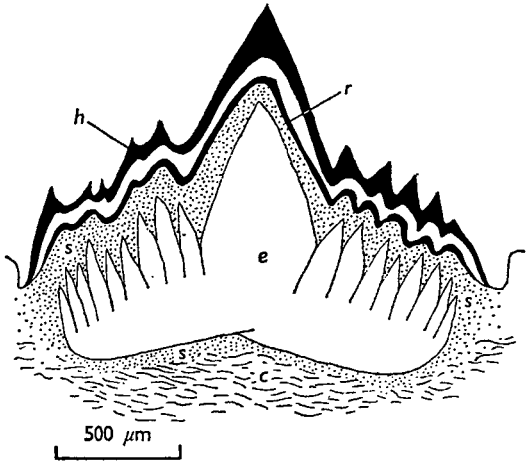

Figure 2. Postulated structure of the conodont-supported horny tooth: *c*, connective tissue of dermis; *e*, conodont element; *h*, horny cusp; *r*, replacement cusp forming below the earlier one; *s*, conodont secreting cells.

It may be postulated that each conodont element supported a horny cusp, epidermally derived and perhaps replaceable when worn (Fig. 2); the whole assemblage being borne on an eversible lingual structure. This reconciles the internal nature of conodonts with a tooth function (whereas it was previously generally assumed that to function as teeth the elements had to be external – see Rhodes, 1954), and provides an explanation for the bilateral symmetry of the known assemblages. However, with no conclusive evidence to link the Conodontophorida to any known group, their affinities must remain in doubt.

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References

Boyde, A. 1967. The development of enamel structure. *Proc. R. Soc.Med.* **60**, 923–8.
Boyde, A. 1969. Correlation of ameloblast size with enamel prism pattern: use of Scanning Electron Microscope to make surface area measurements. *Z. Zellforsch.* **93**, 583–93.
Boyde, A. & Lester, K. S. 1967. The structure and development of marsupial enamel tubes. *Z. Zellforsch.* **82**, 558–76.
Halstead, L. B. 1969. *The Pattern of Vertebrate Evolution.* Oliver & Boyd, Edinburgh.
Jensen, D. 1966. The hagfish. *Scient. Am.* **214**, 82–90.
Lindström, M. 1964. *Conodonts.* Elsevier, Amsterdam.
Lindström, M. 1972. On the affinities of conodonts. *In* Rhodes, F. H. T. (Ed.): Conodont paleozoology. *Spec. Pap. geol. Soc. Amer.* **141.**

Lindström, M., McTavish, R. A. & Ziegler, W. 1972. Feinstrukturelle Untersuchungen an Conodonten. 2. Einige Prioniodontidae aus dem Ordovicium Australiens. *Geologica et Palaeontologica* **6**, 33–44.

Lindström, M. & Ziegler, W. 1971. Feinstrukturelle Untersuchungen an Conodonten. 1. Die Überfamilie Panderodontacea. *Geologica et Palaeontologica* **5**, 9–33.

Melton, W. & Scott, H. W. 1972. Conodont animals from the Bear Gulch Limestone, Montana. *In* Rhodes, F. H. T. (Ed.): Conodont paleozoology. *Spec. Pap. geol. Soc. Amer.* **141**.

Müller, J. von K. & Nogami, Y. 1971. Über den Feinbau der Conodonten. *Mem. Fac. Sci. Univ. Kyoto, Ser. Geol. Min.* **38**, 1–87.

Rhodes, F. H. T. 1954. The zoological affinities of conodonts. *Biol. Rev.* **29**, 419–52.

Schmidt, H. 1934. Conodonten-Funde in ursprünglichen Zusammenhang. *Paläont. Z.* **16**, 76–85.

Schmidt, H. 1964. *In* Schmidt, H. & Müller, K. J. Weitere Funde von Condonten-Gruppen aus dem oberen Karbon des Sauerlandes. *Paläont. Z.* **38**, 105–35.

Ulrich, E. O. & Bassler, R. S. 1927. A classification of the toothlike fossils, conodonts, with descriptions of American Devonian and Mississippian species. *Proc. U.S. Nat. Mus.* **68** (12), 1–63.

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