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Structure of a sea urchin tooth

Markel and Gorny in 1973 pointed out [1] the remarkably similar appearance of the central region of a sea urchin tooth and a glass fibre-reinforced plastic. We thought it might be of interest to materials scientists to describe this structure briefly in a journal more accessible to them.

The common British sea urchin *Psammechinus miliaris* feeds on plant material. It has five ever-growing teeth with which it scrapes and triturates its food. The major part of the tooth is like the rest of the sea urchin's skeleton, being made of substantial crystals of calcite which, because of the influence of the living tissues surrounding them, do not look like crystals but have smoothly rounded outlines and are pierced by a series of interconnected holes.

The central region is different. Its appearance is shown in Fig. 1 and 2. The fibres are single crystals of calcite; the matrix is probably amorphous calcium carbonate. The aspect ratio of the fibres is extremely large. Indeed, since the fibres are 1 mm or more in length and about 6 μm in diameter, they can be considered to be effectively continuous. Two other features of interest can be seen in Fig. 2: the packing of the fibres is very regular, and their volume fraction is high, about 55% in the part of the tooth shown here. The central region

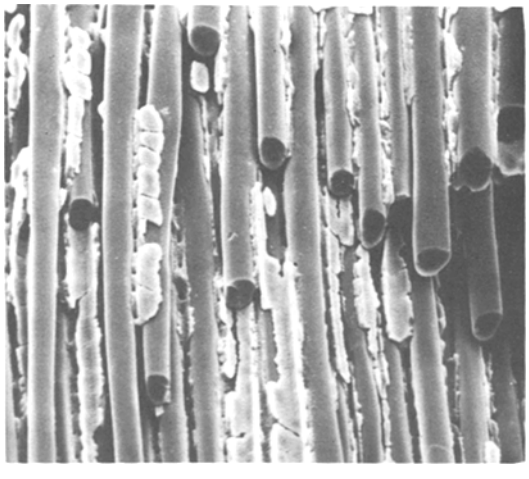

Figure 1 Scanning electron micrograph of the central region of the tooth of *Psammechinus miliaris.* The tooth was fractured and then vibrated in an ultrasonic bath for 2 min. The fibres are about 6 μm in diameter.

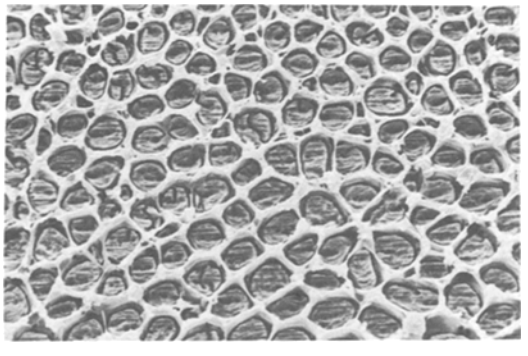

Figure 2 Scanning electron micrograph of the central region of the tooth of *Psammechinus miliaris.* The tooth was embedded in resin, ground down to a plane normal to the long axis of the fibres, polished and etched briefly in dilute hydrochloric acid. The mean diameter of the fibres is about 6 μm. Note the parallel lines on the etched surfaces of the fibres. These show that the fibres have all essentially the same crystallographic orientation.

of the tooth wears least so that it stands proud and forms a sharp point. It is too small for mechanical testing, having a cross-sectional area of about $\frac{1}{2}$ mm^2, but we have found that the Vickers hardness of this region is higher, although not spectacularly so, than that of the rest of the tooth.

Any reader who would like a tooth of *Psammechinus* is invited to get in touch with the authors.

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