

(known as silver apricots) had been spread across China; by the 13th, *Ginkgo* was in widespread cultivation. The author's account of the economic exploitation of ginkgos across Asia involves shipwrecks and ancient trade routes from China as well as the western discovery (1690) of ginkgo by physician-botanist Englebert Kaempfer in Japan.

Crane concludes *Ginkgo* where he started, with a passionate advocacy for the importance of trees in the wild and in our cities. He highlights that 8000 tree species, representing around 10% of the global diversity, are currently threatened with extinction, and he stresses the importance of ex situ conservation measures involving collections of living specimens in botanic gardens around the world. The actions of *Homo sapiens* have led to species loss at an unprecedented rate, but in the case of *Ginkgo biloba*, we have served as a highly effective dispersal agent. As a result, a once-dwindling population in China is now represented and loved in botanic gardens and cities around the world.

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## PALEONTOLOGY

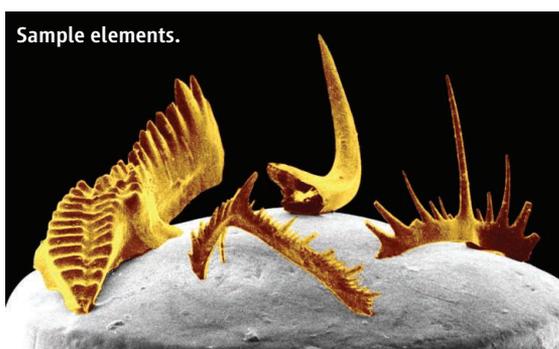
# "Fascinating Little Whatzits"

Philip Donoghue

Conodonts have captured the imagination of paleontologists like no other group, perhaps because they are among the most common and, paradoxically, the rarest of all fossils. Conodonts usually manifest themselves as microscopic, toothlike "elements," the biology of which remained a mystery for much of the time following their discovery in the 1850s. Not until the 1980s was some flesh added to these meager bones by a handful of specimens that preserved the soft-tissue anatomy of these eel-like organisms.

The mystery of the nature of the animal might not have inspired any attention were it not for the fact that conodonts became phenomenally useful geological tools, employed by hundreds of researchers in academia and industry. On the

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basis of "species" identified through subtle differences in the tooth elements, it became possible to determine the relative age of rock sequences with unrivaled accuracy and precision, correlating time-equivalent strata across hydrocarbon-bearing basins and among continents of the Paleozoic and Triassic. And through analysis of the effects of carbonization on the organics entombed with the calcium phosphate skeleton, conodonts revealed the thermal history of rock sequences, making them invaluable in hydrocarbon and precious metal exploration. Very little of this utilitarian research evoked interest in conodont biology except when it occasionally boggled the minds of those who spent their working lives staring down microscopes at the fascinating little whatzits.

The history of research into conodont biology, particularly of attempts to deduce the animal's position on the tree of life, can be viewed as one long parlor game, the rules of which required participants to find in candidate relatives structures similar in size, shape, and composition to conodont elements. Because many organisms have aspects of their anatomy that are small and pointy (e.g., the teeth of molluscs, priapulids, and chaetognaths), conodonts have been identified as fossils of just about every major group of animals, as well as fungi, plants, and algae.

Simon Knell's *The Great Fossil Enigma* recounts this history of conodontology by drawing on the primary research literature and also on interviews with and personal correspondence among the participants and witnesses. He does not shirk interest in the development of conodonts as geological tools, but his focus is on the development of conodont biology. In so doing, Knell (a historian of science at the University of Leicester) takes the unexpected and thought-provoking approach of building a narrative on the shifting concept of a conodont organism that occu-

ried the minds of conodontologists and how this affected other spheres of research from taxonomy to biostratigraphy to paleoecology. He documents also the discovery of the flesh behind the conodont's enigmatic smile and how those additional anatomical details removed debate over conodont biology from the parlor to the laboratory bench. No longer was it necessary to imagine the conodont—there was hard evi-

dence of the organism's soft-tissue anatomy written in stone.

There can be no doubt that Knell has written a singular history of conodont research, and likely anyone else would have written it differently. In particular, conodont specialists will lament Knell's focus on biology rather than the rich practical utility of these fossils. Equally, those whose interest is piqued by conodont biology will complain that Knell fails to exact critical judgment over the differing interpretations of the evidence marshaled in debates over their biological affinities. Such approaches, however, would have made for very obvious and very boring alternative narratives, as may be predicted from Knell's foray into the development of conodont biostratigraphy—which makes hard work of an esoteric debate over the dating of some parochial rock sequences.

Instead, Knell uses the history of conodont research to show how the ideas and actions of scientists are influenced not merely by the clinical interpretation of the evidence but also by their imagination. And surely the history of the field shows that until comparatively recently there was precious little evidence to constrain imagination. It also shows how the scope for such speculation is inevitably diminished by the discovery of new evidence—of the architecture of the conodont dentition, of the function of conodont elements, and, ultimately, of the anatomy and biological affinity of conodonts.

If you want an authoritative interpretation of the biology of conodonts, then you can do no better than to review the meager evidence and exact your own critical judgment. However, if you want a far more entertaining and interesting account of the discovery of knowledge through the analytical, political, and idiosyncratic activities of researchers, *The Great Fossil Enigma* will serve you well.

### References and Notes

1. Title of this review after (2).
2. W. C. Sweet, *J. Paleontol.* **59**, 485 (1985).

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