

The complex discovery of coccolithophores, from Ehrenberg to Lohmann *via* Sorby, Wallich and Huxley

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Coccolithophores are the smallest of routinely studied microfossils, only a few microns in diameter, in consequence the nineteenth century history of their study is not a tale of dedicated descriptive work by heroic pioneers. Instead it is a complex history of slow discovery and controversy, involving many of the greatest microscopists of the era. It is in part a well-documented story, with different aspects being covered by Gould (1978), Rehbock (1975), Rice *et al.* (1975), Rupke (1976) and Siesser (1994), especially as a result of the *Bathybius* controversy. However, re-examination of original material and manuscripts allows new perspectives to be given.

Like many other microfossils, coccoliths and discoasters were first described by the 'founder of micropalaeontology' Christian Gottfried Ehrenberg, and they are figured in many of the plates of his magnum opus *Mikrogeologie* (Ehrenberg, 1854). However, they were at the limit of resolution of his microscopes and he regarded them as inorganic precipitates – kalk-morpholithien and crystalldrüsen. Subsequently, they were rediscovered in ocean bottom sediments by Thomas Huxley (1858), who coined the name 'coccolith' for them on the basis of fine experimental observations that they were calcareous (hence '-lith'), and a rather less impressive misinterpretation of them as spherical structures similar to 'Protococcus' cells (hence 'Cocco-'). He also sent some of the sediment to Henry Clifton Sorby, the founder of petrographic microscopy. Sorby had previously observed that the chalk is largely composed of Ehrenberg's calc-morpholiths and had inferred that they were organic in origin. He rapidly established (Sorby, 1861) that Huxley's coccoliths were the same as Ehrenberg's calc-morpholiths, and so that deep-sea oozes provided an analog for the chalk.

The story then gets complex, as agglutinating foraminifera and inorganic precipitates lead the prime protagonists Wallich (a retired army doctor with scientific ambitions) and Huxley to infer that coccoliths were formed by the larvae of foraminifera (Wallich, 1861) or by a primordial slime covering the entire ocean bottom – *Bathybius haeckelii* (Huxley, 1868). The latter theory sounds like implausible fantasy, but in fact stemmed from predictions of Lorenz Okel, and especially Haeckel, and it briefly became a major scientific discovery, before being debunked by the observations of the *Challenger* expeditions' shipboard scientists in 1875. In parallel, Wallich became increasingly embittered at the lack of recognition of his contributions; his annotated reprint collection, archived in the NHM, provides spectacular evidence of his multiple grievances. Nonetheless, he first demonstrated that coccoliths are components of coccospheres (a term he coined in 1861) and, rather belatedly (Wallich, 1877), he documented that coccospheres were planktonic and described

the first two species – *Coccosphaera pelagica* and *C. carteri*. However, the numerous nineteenth century publications on coccoliths did little beyond establishing their basic nature. The first truly heroic study of them only occurred in the early twentieth century, with the remarkable work of Hans Lohmann, who coined the terms coccolithophore and nannoplankton, identified them as a major component of the phytoplankton, developed techniques for sampling them, and documented their taxonomy and biogeography (Lohmann, 1902, 1919).

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