Using Cycladophora

From microfossils to planetary sciences

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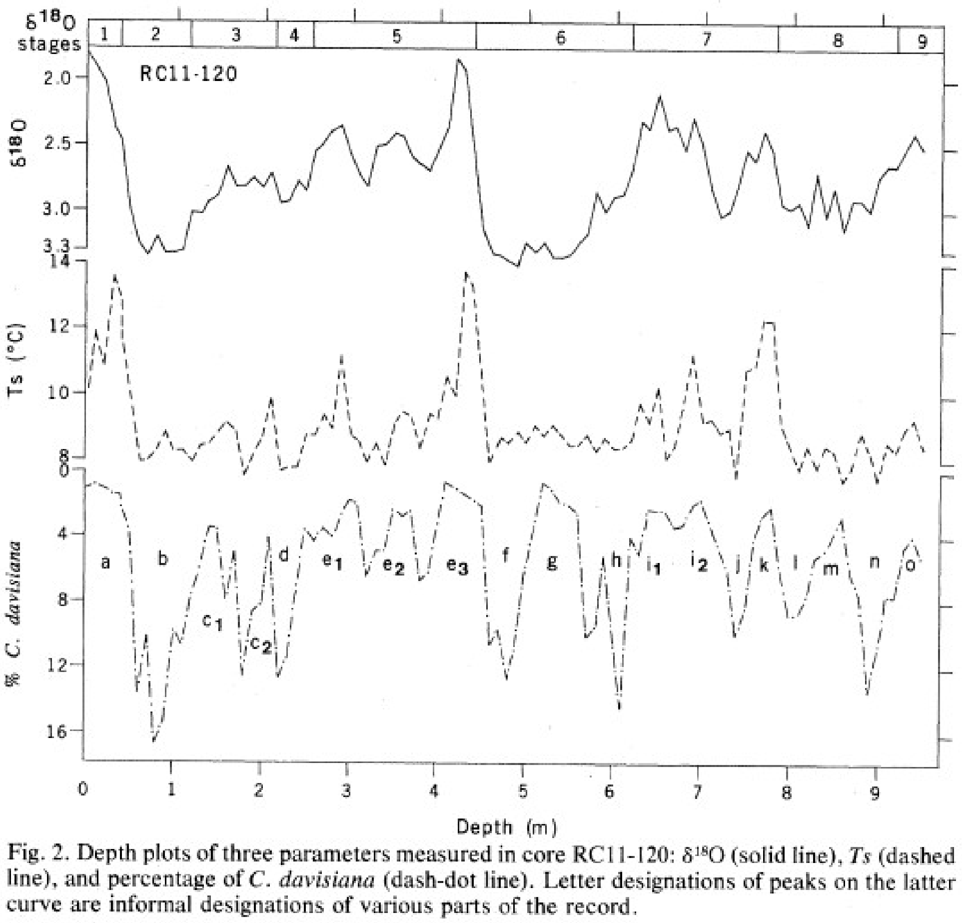

A graph from the milestone publication of James D. Hays et al. in Science *from 1976, linking variations in Cycladophora's abundances with glacial cycles. (All rights reserved.)*

Despite the early efforts of classifying Cycladophora over the second half of the 19th century, interest in this species (and radiolarians in general) subsided before the turn of century. This was at least partly due to the dead ends that Ernst Haeckel's study of radiolaria had led to. As a result, *Cycladophora* remained at the margins of natural sciences. That is, until the 1950s, when a young graduate student – William Rex Riedel – reassessed Haeckel's materials on this neglected group. Riedel soon realised that the German naturalist had mixed current radiolarians with more ancient ones. The long ranges hypothesised by Haeckel for radiolarians were incorrect, and these microorganisms could provide useful stratigraphic information, just like Foraminifera did for industrial micropaleontology already since 1921. Furthermore, the wartime technical developments made it possible to resolve the evolution of radiolarian species along the stratigraphic record more clearly. As the Cold War justified the financing of ambitious technoscientific projects, the exploration of the oceans reached a planetary scale – especially through the launch of JOIDES and the various deep sea drilling programmes already in the 1960s. Thanks to Riedel, who had a prominent role in these developments, radiolarians had now a front row seat during the return of micropaleontology at sea. As the study of microfossils connected more closely with oceanography, radiolarians revealed their potential for shedding light on the deep history and dynamics of our planet. Given its distribution in cold waters at high latitudes, Cycladophora davisiana was going to have a particularly important role in these histories of microbes and planets.

Up until the 1950s, foraminiferans had been the main tool in biostratigraphy. Because of their carbonate biochemistry, foraminifera shells (also called 'test') are not well preserved in high latitude sediments. In contrast, radiolarians are more widespread and better preserved in these sediments thanks to their siliceous tests. Furthermore, *Cycladophora*'s climatic preferences and distribution connect their abundance to glacial and interglacial variations in temperatures. For these reasons *Cycladophora davisiana* quickly became an important stratigraphic tool – in particular in relation to the dynamics of ice-age cycles. Instrumental to this success of *Cycladophora* as a scientific tool, was the ever-growing collection of data and sediment samples made possible by deep sea drilling. This impressive collection of scientific data joins longstanding natural history efforts in recording worlds, and has allowed scientists to expand their analyses. To organise these data, a series of databases have been developed since the 1990s. They converged in the NSB databse at the Museum für Naturkunde Berlin, which gathers over 700,000 records from the various deep sea drilling programmes. Today, digital databases have replaced earlier systems of record-keeping in natural history collections like logbooks, inventory books or index cards. In this way, the planet and its complex dynamics and systems emerge as objects of scientific study, as Big Data makes them more accessible and manageable.[1]

The case of *C. davisiana* is useful for illustrating this transformation of the natural sciences. The early studies of this microorganism focused on its description and classification within an order of nature at first, and a universal genealogy of life, later. But already with the emergence of industrial micropaleontology, microfossils had become interesting not on their own account, but as indicators that could be used in solving stratigraphic problems. By the 1950s, *Cycladophora* was also being used in this way, as records documenting its occurrence help date specific formations and sediments. As the microfossil record continued to grow, and novel techniques emerged, the information that could be extrapolated from *Cycladophora* also grew exponentially. This – combined with the astounding developments in computing made possible by the digital revolution – allowed scientists to trace phenomena of larger and larger magnitudes, like the movement of plate tectonics, the magnetic shifts of polarity, and the alternating of ice ages. For instance, in 1976 a landmark paper published in *Science* used an abundance of *Cycladophora davisiana* from two oceanic core samples (along with oxygen isotope fractionation in foraminiferal shells) to demonstrate the hypothesised relation between ice-age cycles and planetary orbital dynamics.[2] This paper, along with many others that followed, paved the way for current understandings of climate and planetary sciences.

In this sense, *Cycladophora davisiana* continues its scientific (after)life as an important gear in the 'vast machine' that subtends current climate sciences.[3] As the Museum für Naturkunde Berlin just received the Lamont-Doherty Collection of micropaleontological slides to complement its NSB database, a collection which includes the original specimens used in the 1976 *Science* publication, these various post-mortem lives of *Cycladophora* come together under the same roof again, as they prepare to travel even further in the future.

Footnotes

1. Although some scientists seem concerned that the handling of data needs to change, if climate models and predictions are to improve. See P. Bauer et al. "The Digital Revolution of Earth-System Science". *Nature Computational Science* 1 (2021): 104-113. https://doi.org/10.1038/s43588-021-00023-0.↩
2. James D. Hays, John Imbrie, and Nicholas J. Shackleton. "Variations in the Earth's Orbit: Pacemaker of the Ice Ages". *Science* 194 (1976): 1121-1132. https://doi.org/10.1126/science.194.4270.1121↩
3. Paul Edwards. *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*. Cambridge: MIT Press, 2010.↩