Micropaleontology at Sea

Microfossils and ocean exploration

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High Drama of Bold Thrust through Ocean Floor

AUTHOR STEINBECK AND PHOTOGRAPHER GORO ON DECK OF THE CUSS I

EARTH'S SECOND LAYER IS TAPPED IN PRELUDE TO MOHOLE

Last week Project Mohole (LIFE, April 7) made scientific history when its drilling barge, CUSS I (whose name is made up of the initials of oil companies who developed it: Continental, Union, Shell and Superior), pierced 601 feet into the sea floor to get core samples of the earth's never-before-penetrated second layer. On board to describe the extraordinary operation for LIFE was Novelist John Steinbeck, who is also an amateur oceanographer.

by JOHN STEINBECK

This is a short and casual log of CUSS I, the experimental drilling barge of Project Mohole. I am aboard because of a long-time interest in oceanography and some small experience in matters of the sea. I feel privileged and greatly excited.

CUSS I is a Navy barge redesigned to take sample cores from deep in the earth's surface under 12,000 feet of ocean. Our station is 44 miles east of Guadalupe and 220 miles south of San Diego. The sea bottom there is 11,700 feet beneath the surface. In a practice run we drilled a hole under 3,100 feet of water off La Jolla so we know it can be done.

CUSS I has the sleek race lines of an outhouse standing on a garbage scow. Actually it is an oil rig, straddle-legged over a hole cut through the middle of a barge 260 feet long and 48 feet wide. In addition to drilling equipment, cores and diamond bits it is loaded with electronic equipment, much of it invented and designed for this project. But the most important and unique equipment we have is the group of men aboard, an elite and motley crew. The drilling men are the cream of a very special profession already trained in offshore oil drilling in shallow water. Then we have engineers of a dozen kinds, oceanographers, geologists, paleontologists, petrologists, geophysicists and seismologists. Our expedition should destroy the old and well loved error that doers and thinkers are different breeds—and about time too.

This is the opening move in a long-term plan of exploration of the unknown two thirds of our planet that lies under the sea. We know less about this area than we do about the moon. Therefore this log will concern itself with men and events rather than with scientific conclusions. Those will have to come later after analysis of what we find.

Thursday March 23—After five days in a San Diego shipyard refitting and taking on additional equipment, we sailed at 1:30 for our Guadalupe Station, a point in the Pacific Ocean described as 27° North latitude, 117° 30′ West longitude.

Sailed is a status word for what we did. CUSS I waddled like a duck into the channel on its four gigantic Diesel outboard motors. Come to

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"High Drama of Bold Thrust through Ocean Floor", a reportage on the early phases of space age project Mohole by John Steinbeck for Life *magazine, 14 April 1961. Project Mohole was the prelude to the international efforts in deep sea drilling, which radically transformed micropaleontology.*

The global conflicts of the first half of the 20th century only increased society's thirst for fossil fuels. Thus industrial micropaleontology – which had quickly become crucial for oil exploration – continued its rise to fame. Until the end of the Second World War, the efforts of micropaleontologists had concentrated almost exclusively on Foraminifera. As oil became more profitable, requiring even better knowledge of global stratigraphy, a new understanding of earth's complex dynamics was taking shape. In this context, William Rex Riedel's[1] reassessment of the ranges of Radiolaria species represented a pivotal point in the history of micropaleontology, bypassing the dead ends of the previous century. It also opened new questions and research avenues. As a graduate student, Riedel had started focusing on this group, which had largely been neglected since the end of the 19th century. Analysing more closely the material studied by Ernst Haeckel from the "HMS Challenger" expedition from 1872-1876,[2] Riedel noticed that the

German naturalist often didn't correctly discriminate between older fossils and more recent materials. Rather than presenting long ranging forms, he realised that radiolarian species could also be used in biostratigraphy, since their species ranges, like those of foraminifera, offer helpful tools to interpret geological formations and their relations as they do change considerably over relatively short geological times. After the earlier, less successful, experience of micropaleontology at sea, which by the end of the 19th century had led scientists to overlook the importance of microfossils – see Micropaleontological Dead Ends – micropaleontologists were to become once again deeply involved with the exploration of the oceans.

The introduction of the piston corer,[3] a tool that allowed the collection of core samples up to nine meters long from the deep ocean floor, was particularly instrumental in micropaleontology's return to the sea. Studying the first of such cores collected by the Albatross scientific expedition[4] during his visit to Sweden in 1950, Riedel became aware of the value of these samples for micropaleontology. When he moved to California the following year, he brought this insight with him to the Scripps Institution of Oceanography,[5] placing micropaleontology at the forefront of postwar oceanography. As Riedel and others quickly understood, the stratigraphy of the ocean floor held an impressive and important record useful not only to the extractive industries, but also, increasingly, to an understanding of the planet's dynamic history. In a complementary development, novel techniques emerging from wartime developments in nuclear physics supported and transformed knowledge production in other fields, as Cesare Emiliani's work exemplifies.[6] In the 1950s, Emiliani was working at the Enrico Fermi Institute for Nuclear Science, as a research associate in the geochemical laboratory of Harold Urey – who was pioneering the study of the relationships between stable isotopes and environmental variables. Applying these insights to Foraminifera, Emiliani was able to relate changes in oxygen isotopes contained within microfossils with changes in ocean temperatures: he demonstrated that the microfossil record that had accumulated on the bottom of the sea could work as a paleothermometer. It registered environmental changes within the microorganisms' biochemistry which in turn signaled past changes in temperatures, for other examples of how organims change their role and status, see Logistical Metabolisms.

These novel insights were built on ocean sediments and particularly on the microfossils in them, which turned out to provide vast and useful data for shedding light on the deeper and less visible processes shaping our planet: data from microfossil records, for instance, provided experimental evidence for the theory of plate tectonics, for the planet's geomagnetic reversal, as well as for the effect of orbital variation on glacial cycles; see Cycladophora davisiana.[7] The vast apparatus required to collect these samples and data was made available thanks to a broader epochal change in the landscape of the technosciences set off by wartime research, and propelled further by postwar geopolitics: the advent of 'big science'. Fuelled by massive national and military funding, this new version of science was characterised by bigger budgets, teams, labs, and instruments, and it effectively boosted the micropaleontology-oceanography connection through the development of deep sea drilling. Championed by Riedel, Emiliani, and many other scientists, the effort to explore and document the global oceans, and especially their stratigraphy, gave rise to a number of research projects that continue to this day. Thanks to these technological and conceptual transformations, industrial micropaleontology consolidated its importance not only as an applied aspect of the extractive industries, but also – increasingly – as a foundational tool in the study of the planet's dynamics and deep history. As the examples of both Riedel and Emiliani illustrate, this novel role of micropaleontology was especially associated with the ongoing effort to map Earth's history and its geological strata and resources. But, for this mapping to succeed, an impressive variety of data from different sources needed to be collected and interrelated. Museums, and other scientific institutions and collections, were going to have a pivotal role in this effort, telling novel stories of microbes and planets.

Footnotes

1. For Riedel's biography, see the electronic journal that he helped create in the early years of the internet; "William Riedel". *Paleontologica Electronica (Staff)*, no date. https://palaeo-electronica.org/staff/bill.htm (01.07.2021).↩
2. This was one of the most celebrated oceanographic scientific explorations of the 19th century. See Ben Lerwill. "HMS Challenger: The Voyage that Birthed Oceanography". *BBC Online*, 21.07.2020. https://www.bbc.com/travel/article/20200719-hms-challenger-the-voyage-that-birthed-oceanography (01.07.2021); Kate Golembiewski. "H.M.S. Challenger: Humanity's First Real Glimpse of the Deep Oceans". *Discover Magazine*, 20.04.2019. https://www.discovermagazine.com/planet-earth/hms-challenger-humanitys-first-real-glimpse-of-the-deep-oceans (01.07.2021). For a more in-depth history, see Helen M. Rozwadowski. *Fathoming the Ocean: The Discovery and Exploration of the Deep Sea*. Cambridge: Harvard University Press, 2005.↩
3. For more on how a piston corer works, see "Piston Corer". *Woods Hole Oceanographic Institution*, no date. https://www.whoi.edu/what-we-do/explore/instruments/instruments-sensors-samplers/piston-corer/ (01.07.2021).↩
4. Hans Pettersson. "The Swedish Deep-Sea Expedition". *Nature* 162 (1948): 324-325. https://scholarspace.manoa.hawaii.edu/bitstream/10125/9061/1/vol2n4-231-238.pdf (01.07.2021).↩
5. Today, Scripps is still one of the most renowned centers for oceanography. See "Scripps History". *UC San Diego*, no date. https://scripps.ucsd.edu/about/history (01.07.2021).↩
6. For more on Cesare Emiliani, see Paul F. Hoffman. "The Tooth of Time: Cesare Emiliani". *Geoscience Canada* 39, no. 1 (2012): 13-16. https://journals.lib.unb.ca/index.php/GC/article/view/19452/21009 (01.07.2021); William W. Hay and Eloise Zakevich. "Cesare Emiliani (1922-1995): The Founder of Paleoceanography". *International Microbiology* 2 (1999): 52-54. http://www.soes.soton.ac.uk/staff/tt/eh/ce.html (01.07.2021).↩
7. For more about the development of paleoceanography in connection to the history of data, see Christof Rosol. "Hauling Data: Anthropocene Analogues, Paleoceanography and Missing Paradigm Shifts". *Historical Social Research*, 40, no. 2 (2015): 37-66. https://doi.org/10.12759/hsr.40.2015.2.37-66.↩