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## Pioneers of Plankton Research: Easter Ellen Cupp (1904-1999)

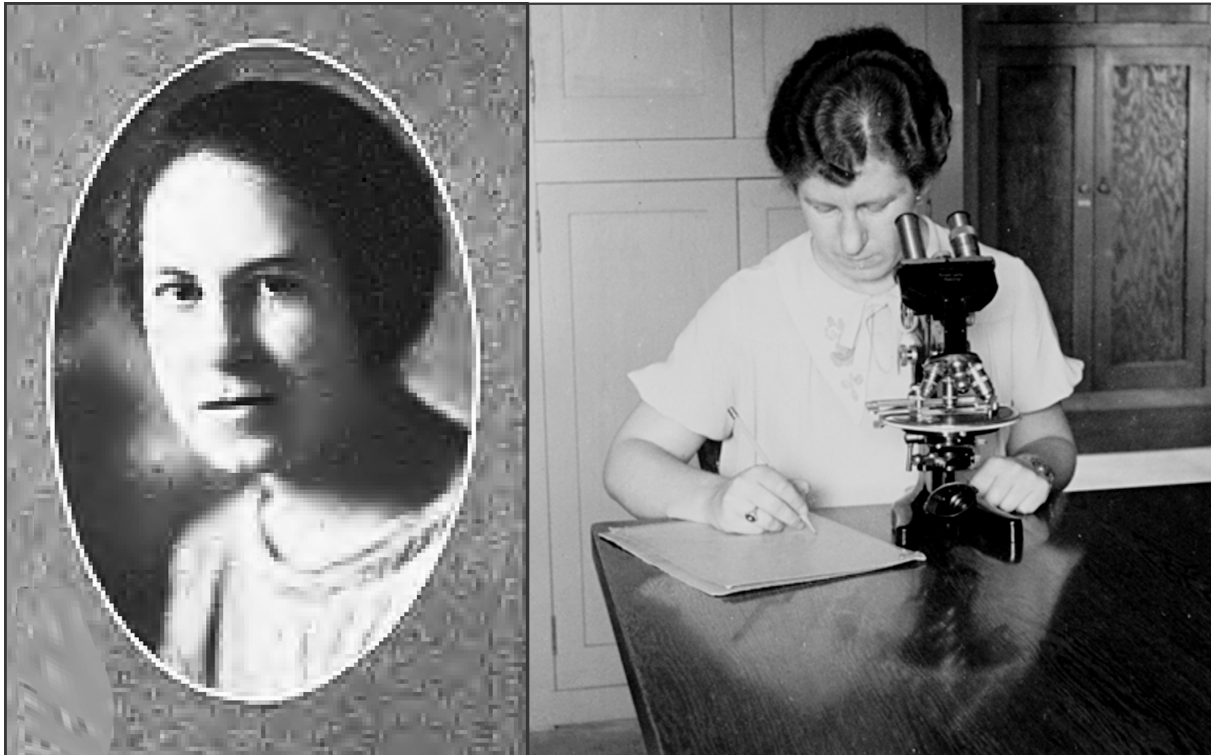
Easter Ellen Cupp (Fig. 1) authored a book familiar to many of us, *Marine Diatoms of the West Coast of North America*. It was published in 1943 and is today still regularly cited. Lesser known to most of us is that Cupp was also a remarkable figure in the history of Oceanography. In 1934, she was the first woman to earn a Ph.D. in Oceanography in the United States, and probably the first in the world. Perhaps most remarkably, Cupp was very likely the first oceanographer to lose her job because she was a woman. Here an introduction to the life of Easter Ellen Cupp (fig. 1), with a focus on her short but significant, and singular, career in plankton research will be provided based largely on the works by Day (1999, 2002) and Russell (2000).

Easter Cupp was born on Easter in 1904, hence her first name. She grew up in Whittier, in Southern California near Los Angeles, and attended Whittier College (Fig. 2), graduating with a Bachelor's degree, with a major in Zoology in 1926. After Whittier College, Cupp and her lifetime companion, Dorothy Rosenbury, went to the University of California in Berkeley to pursue Master's degrees. Cupp worked on protists, and graduated in 1928 with a Master thesis in Zoology on the flagellate gut symbionts of termites. At some point, Regina Woodruff, Cupp's Professor of Biology at Whittier College, contacted Winifred Allan at the Scripps Institution of Oceanography (SIO), advising him that Cupp would be an outstanding Ph.D. student to take on. Allen's field was phytoplankton ecology. He was concerned at the time with the lack of knowledge concerning the characteristics and distributions of individual species (e.g., Allan 1929a,) as well statistical analyses (Allan 1929b). Allan wrote to Cupp asking her to apply to the doctoral program at the University of California and work with him at SIO in La Jolla. Allan would prove to be both a fortunate and unfortunate choice as a Ph.D. advisor.

Allen was an 'old-timer' of SIO having begun working on plankton in La Jolla in during the summers from 1917 onward, when he was a high school teacher. Allen was recruited by Thomas Waylan Vaughn in 1919 to work on plankton and also to write reports for the newly re-named institution he directed. For Cupp, Allen was a fortunate choice as a Ph.D. advisor as he had a wide range of interests, published extensively, and was active in scientific societies such as the Ecological Society of America and the American Microscopical Society. Allen was an unfortunate choice as he did not hold a Ph.D., and so was not well regarded by some members of the faculty. Allen retired in 1943 with the rank of Associate Professor; he was never promoted to full Professor.



**Fig. 1.** Easter Ellen Cupp in 1938, at age 34. She was the first woman to earn a Ph.D. in oceanography in the United States and the author of *Marine Diatoms of the West Coast of North America*.

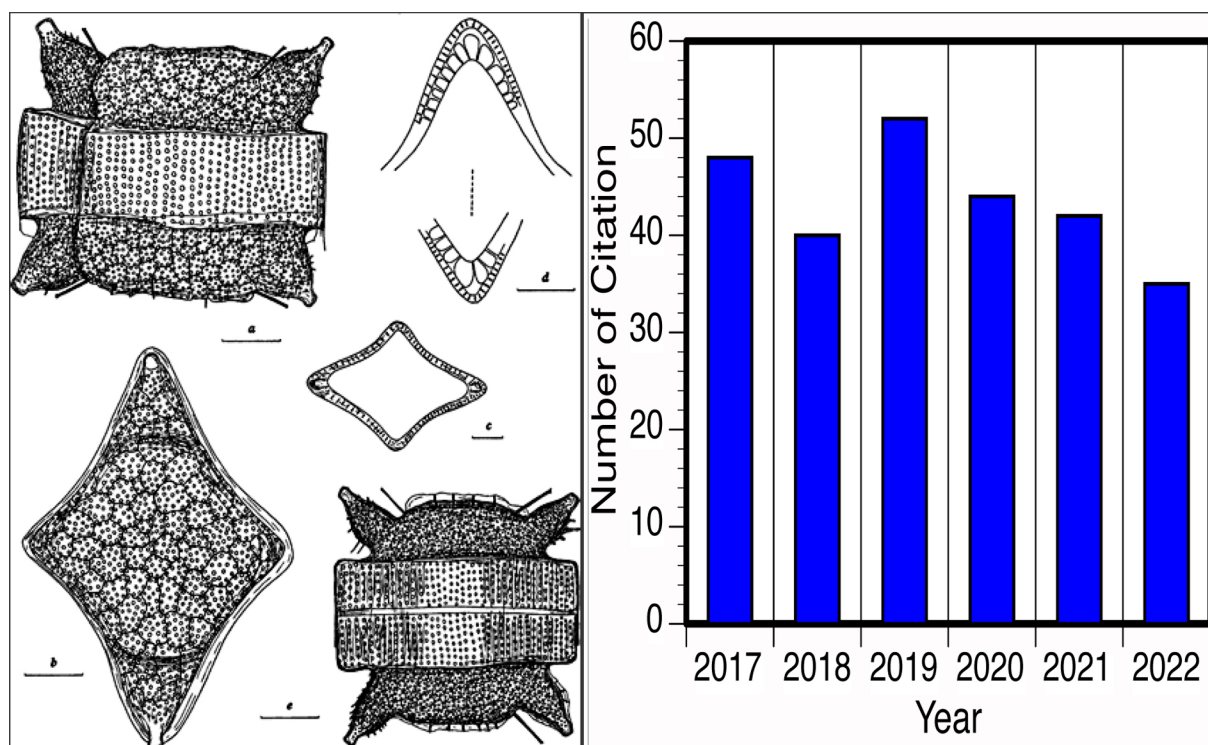


**Fig. 2.** Easter Ellen Cupp in 1925, at age 21, as a 3rd year student at Whittier College, majoring in zoology (left panel) from the Wittier College yearbook for 1925 and in 1935 at age 31 in an SIO portrait as a Research Associate and Instructor at work (right panel).

Cupp arrived in La Jolla in 1928 and began working on phytoplankton, focusing on problems of identification, and analyzing samples that had been taken years earlier for Allen. She quickly became recognized as a productive member of the staff of SIO. In the publications summarizing the research carried out at the Scripps Institution of Oceanography by the director Thomas Wayland Vaughn. Cupp was specifically mentioned, and associated, in general, with Allen's work on field studies of phytoplankton, and also with some of Claude ZoBell's experimental work on marine microbiology (e.g. Vaughan 1930; Vaughan 1933).

In 1930, Cupp's first publications appeared, one from her Master's thesis on a new flagellate species found in a termite (Cupp 1930a). Recently, in honor of that work, a new genus of flagellates was named for her, *Cuppa* (Taerum et al. 2020). Cupp's other 1930 paper was her first on diatoms and dinoflagellates. She analyzed 391 samples taken from the surface waters in the North Pacific in a variety of locations between 1924 and 1928 (Cupp 1930b). Echoing a problem many of us have encountered, in the conclusion, she admitted that her attempts to correlate temperature and salinity with community characteristics had 'yielded no positive results'!

Cupp soon began the culture work on diatoms that would form the basis of her Ph.D. dissertation. On May 8th of 1934 at the University of California (UC) in Berkley she defended her thesis in Biological Oceanography, entitled "*A Critical Study of Certain Distinguishing Characters in Three Closely Allied Plankton Species of the Diatom Genus Nitzschia and their Relationship to Certain Environmental Conditions*". All of the members



**Fig. 3.** The left panel some of Cupp's detailed illustrations from her monograph *Marine Diatoms of the West Coast of North America*: various aspects of *Biddulphia dubia*. The right panel shows the number of times the monograph was cited in publications by year from 2017 to 2022. An average about 40 citations per year for a work published 80 years ago is clear evidence of contemporary value.

of her examining committee were biologists of very considerable renown. The committee was chaired by Cupp's advisor Winifred Allen at SIO, and composed of the UC phycologist William Setchell, the UC botanist Alva Davis, the bacteriologist of SIO, Claude ZoBell, and the UC protozoologist and Zoology Department Chair, Charles Kofoed.

Cupp's Ph.D. in Biological Oceanography in 1934 was the first Ph.D. in Oceanography granted to a woman in the United States and possibly in the world. For SIO, Cupp was only the second Ph.D. in Oceanography and but the fifth doctoral dissertation since its inception in 1919. It would be quite some time before another woman earned a Ph.D. in Oceanography at SIO. It was not until 1957 that June Pattullo, earned a Ph.D in Oceanography at SIO. It is fair to state that women Ph.D. students were exceedingly rare at SIO for many years. From 1919 to 1966, out of a total of 103 Ph.D. degrees granted, only 4 went to women (data from Raitt & Moulton 1967).

With her dissertation defended she was Dr. Cupp, and promoted from Research Assistant to Research Associate and Instructor. She worked, as before, on analyzing samples taken from open water sites and reporting on the occurrences of diatom and dinoflagellate taxa (Cupp 1933; Allen & Cupp 1935). With her cultures of diatoms she also collaborated with other SIO researchers. For example Cupp worked with ZoBell who was beginning to study biological film formation and Fox who was investigating the biochemistry of 'heavy water'. However, she devoted most of her time to working on her monograph, *Marine Diatoms of the West Coast of North America*. Cupp did all of

drawings, many of which are quite striking (e.g., Fig. 3), and the photomicrographs herself.

Vaughn retired as the director of SIO in 1936. Cupp's activities were well in place when the new director, Harald Sverdrup, arrived in August of 1936. Sverdrup, trained as a meteorologist, had little familiarity with biology. He had a three-year contract with the University of California and his goal was to transform SIO, which he judged to be a laboratory of "marine research", into a laboratory focused on oceanography, especially physical oceanography.

Sverdrup, at first, appeared to be appreciative of Cupp's work. He noted, in his first report of SIO activity, her efforts to work out methods for analyzing nanoplankton, and her ongoing work on the diatom monograph (Sverdrup 1937). Thus, it was a surprise to Cupp, and the staff of SIO, when he summoned her to his office in December of 1938 and told that she should seek employment elsewhere. Sverdrup told her that taxonomy did not fit within the future research program of SIO. However, according to Sverdrup's letter to the head of the University that same month, Sverdrup simply wanted to replace Cupp with Marston Sargent (Rainger 2003). Sargent was not trained as an oceanographer. His Ph.D. thesis concerned culturing blue green algae (Sargent 1934). Replacing Cupp, with her degree in Oceanography and thesis on culturing diatoms, with Marsten makes little sense absent the consideration that Marsten was a man and Cupp was a woman. Later, Sverdrup would outright tell a female student, considering oceanography as a career (Margaret Robinson) that oceanography was a man's field: "*My Dear Mrs. Robinson, this is a man's field. You would never be accepted*" (Oreskes 2000). Sverdrup's statement reflected reality with regard to going to sea at SIO. At the time, women were not allowed to go to sea except on day cruises. A taboo against women at sea was as a matter of official policy, not only at SIO but other institutions as well, such as the Woods Hole Oceanographic Institution (Day 1999). A goal of having sea-going faculty likely was behind Sverdrup's action of replacing Cupp with Marsten. Sadly, none of the accounts of Cupp's dismissal mention that Allen or any other SIO staff interceded in her behalf.

As remarked by Legg et al. (2023) "*Women have been able to pursue an education in oceanography for longer than they have been able to go to sea*". In this regard it is interesting to note that excluding women from expeditions at sea were the policies of oceanographic institutions (up until the 1960's), but did not extend to all institutions. For example, women did participate in the oceanographic expeditions of William Beebe of the New York Zoological Society (see images in Dolan 2020).

Although Cupp's work was supposedly not within the SIO research program in Sverdrup's view, this did not prevent Sverdrup, as Editor of the *Bulletin of the Scripps Institution of Oceanography*, from publishing her study of arctic phytoplankton in 1937 (Cupp 1937) nor did it dissuade him from publishing Cupp's monograph "*Marine Diatoms of the West Coast of North America*" in 1943. It appeared in March of 1943. However, it had been 'in press' since December of 1940, a year after Cupp was told her contract at SIO would not be renewed.

Cupp left SIO in 1940 and worked as an Assistant Biologist at the Naval Biological Laboratory in San Diego working on studies such as the 'fouling of ship's bottoms'

(Whedon et al. 1943) until 1943. In 1944 she left science entirely. She became a teacher of Science and English at the Woodrow Wilson Junior High School where her companion, Dorothy Rosenbury, was already a teacher. Cupp retired in 1967 and passed away at the age of 95 in 1999.

Easter Cupp's legacy is threefold. First, there is her place in the history of Oceanography as the first woman to earn a Ph.D. in Oceanography. Second is that because she was woman, she lost her job as an oceanographer, an event that appears remarkable today. The third part of Cupp's legacy is her detailed diatom monograph. Cupp's first accomplishment has been highlighted in histories of the early years of SIO with the second fact simply not mentioned (Raitt & Moulton 1937; Shorr 1978). However, in more recent studies that consider gender in ocean sciences, the ultimate fate of Cupp has been highlighted (Oreskes 2000; Legg et al. 2023). The role of Cupp in the history of Oceanography has overshadowed, and left somewhat neglected, the third and most important legacy of Cupp in plankton research, her *Marine Diatoms of the West Coast of North America*. According to Google Scholar it has been cited a phenomenal 1,446 times. One could say that Cupp's posthumous revenge for being fired by Sverdrup is that her work became the most cited item ever published in the journal Sverdrup edited, the *Bulletin of the Scripps Institution of Oceanography*.

The monograph of 237 pages is today in free access (<https://escholarship.org/uc/item/922945w8>). It begins with a detailed introduction to the basic biology of diatoms. The bulk is given over to illustrations (approximately illustrations and 5 plates of photomicrographs), and text descriptions of diatoms. The enduring value of Cupp's monograph can easily be demonstrated by a simple tabulation of recent citations (Fig. 3). Most of us would be quite happy to have a work we published still cited 80 years from now at about 35 times a year! Apart from her role of 'first woman' of Oceanography, Easter Cupp deserves a place in the history of plankton research, if only for her magnificent monograph.

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