

Intersecting Stories: Exploring the History of Marine Exploration, Oceanography, and Women in Science through a Small Historical Research Vessel Data Archive

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Abstract

The MLML/MBARI Research Library at Moss Landing Marine Laboratories has begun a project to process and analyze a small archive of records and data from Jacques Cousteau's 1972 expedition to the Antarctic Peninsula on the research vessel *Calypso*. This paper explores the multiple stories embedded in this small archival collection of papers and data from Dr. Ellen Weaver. It tells the story of a collaboration between Jacques Cousteau and a researcher at NASA Ames, illuminating early research on chlorophyll fluorescence and remote sensing measurements of phytoplankton. It reveals the contributions of a pioneering woman scientist who was a faculty member at San José State University and an influential biochemist. And it also tells the story of an archive of oceanographic data, the challenges of processing it and its usefulness for modern-day research. This project brings together collaborators with expertise in information science, biogeochemistry and physical oceanography to work across disciplines to explore the historical and scientific aspects of this archive. The paper presents initial activities to evaluate and process the paper-based data sheets, strip charts, and ship's log that make up this archive.

Keywords: Ellen C. Weaver, *Calypso* (Ship), oceanography -- research, women in science -- United States, archival materials

Introduction

One Tuesday morning the late fall of 1972 Dr. Ellen Weaver received a "startling proposition" (Weaver, 2009, p. 1). Could she be on a plane bound for Buenos Aires on Saturday morning, with a fluorometer? Captain Jacques Cousteau was preparing for another of his famous ocean cruises on the ship *Calypso* and wanted to install the oceanographic instruments Dr. Weaver had been working with at NASA Ames. (E. C. Weaver, 2009, "hJ.Y. Cousteau, Part 1," p. 1)

Cousteau had heard about the work Ellen Weaver and John Arveson at NASA Ames had been doing using first airborne and then satellite imagery to detect the presence of chlorophyll in water. They were using a fluorometer analyze water samples in order to ground-truth measurements of chlorophyll made

using remote sensing imagery. Cousteau was interested in continuing that research on his upcoming *Calypso* cruise to the Southern Ocean. Dr. Weaver agreed to go to Buenos Aires to install her instruments and train the crew responsible for them. Each day the data and the ship's log were to be sent back to her in Mountain View, California at NASA.

In 2010, Dr. Weaver sent a small archive of these data and documents from the *Calypso* Cruise and a four-part essay she had written about her experiences to Moss Landing Marine Laboratories (MLML) on California's Central Coast where it was deposited in the MLML/MBARI Research Library.

This paper explores several narratives embedded in this archival collection. It tells the story of a collaboration between Jacques Cousteau and a researcher at NASA Ames, illuminating early research on chlorophyll fluorescence and remote sensing measurements of phytoplankton. It reveals the contributions of a pioneering woman scientist who was a faculty member at San José State University and an influential biochemist. And it also tells the story of an archive of oceanographic data, the challenges of processing it, and its usefulness for modern-day research.

The Archival Collection

The Ellen C. Weaver Collection consists of two boxes of original strip charts of underway cruise data, handwritten meteorological observations and other data sheets, Dr. Weaver's essay, the ship's log, NASA communiqués, and other documents. It was added to the Library in 2010 and many documents were scanned at that time. However, it has not been fully inventoried or evaluated for preservation needs. The collection contains many types of documents, some printed with fugitive ink and on acidic paper in acidic housing, as shown on the photograph below. I plan to assess the documents for conservation and storage needs and treat them accordingly. After that has been done, I will scan all the documents in the archive and create metadata and finding aids. It will be made available through Moss Landing Marine Laboratories' institutional repository and shared widely through appropriate portals.

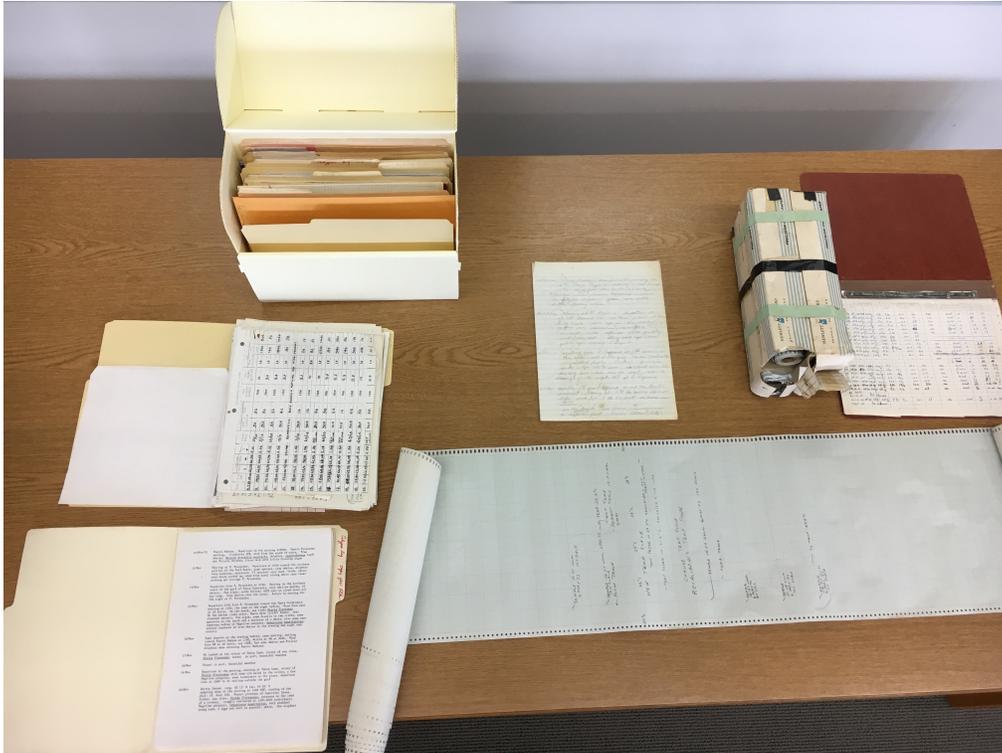


Figure 1. Photograph of papers and data sheets from the Ellen C. Weaver Collection, MLML/MBARI Research Library

Early Research & Career

Dr. Ellen C. Weaver (1925-2011) was a chemist, biologist, geneticist, and plant physiologist, who had a varied career in science. Ellen was a skilled musician and skier and a dedicated conservationist and environmentalist (“Ellen Weaver Obituary,” 2011). In 1945, she received her BA in Chemistry from Flora Stone Mather College at Western Reserve University. After she graduated she worked as an analytical chemist for the Manhattan Project in Oak Ridge, Tennessee for two years. She returned to school and received an MA in Biological Sciences from Stanford University in 1952 and a PhD in Genetics from University of California, Berkeley in 1959. After working for Standard Oil of Ohio and the Stanford Biophysics Lab, Ellen took a job at NASA Ames Research Center in the 1960s. (Marshall, Herzenberg, Howes, Weaver, & Gans, 2010, p. 230-231.) She started as a part-time instructor at San José State University in 1969 and in 1970 moved to a tenure-track faculty position. Around this time, she and her collaborators published one of many articles on their research into remote sensing of chlorophyll and temperature. (Arvesen, Millard, & Weaver, 1973)



Figure 2. Ellen Weaver, in front of the Research Vessel *Calypso* in Buenos Aires, Argentina, 1972 (photograph from Ellen C. Weaver Collection, MLML/MBARI Research Library)

Dr. Weaver and Jacques Cousteau

Jacques Cousteau was interested in knowing more about the Antarctic waters and the life they supported. Four days after the Tuesday phone call to NASA Ames from Cousteau, Dr. Weaver was on a plane bound for Buenos Aires. Ellen explained to Cousteau how photosynthesis works and how the fluorometer measured the presence of chlorophyll, which signifies that photosynthesis is taking place. Dubbed “Madame Chlorophyll” by Cousteau’s wife, she explained that the fluorometer shines a blue light on a constant stream of water flowing through the instrument. Chlorophyll fluoresces bright red under the light and the fluorometer she would install could measure even very small amounts of chlorophyll. As Ellen tells it, Cousteau was an intelligent and attentive student during her lecture. (E. C. Weaver, 2009 “Cousteau, Part 3,” p. 1)

Dr. Weaver set up a Turner fluorometer on the ship—no small feat as she had to adjust for a mismatch in the fluorometer’s power requirements and that available on board, purchase and calibrate new parts locally, and (with assistance from an uninterested crew) drill through the ship’s hull to complete the installation. Since she was not invited to accompany Cousteau on the cruise, she trained the ship’s doctor to maintain and run the instruments and showed him how to extract and measure chlorophyll from water samples. Dr. François would transmit the data to NASA each day (E. C. Weaver, 2009).

Dr. François spoke no English and Dr. Weaver spoke no French (E. C. Weaver, 2009, “Cousteau, Part 3,” p. 2); the sketch reproduced below may have been a way to bridge the language gap and explain that transmission. The *Calypso* is on the left: the data is transmitted up to a satellite and back down to Ellen in Mountain View CA.

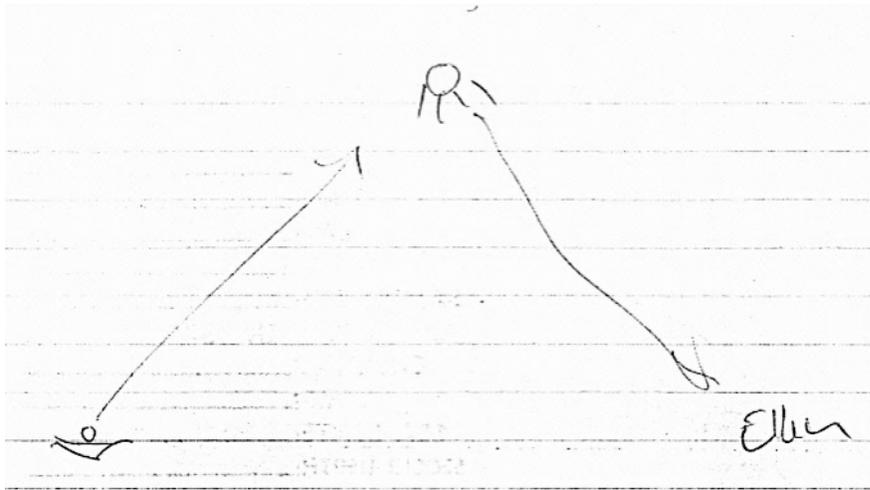


Figure 3. Sketch from the Ellen C. Weaver Collection, MLML/MBARI Research Library

NASA touted their collaboration with Captain Cousteau in a press release, noting their research would investigate “how spaceage [sic] technology can be used in oceanographic investigations to define biologically productive ocean regions” (Miller, 1973, p. 1).

The *Calypso* began her 10-month South American cruise in November 1972 in Puerto Madryn, Argentina, and ended in Galveston, Texas. Continuing south along Argentina, the *Calypso* journeyed around Cape Horn, through Drake’s passage and explored the Antarctic Circle, filming all the while. Data collection continued, although it seems from gaps in the data that for some time the fluorometer was not working. On Feb. 11, the *Calypso* was damaged by huge ice floes in a storm. In spite of this, after some repairs and with satellite weather forecasting support from NASA, she made it back to Punta Arenas, in the southern tip of Chile, and then eventually back north in the Pacific Ocean, through the Panama Canal, and back to Galveston, TX.

Data collected throughout the cruise included underway temperature and fluorescence intensity measurements, secchi depth measurements of the transparency of the water, weather conditions, and water samples upon which additional fluorescence analysis was performed by Dr. François. The log kept by Dr. François also provides observational data, noting weather and sea conditions and animals sighted.

12/Nov/72	Puerto Madryn. Departure in the morning at 0600. Puerto Pyramides mooring, cloudiness 50%, wind from the south 25 knots. True whales, <u>Baleine glacialis australis</u> , dolphins, <u>Lagenochyneus</u> (sp?) one Fitzroy dolphin, flora rare with little floating algae <i>Sea slat</i> <i>. 5 miles from shore</i>
13/Nov	Mooring at P. Pyramides. Departure at 0700 toward the northern portion of the Gulf Nuevo, same species, true whales, dolphins very numerous, merralmie (? species) very weak winds, afternoon winds picked up, wind from east; strong white caps (seas picking up) moorage P. Pyramides
14/Nov	Departure from P. Pyramides at 0730. Mooring on the northern coast of the gulf of Punta Comorants, very shallow depths, 10 meters. Few algae, sandy bottom; 100% sun; no cloud cover all day long. Some whales near the coast. Return to mooring for the night at P. Pyramides. <i>Rough</i>

Figure 4. Ship's log entries from the beginning of the cruise. From the Ellen C. Weaver Collection, MLML/MBARI Research Library.

Academic Life, Administration, and Activism

Dr. Weaver's research on photosynthesis and the measurement of chlorophyll using remote sensing has been influential in the field. Early on, as Ellen noted in an interview in 1991, she "worked in the lab that made the major breakthrough of biochemical mechanism of photosynthesis" (Schatz, 1991, p. 8) during her graduate work at UC Berkeley. This was Professor Melvin Calvin's lab, who would later win a Nobel Prize for his work on photosynthesis (the Calvin Cycle is named for him). Ellen's first article published in *Science* was in 1963, while she worked in the Stanford Biophysics Laboratory. She went on to publish 2 more articles in *Science*, one in *Nature* among her total of 14 scientific articles. Her article with Arvesen and Millard in 1973 has been cited 21 times in Scopus and 51 in Google Scholar and is still being cited today—20% of the citations in Scopus were from 2010 on, showing the long-lasting impact on the field.

In spite of Dr. Weaver's impressive pedigree, she recounts many incidents of discrimination that impacted her career. Although she published an article in *Science* during her time at the Stanford Biophysics Laboratory, she was told the Stanford biology department was "not ready to hire a woman faculty member" (Marshall et al., 2010, p. 230). Even after she had secured a tenure-track faculty position at San José State University, she recounted hearing from other faculty members that the Dean of Science "had vowed" she would not get tenure and posited that the convincing element of her dossier was a letter of recommendation from none other than Jacques Cousteau to the president of the University. (Weaver, 2009, "JYC Comes to Visit," p. 3)

As Ellen's career progressed she took on administrative roles at San José State University, becoming a strong advocate for women in science. In a 1971 response to an article published in *Chemical and Engineering News* she wrote a spirited defense of the scientific abilities of women, excoriated men who "express admiration for my successful combining of doing research and staying feminine" and yet who do not work toward including women as full colleagues in science, and pointedly remarked that men are

afraid that a woman would prove to be a better scientist than they, should she be allowed to fully participate in scientific work (E. C. Weaver, 1971, p. 4). In the 1970s Ellen was Director of the SJSU Foundation, Interim Executive Vice President, and Associate Dean for Development at San José State University ("Ellen Weaver Obituary," 2011). She was active in California SeaGrant and on the governing board of Moss Landing Marine Laboratories. She advocated for the inclusion of more women in administration in academia (E. Weaver, 1979). She retired from San José State University in 1991, but continued her service to the profession and advocacy in her role as president of the Association of Women in Science (AWIS). She served as President of AWIS from 1992-93 and was elected as a Fellow of the AWIS in 1996. Her advocacy was honored by the Northern California chapter of AWIS with an award in her name, given to an early career scientist who helps others. (Association for Women in Science, n.d.)

Future Research with the Weaver Archive

My future research with this archive is inspired by Dr. Weaver herself, as portrayed by a student quoted in San José State University's *Spartan Daily* who noted that Dr. Weaver "is always a whirlwind [sic] of activity and [has] a sense of enthusiasm that follows her" (Schatz, 1991, p. 8).

As I process the archive, I will also conduct more biographical research and investigate the existence of related archives that might provide more information about Ellen's career or this *Calypso* cruise. Most importantly, I want to make the archive and the historical data available to others for future research. Towards that end, a primary project goal is to convert the paper data sheets to digitized data, ready for use in quantitative analysis. I plan to research how to automate the conversion of the hard-copy tabular data to digitized spreadsheets, as well as the more complex conversion of the continuous data depicted on the strip charts.

One research project in the planning stages that will use the digitized data aims to analyze data from this 1972 *Calypso* cruise and a Moss Landing Marine Laboratories (MLML) cruise to Antarctica on the R/V *Point Sur* in 2011. MLML Physical oceanographer Professor Tom Connolly and I plan to work with students in his marine science data analysis class to analyze the data from the two cruises with overlapping transits, 40 years apart. This paper has only touched upon the ways in which this small archival collection can contribute to research in the history of women in science, the legacy of Jacques Cousteau, and climate change in the Antarctic. When the Weaver Collection has been fully processed and made available through the MLML/MBARI Research Library it will be accessible to researchers in these fields and more.

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