STEM Council: June 2014-Biographies and Company Backgrounds

Pre-Meeting with WHOI Leadership (11:40 am – 11:55 am)

Susan Avery, Larry Madin, Peter Hill, Congressman Joe Kennedy, Jeff Leiden, and Adam Freudberg

Dr. Susan Avery, President and Director of Woods Hole Oceanographic Institution

Susan K. Avery took office as president and director of WHOI on February 4, 2008. Avery is the ninth director in the institution's 78-year history, and the first woman to hold the position.

As an oceanographic leader with a background in atmospheric research, Avery has used her unique position to underscore the importance of ocean-atmosphere interactions in understanding whole Earth systems. Since taking the helm at WHOI, Avery has delivered Congressional testimony and presentations at scientific conferences such as the American Meteorological Society, the IEEE International Geoscience & Remote Sensing Symposium, the American Geological Union, and the Partnership for Observation of the Global Ocean (POGO), often directing her comments at the intersection of atmospheric, earth, and ocean science.

Avery has extensive experience as a leader within scientific institutions, She came to WHOI from the University of Colorado at Boulder (UCB), where she was a member of the faculty since 1982, and where she served in interim positions as vice chancellor for research and dean of the graduate school, as well as provost and executive vice chancellor for academic affairs. From 1994-2004, she served as director of the Cooperative Institute for Research in Environmental Sciences (CIRES), the first woman and first engineer to hold that position. There, she facilitated new interdisciplinary research efforts spanning the geosciences while bringing them together with social and biological sciences and helped establish a thriving K-12 outreach program and a Center for Science and Technology Policy Research.

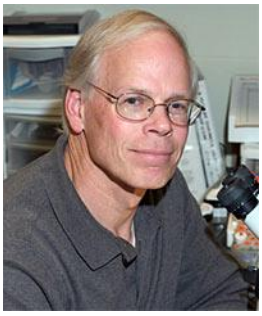
Avery's research includes studies of atmospheric circulation and precipitation, climate variability and water resources, and the development of new radar techniques and instruments for remote sensing. The author or co-author of more than 80 peer-reviewed articles, Avery helped form an integrated science and assessment program that examines the impacts of climate variability on water in the American West. She also worked with the National Oceanic and Atmospheric Administration and the Climate Change Science Program to help formulate a national strategic science plan for climate research.

Avery is a fellow of both the Institute of Electrical and Electronics Engineers and of the American Meteorological Society, for which she also served as president. She is a member of the advisory board

for the Jet Propulsion Laboratory and a past chair of the board of trustees of the University Corporation for Atmospheric Research. She has also served on numerous advisory panels, committees, and councils for the National Science Foundation, the National Research Council, the National Oceanic and Atmospheric Administration, and the National Center for Atmospheric Research.

Avery earned a bachelor's degree in physics from Michigan State University in 1972, a master's in physics from the University of Illinois in 1974, and a doctorate in atmospheric science from the University of Illinois in 1978.

Dr. Larry Madin, Executive Vice President and Director of Research



Laurence Madin is the executive vice president and director of research and senior scientist at the Woods Hole Oceanographic Institution in Woods Hole, Mass. Madin received his AB degree from the University of California, Berkeley and his PhD from UC Davis, and has been at WHOI since 1974. His principal research interests are in the biology of oceanic and deep-sea zooplankton and fishes. He has participated in over 70 research cruises, serving as chief scientist on half of them, and was among the first biologists to use SCUBA and submersibles for the in-situ study of the oceanic plankton. As director of research since 2006, Madin oversees the science departments and related research institutes and centers at WHOI. He has been active in the development of new international and industry partnerships and in the formation of the Center for Marine Robotics. He holds an adjunct appointment at the Monterey Bay Aquarium Research Institute and serves on several advisory and steering committees. He is a member of the American Geophysical Union, the Association for the Sciences of Limnology and Oceanography, and the scientific research society, Sigma Xi.

Dr. Peter Hill, Director of Government Relations

Peter has spent 20 years working for the U.S. Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA) before becoming the Director of Government Relations for Woods Hole Oceanographic Institution in 2011.

As the Director of Government Relations, Peter is responsible for coordinating WHOI's engagement with federal agencies and Congress in Washington DC. The primary objective of his work focuses on advancing ocean science and policy through legislation, appropriation, and Administration policy making. He works in collaboration with other academic and nonprofit research entities as well as nongovernmental organizations.

During his tenure with NOAA, Peter's work included staff on the US Commission on Ocean Policy, a Congressionally mandated and Presidentially appointed panel that develop comprehensive recommendations for ocean science and policy. Following the release of the report, he co-managed the work of the Joint Ocean Commission Initiative. The Joint Initiative was co-chaired by Admiral James D. Watkins USN (Ret.), and the Honorable Leon Panetta, and focused on elevating awareness of ocean-related issues and the implementation of the recommendations developed by the U.S. Commission on Ocean Policy and the Pew Oceans Commission.

Prior to working for the Commission, Peter spent time facilitating federal intra- and inter-agency coordination and cooperation in the Chesapeake Bay region and leading the NOAA Office of Legislative Affairs activities of the National Marine Fisheries Service. This worked included reauthorization of the Marine Mammal Protection Act (1994), the Magnuson-Stevens Fishery Conservation and Management Act (1996), and enactment of the American Fisheries Act (1998).

Peter's career in NOAA began in 1990 as a Sea Grant Fellow, following his academic work at Hobart College and graduate studies at the University of Virginia.

Environmental Science Workforce Pathway Panel (1:10 pm – 1:55 pm)

Panelists: Ben Jones (Graduate Student), Andone Lavery (Associate Scientist with Tenure), Duane Fotheringham (President of Hydroid, Inc.)

Ben Jones, WHOI/MIT Joint Program graduate and Falmouth HS graduate

Benjamin Jones: recently completed his second year in the Joint Program, and is a student in Rubao Ji's lab in the Biology Department. His research focuses on using spatially explicit models together with observational data to forecast the population dynamics of marine fisheries. Ideally, Ben hopes to increase the accuracy of forecasting methods and provide fisheries managers with new tools. This research has been funded by a Graduate Research Assistantship via an NSF grant and will continue to be funded by the National Defense Science and Engineering Graduate Fellowship (NDSEG) come September. Prior to the Joint Program, Ben graduated from Tulane University in New Orleans with a double major in Mathematics and Environmental Biology, summa cum laude. His undergraduate research there was the application of a biophysical oceanographic model to simulate dispersal patterns of blue crab larvae. Part of Ben's funding as an undergraduate came from NOAA's Hollings Scholarship Program, which also provided the opportunity for him to take part in a summer internship analyzing fin whale vocalizations at NOAA's Southwest Fisheries Science Center. Ben is an alumnus of Falmouth High School in Falmouth, MA.

Andone Lavery, Associate Scientist with Tenure, Applied Ocean Physics and Engineering

Dr. Lavery's research is in the area of acoustical oceanography, that is, the study of the physics and biology of the ocean, and their interactions, through the use and development of acoustic techniques. The specific areas of research that Dr. Lavery is involved in include 1) acoustic scattering by marine organisms, such as zooplankton, micronekton, fish, and squid, 2) acoustic scattering from physical process that occur in the ocean interior, such as oceanic microstructure, turbulence, shear instability, double-diffusion, and internal waves, 3) acoustic propagation in highly turbulent environments with dense bubble clouds, the impact of these physical processes on the propagation of mid- and high-frequency sound in shallow coastal environments, and implications to acoustic communications, and 4) acoustic scattering from sea ice and oil under, or encapsulated in, sea ice. To date, her research has been focused in coastal regions

(shore ward of the continental shelf break) in water depths of less than 200 meters (e.g. the Gulf of Maine, Georges Bank, New Jersey Continental Shelf), as the natural abundance of zooplankton is high and turbulent dissipation rates and stratification tend to be high, resulting in strong acoustic signals.

Dr. Lavery's research approach encompasses the theoretical development of analytical physics-based models to understand the scattering and propagation of high-frequency sound in the ocean, laboratory experiments to verify acoustic models in a controlled environment, *in situ* field experiments that make use of the models and allow the physics and/or biology of the ocean interior to be explored and better understood, and the development of instrumentation (e.g. press release) to improve our ability to remotely investigate the biology and physics of the ocean interior and boundaries.

Duane Fortheringham, President of Hydroid, Inc.

Duane Fotheringham serves as president of Hydroid Inc., located in Pocasset, Massachusetts. His love for the ocean has led to a career spent in the subsea industry, including everything from submarines to sonars. Prior to joining Hydroid in 2008, Fotheringham was employed for 11 years as an engineer and project manager for Kongsberg Maritime. His career includes eight years of service in the U.S. Navy as a submarine warfare officer. Fotheringham earned a bachelor's degree in electrical engineering from Washington State University and a master's degree from City University of Seattle. Hydroid manufactures intelligent marine robots. Hydroid's flagship line of REMUS autonomous underwater vehicles (AUVs) provides marine professionals worldwide with reliable and innovative full-picture AUV systems for marine research, defense, hydrography and energy exploration.

Organization and Industry Backgrounds

Woods Hole Oceanographic Institution (Woods Hole, Massachusetts)

Vision

The ocean is a defining feature of our planet and crucial to life on Earth, yet it remains one of the planet's last unexplored frontiers. For this reason, WHOI scientists and engineers are committed to understanding all facets of the ocean as well as its complex connections with Earth's atmosphere, land, ice, seafloor, and life—including humanity. This is essential not only to advance knowledge about our planet, but also to ensure society's long-term welfare and to help guide human stewardship of the environment. WHOI researchers are also dedicated to training future generations of ocean science leaders, to providing unbiased information that informs public policy and decision-making, and to expanding public awareness about the importance of the global ocean and its resources.

Mission Statement

The Woods Hole Oceanographic Institution is dedicated to research and education to advance understanding of the ocean and its interaction with the Earth system, and to communicating this understanding for the benefit of society.

History

At its founding in 1930, the Woods Hole Oceanographic Institution joined a thriving ocean science community in the village of Woods Hole, Massachusetts, that included the Marine Biological Laboratory and the National Marine Fisheries Service. At the time, the world was only a little more than 50 years removed from the first efforts to systematically study the ocean.

One of WHOI's greatest contributions came even before a single building was constructed: As a result of the discussions and correspondence that surrounded planning the Institution, scientists formed a vision for oceanography that foresaw experts from many fields working together on questions related to the global ocean—one that continues to the present day.

The idea for WHOI dates to the early 1920s and the first of a series of conferences between Frank R. Lillie, then the MBL director, and Wickliffe Rose, then president of the Rockefeller Foundation's General Education Board. Their discussions resulted in the 1927 appointment of a National Academy of Sciences Committee on Oceanography "to consider the share of the United States of America in a world-wide program of Oceanographic Research."

The committee, chaired by Lillie, recommended that oceanographic activities on the West Coast be strengthened and that a well-equipped oceanographic institution be established on the East Coast. The committee members, including its secretary, Henry Bryant Bigelow of Harvard University, formed the nucleus of a board of trustees for the new institution. Lillie became president of the board, Bigelow WHOI's first director. After considering many sites, Woods Hole, Mass., was chosen for its established scientific research community, extensive library facilities, ready access both to the deep sea, to the contrasting conditions north and south of Cape Cod, a small but deep water harbor suitable for berthing oceanographic vessels, and its proximity to several universities.

The Rockefeller Foundation provided $1 million for construction, boats, equipment, and upkeep, $1 million for endowment, and $500,000 for 10 years of summertime operating expenses. Bigelow had conducted extensive studies in the Gulf of Maine using boats begged and borrowed from the Fisheries Commission and often not suited for the work being done. He knew firsthand the importance of a seaworthy and reasonably comfortable working platform. "The most essential activities of the institution may be expected to center around the work at sea," wrote Bigelow. That statement eventually formed the centerpiece of the Institution's longest-lasting (and continuing) legacy, one rooted in seagoing research to further knowledge of the ocean.

In May 1930 the trustees authorized $175,000 for construction of a new vessel, a 142-foot, steel-hulled ketch spreading 7,500 square feet of canvas eventually christened *Atlantis*. Construction also began on a four-story brick laboratory, which is still in use and today called the Bigelow Laboratory. *Atlantis* was launched December 31, 1930, and arrived in Woods Hole in August 1931.

Throughout the 1930s, the Institution operated primarily during the summer months. A typical summer would find *Atlantis*exploring newly discovered canyons off Georges Bank, collecting mud cores for bacteriological studies, taking current measurements at anchor stations, dragging for Gulf of Maine

shrimp, collecting plankton, and crisscrossing the Gulf Stream taking water samples and making hydrographic measurements. During the winter, *Atlantis* generally made a longer cruise or two to the Caribbean or Gulf of Mexico.

The turn of the decade, however, brought profound change to oceanography. During the war, the U.S. Navy realized that many of its operations were intimately dependent on the environment in which ships operate, and oceanographers found themselves consulted more frequently on matters of national defense.

One of the first Navy-sponsored programs of research at Woods Hole concerned the composition of different paints to prevent marine fouling on ships, a project for which the Navy commended associate director Albert Redfield for helping them save an estimated 10 percent of their fuel budget. Another project involved the intensive study of the effects of salinity and temperature on the transmission of underwater sound and its application to anti-submarine warfare. Many other research activities with direct application to naval problems followed, the largest of which was the investigation of underwater explosives.

After the war, there was a period of uncertainty about oceanography's future. For a while it appeared that the Institution might return to the pre-war routine of busy summers and quiet winters. But both the direction of oceanography as a science and its economic situation had changed, as had the demand for advanced research in the U.S.

Throughout the Cold War, the Navy supported additional research that spawned greater knowledge of planetary and marine processes. Extensive work in physical oceanography led to better understanding of the Gulf Stream as well as the distribution of physical and chemical properties in the North Atlantic Ocean. Acoustic methods stimulated by wartime research allowed geophysicists to extend their knowledge and understanding of the structure of Earth's crust under the ocean basins. Interest in meteorology led to the development of a strong group at Woods Hole making observations on trade wind physics and dynamics.

In 1950, the U.S. Congress established the National Science Foundation (NSF) to promote national efforts in science and engineering. WHOI's first support from NSF came in 1952 for work on summer plankton blooms in Long Island bays and for eight training fellowships. Over the years, NSF's share of Institution support grew slowly and steadily until it surpassed Navy support.

But the Navy remained pivotal in two areas: ship-based oceanography and underwater vehicles. In the late 1950s and early 1960s, the Navy supported development of a manned submersible for scientific research. Eventually named *Alvin* for one of its prime advocates, Allyn Vine, *Alvin* continues to take geologists, biologists, and chemists deep beneath the surface of the ocean to observe processes and phenomenon firsthand that would be difficult or impossible to study otherwise.

The Navy also continues to support sea-going ocean science through the construction of oceanographic research vessels. WHOI's two Global Class research vessels, R/V *Knorr* and *Atlantis* are both operated by the Institution on behalf of the Navy, which paid for their construction. Another in the long line of research vessels operated by WHOI is scheduled to be delivered to the Institution in 2015.

WHOI's leadership in ocean science and engineering has resulted in a long line of notable discoveries and advancements in knowledge of the ocean. These range from the distribution and role of microbes in the marine environment to development of revolutionary new tools and techniques to study the ocean

to the discovery of life in the deep ocean near hydrothermal vents to a deeper understanding of the nature and impacts of hydrocarbons in the ocean.

In addition to scientific research and technical innovation, education has been a critical part of WHOI's mission over the years. The first formal education program was a summer research experience for undergraduates initiated about 1955. Postdoctoral fellowships followed in 1960, and the long-running flagship of WHOI's education program, a Joint Program in Oceanography with the Massachusetts Institute of Technology, was begun in 1968 to grant doctoral degrees to students interested in pursuing a career in ocean science or engineering.

Today, the WHOI community numbers over 1,000, including scientific and technical staff, ships' crew and officers, and a variety of scientific, service, and administrative support staff, as well as about 130 Joint Program students. All of these individuals contribute to a common goal: to help advance research and understanding of the ocean and its role in shaping and sustaining the planet. It is not a mission that WHOI takes lightly, now or at any time over the course of its history. The ocean is too important to all of us.

Hydroid, Inc. (Pocasset, Massachuetts)

Background

Hydroid was founded in 2001 by the inventors of REMUS to allow this remarkable technology to reach a wider market and to provide for continuous product development. REMUS is the product of over 15 years of leading edge research and development, which has culminated in the world's most capable and reliable compact AUV.

Accomplishments

Hydroid has grown at an amazing rate, and now boasts over 250 AUV system sales to a variety of domestic and international customers. To support this growth, Hydroid now has a staff of over 120 full and part-time employees that continuously strive for the highest level of product quality and support. This team is enhanced by the organization's growing representative network, which provides local sales and support in nearly 30 nations around the globe.

Location

Hydroid is located in a state-of-the-art facility in Pocasset, Massachusetts. This facility has been uniquely designed to support Hydroid's growing product offerings.

Quality

Since its inception, Hydroid has delivered a continuous stream of products through a highly efficient and well organized manufacturing system, which allows for volume production of REMUS vehicles, tracking transponders, and other system components. The result is a highly repeatable system that produces quality products in a timely and efficient manner. Hydroid's products are backed by the organization's skilled customer service staff, which provides on-site training, system commissioning, and continuous product service and support.