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A Journal of Pacific Maritime History



Diving in San Diego

A Concise History Encompassing the World

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Back Cover: Mia Tegner hovers over a reef in the kelp bed at Catalina Island.



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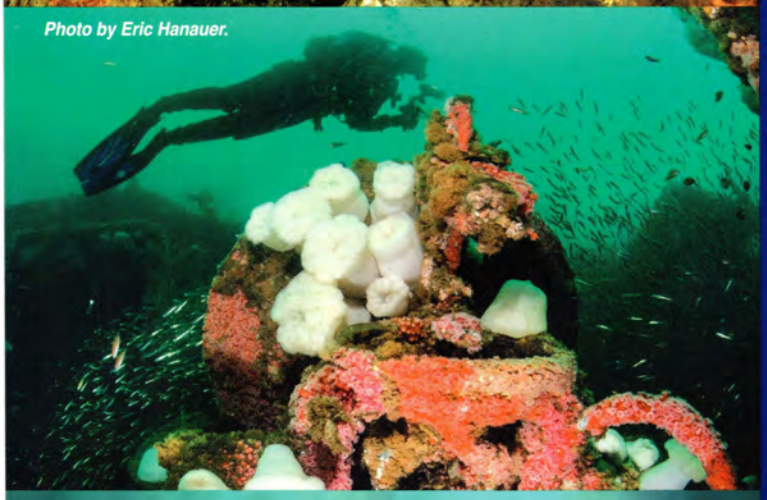
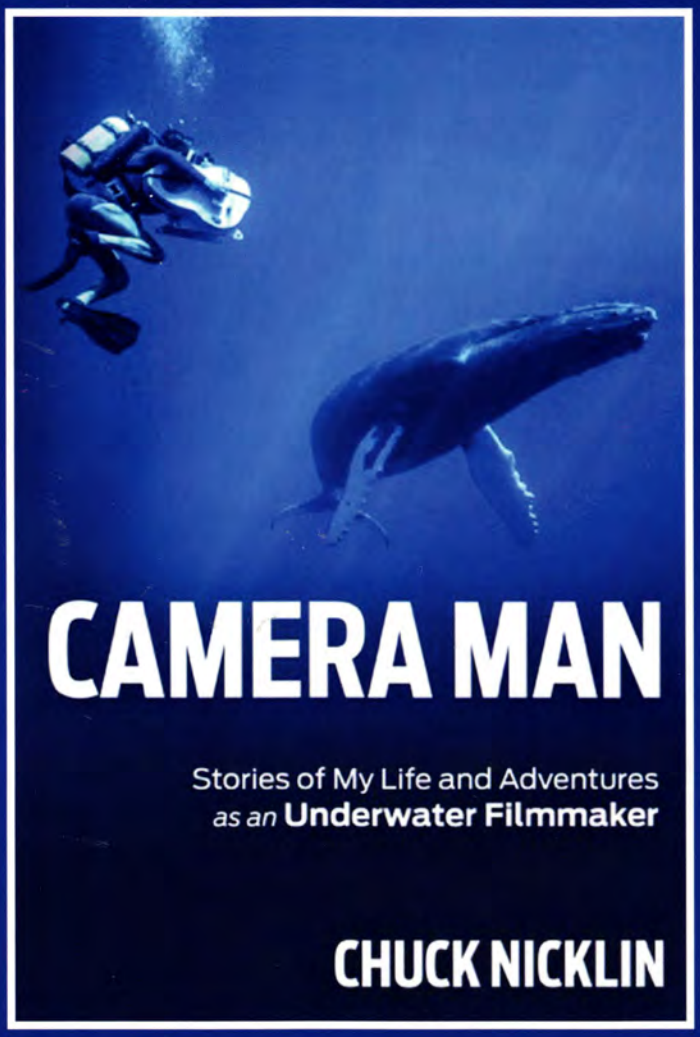


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Front Cover: Flip Nicklin photographs his father, Chuck, with and IMAX camera filming a Humpback Whale.

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MAINSAIL HAUL—An order in tacking ship bidding, "Swing the main yards."

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Vol. 52: 1&2 Winter/Spring 2016

MAINS'L HAUL

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As is so often the case, the wish was the father of the machine, the dream gave birth to the engine. And magic was the womb in which the engine grew… but always at the heart, this is the story of magicians and their motives – their dreams of power, their engines of fulfillment.

—Alex Roland, Ph.D.
Underwater Warfare in the Age of Sail (1978).

FROM THE HELM

by Ray Ashley, Ph.D.
President and CEO,
MARITIME MUSEUM *of* SAN DIEGO

By now, some might think it odd that *Mains'l Haul,* the research arm of the Maritime Museum of San Diego, the flagship publication of this institution and, as of this date, the sole and foremost academic historical research journal devoted to the study of maritime history in the United States, should so frequently alternate between thematic issues devoted to the history of what happened on the surface of the sea, to the history of what happened beneath the surface of the sea. This fluctuation might also seem odd given the day-to-day epic struggle of our institution in the preservation of historic and *floating* vessels to prevent them from becoming the kind of submerged cultural resources celebrated toward the end of this issue. From the conventional perspective of our field, the story of submergence under the sea is the history of what happens after things go very wrong.

Yet to assume this point of view would be a shortsighted understanding of one of our principal strategic objectives. Long ago, when considering our place – our role – and our future as an institution in what it could contribute, our Board voted to embrace the following as a "premise statement" for our Museum:

The history of human achievement is defined in large measure by our historical relationship with the sea. Not only has the sea determined the progress and shape of civilization,



our understanding of that relationship and our responsibilities for stewardship of the oceans will determine our future. This relationship cannot be understood or defined purely in scientific terms: culture exerts a dominating influence. The role of any maritime museum is translation between human experience of the oceans and our understanding of their nature.

This is no ordinary aspiration for a regional Maritime Museum. Today, when the sea is presented in some formalized, packaged, and institutional way to a visiting audience it usually takes two forms: aquariums and maritime museums. When one visits a typical maritime museum, the story is inevitably some variant of an heroic tale of struggle with the sea or a struggle upon the sea for its control. The heroes of the story are the ships themselves as worlds in microcosm, *their dreams of power and their engines of fulfillment*, in the world of wind, and wave – avatars of who we are and what we believe cast into a life and death struggle in which the sea is the ultimate and relentless enemy.

No such avatars are presented to those who visit aquariums. If one sees a vessel at all, it might take the form of a wreck in the bottom of the tank with fish swimming in and out, a trophy and reminder of who the enemy really is. For in almost any aquarium one visits, the main theme is the relentless pressure imposed on the oceans because of human activity: overfishing, plastic accumulation in the oceanic gyres, ocean acidification, tropical reef devastation, etc. These are presented as consequences of human activity, but stripped of human history as though an understanding of how we came to this point over time is irrelevant to any discussion of what we need to do about it. If our fate does lie with the oceans, and if we are to have any chance at all, we must find some way to bridge and reconcile these points of view.

To that end, San Diego is no ordinary place, nor is its special relationship with the sea and the undersea world insignificant, as this issue will make clear. Here we are uniquely equipped not only to examine the surface, but dive beneath it, projecting history along with the science it enfolds to its greatest depths.



An Overview of *Diving in San Diego*

By Paul K. Dayton, Ph.D.
Scripps Institution of Oceanography

All divers vividly remember their first undersea experience. They recall the sense of a forest of underwater plants, or perhaps a forest of huge white sea anemones, or if they were lucky enough to begin in a tropical setting, they will surely remember the diversity of fish with their exotic, even psychedelic, brightly painted patterns. Even if the water was rough or the visibility poor, the diver's memory of the first immersion into the sea is one of excitement, perhaps seasoned with a dash of fear, but also a realization that their lives are changed forever, and they will return again, and again, and again.

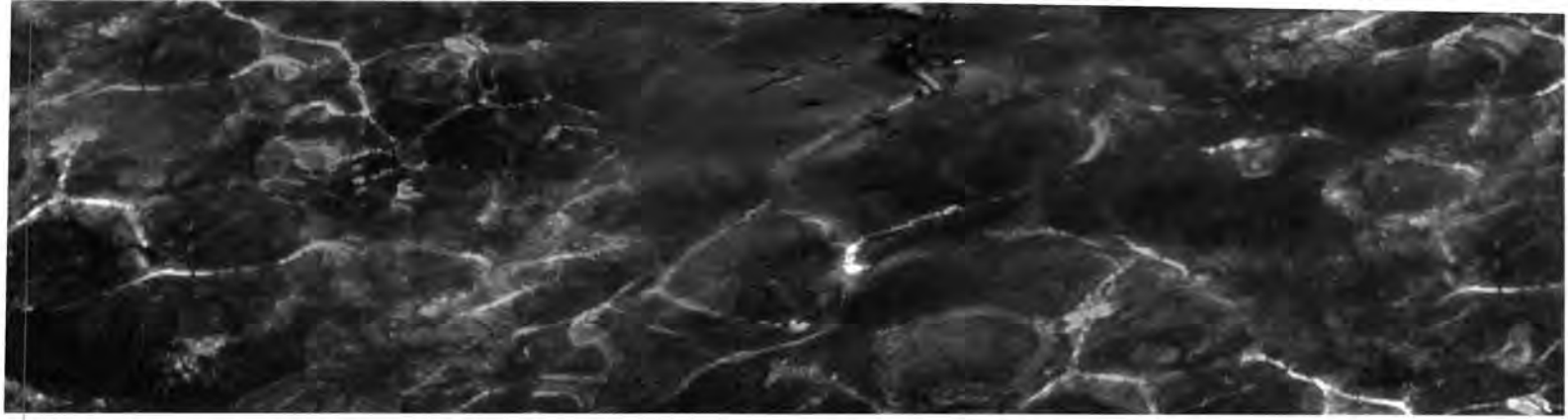
Modern divers have been exposed to wonderful photographs and videos of the undersea world. Most have visited aquariums and listened to experienced divers emote about the different world, so the first dive will include a considerable knowledge and understanding of what to expect. By the time they graduate to scuba diving, they will have been trained to use sophisticated equipment that is safe and reliable and comfortable to use. Many modern divers are unaware of the interesting evolution of the accumulated knowledge they take for granted that relied on people and organizations, who sought and created the natural history observations and technology. This Journal is about those early San Diego divers and programs that moved into the undersea world, starting in the 1930s, and created the entire foundation for all that we do in diving today.

These people were explorers in every sense of the word. They had no idea what to expect when they first put their goggled heads underwater, and in many cases they made all their equipment by themselves. When asked about their first memories they inevitably pause; their eyes simultaneously glaze over and start to glow as the intense memory comes into focus. They recount finding themselves in an utterly alien and wonderful world. For me, as an eleven-year-old visitor from a life in logging camps in 1952, everything in that undesea world was unknown and, to be honest, scary! I recall being afraid to touch anything, even a large *Strombus* conch plowing through the sand, but I was hooked, and within two to three years I had made my own scuba system with tanks discarded by the local fire department and a modified B-29 regulator. I saw fish as big as small cars and set about trying to kill them, quickly downsizing to pan-sized fish. When Cousteau's *Silent World* was published, I realized that it was an entirely new world to explore, and I dedicated the rest of my life to working to understand and preserve this world that had such a deep attraction to my soul.

Here you will read the recollections of the true pioneer divers moving into the strange new underwater world, while learning to hunt fish and invertebrates, and eventually focusing on recording their experiences with ever increasingly sophisticated photographic equipment that they invented. You will meet inventors developing their own equipment in their garages and basements, and eventually teaching the general public about the silent world by establishing dive



By fourteen, Paul Dayton had fashioned his own scuba gear using discarded tanks from the local fire department and a modified B-29 regulator. Pictured in San Carlos Bay, just north of Guaymas, on mainland Mexico, the once lonely outpost offered a great escape for the family. Dayton recalls nights camping along the beach in solitude, until one evening when a Scripps research vessel anchored just offshore. The researchers' voices were clearly audible; Dayton could hear excited discussions about the gorgonian forests that he had just explored. Wrapped in images of colorful sea fans, he drifted off as the shared discoveries of the day took hold. Dayton would one day become a marine biologist at Scripps Institution of Oceanography (since 1970).



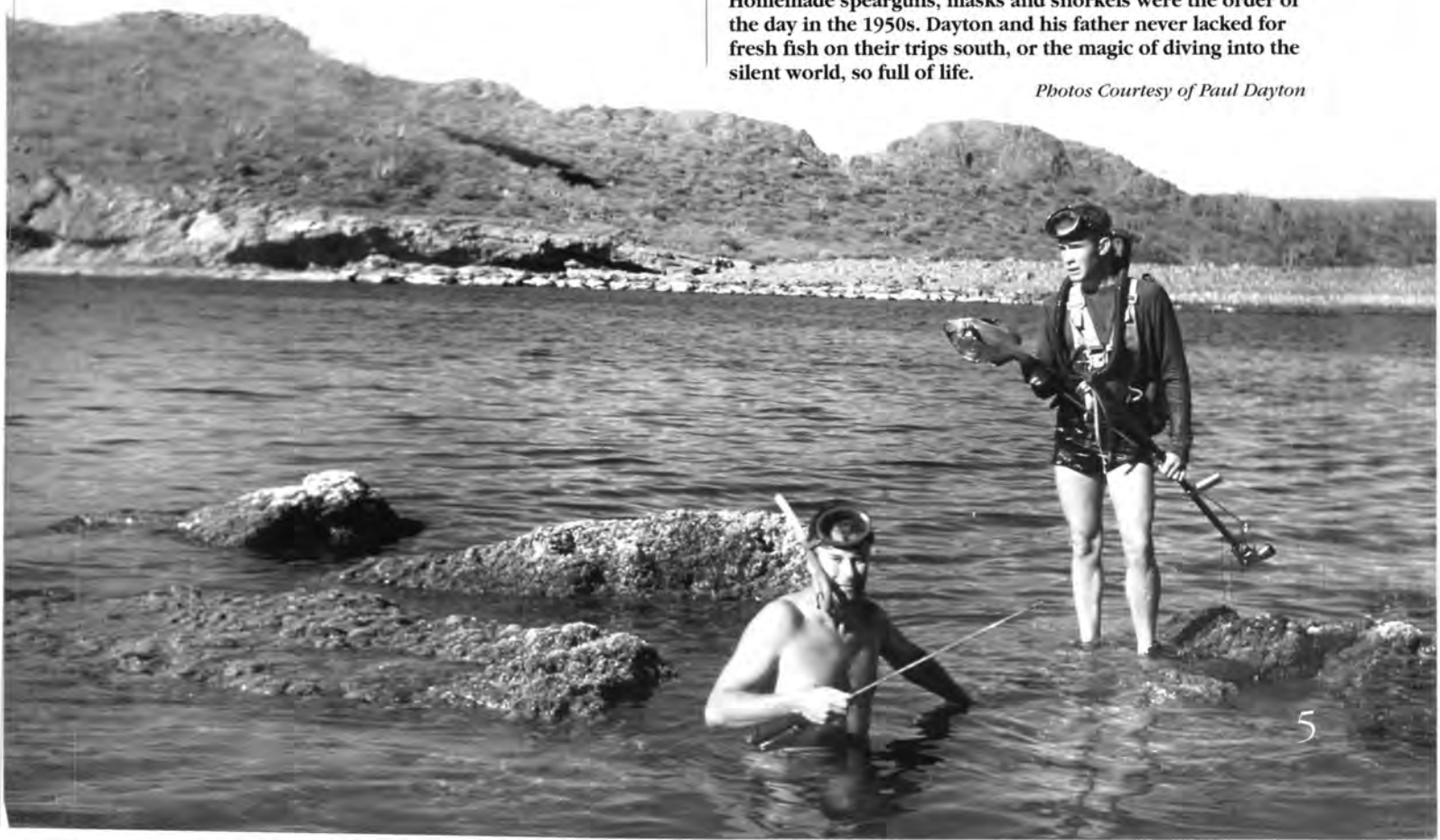
shops and instigating diver training programs. You will meet superb scientists developing an entirely new discipline of underwater research. These pioneers are modest about their accomplishments, but the joy of what they were doing is extremely real and infectious. These are wonderful people, their enthusiasm and tremendous competence shine through every page and you will be inspired by their bold human achievements in modern diving. As a marine ecologist, I have always been in awe of the early Scripps divers reviewed here. With extremely primitive equipment, these early divers did spectacular groundbreaking training and underwater research, still considered to be the foundation of underwater science. A remarkable amount of the development of diving equipment from spearguns to cameras was done in the San Diego area. These people are heroes, by any definition; they have laid the foundation of scuba diving.

Another forgotten but critical component of our diving culture is the huge but not well-publicized role of the U.S. Navy. The story of SEALAB II offers the virtually untold history of visionaries working within military constraints, able to funnel meager Navy resources into research and underwater habitats. To be sure, such habitats have long been a dream of science fiction writers and are based on early Greek "diving bells" that sat on the sea floor. Pliny the Elder (23CE - 79CE) is said to have gone down in one and collected specimens, but it was the U.S. Navy that truly developed the technology to make this dream real. It is always a person or group of people who make dreams come true, and the history of SEALAB II barely touches on the contributions of U.S. Navy diving – ranging from the Office of Naval Research support of undersea science, to the evolution of diving technology. Indeed, many dive equipment developments have been based in San Diego. For instance, Diving Unlimited International is renowned as a world leader in drysuit design.

Why are we so driven to continue diving? What is it about the underwater world that kindles such powerful passions, that has such a strong attraction for so many talented people? What draws us back to the cold sea, maintains our curiosity and enthusiasm, keeps us returning year after year, decade after decade? These histories, the powerful memories of truly remarkable people, will help you understand our obsession with the wonderful undersea world at our doorstep. As you read this issue and contemplate this question, remember that the history involves real people working to realize their dreams. Dreams can come true, but only when there are visionaries to find ways to make them real.

Homemade spearguns, masks and snorkels were the order of the day in the 1950s. Dayton and his father never lacked for fresh fish on their trips south, or the magic of diving into the silent world, so full of life.

Photos Courtesy of Paul Dayton



TIME

332 BCE
Aristotle's *Problemata* describes a diving bell used by Alexander the Great at the siege of Tyre.

1500s
Leonardo da Vinci designs the first known scuba, combining air supply and buoyancy control into a single system.

1622
Spaniards build a diving bell to attempt salvage of the Spanish Treasure fleet decimated by a hurricane near the Florida Keys.

1680
Italian physician Giovanni Borelli draws a closed circuit "rebreather," showing a giant bag using a chemical compound to regenerate exhaled air.

1808
Friedrich von Drieberg develops a system using an air reservoir worn by the diver, but the tank is filled via surface hoses.

1819-1830s
Brothers Charles and John Deane develop, manufacture and market diving outfits.

1825
William James develops a system that several historians consider to be the first true scuba, with tanks of compressed air, full diving dress and helmet.



1825
American Charles Condert develops a compressed air reservoir consisting of copper tubing bent around the diver's body. It included a valve to inflate the diver's suit.

1828
Lemaire d'Augerville patents a "swimming belt" for buoyancy compensation.

1836
Charles Deane publishes the first "how to" diving manual.



1863/1865
Frenchman Benoit Rouquayrol and Auguste Denayrouze develop a diving system that feeds air to a diver-carried tank from a pump on the surface, and to the diver through a membrane-controlled "demand" valve.

1869
Jules Verne popularizes the concept of scuba in *20,000 Leagues Under the Sea.*



1869-1883
New York's Brooklyn Bridge is built. Workers in high pressure caissons experience what will eventually be dubbed by reporters – "the bends".

1876
English merchant seaman Henry Fleuss revives the idea of the close-circuit rebreather. It goes into commercial production.

1880
Dr. Paul Bert, a French physiologist, suggests the causes of "the bends" is the release of dissolved nitrogen from the bloodstream. He also shows that oxygen can become toxic when breathed under pressure.



1892
Frenchman Louis Boutan develops a variant of the closed-circuit system. It can be used for up to three hours in shallow depths.

1909
The Draeger company (Germany) creates a self-contained dive system combining a hard hat helmet with a backpack containing compressed oxygen.

1910
Dr. John Scott Haldane develops a procedure for gradually staged decompression. His research is published and becomes the first dive tables.

1911
Sir Robert Davis refines the self-contained rebreather and it is used worldwide as an emergency escape device for submarine crews.

1915
An early film of *20,000 Leagues Under the Sea* marks the first commercial use of underwater cinematography.

1917
Draegar produces a true scuba system that combines tanks containing a mixture of compressed air and oxygen.

1918
The Ogushi Peerless Respirator (tested to 324 feet) combines rebreather technology with a compressed air reserve.

1919
C. J. Cooke develops a mixture of helium and oxygen for use as a breathing gas for divers. The mixture enables divers to avoid nitrogen narcosis, while diluting oxygen to non-toxic concentrations.

1926
French Navy officer, Yves le Prieur, patents the Fernez/Le Prieur diving system based on compressed air carried in tanks.

LINE

Early 1930s
Guy Gilpatrick, an American living in France, waterproofs a pair of pilot's goggles – commercial versions follow.

1933
Jack Prodanovich, Ben Stone and Glen Orr (later joined by Jack Corbeley, Bill Batzloff and Wally Potts) start a skin diving club in San Diego, the first of its kind – the Bottom Scratchers.

1935
Louis de Corlieu patents a broad-bladed fin to be worn on the feet by swimmers.

1937
DESCO diver Max Nohl sets world depth record of 420' using self-contained mix-gas rebreather developed by American Diving Equipment and Salvage Co. (known as DESCO).

1943
The French Naval officer and diver Jacques Cousteau and engineer Emile Gagnan design a regulator and develop a scuba system – the Aqua-Lung.



1948-1949
The first Cousteau/Gagnan Aqua-Lung is available in a Southern California store – Rene's Sporting Goods (in LA), which would eventually become US Divers, a leading manufacturer of diving equipment.

1950s
The popularity of the Aqua-Lung surges and Dive stores open along coastal cities. Books, magazines and movies explore the brave new underwater world. Advancements in equipment continue.

1954
Al Tilman (L.A. Parks and Rec.) and Bev Morgan (L.A. County Lifeguard) develop the first formal skin and scuba diver training program, based on the SIO diver training program. The first full textbook follows – *The Science of Skin and Scuba Diving*.

1956
Dr. Hugh Bradner, UCB physicist, uses neoprene (at the time used as automobile insulation), creating a thermal barrier "wetsuit".

1962
Jacques Cousteau conducts "Conshelf One" – a habitat housing six men breathing oxygen-enriched air (nitrox) at 35' for seven days.

1964
The U.S. Navy launches SEALAB I - four divers stay underwater at 193' for eleven days.

1965
SEALAB II - Three teams of ten divers live and work at a depth of 205' for two weeks at a time.

1970
Marine Biologist Dr. Sylvia Earle leads an all-female research team in a two-week saturation stay in the Tektite habitat.

1972
The Marine Protection, Research and Sanctuaries Act extends protection to estuaries and coastal waters. The tide changes and the focus becomes preservation of ocean resources.



1975
Box office blockbuster *Jaws* propagates fear of sharks and the ocean, a serious blow to the diving industry.

1983
Co-inventors Craig Barshinger, Karl Huggins and Jim Fulton introduce the first American electronic dive computer – The Edge.

2002
Skin Diver Magazine ends publication after fifty-one years. It had been the first dive magazine in North America, and the most widely read dive publication in the world.

21st Century
Technical divers, using computerized mixed gas rebreathers, extend depth and time limitations previously restricted to commercial divers. The digital revolution makes underwater photography available to the masses. An entire new generation of photographers, spawned by the internet, pushes the boundaries of what was once thought impossible in underwater imaging.



Photo by Julie Lorenzen

The Timeline is a condensed version of: "Time Line of SCUBA - A Chronology of the Recreational Diving Industry," by Mark Dorfman, reprinted with permission from DEMA (Diving Equipment Manufacturers Associations) from Eric Hanauer's, *Dive Pioneers - An Oral History of Diving in America* (San Diego: Watersport Publishing, Inc.) 22-43.

Scientific Diving at Scripps Institution of Oceanography

By Peter Brueggeman

A Concise History

Scientific diving is more than making observations in the water: the objective of science is to understand the important processes that define and regulate natural patterns. The science component is much more difficult than the diving, and the Scripps Institution of Oceanography (SIO) diving program has built its reputation by making excellent scientists into safe divers. A complete history of scientific diving at SIO would fill a book, so highlights are presented in this shorter form. The focus of this history is on scientific diving: many SIO divers were active recreational divers in San Diego, and were well known in the San Diego and Southern California recreational diving community.



Cheng Kui Tseng helmet diving, c. 1942.
Courtesy of Victor B. Scheffer, U.S. Fish & Wildlife Service

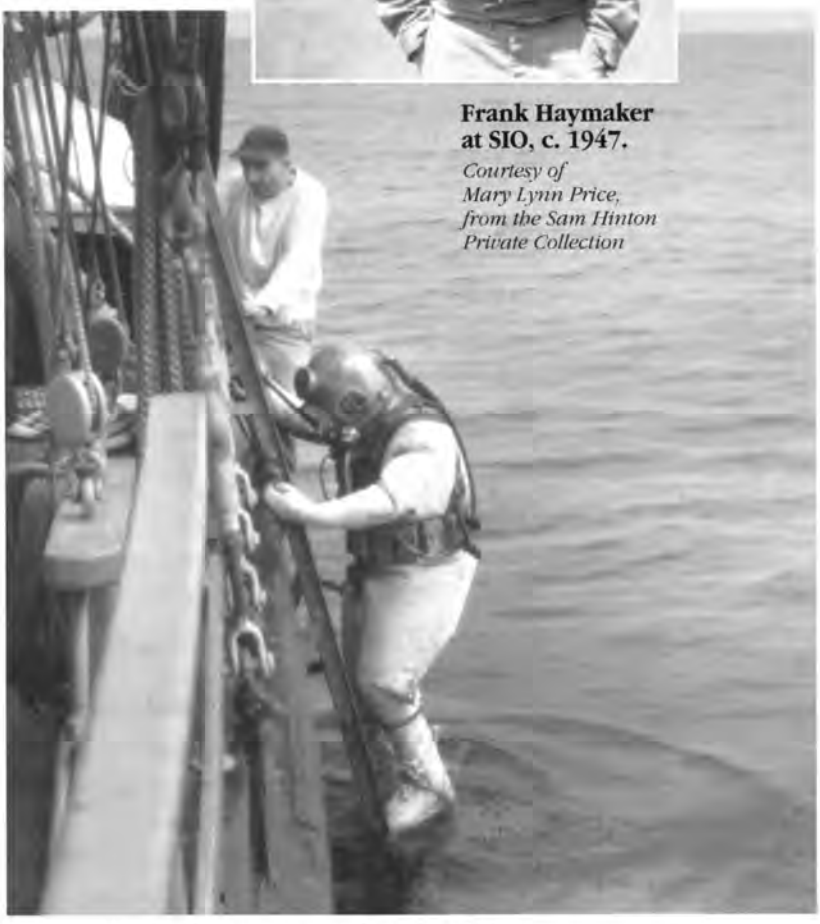
Peter Brueggeman is the retired and final Director of the Scripps Institution of Oceanography Library and Archives, University of California San Diego Library. Peter would like to thank Paul Dayton, Christian McDonald, Mary Lynn Price, and Kevin Hardy for their assistance with this article. Peter also thanks James Stewart for certifying him into the SIO scientific diving program in 1990, which led to countless interesting diving experiences outside the walls of the SIO Library where Peter worked.

The first scientific diver at SIO was Cheng Kui Tseng. Tseng, a Chinese marine botanist, came to SIO in 1942 on a post-doctoral fellowship from the University of Michigan. In early 1942, after his arrival at SIO, U.S. Fish and Wildlife Service scientists approached Tseng to enlist him in the cultivation and utilization of marine algae for agar, due to the wartime loss of Japanese agar imports that had provided ninety percent of U.S. needs. Tseng assessed developing a renewable domestic source of agar, and learned that a few Southern California divers with assistants were already collecting up to two wet tons a day of *Gelidium* red algae. Starting in 1942, Tseng made monthly helmet dives in San Diego, with surface-supplied air to thirty-foot depth, to tag and measure *Gelidium cartilagineum* red algae, comparing its growth rate in natural versus artificial laboratory conditions. Tseng also collected seawater samples to analyze for nutrient content to study their relation to algal growth.



Frank Haymaker at SIO, c. 1947.
Courtesy of Mary Lynn Price, from the Sam Hinton Private Collection

Starting in October 1946, Frank Haymaker of SIO began helmet diving in the local La Jolla submarine canyons using surface-supplied air, as part of SIO geologist Francis Parker Shepard's research on submarine canyons and their formation. Shepard had been studying several submarine canyons for many years, and of particular interest to Shepard were the canyons in San Diego's backyard – the La Jolla and Scripps Submarine Canyons. Immediately offshore of SIO and approaching in a single canyon from the west, they branch into the La Jolla Submarine Canyon, with its canyon head off La Jolla Shores beach, and the Scripps Submarine Canyon, with its canyon head off the south end of Black's beach. Shepard began probing these local underwater canyons in the 1930s, using a rowboat, plotting position with a sextant and landmarks, and dropping weighted sounding lines with a hand reel, to measure and plot both underwater canyons to learn their finer structure – data not available in extant navigational charts, or possible with echo sounding into steep-walled underwater canyons.



Frank Haymaker in helmet diving gear, on the SIO ship *E. W. Scripps*, c. 1947
Courtesy of Mary Lynn Price, from the Sam Hinton Private Collection

Shepard and staff had done almost 2,000 depth soundings off La Jolla by 1934, and their continuing research measured the submarine canyon heads, dredged rocks and analyzed sediment, measured canyon bottom currents, among other data collection. Underwater observations and collecting through diving presented tremendous opportunity to further Shepard's research.

Frank Haymaker was a former Navy diver, and Haymaker's helmet diving for Shepard resulted in more detailed descriptions of submarine canyon topography, including the gas-bubbling decomposing debris fields on the canyon bottoms. He utilized underwater photography to document his findings. From October 1946 to January 1948, Haymaker made sixty-two dives into both La Jolla and Scripps Submarine Canyons, at depths down to 190 feet, supported by a thirty-eight-foot surplus U.S. Navy Utility Boat, with two-way surface telephone communication with Shepard. Haymaker's dives were tended by D. B. Sayner and Robert L. Wisner. Haymaker collected rocks in a canvas bag using hammer and chisel, and made sediment core samples of the canyon floor by hammering in a pipe that was then capped and pulled up to the surface from the boat. Haymaker placed sediment traps in the canyons, and made observations of canyon bottom currents reported to the boat via telephone. If there was good underwater visibility, a 25mm film Ewing submarine camera was lowered to Haymaker for photography of canyon features; if not, he gave verbal descriptions of what he observed via telephone to Shepard in the boat. Haymaker taught helmet diving to other SIO personnel including Sam Hinton, the SIO aquarist, and the SIO ship *E. W. Scripps* was their diving support boat. Haymaker and Shepard's diving operations ceased in January 1948 when the boat broke loose from its anchor in rough seas and was lost with most of the diving gear.

Shepard and staff had done almost 2,000 depth soundings off La Jolla by 1934, and their continuing research measured the submarine canyon heads, dredged rocks and analyzed sediment, measured canyon bottom currents, among other data collection.

Conrad Limbaugh and Andreas Rechnitzer were graduate zoology students under Boyd Walker at UCLA (when SIO was administratively part of UCLA), where they taught themselves to use the (at the time) new Cousteau Aqua-Lung scuba apparatus. These were the third and fourth sold in the U.S., one being a triple tank unit and the other a single tank, and purchased with Walker's funds. There was no training or manual available; Limbaugh and Rechnitzer learned on their own. Limbaugh and Rechnitzer transferred to SIO in spring 1950, under ichthyologist Carl L. Hubbs, and started using scuba diving at SIO to tag fishes, collect specimens, do kelp bed surveys, and explore the submarine canyons off La Jolla. Funding support for kelp bed surveys came from the Kelco Company, which was harvesting kelp. Limbaugh and Rechnitzer used clothing like long johns, surplus Air Force survival suits, and greasy skin coatings to ward off chilling from diving in La Jolla's relatively cold water. Their scuba tanks were filled with air from several 160 cubic feet tanks that were filled and shipped from Los Angeles.

Limbaugh and Rechnitzer began instructing others in scuba diving at SIO, including several from the Submarine Geology Division. Training was both in the ocean and at the La Jolla Beach & Tennis Club swimming pool early in the morning. In 1951 or 1952, Limbaugh and Rechnitzer developed a "Diving Training and Field Procedures Syllabus." In 1952, Limbaugh was authorized by SIO Director Roger Revelle to train and grant permits for SIO scientific divers. In 1953, two UC Berkeley students drowned while scuba diving, and UC diving was halted pending development of a formal course

of diving and safety instruction. In December 1953, Limbaugh was appointed Marine Diving Specialist by Revelle, and became the first SIO diving officer, tasked to develop and maintain a training program, write a diving manual, and issue diving permits. All University of California scuba diving training was done at SIO, and UC scuba diving was coordinated at SIO until 1960, thereafter being decentralized. Limbaugh's SIO program was influenced by Navy diver training, and became the basis of the first public scuba diving certification founded in Los Angeles County in 1954, which led to the founding of other recreational diving certification programs.

Local and submarine canyon life and physical processes were studied by many SIO scientific divers, including Conrad Limbaugh, Andreas Rechnitzer, Charles Fleming, Robert Dill, Earl A. Murray, Dick Mills, Wheeler J. North, Harris B. Stewart, Jr., Theodore K. Chamberlain, and others. Limbaugh made extensive fish and invertebrate surveys of the La Jolla Submarine Canyon encompassing diving, dredging, and photography. In February and March 1953, SIO's John McGowan studied and subsequently published observations on an unusually large spawning of market squid, mating and laying eggs at the head of La Jolla Submarine Canyon off La Jolla Shores beach. This is one of the few areas where scuba divers can access and observe this phenomena nearshore and in relatively shallow water. Recreational scuba divers can be seen night diving off La Jolla Shores beach to observe these infrequent squid runs. The squid runs attract large numbers of sea lions feeding on the squid, and these sea lions enjoy buzzing the sightseeing scuba divers in the dark at depth.



Conrad Limbaugh, 1959.
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library



SIO diver Earl Murray, 1958. Later Murray was a Sealab II aquanaut.
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

In 1956, SIO biologist Edward W. Fager started nearshore sand-bottom faunal studies using scuba diving, recognizing its ability for direct observational and sampling access. Arthur O. Flechsig was Fager's technician and fellow diver in studying marked locations in front of SIO from eighteen to sixty feet deep, leading to an understanding of the nearshore community ecology. Many of Fager's graduate students did extensive research diving, including Ray Ghelardi, Bob Clutter, Dick Ford, and Ann C. Hurley Hartline.

SIO scientific diving involved a learning process about diving itself. On July 31, 1953, a deep scuba dive of 225 feet was made into the Scripps Submarine Canyon by UC Berkeley physicist Hugh Bradner and SIO's Conrad Limbaugh and Robert Dill, with Raymond McAllister as a safety diver, in order to make observations and certify Dill as an SIO diving instructor. Hugh Bradner had invented the neoprene wetsuit and the divers were all wearing Bradner's wetsuit. With contemporary diving physiological knowledge, this was a risky dive to conduct breathing normal air in the scuba tanks, since the toxic effects on the brain of the increased partial pressure of oxygen can appear around 218 feet depth. Today, SIO's scientific diving program would not allow such diving under its auspices.

The underwater canyons off La Jolla have continued to be of scientific interest studied via diving. In the 1990s, SIO graduate student Eric Vetter conducted over 300 dives in Scripps Submarine Canyon and found the canyon's debris mat of drift kelp, eel and surf grass, washed down along San Diego County's coastline by its longshore current, supporting the highest reported natural secondary productivity in the world's ocean. Secondary production is those animals and unicellular protists that eat photosynthetic organisms and bacteria, and La Jolla's underwater canyon debris mats support intense microbial and invertebrate populations, on which fish flock in to feed. This rich canyon sea life attracts the considerable scuba diving seen at La Jolla Shores, wherein easy access is afforded to a diverse underwater environment. There are few similarly rich underwater canyons so close to shore

On July 31, 1953, a deep scuba dive of 225 feet was made into the Scripps Submarine Canyon by UC Berkeley physicist Hugh Bradner and SIO's Conrad Limbaugh and Robert Dill, with Raymond McAllister as a safety diver, in order to make observations and certify Dill as an SIO diving instructor.

and sufficiently shallow that scuba divers can visit them.

In conjunction with SIO scientific interest in La Jolla's underwater canyons, the physical environment of the long La Jolla beach with its waves, rip currents, and sand movements functioned as a scientific laboratory, and was studied by several SIO scientists, and in the 1950s diving became a tool to install measuring instruments, and make observations. Converted U.S. Navy surplus DUKWs were used to transport equipment and divers from SIO through the surf zone to nearshore research areas. The steep concrete ramp just north of the SIO Pier and leading from the beach up to SIO, was the DUKW driveway on and off the beach; the concrete block building to the left at the top of that ramp garaged the DUKWs, and is now the SIO Diving Locker.



SIO DUKW exiting the beach, early 1950s.
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

In the 1950s, scuba divers were finding large numbers of small Native American grinding mortars or bowls in shallow waters inshore of the La Jolla Submarine Canyon head, in front of the La Jolla Beach and Tennis Club, just south of SIO. SIO divers James R. Moriarty and Neil F. Marshall published research on them, postulating that rising sea level had drowned the site. Currently, the California State Department of Parks and Recreation notes that 2,000 bowls have been found there, at depths to eighty feet.





SIO DUKW used for diving, at the head of Scripps Submarine Canyon. Douglas Inman is adjusting the diver's tank, early 1950s.
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

View south from Black's Beach



Diving on Alexa Bank during the Capricorn Expedition, December 9, 1952. Left to right: **William King (profile at left edge) and SIO divers Robert Dill (in tee shirt), Walter Munk, Robert Livingston, Philip Jackson, John MacFall (from behind, holding an underwater camera).**

Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

Scripps scientific diving extended beyond Southern California waters. An early overseas scientific diving endeavor occurred during SIO's Capricorn Expedition to the South Pacific, in 1952-1953. Scientific diving on this SIO expedition involved six divers: Willard N. Bascom, Robert F. Dill, Philip E. Jackson, Robert S. Livingston, John B. MacFall, and Walter H. Munk, who did scuba diving between December 1952 and February 1953 in order "to apply underwater man as an oceanographic tool." The divers used U.S. Divers Aqua-Lung regulators that had been modified at SIO to be more responsive to respiratory demand; they also used a Lambertsen Amphibious Respiratory Unit.

Dives were made at Banaba Island (aka Ocean Island) in Kiribati, Alexa Bank in Fiji, Tonga, Samoa, Tahiti, Takaroa in the Tuamotus, and Nuku Hiva in the Marquesas. Underwater work focused on coral atoll surveying and geological observations, experiments on the effects of diver distance from underwater explosions used in seismic surveying work, and the location and exploration of a sunken Navy tanker, the *Chehalis*, in 163 feet of water at Pago Pago, Samoa. MacFall took color underwater photographs.



SIO divers on Guadalupe Island during Andreas Rechnitzer's research project, November 1954. From left: **James Stewart, Andreas Rechnitzer, Charles Fleming, John Carter, Thomas Urban Thies (U.S. Navy UDT diver) and Earl Murray.**
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

James Stewart started as a volunteer diver at SIO in 1952, helping in research diving and in diver training. After many years of skin diving, Stewart had started Aqua-Lung scuba diving in 1950, and interacted with many SIO divers locally, including Limbaugh. Throughout the 1950s, there were various SIO scientific expeditions to Mexico, including Clipperton Island, Guadalupe Island and Cabo San Lucas; Conrad Limbaugh and others participated as divers. In 1955, a Scripps research team travelled to Enewetak/Eniwetok and Bikini atolls to study the aftermath of atomic bomb testing. James Stewart and other SIO divers participated in the research diving component of that work on trips in successive years. From the late 1950s on, ichthyologist and fish collection curator Richard Rosenblatt used diving to collect fish. In 1958, Michael Neushul, Jr., an SIO research biologist, made thirty-three dives in the South Shetland Islands and the Antarctic Peninsula using wet and dry suits, Pirelli closed circuit rebreathers, and open circuit scuba gear. After he came to SIO in 1970, Paul Dayton continued his Antarctic research diving on benthic ecology, spending more than an aggregate of fifty months at McMurdo Sound, doing more than nine hundred research dives through 1989, under the ocean's thick overlying ice sheet. The scientific papers that resulted from Dayton's extensive research diving on Antarctic benthic ecology set a standard for such work.



Paul Dayton diving under the sea ice ceiling in Antarctica, 1974.
Courtesy of Gordon Robilliard

By 1955, Stewart was employed part time at SIO, and later full time in 1956. In 1960, Conrad Limbaugh drowned in a cave diving accident in France, and James Stewart was named to replace Limbaugh as SIO's Diving Safety Officer.

In 1955, a Scripps research team travelled to Enewetak/Eniwetok and Bikini atolls to study the aftermath of atomic bomb testing.



James Stewart at the SIO Pier, 1965.
Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

In 1965, Stewart was a diving coordinator for the Office of Naval Research's Sealab II underwater habitat. Sealab II involved three teams of ten men living two weeks at a time in a steel cylinder. It was located half a mile off the SIO pier, at 205 feet depth, on a slope above Scripps Submarine Canyon.

Among the many Sealab II diving inhabitants were SIO divers Earl A. Murray, Arthur O. Flechsig, and SIO graduate students Thomas A. Clarke, J. Morgan Wells, and Richard W. Grigg. From Sealab II, saturated divers swam out and made observations and performed experiments for military and scientific interests as well as diving physiology, performance and equipment.

Sealab II being readied for submergence into Scripps Submarine Canyon off SIO, 1965.
Courtesy of the U.S. Navy

Dives were made down to a depth of 300 feet. SIO divers published that the Sealab II habitat functioned as an artificial reef, with fish biomass increased thirty-five times compared to nearby areas.

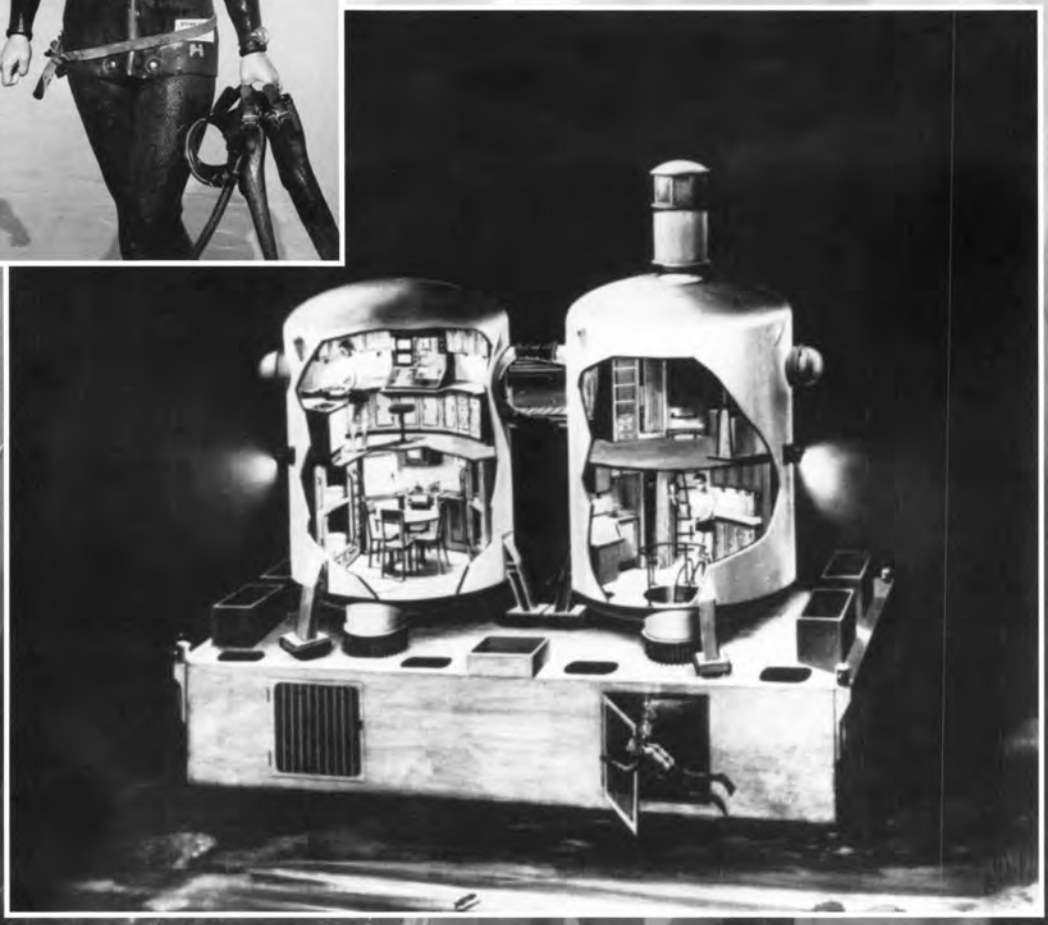
From Sealab II to date, SIO divers have occasionally participated in research projects conducted via underwater habitats. Notable was Mission 6, of the Tektite II underwater habitat in 1970, which included SIO graduate student divers Alina Szmant and Ann C. Hurley Hartline. SIO scientific divers have also conducted research in the Hydrolab and Aquarius underwater habitats.



Above: **Sealab II divers perform hand-eye coordination test, 1965.**
Courtesy of the U.S. Navy



Above: **SIO graduate student divers Alina Szmant (left) and Ann C. Hurley Hartline at SIO Pier, April 1, 1970. They were research divers in Mission 6, of the Tektite II underwater habitat.**
Courtesy of SIO Photographic Lab



The Tektite II habitat, 1970
Courtesy of the U.S. Dept. of the Interior

The kelp beds off San Diego have long been a focal point of SIO research diving. In the 1950s, the San Diego-based kelp harvesting company Kelco had a contract with SIO's Carl Hubbs to study fish life in kelp beds and the effects of harvesting kelp, which incorporated diving. Divers Conrad Limbaugh, James Stewart and others worked on this multiyear project, integrating diving research and observations. The Point Loma kelp forest, offshore San Diego and crossed by the sewage treatment plant outfall, supports sport and commercial fisheries, and its kelp was harvested for many decades. In the 1950s, the kelp forest was stressed by minimally treated sewage, and virtually collapsed in the late 1950s El Niño. In 1956, the State of California funded a five-year Kelp Program study, beginning in 1956 and directed by SIO diver Wheeler J. North, using divers James Stewart (the chief diving technician), Jay C. Quast, Jean Kauanui, Chuck Mitchell, David Leighton, Earle G. Cunnison and others, to determine the reasons for the diminishing kelp and the relationships of harvesting, pollution, and fisheries. Support for kelp research came from other sources, and a boat from SIO was commonly seen supporting scientific divers in the Point Loma kelp beds. Divers studied the impact of harvesting techniques, measured kelp growth rates, transplanted Mexican kelp adapted to warmer water, and studied sea urchin grazing on kelp. The SIO Kelp Program itself ended by 1963, and some kelp research continued.



Wheeler J. North
commons.wikimedia.org/wiki/File:Wheeler_J._North_diving.jpg

Since 1971, long-term kelp studies led by SIO divers Paul Dayton, Mia Tegner and Ed Parnell, and utilizing SIO divers: Richard J. Rosenthal, Kristin Riser, Peter Edwards, Vickie Currie, Bob Butler, and others, have examined permanent study sites in Point Loma kelp forest habitats. Divers conduct up to five dives a day several times a week and have logged over 30,000 dives to date, with Kristin Riser logging over 7,000 of them. Divers take temperature and water samples, check on reproductive health of mature kelp, tag and measure algal growth as well as cut or remove algae to manipulate conditions and test hypotheses. Sixteen SIO graduate students have done their thesis work diving in the kelp system. In conjunction with the preceding SIO Kelp Program, these ongoing SIO kelp studies have compiled one of the longest time-series of marine ecological data in the world.

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Kristin Riser (left) is handed a sample of kelp frond encrusting growth by Mia Tegner in the Point Loma kelp bed, 1978.
Courtesy of Scripps Institution of Oceanography



James Stewart cartoon of an Occupational Health and Safety Administration-regulated scientific diver, c. 1980.

Courtesy of Scripps Institution of Oceanography Archives, UC San Diego Library

As scientific diving became more prominent, James Stewart was fundamental in the formalization and perpetuation of scientific diver training and operational standards. Stewart created a University of California system-wide diving program in the mid-1960s. Divers were fairly unregulated at the U.S. McMurdo Station in Antarctica until James Stewart drafted scientific diving rules starting with the 1967/1968 season, for example, prohibiting solo diving, and requiring a dive tender on the surface. Stewart later became the U.S. Antarctic Research Program Polar Diving Officer for many years. In 1971, Stewart's diving manual was published by the California Sea Grant program, which increased his influence on scientific diving guidelines at other universities. In 1975, the United Brotherhood of Carpenters and Joiners of America, supported by the AFL-CIO, petitioned the U.S. Government for a professional diving operations standard that would encompass scientific diving. A commercial diving standard became effective in October 1977. That Occupational Health and Safety Administration diving standard, if applied to scientific diving, would have removed the scientist from scientific diving.

By recognizing the difference between safe diving and doing excellent science, Stewart defined the American philosophy of the role of the diving safety officer.

James Stewart was fundamental in organizing the American Academy of Underwater Sciences in 1977. In 1979, Stewart organized the AAUS' university dive safety officers to submit exemption arguments to OSHA, citing the long established self-regulation and standards of scientific diving, and an accident rate significantly lower than commercial diving. After negotiation and Congressional hearings, the scientific diving exemption to commercial diving standards was issued in 1982, leaving scientific diving to its own professional regulation.

By recognizing the difference between safe diving and doing excellent science, Stewart defined the American philosophy of the role of the diving safety officer. He emphasized that the diving safety officers usually are not trained to teach science, and their role is to make it easy for excellent scientists to

dive safely. This recognition of the dual nature of scientific diving is critically important and can be problematic with increasing university risk management over time, and thus increasing restrictions on scientists. James Stewart retired as the SIO Diving Safety Officer in 1991, and was followed by Wayne Pawelek. In 2004, Christian McDonald became the SIO Diving Safety Officer. Today, scientific diving at SIO is much the same as it was in the beginning, with a diving safety officer and oversight by a diving control board.

With the opening of the Birch Aquarium at Scripps in 1992, the focus on scientific diving was expanded with volunteer aquarium divers who were incorporated into the SIO diving program. In 2015, there are more than 160 scientific divers affiliated with SIO. Scientific dives logged annually number more than 4,000 in Southern California, in the Birch Aquarium at Scripps, and at research locations worldwide. Scientific diving at Scripps Institution of Oceanography is built on its past and has steadily increased diving knowledge and underwater research, diving and equipment support, and greater diving safety. Scientific diving is scientific work at its core and not underwater sightseeing, but even with the work, the divers always enjoy being underwater – that has never changed from the beginning.

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SEALAB II

50 Years Later

The Lesser-Known Legacy of SEALAB II Lives On

By Ben Hellwarth

About fifty years ago, as the first divers were getting ready to swim into the U.S. Navy's new and improved sea-floor base, dubbed SEALAB II, events on shore provided a considerable distraction from the history being made about a mile offshore from La Jolla, California. The Watts neighborhood of Los Angeles had just exploded into riots. In nearby San Diego, The Beatles were putting on one of their final American shows of the year. It was 1965, a year which, by the conclusion of SEALAB II in October, had already seen Reverend Martin Luther King Jr. leading civil rights marchers from Selma to Montgomery, the ramping up of U.S. troops in Vietnam, and the first walk in space – although it was actually more like a dive, considering the way Soviet cosmonaut Aleksei Leonov floated outside his capsule on a tether, but the term "spacewalk" stuck. It was, after all, the Space Age.

Tumultuous times and the limitations of mid-1960s media, including the still novel concept of TV news, may help explain how a giant leap like living on the seabed could be eclipsed by other events, especially those having to do with the space race between the United States and the Soviet Union. Even a half-century later, the advances and adventures of SEALAB II linger in historical shadows. Consider, for example, the recent *National Geographic* issue celebrating the history of exploration. Its extensive timeline – filled with such milestones as the naturalist William Beebe's 1930s plunge in a bathysphere – made no mention of SEALAB I, II or III.

One side effect of the SEALAB program's relatively low visibility has been that the risks and technical challenges that come with living and working on the seabed never seeped into public consciousness in the way that the risks and challenges associated with manned space flights did. Back in the sixties as today, key issues for space flights are part of the popular science lexicon – like enduring multiple G forces, the effects of weightlessness, and the haunting prospect of burning up upon re-entering the Earth's atmosphere, as the astronaut John Glenn almost did in early 1962. Many earthlings have even felt the physical sensations of G forces and weightlessness for themselves in such places as a rollercoaster ride.

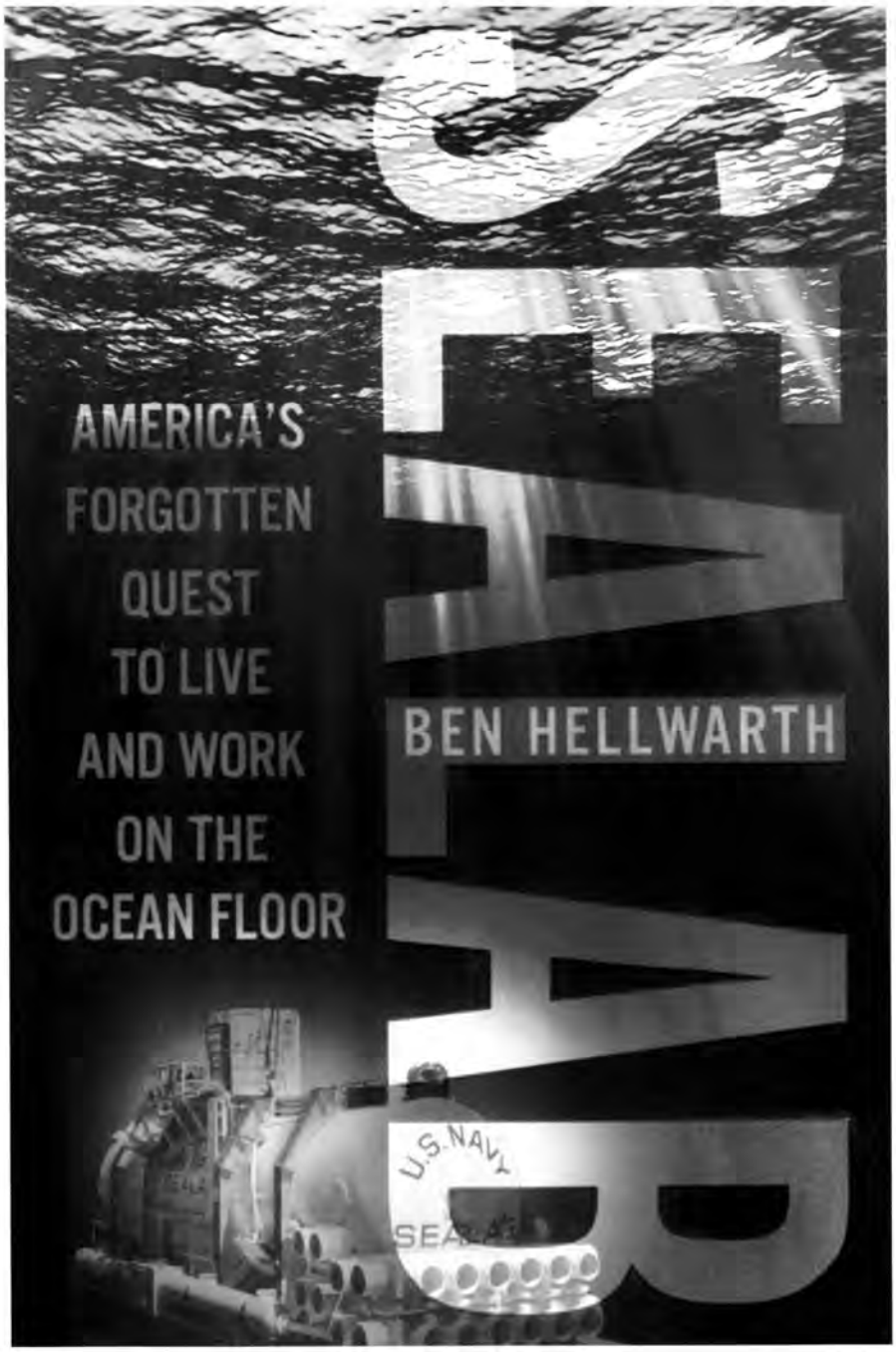
Tumultuous times and the limitations of mid-1960s media, including the still novel concept of TV news, may help explain how a giant leap like living on the seabed could be eclipsed by other events, especially those having to do with the space race between the United States and the Soviet Union.



Ben Hellwarth is the author of ***SEALAB: America's Forgotten Quest to Live and Work on the Ocean Floor*** (Simon & Schuster, 2012). Hellwarth, a veteran journalist, interviewed many surviving SEALAB participants and dug up a variety of lost documentation to write the first full account of the U.S. Navy's SEALAB venture and the resulting breakthroughs in deep diving. His writing has appeared in a variety of media, including *The New York Times, Discover* magazine and *The Huffington Post*.

Obviously, everyone has a primordial dread of drowning and can appreciate the importance of a diver's air supply, whether it's pumped from the surface through a hose, as with the iconic "hardhat" system – featuring a bulbous metallic helmet, a bulky rubber-lined canvas suit and lead-weighted boots, as seen in old movies – or whether a diver carries his own air, compressed into a metal tank on his back, as with self-contained underwater breathing apparatus (scuba). By the sixties, scuba was transforming diving from a strictly professional occupation into a recreational sport.

Still, the notion of divers living in a stationary vessel something like an underwater camper could sound simpler than it was, especially at depths that while deep by conventional diving standards, they might seem unimpressive compared to, say, soaring in a space capsule miles above the Earth. In addition to depth there was duration, no small physiological matter when breathing underwater, and not just because you might run out of air or your gear might fail, but because of the complications that come with breathing air under higher pressures, as is necessary underwater.



These complications, which can be a matter of life or death, remained lesser known. Thanks largely to the popularity of scuba, at least one has become more firmly embedded in the lexicon, and that is a diver's need for decompression – a gradual and methodical return to the surface to allow for the safe release of the gases that get absorbed into the blood and tissues while a diver breathes under pressure. Surface too quickly and you can get "the bends," the achingly painful and potentially fatal condition brought about by bubbles forming in the body, much as they do in soda when a can or bottle is popped open. Bubbles in the body can cause all manner of physiological short circuits, depending on where they form.

In the late 1950s, a country doctor from western North Carolina named George F. Bond, who had no prior diving experience, joined the Navy and became fascinated by how – at the dawn of the Space Age, no less – divers were still largely abiding by depth and duration limits established decades before. As Bond learned during his training to become a submarine medical officer, whether you were doing a job in heavy hardhat gear or swimming freely in modern scuba, the same conventional limits applied: You couldn't dive very deep, and if you did venture much below about 130 feet, you couldn't stay down for very long. During the historic rescue and salvage of the American submarine *Squalus*, which sank in 1939 in Atlantic waters of about 240 feet, Navy divers could spend no more than about a half-an-hour at a time at the downed sub before they had to begin the gradual process of decompression. It took dozens of divers and many dives to put in the hours needed to get a difficult job done. When Dr. Bond joined the Navy that was still pretty much the state of the art.



Captain George F. Bond, affectionately known as "Papa Topside" by the SEALAB crews, is pictured during SEALAB II with his ubiquitous pipe and tobacco pouch in hand.

Decompression schedules, also known as dive tables, had been worked out in the early twentieth century to prevent divers from getting the bends, more formally known as decompression sickness. These tables looked like bus or train schedules, with rows and columns of numbers telling divers how long to pause at given depths en route to the surface depending on the total time they had spent at their working depth. The schedules were always being refined to maximize dive times and minimize decompression times, while keeping a diver safe and free of the bends. But these refinements were more like tinkering than a total transformation, and Dr. Bond marveled that with the world fixated on the lofty goal of sending human beings into outer space and to the distant moon, there was no like-minded effort to send them in the other direction, deeper into the realm that some liked to call "inner space," perhaps in the hope of siphoning a little enthusiasm from the Space program.

Not only were there the longstanding limits on depth and duration intended to prevent the bends, there were other sub-aquatic quandaries, like the drunken stupor brought on at depths of more than about 130 feet when breathing the nitrogen that makes up four-fifths of ordinary air. The narcotic effects of nitrogen had successfully been eliminated a couple of decades earlier by substituting helium into a diver's breathing gas. That enabled divers to stay clear-headed when diving deeper – a critical improvement, especially on tricky jobs – but both depth and duration remained restricted by conventional limits, as set forth in the dive tables.

So, while diving had made some progress, Dr. Bond nonetheless found it surprising that no one had the answer to a pair of questions that seemed to him as fundamental as knowing the speed of sound or how fast a human could run the mile: *How long can a diver stay down? How deep can a diver go?*



For a time Bond's Navy bosses weren't entirely aware what he was up to in his lab, and Bond knew that some would not have approved.



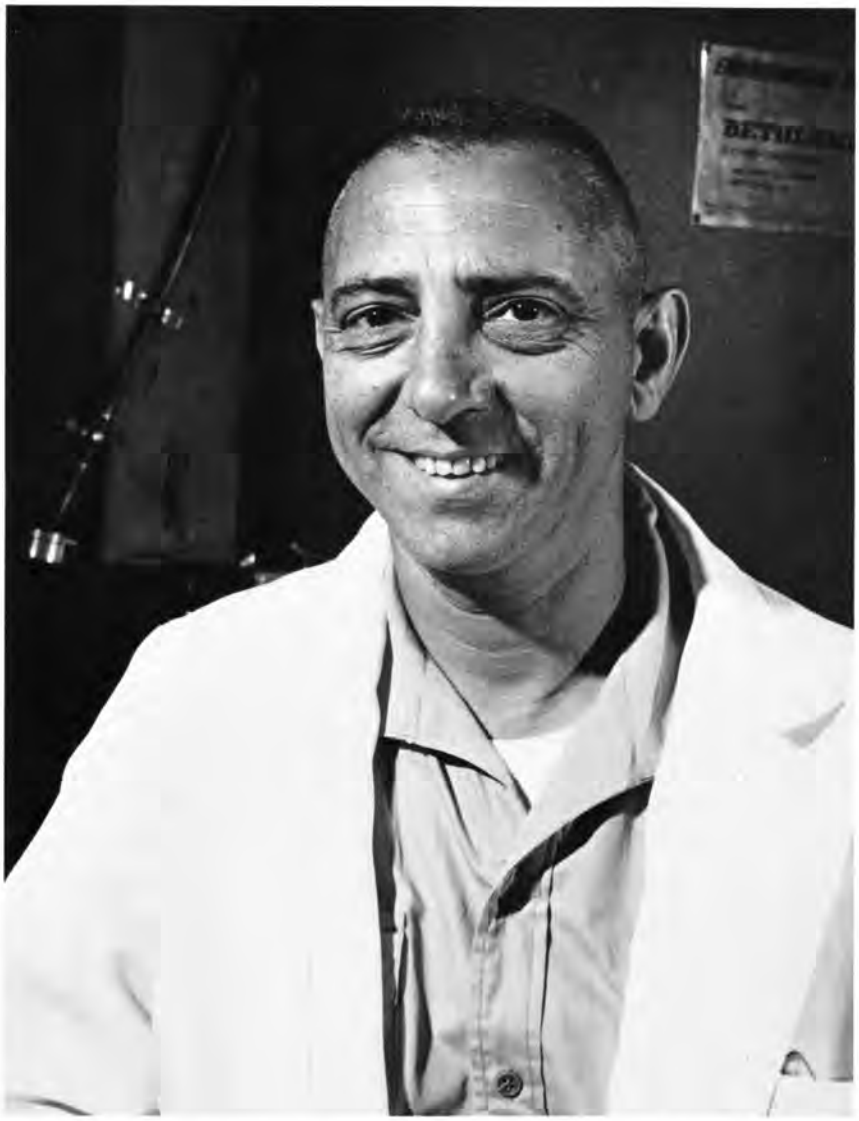
After serving in the Navy for several years in the early 1950s, Bond could have returned to his rural medical practice and he almost did. But he had become hooked on diving and the prospect of achieving breakthroughs that would somehow get around the old decompression limits and afford divers a lot more time underwater. So Bond continued to pursue a career as a Navy medical officer, and he would make it his job to seek answers to those questions about dive depth and duration.

Commander Bond soon got promoted to captain and became officer-in-charge of the Medical Research Laboratory at the U.S. Naval Submarine Base at New London, Connecticut. It was there, in the late 1950s, that he began the laboratory experiments aimed at proving the concept of "saturation diving," a term that referred to allowing a diver's body to fully absorb the gases breathed at a given depth. The greater the depth and pressure; the greater the degree of saturation. The conventional approach to diving didn't allow enough time for a diver to become saturated. Results of some preliminary lab experiments that did allow for total saturation, which took about a day at a given depth, indicated that allowing for total saturation might actually be ineffective, if not downright dangerous.

But Bond and a few others around the New London lab believed that saturation diving could hold the key to enabling a diver to spend hours, days, even weeks at depth instead of mere minutes. There would still be no getting around the need to decompress, but that process might be postponed indefinitely, until it was finally time to surface. That was the idea, anyway.
To test it out Bond and his team at the lab began running experiments on assorted animals, much as tests were run on animals in the early years of the Space program before humans were allowed to ride rockets into the sky.

The early experiments on saturation diving began quietly, even unofficially, in stark contrast to the animal experiments for the Space program – monkeys like Able and Baker made the cover of *LIFE* magazine. For a time Bond's Navy bosses weren't entirely aware what he was up to in his lab, and Bond knew that some would not have approved. But he had an iconoclastic streak that served him well, and he was determined to do what he could to gather favorable evidence and gain support for the revolutionary concept of saturation diving.

Bond's effort might have withered in a hyperbaric test chamber if not for the participation of Captain Walter Mazzone, a top administrator and a decorated veteran of World War II submarine patrols. Mazzone's official job at the New London base involved preparing new submariners for duty, but Mazzone had a background in biological science and, perhaps more importantly, he had an innate sense of curiosity. Before the war, he had hoped to become a medical doctor himself and his interest was piqued the day he was introduced to Captain Bond, rather by chance, during a visit to the Medical Research Lab. Mazzone was not one to be easily impressed, but from his very



Captain Walter Mazzone, during one of the Genesis laboratory experiments in the early 1960s.



Above: **Capt. Walter F. Mazzone, aboard the surface support vessel, *Berkone*, overseeing SEALAB II, August-October 1965. Mazzone was instrumental in creating the support ship from two barges with Joe Berkich, a top civilian technician from the Naval Ordnance Test Station, which is why parts of each man's last name were combined to form the ship's name, SS *Berkone*.**

first conversation with Dr. Bond he was struck by Bond's personal charisma and his professional zeal about pursuing the concept of saturation diving. Bond even talked seriously about the prospect of creating the equivalent of space stations on the seabed.

Fortunately for Bond, and for the future of saturation diving, Mazzone was just the kind of detail-oriented man for the job of running the early saturation experiments, which Bond called "Genesis," not only because he saw them as the beginning of a new era in diving, but because of what the opening lines of the Bible in the Book of Genesis said about man having dominion over the fish of the sea. In addition to being a doctor and scientist, Bond was a religious man and had served as a lay preacher during his half-dozen years as a country doctor. He often gave sermons at the little church in the backwoods of the Blue Ridge Mountains, in North Carolina, where he lived and worked. What was written in scripture seemed to him welcome corroboration that saturation diving was more than just feasible. It was meant to be.

Favorable results from the animal tests led to the next phase of Genesis, one in which human volunteers would be sealed in hyperbaric chambers, with scant amenities, and subjected to a pressurized environment similar to what they'd have to live in underwater. That meant breathing newly concocted gas mixtures, very different from the roughly seventy-nine-percent nitrogen and twenty-percent oxygen found in



The volunteers in the chamber would also know that, once saturated, there was no quick way out before undergoing a lengthy and carefully orchestrated decompression.

ordinary air. Helium was in the mix to avoid the stupor of nitrogen narcosis and the percentage of oxygen had to be reduced because the gas that sustains life reaches concentration levels under pressure that are actually poisonous – one of those complications of living underwater and under pressure that wasn't exactly common knowledge. Another complicating factor was that breathing a lot of helium gave everyone garbled falsetto voices that made them sound like Donald Duck. The Genesis volunteers were also being exposed to heightened pressure for much longer than anyone usually was – about a week was the initial goal. The volunteers in the chamber would also know that, once saturated, there was no quick way out before undergoing a lengthy and carefully orchestrated decompression. Of course, there was no way of knowing whether the customized gas mixtures and decompression schedules that seemed to work for rats, monkeys, or goats would be safe for humans. In short, there was no way of knowing for sure whether anyone who went into a chamber would come out alive and unharmed.

Even as Genesis was going on, Bond was looking ahead to the next step: How to persuade the Navy to build a first prototype sea-floor station. If divers were to spend days or weeks on the seabed instead of mere minutes, they'd need a shelter of some kind, much as a mountaineer needs a tent. They also needed to find out whether the methods that seemed to work in the lab would work at sea, with all the added variables and challenges that come with operating in the ever-changing marine environment.

In the meantime, Bond was happy to share the promising results he was getting in the lab – a report on the animal experiments, while not widely distributed, was publicly available. Two prominent figures in undersea exploration were intrigued, and Bond met them both. One was the American industrialist Ed Link, inventor of the first flight simulator, who was turning his attention from aviation to diving and ocean-going technologies.



Jacques Cousteau, co-developer of modern scuba.

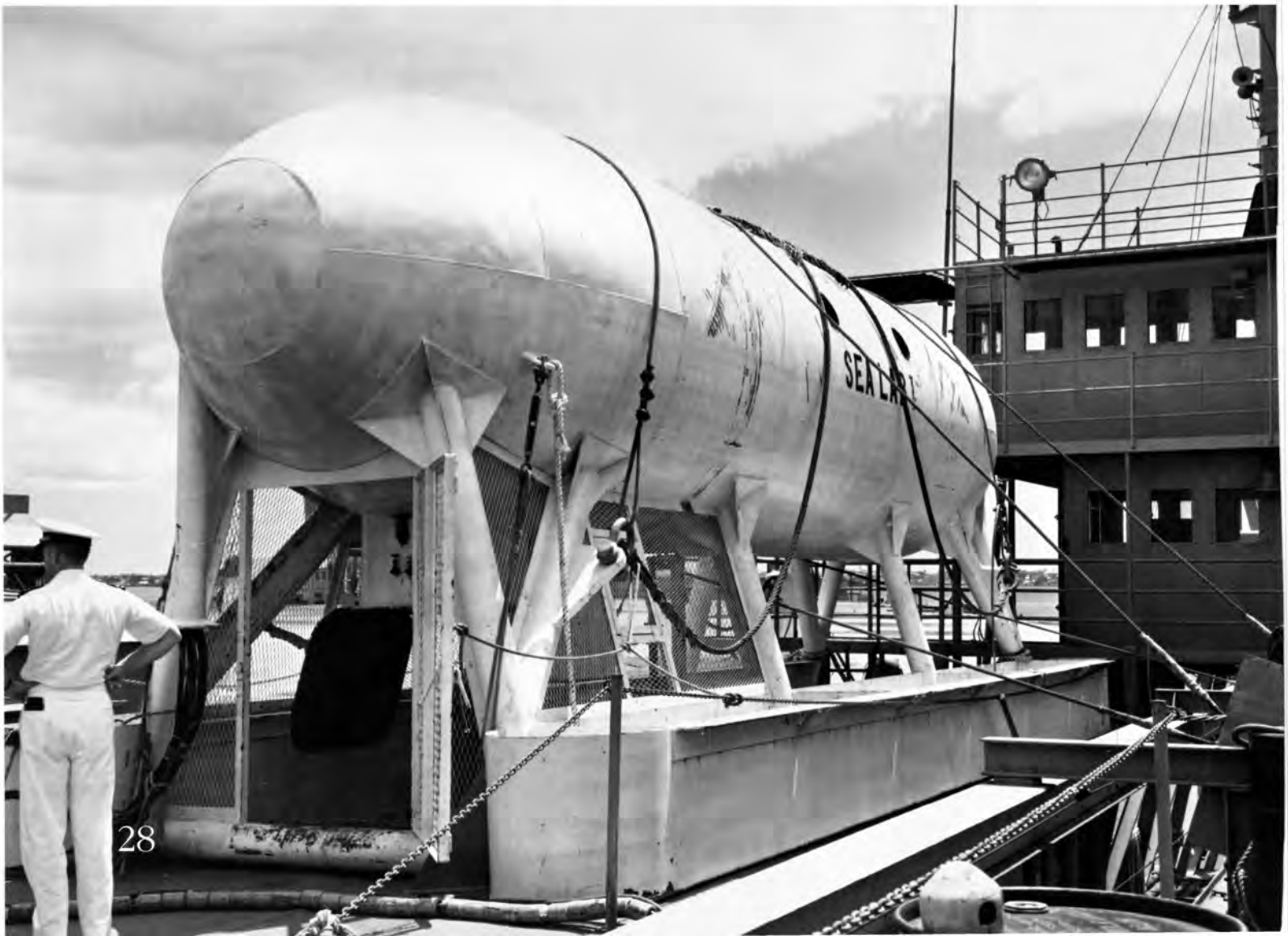
The other was Jacques Cousteau (left), co-developer of modern scuba, who was fast becoming a household name. Link and Cousteau, both eager to test the concept of saturation diving, had initially planned to join forces and run a first saturation dive at sea but their relations soured and they went ahead separately, with two saturation trials each, between 1962 and 1964. They each took relatively cautious approaches, with Link more focused on achieving depth and Cousteau more focused on duration. Bond and his Navy team, once they could get the kind of official approvals that Link and Cousteau, as private operators, didn't need, were aiming for a more definitive demonstration by achieving both substantially greater depth and duration. They also wanted to continue to gather the physiological data needed to ensure diver safety and to attempt longer, deeper dives. This data they found lacking in the Link and Cousteau ventures.

By early 1964, the Navy agreed to build SEALAB I, its first-ever undersea "habitat" – the Roman numeral optimistically suggesting that this habitat would not be the last, but a lot depended on how this undersea debut turned out. SEALAB I was cigar-shaped, about forty feet long and nine feet in diameter, its hull pieced together from a pair of old minesweeping floats to help stay within a skimpy budget. When finished, the habitat weighed thirty tons, with multiple legs attached, like those on a dining table, to allow the structure to sit about six feet over the seabed. This positioning was important because those living inside would come and go through an open hatch in the floor. With the habitat's dry, helium-rich interior kept at a pressure equal to the water pressure outside, the ocean stopped at the brim of the hatch – a key to the SEALAB concept.

SEALAB I was towed to a site about twenty-five miles southwest of the U.S. Navy base at Bermuda, and lowered to a depth of 193 feet on a flat, sandy expanse of seabed called Plantagenet Bank, close to the benchmark of 200 feet used in the final Genesis lab experiments.

This was a substantial depth, then and even now, and at least as challenging as the depth was the planned duration. The goal was to house four "aquanauts," as Dr. Bond liked to call sea-dwelling saturation divers, in SEALAB I, for three weeks.

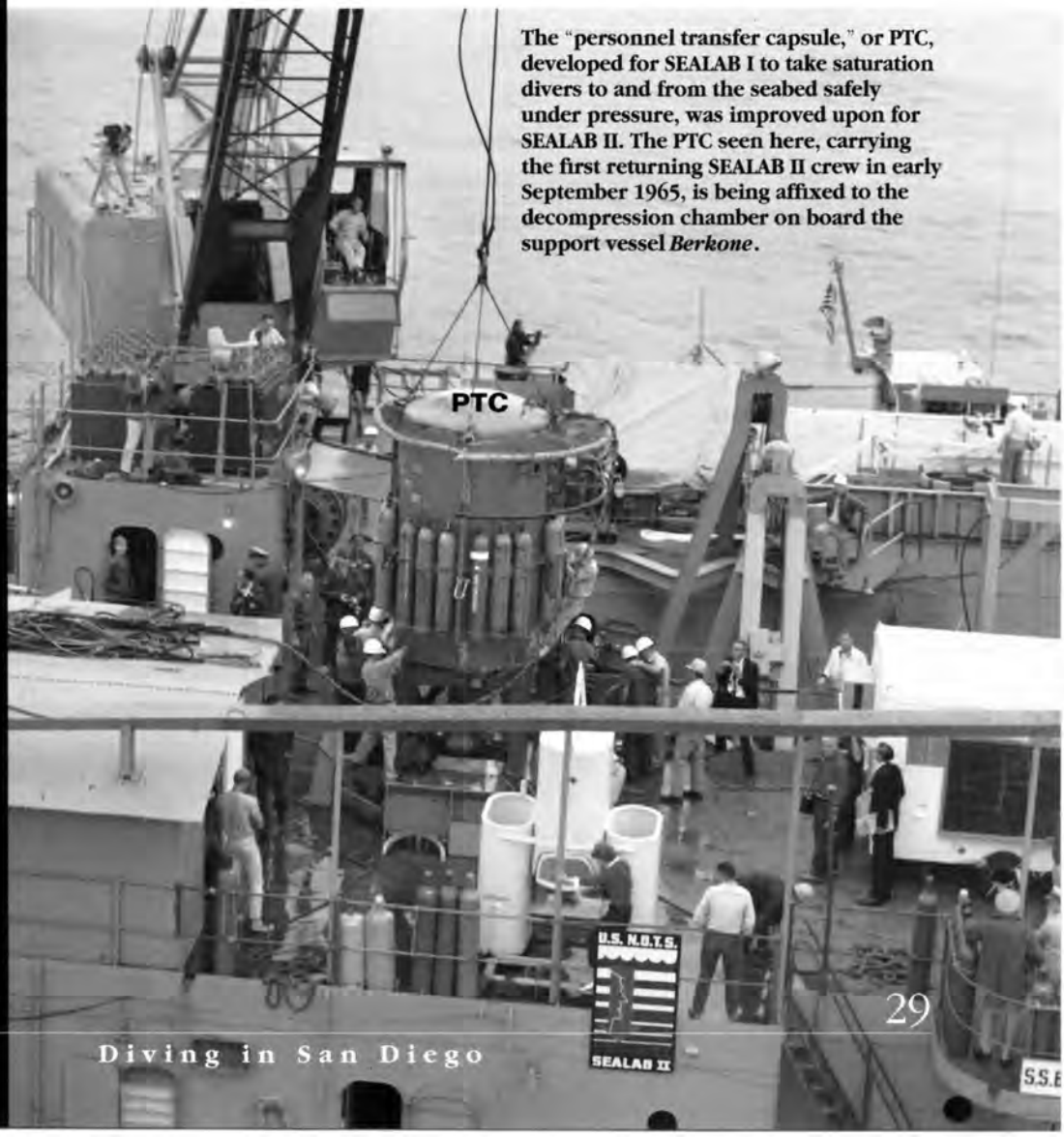
SEALAB I, the U.S. Navy's first undersea "habitat," en route to Bermuda in 1964.



On July 20, 1964, exactly five years before the first manned landing on the moon, four Navy divers squeezed into an oil-drum-shaped capsule, later dubbed a "personnel transfer capsule," or PTC, that functioned like a pressurized elevator. The PTC was designed to take saturation divers to and from the seabed safely under pressure, so on that July day it was lowered by crane to the vicinity of SEALAB I. From there, they could open the hatch in the floor of their pressurized PTC, drop into the water and swim over to the open hatch in the belly of SEALAB I. Those first four aquanauts, all Navy divers, were: Bob Barth, who had been a test subject throughout the human phases of Genesis, along with Lester "Andy" Anderson, Sanders "Tiger" Manning and Dr. Robert Thompson.

Their stay had to be cut short because of an approaching hurricane, but by that time they had already logged nearly eleven days living and working on the seabed, an unprecedented duration at such depth, and in the process they had collected a lot of the physiological data. The aquanauts had also demonstrated the benefits of diving from a sea-floor shelter. They could don their gear and drop through the open hatch at any time of day or night. Most important, they had all survived the experience, including a process of decompression that lasted more than fifty hours.

By early 1964, the Navy agreed to build SEALAB I, its first-ever undersea "habitat" – the Roman numeral optimistically suggesting that this habitat would not be the last, but a lot depended on how this undersea debut turned out.



The "personnel transfer capsule," or PTC, developed for SEALAB I to take saturation divers to and from the seabed safely under pressure, was improved upon for SEALAB II. The PTC seen here, carrying the first returning SEALAB II crew in early September 1965, is being affixed to the decompression chamber on board the support vessel *Berkone*.

You won't find their names in many history books, but they had put themselves at considerable risk to advance the cause of saturation diving and, in so doing, gave the Navy greater confidence that Dr. Bond was onto something.

More money flowed into the young SEALAB program – about $2 million, still a drop in the bucket by space-going standards – and by the following year a bigger, better habitat, with room for ten aquanauts at a time, called SEALAB II, was built at the Hunters Point Division of the San Francisco Bay Naval Shipyard, a logical place for the unusual construction job. SEALAB II was cylindrical like a railway tank car, and much more sturdy and refined in appearance than its predecessor. It was the same diameter, nine feet, but fifty-seven feet long, almost twenty feet longer than SEALAB I, but within its camper-like confines there still wasn't a lot of space for ten divers.

Upon completion, SEALAB II was shipped by barge to a site not quite a mile off the coast of La Jolla, just north of San Diego. The 200-ton habitat was lowered by crane, with the help of a newfangled ballasting and counterweight system they'd devised, to a depth of 205 feet, just a little deeper than SEALAB I had been in Bermuda.

But this time around, instead of remaining at the depth of the habitat, the aquanauts experimented with making deeper dives from the base depth.

Three teams of ten divers, including a half-dozen marine scientists from the nearby Scripps Institution of Oceanography, would each spend two weeks in SEALAB II and attempt to carry out an ambitious list of underwater experiments to demonstrate the range of jobs a genuine sea dweller could get done.



The first team of ten aquanauts poses with SEALAB II as part of a christening ceremony at the naval shipyard in Long Beach, California, a stopover on the way to the La Jolla test site. Second from the left in the front row is Scott Carpenter, one of the famed Mercury Project astronauts.



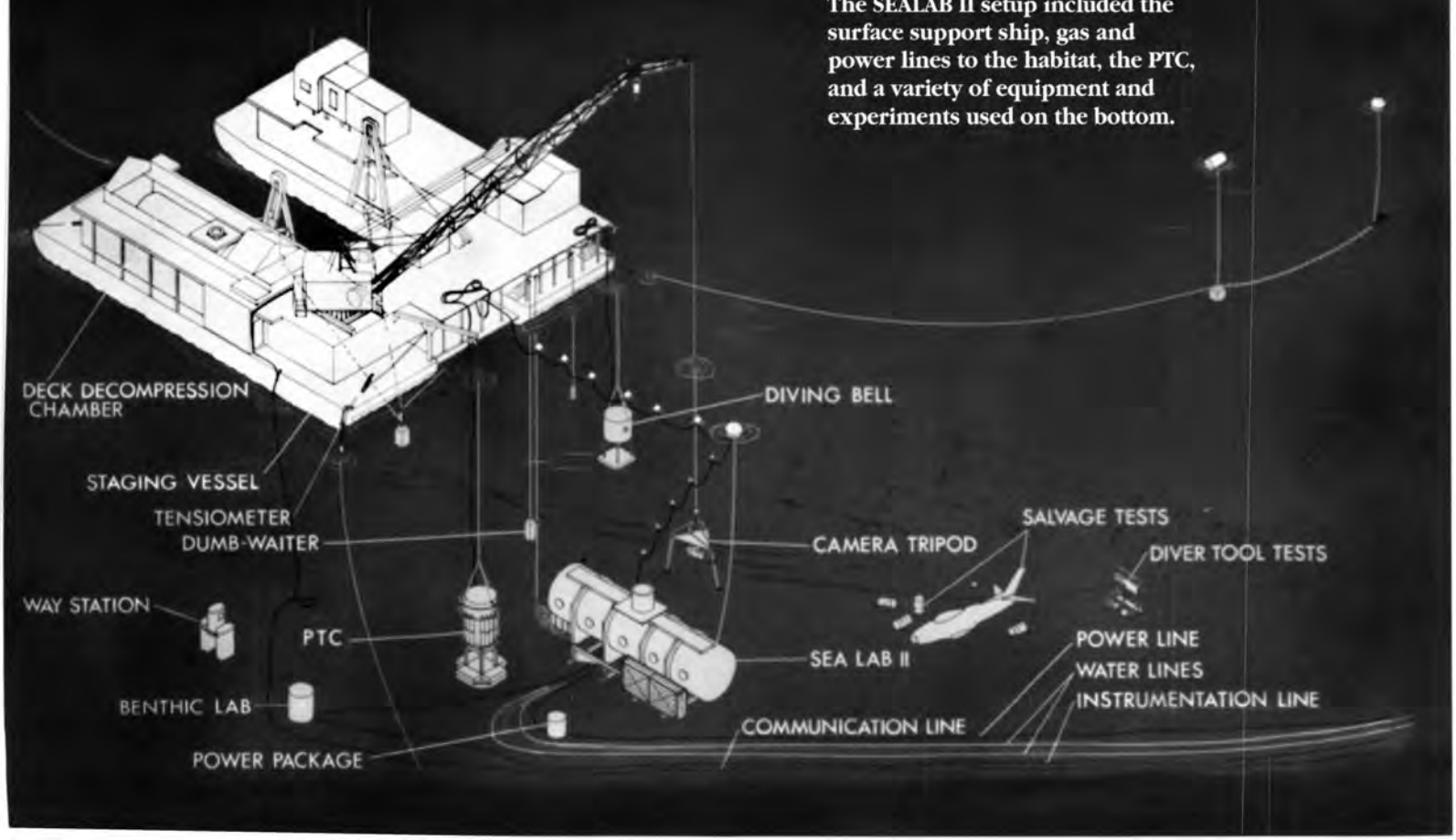
Astronaut Scott Carpenter had gravitated to the SEALAB program from NASA and was going to serve as leader of the first two aquanaut teams.

They would also have to contend with the darker, colder Pacific waters, with temperatures in the forties, instead of the Bermuda temps in the seventies. Three teams of ten divers, including a half-dozen marine scientists from the nearby Scripps Institution of Oceanography, would each spend two weeks in SEALAB II and attempt to carry out an ambitious list of underwater experiments to demonstrate the range of jobs a genuine sea dweller could get done. One of the aquanauts was Scott Carpenter, the famed Mercury Project astronaut who, in 1962, had been the second American to orbit the Earth. For both personal and professional reasons, Carpenter had gravitated to the SEALAB program from NASA and was going to serve as leader of the first two aquanaut teams. That role would not only give him a record-setting month living and working on the seabed, but his celebrity status might even help raise the program's profile.

The notion that living in SEALAB II could be stressful – cramped, stuffy, humid quarters, suffused with the sweaty stench of a locker room in which falsetto helium voices mangled simple conversation – compelled a team of psychologists to monitor the aquanauts throughout their stay. The aquanauts also knew that if they were ever having a serious case of cabin fever, or something went terribly wrong with the habitat, swimming for the surface was not an option – one of many reasons they might as well have been in orbit.

SEALAB II INSTALLATION LA JOLLA

The SEALAB II setup included the surface support ship, gas and power lines to the habitat, the PTC, and a variety of equipment and experiments used on the bottom.





Paul A. Wells, a member of the third and final ten-diver SEALAB II crew, works on a sunken aircraft fuselage, wearing the gas-recycling Mark VI diving gear favored for both SEALAB I and II, despite some dangerous quirks. The Mark VI looks similar to standard scuba, except for the breathing bags worn like a life vest.

Scott Carpenter knew what it was like to be in orbit, and the world knew Scott Carpenter, so as the first of the three SEALAB teams got settled into their stuffy quarters Carpenter was put on a radio hookup with his pal Gordon Cooper, who was then whizzing around the globe, a hundred miles up, aboard Gemini 5 with astronaut Pete Conrad. The "sea-to-sky" voice link was the first of several attempts to generate some headlines and public interest in the risk, the thrill, and the potential of housing aquanauts in sea bases.[2] Captains Bond and Mazzone later donned scuba and dove to SEALAB to join Carpenter for a brief re-enlistment ceremony held for one of the aquanauts. "This will certainly be a first in naval annals," Bond mused.

In another such display, a phone connection was made between the SEALAB aquanauts and the five divers living in Jacques Cousteau's third and final experimental sea base, a spherical structure called Conshelf III, which was more than 300 feet down in the Mediterranean, off the coast of Monaco. Invoking the Cousteau name could be a good way to grab some limelight, but it would take more than a few publicity stunts to make household names out of SEALAB and the aquanauts.



Once settled into the steamy, helium-rich confines of SEALAB II, the aquanauts could cook canned foods on the electric stovetop, but as in SEALAB I frying was verboten – too much risk of contaminating the internal atmosphere. For their dives they had several kinds of gear to choose from, including scuba, but to maximize their dive times outside the habitat they often used a rebreather called the Mark VI, which recycled a lot of the diver's exhalations, thus affording longer dive times than ordinary scuba. The gear had to be precisely calibrated and it could be finicky, as had been learned during SEALAB I. A year later, for SEALAB II, the Mark VI was still a choice piece of equipment, despite its quirks. It looked something like scuba except that wedged between the twin tanks was a canister filled with a carbon-dioxide-absorbing chemical, plus two inflatable breathing bags worn like a life vest.

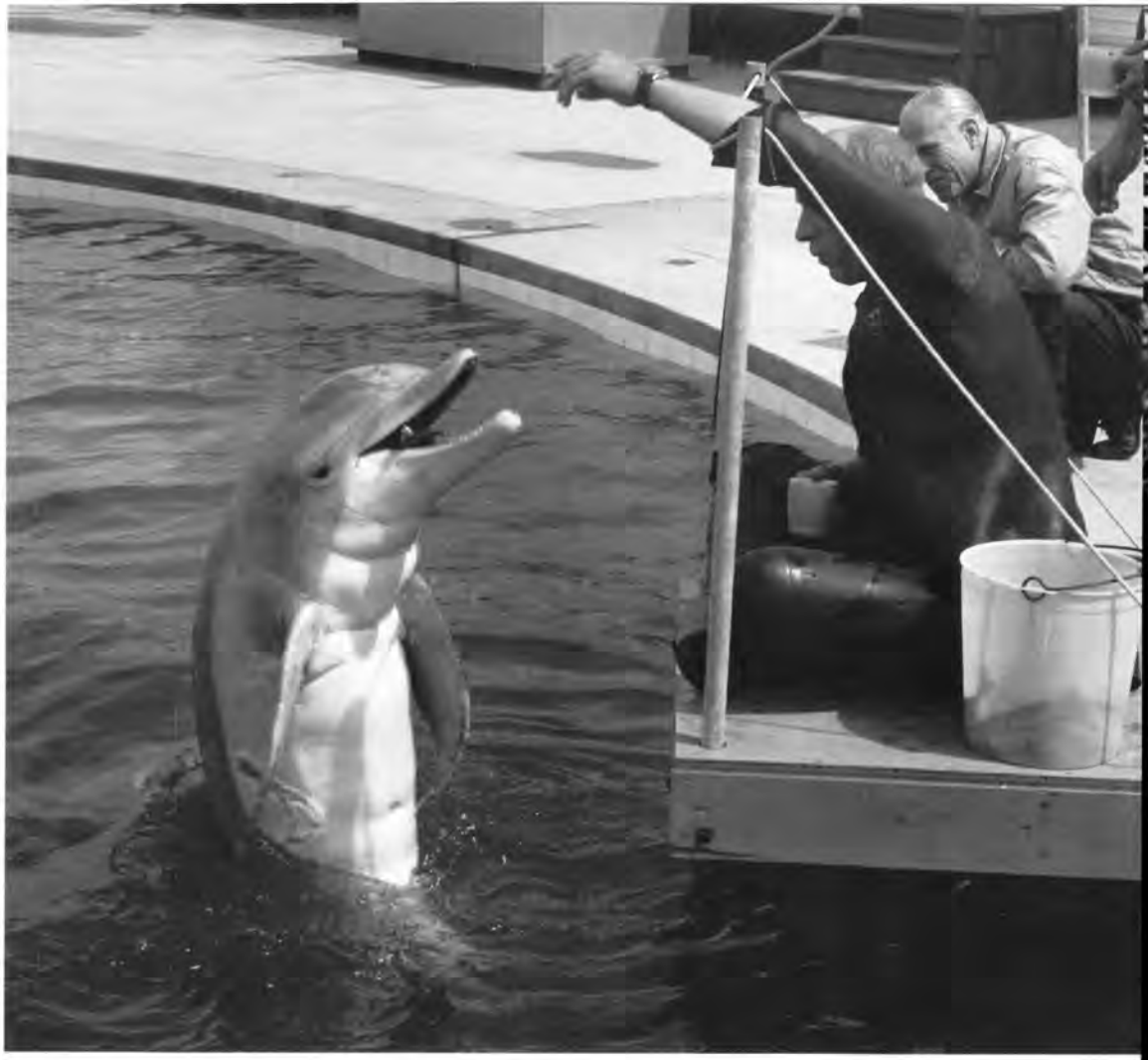
If you thought you were having a problem you couldn't tell anyone – there was no means of voice communication while in the water, only old-fashioned hand signals.

Once the Mark VI was set up, the diver would know approximately how long his gas supply would last, but that was about it. "Approximately" was an operative word. The Mark VI had no warning systems and there were none of the kind of dive computers that would later become commonplace. A diver had to be on constant alert for possible signs of trouble, like overly labored breathing or lightheadedness. If you thought you were having a problem you couldn't tell anyone – there was no means of voice communication while in the water, only old-fashioned hand signals.

The issue of voice communication was one they hoped to resolve during SEALAB II. Diver communications would be especially helpful in cases of emergency, of course, and for complex jobs. When hand signals didn't suffice, the aquanauts had to stop what they were doing and swim back to the SEALAB hatch, where they could pop in, pull out their mouthpieces and talk things over in their helium falsettos. Considering all the advances they were making, it was ironic that communications between divers and their supervisors at the surface had remained elusive. Even old-style hardhat divers had had telephone systems in their bulbous helmets for the previous half-century, since about 1915. But such systems were more easily devised for the dry interior of a helmet, where a diver's mouth wasn't plugged with a mouthpiece or his face squeezed into a dive mask. Hardhat divers also had an air line on which a phone line could piggyback.

For SEALAB II they were going to use a piece of gear called the Aquasonic, a prototype for diver voice communication. The Aquasonic looked something like a fighter pilot might wear, with a mask fitted around the nose and mouth that was supposed to allow for both breathing and talking underwater. It was also supposed to send a radio signal through the water. But in an early test of the Aquasonic they found that the mask leaked badly and even when the signal was received, helium speech made the diver's words incomprehensible. That something as significant as the Aquasonic hadn't been sufficiently tested was another indication that despite a surge in funding, the SEALAB program was not the Space program. Scott Carpenter recognized that as readily as anyone. More than once he remarked that for SEALAB they were "working with mail-order equipment in marginal conditions."





Left: **Tuffy, an Atlantic bottlenose porpoise, was trained to assist the SEALAB II aquanauts.**

Conditions in and around the habitat were a big part of the challenge. Not only was the water cold, but visibility varied greatly. Equipment lowered from the surface support ship – a pair of boxy vessels that had been customized and linked up to form a floating, U-shaped mission control – could be difficult and sometimes impossible to find. They were also diving at night, but even during the day an aquanaut didn't have to swim far to lose sight of the habitat. The prospect of getting lost, disoriented, or injured while working in the water, possibly at some distance from the habitat's hatch, was the reason a porpoise named Tuffy was tapped for duty.

Tuffy was part of a Navy program that trained marine mammals to do a variety of jobs, like coming to the rescue of a lost or injured aquanaut, a skill practiced during SEALAB II. Tuffy lingered near the surface in a pen, and upon hearing a buzzer, he dove to the aquanaut who had summoned him. In these tests Tuffy was to lead the aquanaut back to the habitat, since immediate surfacing was not an option. While not yet flawless in his role as an undersea St. Bernard, Tuffy made progress.

The seabed around SEALAB II became a proving ground for a variety of military and civilian jobs, including the setup and monitoring of a weather station, the salvage of a jet fuselage, a study of plankton and an artificial reef. There was also the daily upkeep and maintenance of the habitat and dive gear. The days were full and often exhausting. When a team finished its two-week stay, the aquanauts would have to swim into their pressurized elevator, a larger version of the oil-drum-shaped capsule made for SEALAB I. It hung near the habitat on a

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SEALAB III incorporated extensive modifications to the SEALAB II habitat.

line from the surface support ship. Once the capsule was sealed shut and lifted back onto the ship, with nine or ten aquanauts crammed inside, it was affixed to a chamber where all the aquanauts could undergo more than thirty hours of decompression – a small price to pay for having spent two weeks living at a depth of 200 feet with some deeper forays. The decompression schedule had even been revised so that it was only about half as long as the more slow and cautious schedule followed for the aquanauts of SEALAB I.

Over the course of the forty-five-day experiment, lessons were learned and, despite some close calls, no lives were lost. SEALAB II was considered a success, much to Captain Bond's relief and delight, and the Navy put more money and personnel into its sea-dwelling program for SEALAB III, an expanded and remodeled version of SEALAB II. The program budget grew to about $10 million and in the winter of 1969, after a series of delays, the habitat was placed at the daunting depth of 610 feet, near San Clemente Island, a few miles out to sea from the site for SEALAB II.

SEALAB III was going to involve five aquanaut teams and a variety of experimental military and civilian projects, expanding on the kinds of jobs done during SEALAB II. The work would be carried out over the course of two months at a depth conventional divers rarely reached, and if they did they could stay for just a few dicey minutes. It was beginning to look like this could be an undersea feat to match the impending Apollo 11 moon shot. But in the early hours of the deep operation, an experienced and well-liked aquanaut, Berry Cannon, died under mysterious circumstances. Instead of a record-shattering undersea adventure, SEALAB III became the focus of a month-long Navy investigation into the technical difficulties, human error, and even allegations of sabotage surrounding the fatal accident.



The program languished for about a year before it was quietly cancelled, but not because of the kind of skepticism that hung over the first SEALAB. The Navy was sold on saturation diving, but instead of creating more undersea bases like SEALAB, the Navy had devised top-secret plans to deploy saturation divers from some of its submarines. It was the height of the Cold War and saturation diving became a valuable tool for high-stakes missions involving undersea espionage. Industry, too, was quick to adopt saturation diving, but instead of living on the seabed divers spent their off-hours in pressurized chambers at the surface and commuted to their working depths in personnel transfer capsules similar to those developed for SEALAB. The arrival of saturation diving methods and related technology was ideal for offshore oil operations because in the 1960s they were moving into deeper waters and divers were needed who could work at greater depths for hours at a time. They still are. It's not a stretch to say that since the time of SEALAB II, saturation divers have helped put gas in your tank – just one of the many possibilities George Bond envisioned.

But Bond and contemporaries like Jacques Cousteau were especially keen on what saturation diving and habitats could do for science and exploration. Marine scientists were – and are – understandably enthralled by the prospect of spending the kind of time on the seabed that Jane Goodall could spend in the jungle, or, for that matter, that astronauts can now spend in space. A motley assortment of SEALAB-inspired habitats designed for ocean research appeared in the U.S. and around the world, but funding and maintaining sea-floor bases primarily for science proved to be difficult. Still, a few visionaries have kept the concept alive. One SEALAB descendant – built by American entrepreneurs and known as "La Chalupa" – was successfully used in the 1970s for a series of research projects around Puerto Rico and continues to operate in a shallow Key Largo lagoon as Jules' Undersea Lodge. The Aquarius Reef Base, originally built by the National Oceanic and Atmospheric Administration, has been located for the past two decades a few miles south of the Florida Keys, at a reef sixty feet below the surface. Dozens of researchers have spent days at a time at Aquarius, including NASA astronauts-in-training, because living and working for extended periods underwater turns out to be the best way to replicate the challenges of living in space, or even on another planet. The parallels between sea and space can also be found in the blueprints for SeaOrbiter, a roving sea base being developed in France that bears a striking resemblance to the *Starship Enterprise*. It will float and drift with the currents, like a twenty-story buoy. About half of the towering craft will remain below the waterline and include accommodations for saturation divers, who will venture outside for their own brand of spacewalk.

The Navy was sold on saturation diving, but instead of creating more undersea bases like SEALAB the Navy had devised top-secret plans to deploy saturation divers from some of its submarines.



The part submarine, space simulator, underwater habitat, scientific platform and research vessel is the concept of French architect Jacques Rougerie. Admittedly influenced by Jules Verne in his youth, Rougerie's vision of an underwater habitat began taking shape in 1973. Jacques Piccard (of Trieste fame – deepest dive in 1960) joined forces to explore the development of a vessel drifting in the currents, while researching the ocean depths. France's first space astronaut, Jean-Loup Chrétien, joined the visionary Rougerie, intrigued by the space/ocean link. Chrétien eventually worked with NASA, adding the space simulator component to the project.

As of 2015, the above surface portion of SeaOrbiter – the Eye – has been completed in ACCO's shipyard in France. The futuristic habitat is no doubt built upon the inspiration, experience, courage, ingenuity and research of all those who came before.

From seaorbiter.com/medias/photos/

Notes

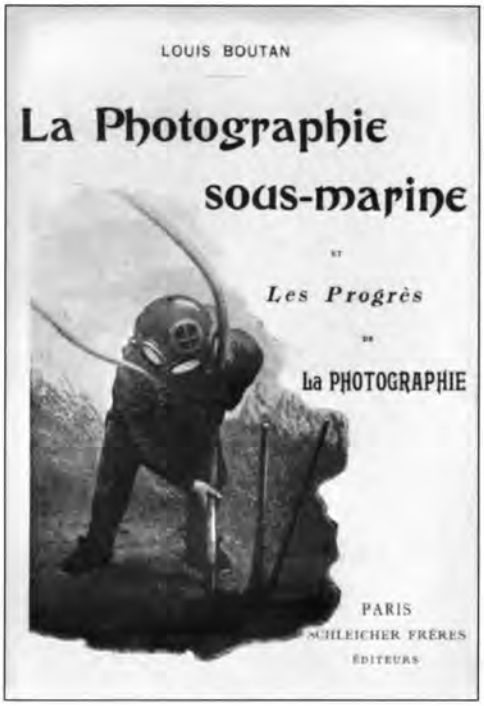
1 This article is based on the book by Ben Hellwarth, *SEALAB* (New York: New York, Simon & Schuster, 2012). The book contains an extensive *Notes* section.

2 Scott Carpenter's helium-falsetto voice, in his radio communiqué to President Lyndon B. Johnson, can be found on Hellwarth's blog: huffingtonpost.com/ben-hellwarth/a-few-reasons-youre-unlik_b_8033684.html

Photos Courtesy of the Author unless otherwise noted.

The Origins of Underwater Photography in San Diego

By Eric Hanauer

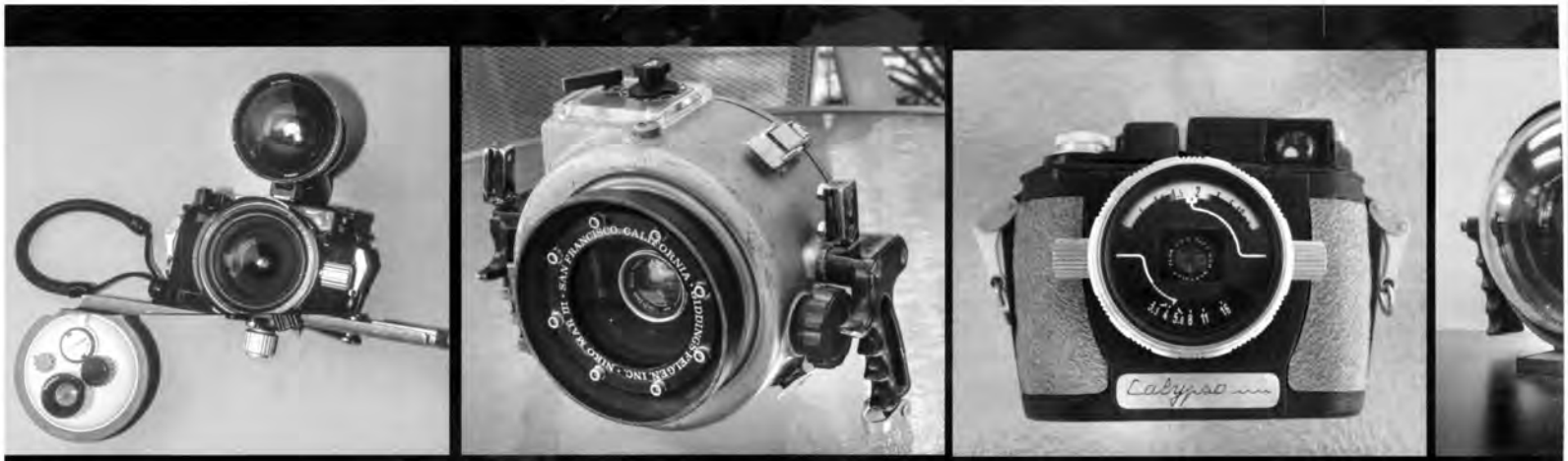


With the advent of digital photography and video, master shooters may now be found anywhere in the world. It wasn't always so. In the early days of underwater photography, San Diego was an epicenter of the art. Pioneers like Ron Church, Chuck Nicklin, Conrad Limbaugh, and Lamar Boren set the standard in the 1950s. The next generation included Howard Hall, Marty Snyderman, Lee Peterson, and Flip Nicklin, who learned their craft at the feet of the masters.

You probably noticed that all these names are males. In the 1950s, diving was primarily an old boys' network. Few women were divers, and far fewer shot underwater photographs. Lotte Hass, in Austria, and Zale Parry, in Los Angeles, were two notable exceptions, although they spent more time in front of the camera than behind it.

The first underwater photographs were shot by Louis Boutan, of France, in the 1890s. England's Williamson brothers filmed a silent movie version of *20,000 Leagues Under the Sea* in 1916, and William Longley shot the first underwater color photos for *National Geographic* in 1926. But underwater photography hadn't made a transition to the masses, or even to serious divers by the 1930s. That's when San Diego's Bottom Scratchers entered the picture.

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Born in Stuttgart, Germany, and raised in Chicago, Hanauer was educated in the Chicago Public Schools, then earned a B.S. in Physical Education, at George Williams College, and an M.S. in Physical Education at UCLA. Hanauer founded the Scuba program at Cal State Fullerton, and when he moved from being a successful swimming and water polo coach into teaching, he began shooting pictures underwater, instead of shooting fish. He introduced thousands of students to the underwater world during his thirty-five years as an Associate Professor of Physical Education. In 1977, he broke into a new field with his first article in *Skin Diver* magazine. Over the past thirty years, his photos and articles have been published in magazines, books, posters, and CDs worldwide. He has written guidebooks to the Red Sea and Micronesia, as well as an oral history of diving in America. Hanauer turned to shooting underwater video, and his work has been selected for showing in festivals, on the internet, on iTunes, and in TV commercials. He is past president of the San Diego Undersea Film Exhibition. His wife, Karen Straus, is also an active diver and underwater photographer. They live in San Diego. For additional information/photographs/videos visit: www.ehanauer.com





Author Eric Hanauer holds the Niko Mar housing, along with the Ocean Eye, they were the premiere housings of the 1970s. In those days, a camera was good for up to ten years. Today, new models are introduced annually.













Bottom Scratchers

In the exclusive club termed "Bottom Scratchers," of breath-hold divers dedicated primarily to spearfishing, only nineteen members were admitted over its seventy-two year existence. At the forefront were Jack Prodanovich and Wally Potts. Jack was a janitor at a local high school, while Wally was a sheet metal worker. They arranged their work hours to allow for maximum time in the ocean, where their spearfishing exploits earned them renown among watermen of the time. Both were also inveterate tinkerers.

Then as now, divers sought a way to convey visually what they saw underwater. Although he wasn't a serious photographer, Prodanovich, in 1934, fabricated a waterproof housing for Kodak's Baby Brownie camera. A year later Potts, a sheet metal worker at Solar Aircraft, came up with his own version. Although the fuzzy black and white images don't measure up to today's photographs, they remain the only underwater record of the early exploits of the Bottom Scratchers.

Boren's first film depicted the Bottom Scratchers diving for abalones and lobsters, and was shot entirely while breath-holding.

Doubtless there were others who fabricated underwater housings at the time. The early history of diving illustrates the principle of convergent evolution. In other parts of the country and the world, people were working on the same problems and coming up with similar solutions. But there was no communication among them. So housings were also developed in Europe, in Japan, and in Florida. Each was an original, based solely on the experience and ingenuity of its inventors.



Lamar Boren

In 1943, another diver joined the club who would have a major impact on underwater photography – Lamar Boren. During World War II, Boren was working for an electric utility company and owned a photo studio on the side. Potts recalled, "He was a fair diver too. A rugged old guy, he rarely used a shirt (wetsuit), even after they came into being. So any time the water cleared, Jack and I were out there punching fish...Lamar would shoot pictures of us. Now that we are over the hill, we can look back and say, 'I did that one time.'"

"We got a lot of pictures before Lamar's time, but they were box camera types. Lamar started out in still photography." Potts helped him make a housing for his Speed Graphic, which allowed one picture before reloading. He moved on to movies when club member Bill Batzloff fabricated a housing for his 16mm Bolex. Boren's first film depicted the Bottom Scratchers diving for abalones and lobsters, and was shot entirely while breath-holding.

By this time the photo business was so successful that he quit his job with the utility company and shot pictures full time. He founded an aerial photo service, working both as pilot and photographer. In 1950, he was recruited to shoot the sub-surface scenes for the Jane Russell film, *Underwater*, using his own movie camera, because no other was available. That was the start of a thirty-year career as Hollywood's leading underwater filmmaker. His credits include: the *Sea Hunt* television show (which he helped originate), the *Flipper* TV series, four James Bond films, *Old Man and the Sea*, *Day of the Dolphin*, *Around the World Under the Sea*, *Brewster McCloud*, and numerous TV shows. Recipient of many awards including a NOGI and lifetime membership in the Explorers Club, Boren died in 1986, at age 69.



Zale Parry was Hollywood's first underwater stunt girl. She was the damsel in distress in many episodes of *Sea Hunt* with Lloyd Bridges.

When shooting the pilot for the *Sea Hunt* series, Boren recruited Potts and Ben Stone to play the villains. In the final scene they rode a boat into the sunset, dressed in swimsuits and handcuffs. The original heroes were a pair of unknown actors; the title of the pilot was *Sea Divers.* Lloyd Bridges wasn't involved at the time. He was signed to play Mike Nelson once the project was sold.

Jordan Klein, a Florida diving pioneer and cameraman, shared some reminiscences about Boren. Ivan Tors had previously hired Jordan for some projects, so when he launched the *Sea Hunt* series, he called on him again. "Ivan told me to go out to the Bahamas and shoot, and see if I can get along with Lamar Boren.... I don't have an ego problem and just deferred to him. Lamar was a very strange guy. If he was here today and his work was compared to everybody else's, he would probably win the Academy Award over what's available now, and I would probably have to include myself.... A difficult guy to work with, he didn't get along with Rico Browning (writer and director). He wanted to direct, shoot, swim, be in front and behind the camera, and be the dolphin. There were always arguments."

"A big teddy bear, he never wore a wetsuit. He was probably the premiere underwater cameraman of his time. He made his own stainless steel housings for his camera, an antique Aikley. Every time he went deeper than twenty feet they would go 'donnggg' like an oil can.... We were shooting *Thunderball;* my system was loading in thirty seconds; his would take five minutes...to loosen lots of nuts and bolts. One day he came over to me and said, 'If you load your camera in less than fifteen minutes, I'm going to get you replaced.' He was not easy to get close to, he didn't pass on information, everything was a mystery and a secret. I learned very little, if anything from him in regard to the craft. I liked him; I don't think he liked me. I think he was worried about me."

Commander Francis Douglas Fane

Before Commander Francis Douglas Fane came along, the U.S. Navy's Underwater Demolition Teams were strictly surface swimmers. As West Coast commander of UDT at Coronado, California, he introduced the Aqua-Lung to the United States, and to the Navy. Even before that, he was experimenting with rebreathers and their effects on oxygen poisoning, with himself as a guinea pig. Fane was the first to exit and re-enter a submarine underwater, and shot some of the first underwater films. His experiments and advocacy of scuba helped spread its use in both the military and civilian communities. His book, *Naked Warrior,* is the definitive history of the early years of UDT, and was the inspiration for a Hollywood movie about his life.

One day a reservist walked into Fane's office, claiming he could make motion pictures underwater. He was Fenimore Johnson, vice president of Victor Talking Machine Company and a multi-millionaire. During the war, he had enlisted and loaned his yacht to the Navy as a sub hunter. When there were problems with torpedoes not running straight, he developed underwater housings for movie cameras and filmed their launches. Fane stated, "This man really changed the history of diving. He was over forty at the time – the oldest man in our unit. Nothing like him I ever met; he was heroic. He went through training, [got] locked out of subs at depth, and used infrared film at night. Three years we worked together developing this system of underwater swimming, and making pictures." Johnson taught Fane how to use his cameras, and together they filmed UDT swimmers leaving and re-entering submarines underwater. This helped convince the Navy brass that the technique was feasible. Johnson's underwater cameras were later marketed under the Fenjohn label, and are much sought-after collector's items today.



Commander Francis Douglas Fane

Fane's enthusiasm for scuba wasn't limited to military applications. After the Korean War, he was assigned to Coronado. "I used to take Scripps [Institution of Oceanography] people, or any other skin divers that wanted to go, free diving in the Coronado Islands. I thought we should develop a relationship with these people who were really expert swimmers. It was easy to teach them how to use the Lung, just a matter of a couple of days. I thought of building up a reserve unit of trained divers for immediate use in time of war.... They could use our diving equipment. They were great swimmers anyway, as good as us." Some of them included: Conrad Limbaugh, Dr. Andy Rechnitzer, Dr. Nelson Mathieson, Jack Prodanovich, Wally Potts, and Lamar Boren. When Limbaugh taught the first civilian Scuba course to Scripps divers in 1951, there was a strong military influence he had picked up from Fane that remained a staple of diving instruction for years.



Ivan Tors, producer of *Sea Hunt*, heard about Fane through Lamar Boren, and, in 1957, made a movie based on his career. Entitled *Underwater Warrior*, it starred Dan Dailey, with Zale Parry doing the underwater stunt work. Jon Lindbergh, son of Charles Lindbergh and a UDT warrior in his own right, also appeared in the film, as did Alex Fane, the commander's son.





Conrad Limbaugh

Connie Limbaugh is primarily known as the first scientific diving officer at Scripps Institution of Oceanography, for writing the first scientific diving safety manual, and for teaching the first civilian diving course in the United States. He was also an avid underwater photographer in the 1950s, shooting primarily with a Rollieflex, in a Rolleimarine housing.

Chuck Mitchell recalls: "He was probably a hippie before there were hippies.... He never wore shoes...went barefooted or had just flaps on...pants usually kind of baggy, walking on his cuffs. One of the nicest guys you ever want to meet; he was very methodical, and did things very slowly."

"A remarkable individual. I used to marvel at how we would dive an hour someplace rather unexciting, usually the sand dollar beds at the end of Scripps Pier.... He would come back, sit down at the typewriter, and it would be almost like he had a videotape running the whole time. He would fill fifteen or twenty typewritten pages with notes of incredible detail. Nothing was taken for granted, everything was recorded."

"Connie was a good family person, always had his kids around. They were dressed just like him, barefooted.... Always asking lots of questions and he was always patiently answering them. If you saw him today on the beach you would probably think he was some surfer...."

Limbaugh was a frequent participant and award winner in the annual Santa Monica Film Festival, sponsored by the Los Angeles Underwater Photographic Society. He felt they ought to have a similar organization in San Diego. So Limbaugh, Chuck Nicklin, Ron Church, Bill DeCourt, and Chet Tussey founded the San Diego Underwater Photographic Society. Its film festival evolved into a two night extravaganza featuring guest speakers like David Doubilet, Al Giddings, and Stan Waterman. It attracted 3,000 viewers each of the two nights at San Diego's Civic Center. Unfortunately, Limbaugh wasn't around to see its heyday. In 1960, Limbaugh died in a cave diving accident in France, at age thirty-five.

When Limbaugh taught the first civilian scuba course to Scripps divers in 1951, there was a strong military influence he had picked up from Fane, that remained a staple of diving instruction for years.

Ron Church

While Lamar Boren was the first San Diego cinematographer to gain national recognition, the recognition for still photography belongs to Ron Church. Like most divers of the 1950s, his first reason for going underwater was spearing fish. He was good at it, nailing several world record specimens while free diving. At the same time, he learned the stalking skills that would serve him well as a photographer.

Ron had his formal training in photography at the Art Center College of Design in Los Angeles. He went into business as an industrial and scientific photographer, working for such firms as Kodak, Westinghouse, and Convair. He also shot video for Ivan Tors and Jacques Cousteau.

When a group of Scripps scientists opened the Diving Locker, San Diego's first dedicated dive shop, the choice of a manager was between Church and Chuck Nicklin. Ron was better known, but Chuck was chosen on the basis of his retail experience, having run the family grocery store. Ron was hired to run the photo department. He built a darkroom in the back, where he made dye transfer prints. On slow business days, he and Nicklin chatted about photography and video.

"Ron had been a photographer for Convair," Nicklin recalled. "He had experience; I learned from him. By this time Ron and I were very close. He had a Rolleimarine. With it, you only take twelve pictures. We would go out to the edge of Scripps Canyon and take turns. He would shoot one, then I would shoot one. We would look for our next shot while the other guy had the camera."

BEGINNER'S GUIDE TO *Photography* UNDERWATER

by Ron Church
Foreword by
Jacques Yves Cousteau

At last a book that will teach you to make, not just take, good underwater pictures



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Courtesy of the Editor



San Diego free-diver and life-long local fisherman Lauro Saraspe headed straight to the Diving Locker on Cass Street, Pacific Beach (1950s). As was customary, he posed with his catch, winning the "Big Lobster of the Year" Award.

The Diving Locker eventually moved to Grand Avenue, in Pacific Beach, where it trained and supplied divers for forty-two years.

Courtesy of the Saraspe Family



The Gates' Niko Mar IV housing.

Church also did a lot of diving with Scripps scientists, and on one occasion saved the life of diving officer Jim Stewart. At Wake Island, a gray reef shark attacked Stewart and bit his elbow as he raised his arms to protect his head. Ron beat off the shark, pulled Stewart out of the water, and made him a tourniquet from his weight belt.

Church died of brain cancer in 1973, at the age of thirty-nine. Nicklin recalled, "He'd had two operations. The first slowed him down some. The second, he knew that was it. We put together a trip to Cabo. This was sort of a last get-together with some of his dive buddies. The thing that had always bothered me is he wanted me to make a deep dive with him. Everybody was a little nervous. I never did make the dive. Finally, he talked his brother, Mick, into it. I thought, oh hell, his brother is going to take him down and leave him. But he didn't. They both came back. That was probably his last dive."

Elwyn Gates

Elwyn Gates started the underwater video housing company that still bears his name. An inventor and master machinist, he was one of the key figures in San Diego imaging for over thirty years. He recalled, "I started diving in 1963. My older brother had been doing it since the early 1950s, but I couldn't handle it because nobody had a wetsuit. As soon as I got my first wetsuit, I got into it as fast as I could. I wasn't into photography. When the first Nikonos came out, I bought one and started trying to learn what an f-stop was. At that time you couldn't buy anything you needed, so being mechanically inclined, I started building my own things.

"I was a linoleum layer and had mechanical aptitude. [I] had a toy lathe in my garage. I started using close-up lenses. One day a friend asked, 'Why don't you use an extension tube?' I asked, 'What's that?' He said that they use them on other cameras, and allow you to focus closer. I got a piece of plastic, put it in a lathe, and made one for the Nikonos. I went out and started shooting pictures with it, and it worked. That was the first extension tube. We had a secret weapon that nobody else had. Everybody wanted one. We hired a machine shop and went into production. Later I bought my own lathe, did my own production, phased out of construction work and went into this full time."

Subsea, the first company making underwater strobes, needed a source for flash connectors, and hired Gates to make them. He also made metal extension tubes and Subsea started marketing them under their own name. Eventually he made them for almost everybody in the retail end of the business, including Nikon and Ikelite.

When the first Nikonos came out, I bought one and started trying to learn what an f-stop was. At that time you couldn't buy anything you needed, so being mechanically inclined, I started building my own things.

Howard Hall



Elwyn never had any formal training in machining, learning on the job. He eventually started making housings and word got out that he did quality work. "Soon I was making things for *National Geographic*." This was the legendary Niko Mar IV housing. It was for a Nikon FE with a sportfinder, supplied to only a few select photographers. Only fifty cameras were made, and only twenty housings. Gates recalled: "Everybody got their name on it besides me. Al Chandler from *Nat Geo* and I designed it. It was Al Giddings' idea. He did the first prototypes which weren't anything like the final model."

"A guy came in around 1980 and wanted a housing for a broadcast video camera, and that made a big change in my business. It switched me from still to video. Since that time I have been almost exclusively in video camera housings." Gates sold the company to John Ellerbrock some twenty years later. Today, Gates Underwater Products, located in Poway (CA.), is a world leader in underwater video housings.

Ellerbrock also inherited Elwyn's collection of underwater housings, which are on display at his factory. It includes models from Lamar Boren, Ron Church, Hans Hass, and Howard Hall.

Chuck Nicklin



One San Diego cameraman's sixty-five-year career spans the entire range, from the early tinkerers to the 4k video era. That's Chuck Nicklin (right), still actively diving at the age of eighty-eight. He's won every award the diving world has to offer, and has shot everything from *National Geographic* stills to Hollywood movies to Imax features. Some of his protégés have moved on to trailblazing careers of their own, including Howard Hall, Marty Snyderman, and his son, Flip Nicklin.

There were no dive shops in San Diego when a group of Scripps scientists decided to open one of their own. They were all busy with science and had no retail background, so they hired Nicklin to run the Diving Locker. He was a diver and spearfisherman, a friend of Limbaugh's and was running his family's grocery store.

Chuck tells the story from there: "When Connie was lost, Nan, his widow, asked, 'Would you like to use Connie's stuff?' So all of a sudden I had a fairly sophisticated 16mm and a Rolleimarine, and all the things were starting to fall in place. I had a base, the Diving Locker, I had Ron Church to help me. I could get away, and after a couple of years I had employees. I entered the Santa Monica Film Festival and got gold medal awards. That's how it all started."

"In the early 1960s, I was lobster diving on Al Santmeyer's boat, the *Duchess*. Heading across La Jolla Bay, we saw a whale spouting. It was caught in a net; the rope was digging into the flukes...and the weights were pulling it down. It would struggle up to breathe. I said, 'We got to do something about this.' I had to dive down twenty feet or so, then saw what was really happening, forced the line off, and the whale swam away. Bill De Court and I took some stills of this, and it was just one of these things that hit at the right time. Pictures in the paper, TIME Magazine; everywhere people were calling for interviews. Nobody knew anything about whales then. So this got a lot of publicity and I was getting a lot of calls: 'You're the guy who shot the whale, can you shoot this?' So the first thing you know, I was doing more of that kind of thing."



Chuck Nicklin sits astride a Bryde's whale that he freed from a fishing net off the coast of La Jolla, California.

The San Diego Union

Thursday, Jan 24, 1963

Frank Rhoades

A scientist was a little disgusted when he rushed to Chuck Nicklin with a question following the news that Nicklin was one of four skin-divers who had ridden a whale off La Jolla. The scientist was anxious to know about the whale's heartbeats, and Chuck gave him a forthright, if unscientific, answer: " It went thump, thump, thump."

"Al Giddings and I have worked together forever. I was in a spearfishing meet in the early 1960s. Ron Church was there; that's where Al and I met. We all got together at Ron's house that night. Al and I hit it off good."

"Soon afterward, Al came down to the San Diego Film Festival. He said, 'By the way, one of your local divers is going with me and we are going to make a film in Cozumel.' I wasn't sure I could do that; I still had the grocery store.... I told him I can't get away. I called my wife at the time; she said, 'Let's do it.' So I helped him, shot some stuff, and that was the start of our relationship that went on twenty some years."

"The first film work I ever did was a B film for Warner Brothers called *Chubasco*. Wheeler North called and a friend asked for help shooting underwater. He asked if I wanted to try this, I said, 'Sure, I can do that.' They said, 'Bring diving gear, we'll supply the camera.' So I got on the boat and they said, 'Well, this is the camera.' I said, 'Oh my god.' It was the first big Panavision 70mm, about the size of a steamer trunk, and I had been shooting 16mm. It weighed 300 pounds; they had to put it in the water with a crane. I had no idea what it was, how to load it. I had never even seen a roll of 70mm film. They introduced me to my camera assistant. After the producer walked off I asked him, 'What do you know about this thing?' He said, 'I know everything.' I said, 'You're my friend, we are going to be a great team.' So all I had to do was take it in the water and point it."

"Bates Littlehales (*National Geographic* photographer) came out to San Diego to do gray whales. I had a boat, and we would go out and chase them. We hit it off really well. When it was over, he said he had an assignment to go to Turkey and shoot Dr. George Bass' expedition.

I had to dive down twenty feet or so, then saw what was really happening, forced the line off, and the whale swam away. Bill De Court and I took some stills of this, and it was just one of these things that hit at the right time. Pictures in the paper, TIME Magazine; everywhere people were calling for interviews.

Would I like to go along as his assistant? About July he called, and said, 'The bad news is that I ruptured my eardrum. The good news is they want you to go.'"

"They flew me back to Washington. For three days at *Geographic*, they gave me Nikons with black and white film, and I'd go off and shoot. They'd process that night, then they'd tell me, 'We like this, but this is not so hot.... Gave me the little booklet on how to shoot for *Geographic*. You need a sunset, you need a scenic with a little animal or a person, you need so many close-ups. A long list...."

"So I went off to Turkey and shot this story about a Bronze-Age wreck. We had a bell and a submersible chamber, swam into it at twenty feet, then they brought you up for the rest of your decompression. We also decompressed on a line. They had a bucket with books in it. As long as you kept the books wet, they would hold together and you could read."

"Marty Snyderman and Howard Hall worked as instructors at Diving Locker, and got jazzed because of what I was doing. I encouraged them to take pictures. Howard and I used to do shark stuff together. When we did *The Deep*, we needed somebody to bait the sharks. I told Al, 'Let's get Howard.' Al asked, 'Who's Howard?' So he got his first taste of the real film world at that time."

"Jonathan Blair (*National Geographic* photographer) came to San Diego, to upgrade his diving for a tiger shark shoot. My son, Flip, built a cage and was invited to go along as an assistant. He said he would if he was allowed to take pictures. He got a couple of pictures in the article, and that was his start at *Geographic*."

"If I helped people get started, it's by being one of the founders of the Underwater Photographic Society. It was started by Ron and I and Bill DeCourt, about 1962 or 1963. It started because Ron and I were running the Diving Locker, and he wanted to start a photo club and promote business for the shop. So he started this club in the back room."

"At that time a color shot of a red starfish would win a prize. People would listen to Stan Waterman or me talk for five minutes about how we shot it. Then video came. I tried to talk them into going video, but they just wanted to have the biggest video projector that wasn't any good, and we just showed some horrible videos. People could watch better stuff on TV. I wanted to do the next thing. Mary Lynn Price and Steve Douglas and Bob Gladden and I started the San Diego Undersea Film Exhibition (UFEX) in 2000. Little short videos would keep peoples' interest so we could keep it going." Today UFEX has become recognized as one of the world's most prestigious underwater film festivals.

Chuck concluded: "This dual career has allowed me to go to all these places. How fortunate it is to be in the business I'm in. I get to do things others can't do. I've been under the ice in the Antarctic. It was cold and miserable. I hated every minute I was underwater, but it was a great experience and it was beautiful. I dived in Cuba when we did *Ocean Quest*, and met Castro. Some of the things I was able to do because I was in that business, I would have never been able to do otherwise."

"I have a friend who lives his life about what he's done. I want to live my life about what I want to do next."



Notes

Personal interviews with: Chuck Nicklin, Elwyn Gates, Jack Prodanovich, Wally Potts, Andreas Rechnitzer, Jordan Klein, Francis Douglas Fane, Wheeler North and Chuck Mitchell.

Photos Courtesy of the Author unless otherwise noted.

Beneath the Surface
A History of San Diego Sport Diving

By Ashleigh Palinkas

Spanning centuries, human beings have been drawn to the ocean by a sense of wonder, adventure, and curiosity to explore the blue realm beneath the surface. In Southern California, the beautiful coastal city of San Diego has provided a pivotal hub for underwater exploration, innovation, and research throughout diving's relatively short history. Boasted as the home of the first official dive club in North America, the Bottom Scratchers, and the first oceanographic research institution to use diving for science, Scripps Institution of Oceanography, with many of the most influential diving pioneers; San Diego has a richly interconnected cultural heritage in the diving annals. Today, availability of training, equipment and technology enables anyone with an interest in penetrating the underwater realm to dive safely and comfortably year-round. In many ways, the current accessibility to diving is the legacy imparted by the watermen of the past. The early sport divers in San Diego shared that same drive to explore the sea long before any large-scale manufacturing of diving equipment, and long before the mass-marketing of diving as a recreational sport. They drew solely from self-motivation and a shared knowledge to experiment with gear and techniques, and to develop many of the technologies that we now consider standard for diving. The history of sport diving in San Diego was written by hunters, researchers, servicemen, artists, and entrepreneurs, all sharing the analogous drive to explore depths beyond shorelines.

In many ways, the current accessibility to diving is the legacy imparted by the watermen of the past.



Wally Potts, 1954

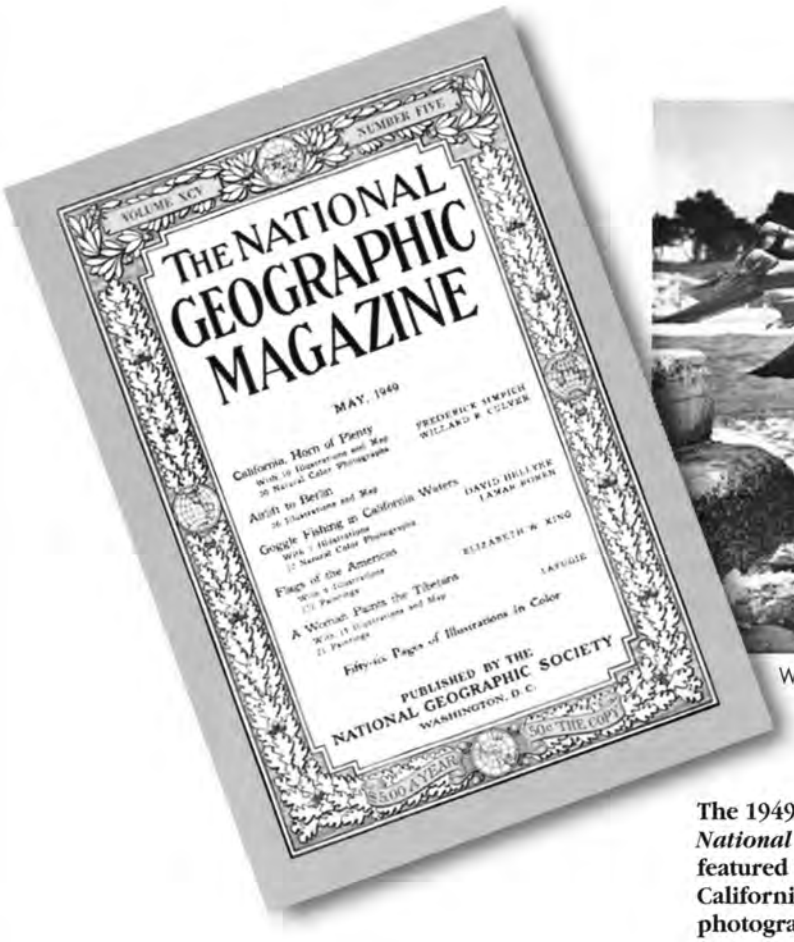
Ashleigh Palinkas was born and raised in San Diego. She is the Field Research Assistant at Hubbs-SeaWorld Research Institute, as well as a scientific diver for Scripps Institution of Oceanography and Blue Latitudes, LLC. This article is an abridged version of her graduate thesis for which she received her MAS Degree in Marine Biodiversity & Conservation from SIO in 2014. Ashleigh would like to thank mentors: Paul Dayton, Ed Parnell, Theresa S. Talley, Phil Zerofski, Christian McDonald, and Mike Shane for making this project possible and for helping to carve the author's niche in the world of diving.

The history of diving isn't visual; it is found in the words of the people who lived it.

—Eric Hanauer

Large and significant portions of this history have gone undocumented, as many stories and observations remain accessible only in the memories of these pioneers. Therefore, it is crucial to ensure that the stories of San Diego's sport diving pioneers no longer remain untold. As a graduate student at the Scripps Institution of Oceanography, in October 2013, I began recording oral histories with experienced San Diego divers, who began diving recreationally in the first half of the Twentieth Century and went on to become influential contributors to revolutions in marine science, equipment technology, dive training and ocean resource management. Local legends: Barbara Allen, Jim Fallon, Pat Gallagher, Bill Howard, Dave Leighton, Frank Leinhaupel, Dick Long, Ron McConnaughey, Chuck Mitchell, Chuck Nicklin, Robin Prodanovich, Andy Skief, Harv Beales, and Chuck O'Grady, along with many of their friends and families, generously contributed their time, stories and artifacts, offering as-yet undocumented perspectives of early diving in Southern California. The recordings were transcribed by a professional court-recording service, and are now archived for public view on several host websites (i.e. Voices From the Fisheries, hosted by the National Marine Fisheries Service).[1] Additional artifacts collected include: photocopies of original photographs and historical newspaper articles; larger items such as diving gear, spear guns, books, and underwater camera housings were photographed in detail with permission from the owners.

The population of San Diego County has increased by 2,760 percent since the year 1920,[2] and subsequently the city has experienced drastic levels of coastal development and pressure on marine resources. The process of sharing and collecting oral histories brings value to all individuals involved. It requires a mutual exchange of knowledge, time and effort likely drawn from shared interests. In the words of diving historian Eric Hanauer: "The history of diving isn't visual; it is found in the words of the people who lived it."[3] In focusing on insight into the exploration and use of a natural resource, oral history can successfully bring the past into the present to help stakeholders discern the best course of action for the future.





With Swim Fins to Boost Speed, a Quintet Takes Off in a Racing Start from a La Jolla Breakwater.

The 1949 May issue of *The National Geographic Magazine* featured "Goggle Fishing in California Waters," with images photographed by a Bottom Scratchers club member and SIO scientific diver, Lamar Boren.



Hunting

Sport diving's narrative begins with hunting, and the story of underwater hunting in San Diego begins with the watermen. The San Diego Bottom Scratchers are widely recognized as the first dive club in the Continent's history and as the first individuals in San Diego to be considered sport divers. Having been watermen all their lives, the Bottom Scratchers lived up to their name by being known to scratch around the bottom of the ocean for food to feed families and friends during the Great Depression in the 1930s. At the time, this was done without the use of swim fins or wetsuits, and they were making their own goggles and masks using rubber hosing and even things such as women's compact mirrors. It is also said that their name came from the scratching of shark horns dangling from their swim trunks, a trophy collected during one of their several formidable club initiation rituals. After a year of diving together and sharing their catch, the club was officially founded in 1933 by divers Jack Prodanovich, Ben Stone, and Glenn Orr. Throughout their lifetimes, members of the Bottom Scratchers were widely accredited for inventing ever-refined models of goggles and subsequent facemasks, underwater camera housings, paddleboards and spearguns, among other miscellaneous tools for exploration beneath the surface. Word of the San Diego Bottom Scratchers continued to spread, and in 1949 they were featured in the May issue of *National Geographic Magazine*. The article estimated there to be 8,000 skin divers in Southern California.

The initiation for prospective club members required capturing three abalone from over a thirty-foot depth on a single breath, catching a ten-pound lobster, and collecting a live horn shark bare-handed. In the seventy years of the club's history, only nineteen divers made the cut.[4]



Right: Jack Prodanovich shows off his first hand-crafted speargun in 1945.

Bottom Scratchers Founders 1933

Glenn Orr
Jack Prodanovich
Ben Stone

Bottom Scratchers

Jack Corbeley, 1933
Bill Batzloff, 1938
Wally Potts, 1939
Lamar Boren, 1943
Tucker Miller, 1943
Rob Rood, 1943
Don Clark, 1950
Jim Stewart, 1951
Conrad Limbaugh, 1953
Beau Smith, 1954
Carl Hubbs, 1955
Earl Murray, 1955
Emil Haabecker, 1960
Bill Johnston, 1964
Harold Riley, 1969
Jack Taylor, 1969



Bottom Scratchers: Wally Potts, Jack Prodanovich and Ben Stone are pictured in 1947.



The 1957 *Skin Diver* magazine featured Wally Potts on the cover with his catch-of-the-day.

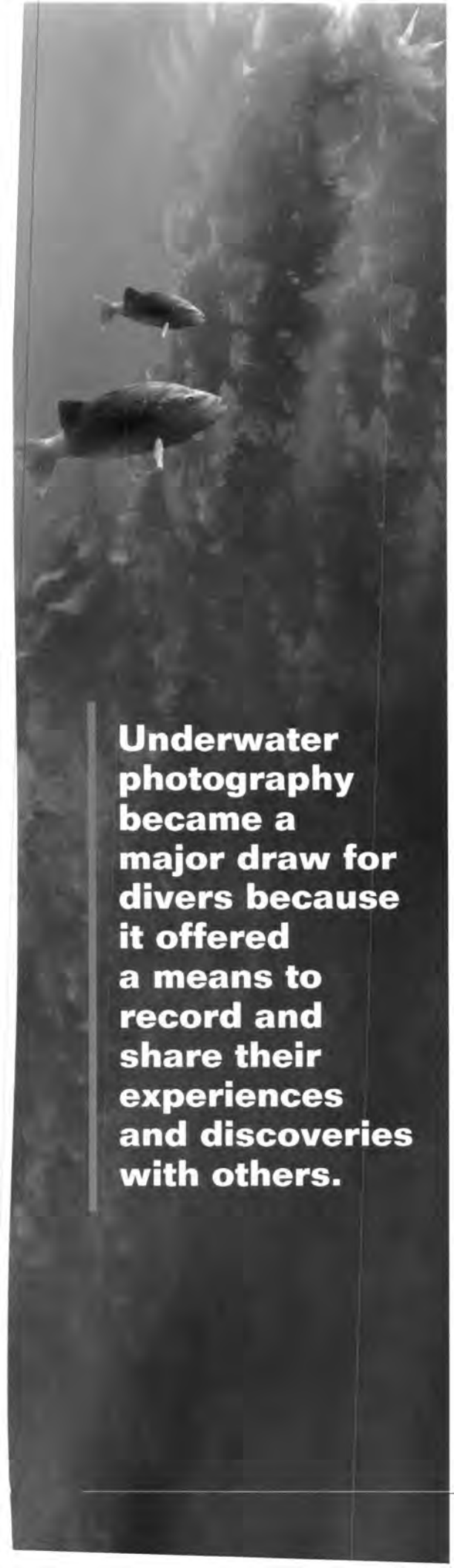
As interest in the bounty of the sea grew, so did the interest in developing more effective means with which to enjoy it. The early 1950s brought on a new element of underwater hunting – competitive spearfishing. With the Great Depression and WWII in the past, hunting for sport went beyond necessity to feed hungry families and into the arena of displaying craftsmanship, marksmanship, and watermanship. While Jack Prodanovich and Wally Potts are most accredited for hand-crafting models of spearguns unmatched to this day, Frank Leinhaupel and Al Larson, of the San Diego Addicts Dive Club, collaborated to innovate and hand-make a new type of speargun known as the "Addict gun." Specifically engineered for maneuverability in thick kelp forests, the Addict gun served as a prototype for the majority of those sold in sport diving shops today. Initially founded by Frank Leinhaupel, Al Larson and Jim Jordan, the Addicts became fierce contenders in local and international diving competitions for decades. The club fostered members who attained remarkable historical achievements and set countless records for their skill. Ron Church speared the first blue fin tuna on the West Coast in September 1954. In March 1956, Jim Jordan submerged himself in a Pacific Beach swimming pool for six and a half minutes to set the world record for underwater breath-holding. His protégé and fellow Addicts member Bill Howard was designated as the second deepest diver on the coast in the November 1955 edition of *Fishing Magazine*. Howard was only sixteen years old at the time.



SIO divers were some of the first to receive formal, standardized training in scientific diving and their training programs would become the basis for all recreational diving certification programs.
Courtesy of UCSD archives

Research

In the 1950s and 1960s, scientific diving in San Diego was greatly intermeshed with the sport diving scene. The largest impact that sport diving had on scientific research was the implementation of the Scientific Diving Program at Scripps Institution of Oceanography in 1953. Conrad Limbaugh, Lamar Boren, Bill Batzloff, Jim Stewart, Earl Murray, and Carl Hubbs were all SIO scientific divers, as well as active members of the Bottom Scratchers dive club. Limbaugh was the first diving officer at SIO and wrote the first diving safety manual, which became the basis for all scientific and recreational diver certification programs. With the aid of graduate student Andreas Rechnitzer, Limbaugh went on to train hundreds of divers, including



Underwater photography became a major draw for divers because it offered a means to record and share their experiences and discoveries with others.

many who contributed their oral histories for this research. Of the Addict's dive club, Frank Leinhaupel logged many SIO scientific dives as a graduate student, including dives in the Devil's Hole cave in Nevada, where he collected Carl Hubbs' famed blind pupfish and discovered a cavern since dubbed "Leinhaupel's Pool,"[5] while Ron Church did underwater still photography for SIO. Chuck Mitchell, with his beginnings as a local spearfisherman, logged hundreds of dives collecting data for Wheeler North's kelp forest monitoring project through SIO and contributed to many research projects over the duration of his still-ongoing career. Ron McConnaughey drew upon his freediving skills to succeed in live collections for SIO under Bob Kiwala, who preceded the current and heralded champion of San Diego scientific specimen collection, Phil Zerofski.

Multitudes of divers received formal SCUBA training under the SIO pier. Today, SIO administers safe and effective diving protocol to students and researchers across the country under the lead of Diving Safety Officer Christian McDonald. With fellow diver Richard Walsh as his "Rechnitzer," McDonald has certified hundreds of scientific divers in San Diego waters, and many have since conducted research ranging from the tropics to the poles, utilizing diving as the primary tool for data collection.

Recreation

The idea to use diving as a tool for scientific research in San Diego was sparked by the import of the Cousteau/Gagnan Aqua-Lung to the United States in 1949. With the scientific world vested in the art of descent, sport diving was launched into the public sphere, and greater numbers of ocean enthusiasts gained access to the depths that were reserved previously for a small number of divers. In 1959, Wheeler North and Connie Limbaugh utilized a building on Cass St. in Pacific Beach, which became known as the "Diving Locker," to store dive gear used for SIO research and training.

Reiterating the interconnection between sport and scientific diving in the early days; the Diving Locker came to be the most locally heralded dive shop in San Diego, providing the general public with access to recreational diving. When the scientific project contract was completed, local diver Chuck Nicklin was designated to run the Diving Locker as a retail establishment. It additionally provided a venue for developing underwater photography, which required skills far beyond those used today by divers with their handy GoPros.

Underwater photography became a major draw for divers because it offered a means to record and share their experiences and discoveries with others. Jack Prodanovich developed underwater housings for both still and movie cameras, and fellow Bottom Scratchers Lamar Boren and Connie Limbaugh were largely influential in both the innovation of housing technology, as well



Jack Prodanovich and Jim Stewart (SIO) look over their lobster catch at Children's Pool in La Jolla, in 1953. They would go on to spearhead conservation efforts to protect ocean resources. By the 1970s, these waters were incorporated into a protected marine reserve.

as photographic technique. Ron Church, of the Addicts, is also recognized as a groundbreaking underwater photographer, and early San Diego divers remember him as being generous with his talent and drive. Perfectly described by historian Edward C. Cargile: "Ron believed that underwater photography is vitally important as a graphic means of presenting the sea's ecological state and as the most fascinating experience a diver can enjoy."[6] By the late 1950s, sport divers in San Diego had become more than just spearfishermen, or research assistants, or diving instructors. Perhaps most importantly, they were expert underwater naturalists.

Conservation

The increasingly popular shift toward diving with the goal of shooting pictures rather than the goal of shooting fish represented a major turning point in the history of San Diego sport diving and recreational diving across the globe. Not only did it give divers the opportunity to engage in the underwater realm without consumptively affecting it; over time, it fueled interest in ocean conservation and responsible



You don't have to go to Africa for your wilderness, says Frank Leinhaupel. It's right here.

—*San Diego Union Tribune*, September 8, 1957

marine stewardship, drawing on the expanding support from non-divers and grassroots organizations.

In the 1930s and 1940s, San Diego's underwater resources were in abundance, and the role of watermen was primarily to develop better gear and techniques with which to access these resources. Paradoxically, this development of access swiftly became coupled with a vast escalation of pressure on resources. Soon, many of the watermen who had been so influential in exploring and exposing the underwater world became more active as the naturalists to first distinguish what ecological thresholds were rapidly being breached. Jack Prodanovich was advocating for a moratorium on abalone before 1950s divers even donned their first underwater mask. Even Bill Howard admits that young, bloodthirsty divers scoffed at the Bottom Scratchers many suggestions for preservation of certain species, even at organized meetings such as those held by the San Diego Council of Divers. However, as hard as the original watermen fought for preservation of the species, they've witnessed firsthand the diminished resources due to commercial and recreational over-fishing. The biodiversity and health of San Diego's waters remain at threat with coastal development and tourism showing few signs of slowing.

Fortunately, recreational and SIO divers have contributed to the success of underwater reserves. In 1970, concern regarding unchecked diving in some of San Diego's most abundant reefs and kelp forests led to the designation of 6,000 submerged acres declared an underwater park. This decision was highly influenced by many divers who had helped shape the early history of San Diego diving. The establishment of 514 acres in La Jolla as a "look-but-don't-touch" ecological reserve in 1971 was a decision supported by these influential divers and the reserve is now enjoyed by locals, as well as divers from all over the world.[7] Now known as the Matlahuayl State Reserve in La Jolla Cove, the protected area has been included in a 2012 effort to designate about fifteen percent of Southern California coastline to marine protected areas (MPA's) under state legislation of the Marine Life Protection Act. These legislative intiatives paved the way for scientists, government officials, recreational divers and San Diego residents to work together in deciding how to plan for future delegation of marine resources.



Once hunted to near-extinction, the Giant Seabass is one of several species enjoyed in the wild by divers today due to successful conservation strategies.

The early divers of San Diego were the first to contemplate, suggest, and implement strategies for conserving the same beauty and bounty that initially enraptured them with the sea. Before scientists were establishing carrying capacities in response to local anthropogenic effects, before policymakers were pushing management decisions regarding coastal resources, and before newcomers to San Diego's world of diving had any inclination toward moderate coastal use; local sport divers drew from their observational expertise and genuine treasuring of their oceanic home to incite interest in conservation endeavors in effect today. Whether divers were getting into the water to fish for sustenance, spear in competition, collect scientific data, or test new diving gear; San Diego's earliest watermen were the most knowledgeable about how increasing human use was affecting their underwater playground. Luckily for us, they took action to protect what they loved given what community influence they had. Now, it is our turn to continue their legacy as ocean preservationists.

Interactions with the master San Diego sport divers who participated in my Master's Thesis provided a pathway to the past and created a powerful link with the present and future of our ocean's health. The act of commemorating the legacy of these skilled watermen is intended to invoke the public to think and act in accordance with the knowledge and experience gained over the century of diving and exploring the marine world, in the hope that those invested in its beauty and resources will seek to preserve them. We may be in the same geographical location today that our early sport divers knew and loved, but it is far from being the same place. The ecological environment is much different now from what it was then, yet the opportunity to develop a relationship between sustainable resource management, scientific research, and recreational use is just as important today as it was at the beginning of the adventure.

Fortunately, San Diego is home to scientific institutions, research labs, ocean advocacy groups and citizen-science organizations that are working toward this integrative goal. Through the Ocean Resources Enhancement & Hatchery Program at Hubbs-SeaWorld Research Institute, scientists work alongside recreational and commercial fishermen and the California Department of Fish & Wildlife to restock local fish populations. Staff and students at Scripps Institution of Oceanography and San Diego State University Marine Lab conduct research to help inform agencies, such as the National Oceanographic & Atmospheric Agency's Southwest Fisheries Science Center and government officials, on how to protect marine resources through policy. Recreational divers, beachgoers and commercial fishermen record observational data that can be used for scientific studies through citizen-science organizations, which include the Reef Environmental Education



Underwater kelp photos: Courtesy of Genoa Sullaway, Coastal & Marine Institute Laboratory, San Diego State University.

Archival photos: Courtesy of the Author.

The health of San Diego's waters is a common goal shared by all.

Foundation. Dive shops such as Ocean Enterprises and North County Scuba Center provide venues for lectures on marine ecology, and current sport diving clubs such as the San Diego Council of Divers and San Diego Freedivers host seminars on coastal conservation that are open to any interested ocean enthusiast.

Just as Japanese dive masks served as the first prototypes for sport goggles used to peer beneath the surface of San Diego waters, these oral histories serve as prototypes for those who wish to pursue that partnership among stakeholder groups, because the health of San Diego's waters is a common goal shared by all. Through responsible diving practice and passionate ocean advocacy, San Diegans can give that same gift to those who will dive, fish, photograph and explore our spectacular underwater environment, long after we have made our final ascent.

Notes

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The Development of Sport Diving Equipment in San Diego

By Ashleigh Palinkas

Strides toward developing modern-day scuba and freediving equipment have been ongoing worldwide for centuries. Impressively, San Diego has served as a locus for many of the contributions to the evolution of diving equipment and technology. Today, the city is a haven for divers – ocean enthusiasts both locally and internationally, sport divers, underwater photographers, research institute divers – and for the businesses that supply all the training and equipment. As levels of enthusiasm and numbers of divers continue to rise, the historical role that San Diego locals have played in the evolution of diving technology is increasingly relevant. Thanks to early pioneers, almost anyone with an interest in diving can enjoy a substantially greater degree of accessibility and comfort than ever before in the sport's history.



Jack Prodanovich with his goggles and underwater camera, 1938.

Freediving: *Goggles and Masks*

The ability to see underwater is perhaps what most primitively differentiates diving from swimming, and local freedivers were creating and modifying the means to do so in the 1930s. The renowned San Diego Bottom Scratchers, recognized as the first diving club in the U.S., were responsible for countless innovations and renovations of freediving equipment. Their handmade masks, dating back to the early 1930s, were crafted in Point Loma, La Jolla, and Pacific Beach. Bottom Scratchers Dive Club co-founding father Glen Orr is credited by club co-founder Jack Prodanovich and longtime member Wally Potts as being "the father of diving in San Diego," due to his conceptualization of a wearable face mask for diving. In 1930, Orr found that rough-water swimming goggles would work for diving, but he had the only pair. Therefore, the three freedivers crafted their

Ashleigh Palinkas was born and raised in San Diego. She is the Field Research Assistant at Hubbs-SeaWorld Research Institute as well as a scientific diver for Scripps Institution of Oceanography and Blue Latitudes, LLC. This article is an abridged version of her graduate thesis for which she received her MAS Degree in Marine Biodiversity & Conservation from SIO in 2014. Ashleigh would like to thank Robin Prodanovich and Ian Williams for contributing their invaluable family artifacts to make this project possible, and special thanks to Christian McDonald for his assistance with this article and dedication to training our diving community.

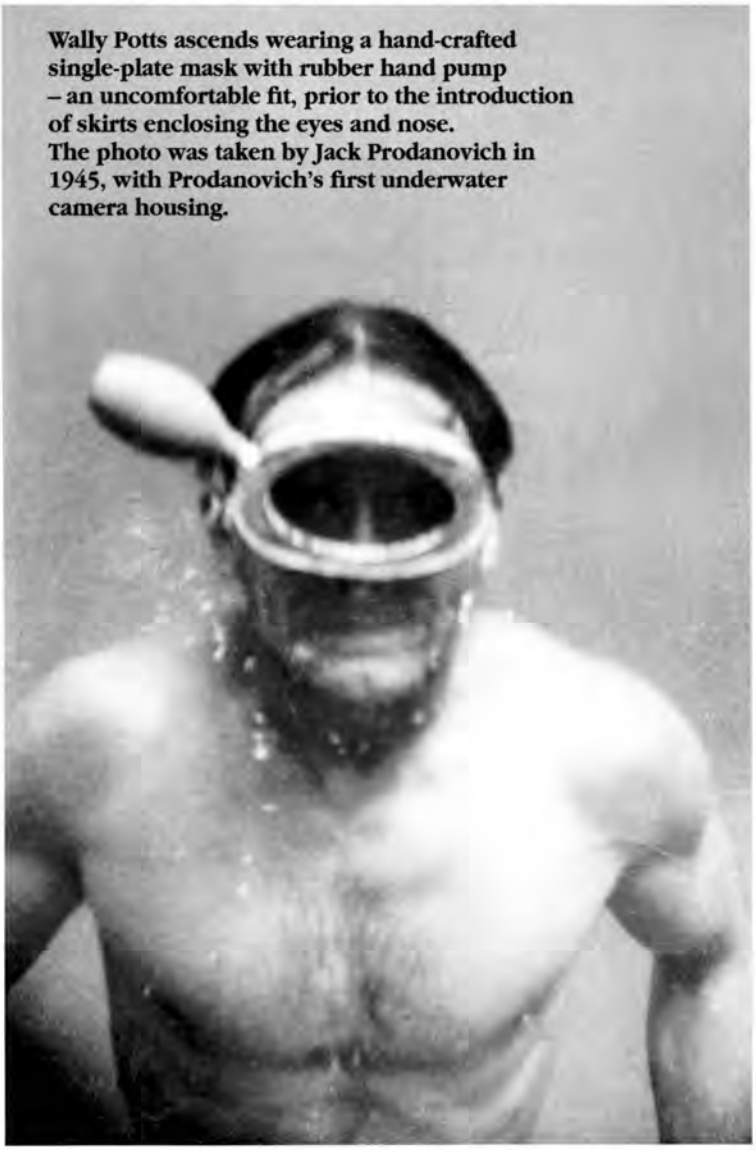
La Jolla, CA: ... on Memorial Day of 1941, I got the courage to ask a girl to come out to the beach with me, and we rode the bus out. Lo and behold, a kid I was with, in junior high school, was in La Jolla Cove and had a face mask.... He said, 'I can see under water.'

I said, 'Nah, you can't see under water.' I put his mask on, and I could see under water. Well, the next week I had me a face mask, and that's how it all started.

—Jim Stewart

own goggles using a 1.5-inch piece of radiator hose, cut into 2-inch sections to the contour of the eye socket, and inserted mirrors from a women's makeup compact with the silver scratched off for lenses. These handmade models were dubbed by early divers as "eye gougers".

Goggles used for swimming at the surface served as a prototype for developing a means to see underwater, but at depths of ten to twenty feet divers soon became fed up with experiencing "eye squeeze." This is a result of compression within each eye's goggle due to additional water pressure at depth, and paradoxically made for greater discomfort among more advanced, deeper divers. Additionally, goggles often made divers like Prodanovich experience double vision. Over time, determined sport divers in San Diego began experimenting with other prototypes being developed in other parts of the world. Using rubber hosing, single-plate masks were initially crafted to avoid eye squeeze and included a rubber hand pump to introduce air into the mask and compensate for air compression when diving.



Wally Potts ascends wearing a hand-crafted single-plate mask with rubber hand pump – an uncomfortable fit, prior to the introduction of skirts enclosing the eyes and nose. The photo was taken by Jack Prodanovich in 1945, with Prodanovich's first underwater camera housing.



La Jolla, CA, 1954: We modified our snorkels, replacing the rubber tubing with aluminum tubing, bent into the typical shape, but perhaps five inches longer. Going out from Boomers through the kelp was done in a series of dives. Swim under the mantle as far as reasonable, then look for a place to find air. The alternative was to hold the snorkel firmly and push up through the mantle. The top was cut at an angle to try to prevent a last kelp frond from becoming a one-way valve by closing the opening. When that failed it was a matter of clawing to the surface with the mask and snorkel around your neck.

—Frank Leinhaupel

Eventually, masks with rubber enclosing the nose as well as eyes enabled divers to equalize the pressure within the mask with air supplied by the lungs, reducing the side-effect of drag produced by the previously attached hand pump. San Diego diving pioneer Frank Leinhaupel also started making his masks with the available round faceplates in La Jolla, in 1953. Later, when models designed for scuba with squeezable nose pockets became available, Leinhaupel and his dive buddies thought to punch a hole in the bottom of the nose extension and put in an exhaust valve. Masks equipped with exhaust valves became more available beginning with the Underwater Demolition Team models. These same valves had also begun showing up in another piece of handy equipment for freediving – the snorkel.

Snorkels

The use of the snorkel as a means of breathing air at the surface without having to lift one's face out of the water didn't become popularized until the mid-1950s, and even then it was barely considered mainstream by the hardy sport divers of the time. In 1955, well-known locals such as Chuck Nicklin were diving La Jolla Cove only with a mask. When snorkels first appeared on the scene, Nicklin commented: "What a silly thing that is. [Laughter] One of the greatest inventions!

Surely, the snorkel was a debatably comical contraption, equally implied by its name. Once the reason behind the technology became apparent to divers, they caught on fast. Leinhaupel modified his own snorkel in 1954, replacing the rubber tubing with aluminum tubing and cutting the top at a slanted angle to prevent a surface-lying kelp frond from becoming a one-way valve by sealing the opening. The reason behind crafting and modifying this gear for freediving near San Diego kelp forests was simple – kelp was where the fish were.

Spear Guns

To fully acknowledge the development in spear gun technology by local San Diego innovators would necessitate an entire book on the subject alone. In summary, their evolution can be broken down into three main periods: the early pole spears, moving from spears to rubber slings and spring-powered guns.

Jack Prodanovich and Frank Leinhaupel are among those known to have designed and welded multiple versions of spearpoints mounted on the ends of poles, ideal for fishing shallow water benthic species such as halibut and shovelnose guitarfish. Jim Fallon, Ron McConaughey, Chuck Nicklin and others recall using pole spears for target practice on stingrays along the shorelines of Mission Beach, Pacific Beach, La Jolla Shores, and Torrey Pines in the 1950s.

A common experience among the original San Diego sport divers was the initiation into spearfishing after purchasing the French arbalete speargun. Crafted for shooting in clear and shallow Mediterranean waters, the arbaletes were problematic for young divers hunting in San Diego's deep and rocky reefs. Being older and more experienced with diving and San Diego's underwater environment, the Bottom Scratchers were known local pioneers in spearfishing and speargun technologies. Potts and Prodanovich made custom spear guns for respected fellow divers, and many

Jack Prodanovich's various spearguns.





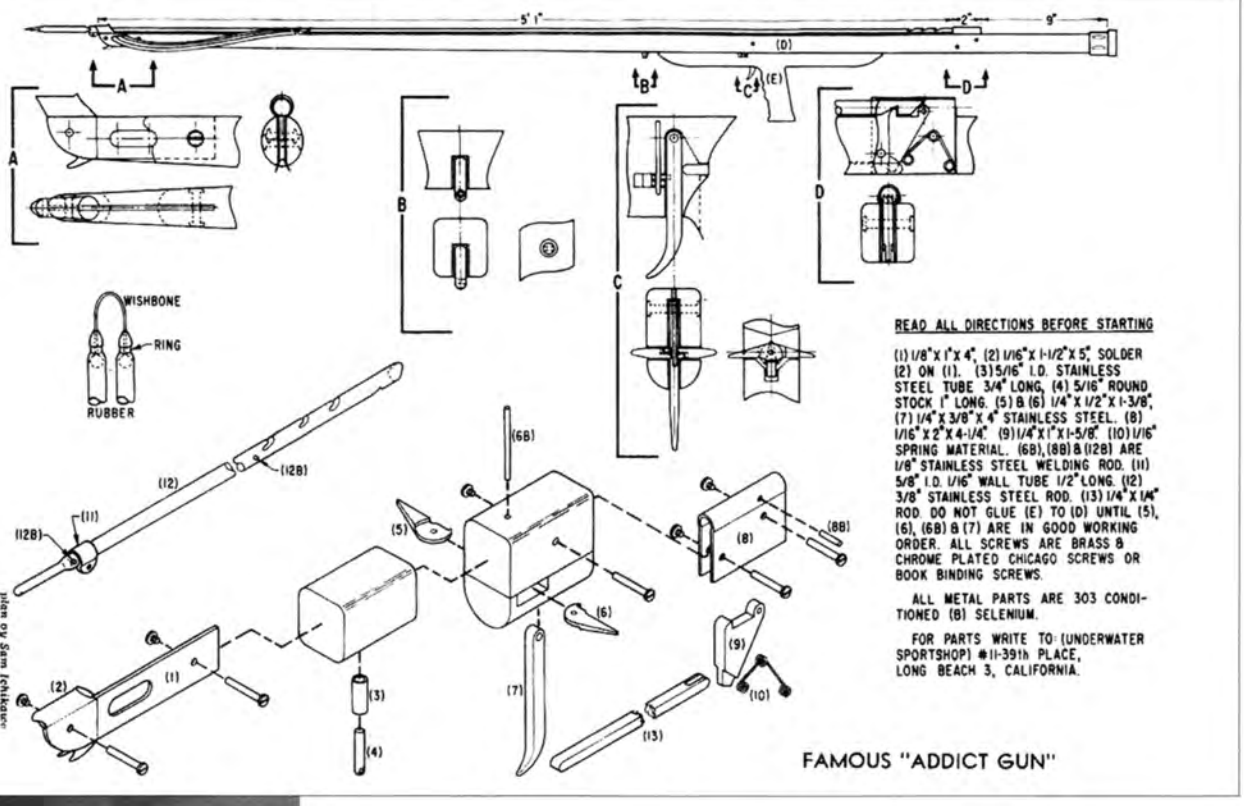
Jack Prodanovich , 1945.

So I went to Wally [Potts] and between my fumbling and Wally's help, I built my first real spear gun. Up until that time we have some little French arbaletes, but when I first started being a real spear fisherman was with Wally Potts and Jack Prodanovich.... I spent a lot of time in their garages for awhile, while they were trying to put together stuff so I could shoot fish.

—Chuck Nicklin



The Addicts, 1954.



READ ALL DIRECTIONS BEFORE STARTING

(1) 1/8" X 1" X 4", (2) 1/16" X 1-1/2" X 5", SOLDER (2) ON (1). (3) 5/16" I.D. STAINLESS STEEL TUBE 3/4" LONG, (4) 5/16" ROUND STOCK 1" LONG. (5) & (6) 1/4" X 1/2" X 1-3/8", (7) 1/4" X 3/8" X 4" STAINLESS STEEL. (8) 1/16" X 2" X 4-1/4". (9) 1/4" X 1" X 1-5/8". (10) 1/16" SPRING MATERIAL. (6B), (8B) & (12B) ARE 1/8" STAINLESS STEEL WELDING ROD. (11) 5/8" I.D. 1/16" WALL TUBE 1/2" LONG. (12) 3/8" STAINLESS STEEL ROD. (13) 1/4" X 1/4" ROD. DO NOT GLUE (E) TO (D) UNTIL (5), (6), (6B) & (7) ARE IN GOOD WORKING ORDER. ALL SCREWS ARE BRASS & CHROME PLATED CHICAGO SCREWS OR BOOK BINDING SCREWS.

ALL METAL PARTS ARE 303 CONDITIONED (B) SELENIUM.

FOR PARTS WRITE TO: (UNDERWATER SPORTSHOP) #11-39th PLACE, LONG BEACH 3, CALIFORNIA.

FAMOUS "ADDICT GUN"

divers were responsible for perfecting their guns by increasing power, range, and maneuverability. Divers Chuck Nicklin, Bill Howard, Chuck Mitchell, and countless others recall spending a lot of time in their garages trying to craft a better means to hunt fish.

The Bottom Scratchers were certainly not the only ones making spearguns in San Diego. Frank Leinhaupel, Al Larson, Vern Fleet and many fellow members of the Addict's dive club developed technologies that are widely sold in stores today. Most innovative was the Addict gun, a rubber-powered spear gun that droves of hunters have considered most efficient in San Diego, since 1950. One of the most easily discernible innovations of the Addict gun is the placement of the trigger mechanism farther toward the center of the gun's shaft. This enabled the Addicts' members, as well as those who purchased Addict-built guns, to have better maneuverability underwater, particularly in and around giant kelp. At the time, the majority of spearfishing in San Diego was done on the edge of kelp forests; today, with bluewater hunting having gained popularity, guns are built much longer for broader shooting range. In retropsect, the groundbreaking Addict's idea for separating the trigger mechanism from the arrow release at the rear of the shaft is one that changed the development of spearguns forever. During the 1940s and 1950s, the early sport divers in San Diego considered the Addicts and the Bottom Scratchers to be the primary leaders in speargun technology and construction. They are still saluted for their innovations today; the Addict gun serves as the prototype for the majority of spearguns sold in San Diego, and Prodanovich guns are considered valuable treasure among divers and collectors alike.



In retropsect, the groundbreaking Addict's idea for separating the trigger mechanism from the arrow release at the rear of the shaft is one that changed the development of spearguns forever.

Wetsuits: Or the Next Best Thing

San Diego Bay, CA, 1954:
The nice thing was, you could stay in the water until you got so cold you are shaking so bad that you couldn't do anything, and then you come out and lay on the big dredge pipe because it would get hot in the sun, and get warm and then go back in the water.... And then I managed to get swim fins and a couple of things, in those days there were no wetsuits, so you always got cold. You wore a sweater, I know we used to wear the Navy watch sweaters, those wool scratchy sweaters that helped keep some of the water from recirculating and that worked pretty well.

—Chuck Mitchell



Being a dry temperate region, San Diego is not known for having particularly warm water. Sea surface temperatures may range from 65-70°F in the summer, and may average around 59°F in the winter. Moreover, upwellings push the even colder sub-thermocline waters closer to the surface creating cold periods when traditional skindiving can be nearly impossible. Many early divers began diving solely in swim trunks. Following World War II, it was common to use wool Navy watch sweaters that provided as much insulation underwater as was possible. In 1952, Dr. Hugh Bradner, a UC Berkeley physicist, invented the first neoprene wetsuit, dubbed the EDCO Sub-Mariner suit. Bradner continued to research diving physiology and gear technology in San Diego, from 1960 to 2008. His invention inspired numerous ocean enthusiasts to develop their own means for avoiding hypothermia in cold water conditions.

In 1956, local diver Dick Long bought a kit for hand-gluing a homemade rubber wetsuit. Long later recalled, with a laugh, that the first thing he did was spill the glue all over the kitchen floor. Dick Long has become one of the world's top experts in dive suit technology today. With only $1,500 and an old air compressor to begin with, Long opened a dive store in San Diego in 1963 where he could make and sell his own custom wetsuits.



Courtesy of Brock Rosenthal

Known throughout his career as "The Guy" for keeping divers warm; military and research institutions worldwide have solicited his expertise in underwater exposure. His manufacturing company, Diving Unlimited International, retains the lead in drysuit diving technology. These stories of diving equipment developments highlight the significant role early sport divers played in San Diego as the innovators who opened many doors for local, recreational and scientific diving enthusiasts.

Monterey, CA, 1956:
...So [a coworker] took me to Monterey, and that's where he introduced me to the ocean.... And after that I just couldn't get enough. At the time I was married; my wife was pregnant. I worked through my vacation. And the baby got half the money and I got the other half of the money and I bought a kit wetsuit, that's mainly what you did in those days. You made a kit wetsuit. It was not nylon lining, just rubber. And the first thing I did is spill the glue all over the kitchen floor.

—Dick Long



When San Diego has 40+ ft. visibility or more, it is absolutely gorgeous. The kelp beds are gorgeous. I think they are my favorite area to go to and snorkel in. Just to dive through there, you see so many fish of all kinds. The calicos, the senoritas...the opaleye – you see so much in the kelp forest.... I feel that's some of my prettiest memories and I'd like to see it again... I'd just like to go and look and see.

— Jim Fallon

SCUBA Diving

By 1949, SCUBA had made its way to Southern California in the form of the imported Cousteau/Gagnan Aqua-Lung. SCUBA came to San Diego by means of San Diego Bottom Scratchers club member and SIO scientific diver, Conrad Limbaugh, shortly thereafter. Limbaugh foresaw vast potential in an underwater contained breathing apparatus and convinced his professor to purchase an Aqua-Lung from Rene's Sporting Goods in Westwood, California. It was one of the first "Lung's" ever sold in the United States. By 1950, Limbaugh and fellow scientific diver Andrew Rechnitzer had *two* scuba outfits, igniting the subsequent heyday of scuba diving in San Diego. After Connie and Andy began the first civilian course of scuba instruction in 1951, the notion of diving underwater without having to rely on a single breath-hold was irresistible enough to sustain an entirely new popular sport and retail venue.

San Diego began to see an influx in gear availability following Bill Hardy and Bill Johnston's opening of the San Diego Divers' Supply store in the early 1950s. Scuba diving was increasingly utilized in scientific research as well as popularized as a hobby, and when SIO research divers needed a place to keep their gear, the Diving Locker, at 4825 Cass Street, in Pacific Beach, was their initial location. Lacking retail expertise, the SIO divers looked to Chuck Nicklin and Ron Church to run the store. Nicklin had retail experience and Ron Church was fast gaining a reputation as an underwater photographer. Together they created the main hub for dive gear, lessons, and underwater photography development. Now closed, the Diving Locker is still revered as the soulful hub where the underwater adventurers gathered for decades to share their stories.

While retailers such as Hardy, Johnston and Nicklin continued to provide accessibility to diving gear for the general population, manufacturers pursued advanced technology with which San Diego divers could better make their descent. These include the establishment of SCUBAPRO in January 1963. Local diver Dick Bonin is known for acting as a primary broker between European dive gear technology and equipment marketing in Southern California. In 1964, Georges Beuchat had invented the first vented fins in Europe, and Bonin successfully sold them to San Diego divers one year later through SCUBAPRO, making the Jetfins one of the most popular models of fins ever used for recreational, commercial and scientific diving to this day. Bonin began working for Swimaster in 1956, where he first met Jack Prodanovich and subsequently became inspired to manufacture spearguns. He also experimented with using silicone compounds for mask skirts, which later became hugely popularized in 1977, after Jacqueline

Bisset donned the SCUBAPRO "hypo-allergenic mask" in the movie *The Deep*. By 1965, SCUBAPRO had successfully patented and marketed their Mark 2 first-stage regulator, solidifying their legacy of top-of-the-line underwater breathing hardware to divers, not only in San Diego but all over the world.

As demand for updated technology in dive equipment continued to grow with the surge in recreational and professional scuba diving; manufacturers continued to produce innovative equipment and retailers enjoyed delivering them to the diving world. Aqua-Lung provided buoyancy compensator devices, fins, wetsuits and a variety of other diving gear to San Diego retailers. In 1974, its sub-branch, Seaquest, opened on North Cedros Avenue, in Solana Beach. A host of dive equipment manufacturers cropped up in the 1970s, refining earlier products or inventing new ones. For instance, in 1978 Neptunic started developing the technology to produce Neptunic Sharksuits and is a world leader in this specialty. The diver, in a flexible suit of armor, could meet the sharp-toothed shark with a little more assurance of survival.

The list of retailers continued to grow, including Kearny Mesa-based Ocean Enterprises, which has served San Diegans since 1979, with its dive training program and a vast array of products. More recently, North County Scuba Center opened in Encinitas in 1998, with its primary focus on dive training, while offering top-of-the-line equipment.

In Summary: The introductory diving equipment considered standard today is the result of much perseverance on the part of early San Diego researchers and sport divers, and certainly involved a lot of trial and error. Although there remains some debate regarding where and when initial inventions of particular diving technology historically took place, San Diego remains an irrefutable hub for innovation in gear development, manufacturing, and distribution. Prior to the level of globalization that divers enjoy today, humans needed to navigate their own access to the underwater world with very limited means. While masks, fins, and other primitive components to the current diving outfit may have been invented in other parts of the world, it was the pioneering efforts of many San Diego divers who brought to fruition the modern diving outfit that hundreds of thousands of divers now enjoy in the very same waters as their predecessors.

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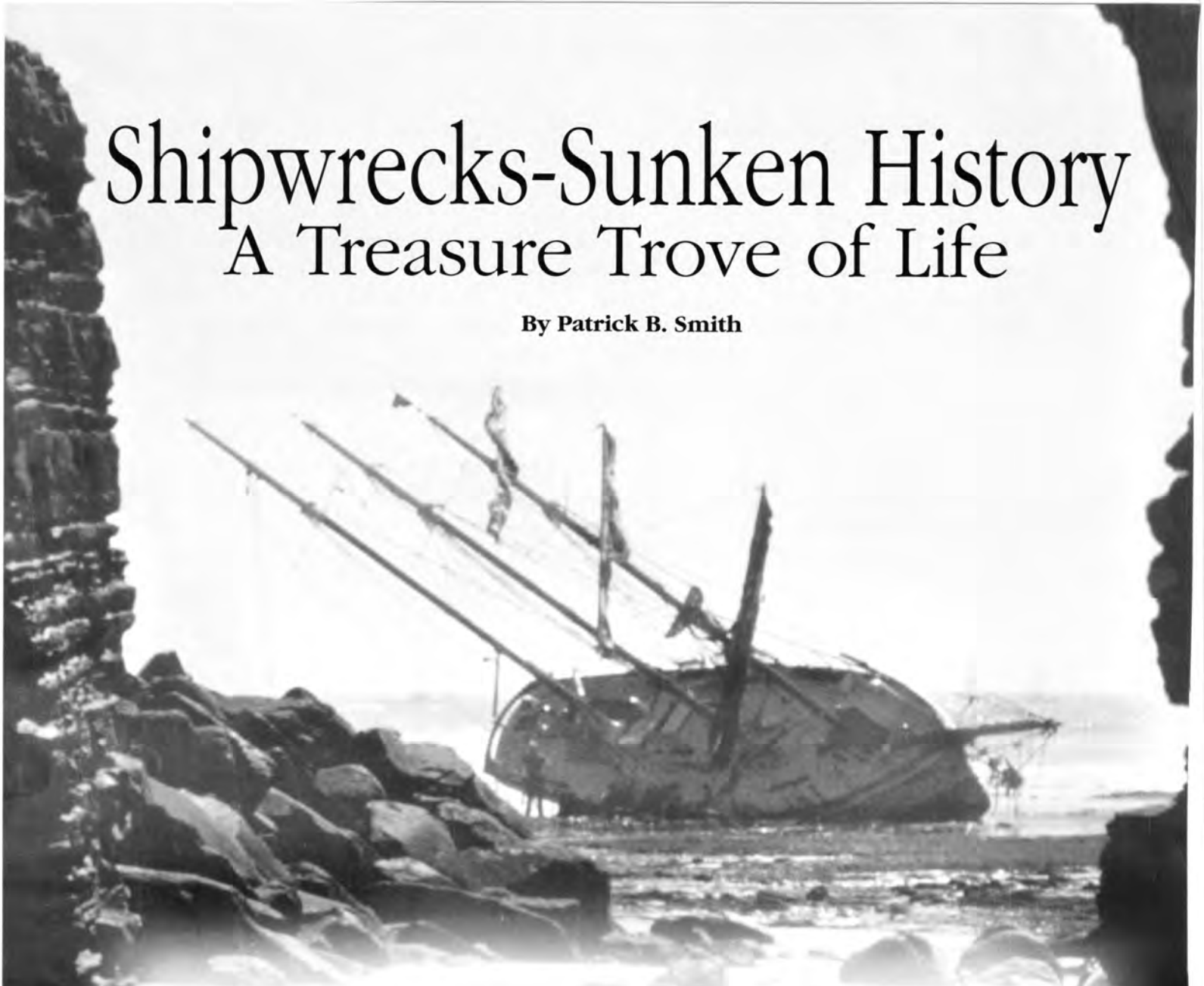
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Archival photos:
Courtesy of the Author, unless otherwise noted.



Shipwrecks-Sunken History
A Treasure Trove of Life

By Patrick B. Smith



From the time of its occupation by Europeans in 1769, the natural harbor at San Diego has been the focus of the area's development. Early on, vessels of exploration, trade, and various governments sought the placid, protected water of San Diego Bay. The benefit of the iconic Point Loma headland that protects the bay from the prevailing Northwesterly winds was offset by the accumulation of silt and sands from Sweetwater, Otay and San Diego Rivers. By the same token, the year-round flow of these rivers created channels allowing access to the harbor by deep-water vessels. Although there were obvious trade-offs, the benefits of San Diego's harbor became common knowledge in the maritime world.

Mid-nineteenth century maritime and naval activities combined with implementation of public ferries from San Diego to Coronado brought rapid improvements to the harbor. In turn, those improvements brought more vessels. Even though Pacific Coast ports have not been the commerce hubs for the duration that many East Coast ports have been in existence, when large numbers of ships congregate in a relatively limited area accidents and "events" occur. Over the years, San Diego and her maritime environs have collected a number of sinkings, groundings, collisions and other events that have scattered the hulls of both ship and aircraft in the local waters. Though sad and tragic, these losses, once on the bottom, typically become robust artificial reefs and have made San Diego waters a focal point for divers.

Captain Patrick B. Smith has been diving for over fifty years and has been a NAUI scuba Instructor since the 1970s. He has worked on commercial fishing and diving vessels, and he has also worked on projects with NOAA and the National Park Service. Smith's deep love of history takes shape in *Shipwrecks of Southern California* (Menasha Ridge Press, 1990), and the many papers published with the Society for Historical Archaeology and the Society for California Archaeology, as well as many articles in Dive magazines. He has served on the Board of Directors for the Los Angeles Maritime Museum Research Society, Coastal Maritime Archaeology Resources (CMAR), and as Education Director for California Ships to Reefs. Smith remains a Consultant to NOAA, the U.S. Army Corps of Engineers, the National Park Service, and the State of California. He has garnered several prestigious awards for his service and dedication to underwater research and preservation.

Over the years, San Diego and her maritime environs have collected a number of sinkings, groundings, collisions and other events that have scattered the hulls of both ship and aircraft in the local waters.

Opposite Left: **The February 1981 news photo of the barquentine *California* aground off Point Loma was donated to the Maritime Museum of San Diego by Steve Weber.**

MMSD Photographic Collections Archival # P-25093

For many, not just divers, the idea of a vessel lost on the sea bottom exerts an emotional pull not unlike that of iron to a magnet. For some of those who actually don the gear and make the plunge, the lure to descend to a wreck may be the dream of treasures. For those dreamers, they are pretty much thwarted by location as few (if any) treasure vessels were lost in West Coast waters. For others, the opportunity to dive to a sunken hulk and commune for awhile with an artifact of history, to explore and actually probe a time capsule is the temptation that calls them to the depths. Yet for other divers it is the prospect to experience and photograph some of the myriad species that call shipwrecks home. Even though their designed use as a working vessel ended with their plunge to the bottom, most shipwrecks have become densely populated homes to innumerable varieties of fish and other sea life. Because of their hard structure and height above the sea floor along with the nooks and crannies provided by wrecks, they become oases on the ocean bottom. Whether it is the opportunity to experience the ambiance of one of man's creations lost to the sea, to mingle with the density and diversity of the wreck's residents, or the desire to capture their images on film or in pixels, divers come.

The palette of wrecks available off San Diego is varied, but with the military's, primarily the Navy's, longtime association with the area, it isn't a surprise that there is a substantial amount of government hardware on the bottom. To be clear, a preponderance of the Navy vessels on the ocean bottom around San Diego was intentional sinkings carried out during and after World War II. War-weary and obsolete naval vessels were often towed offshore and dispatched as target ships. A good number of these are in depths beyond the capabilities of today's technical divers, even with the use of mixed gas breathing mixtures and closed circuit rebreather equipment. But a number are within the reach of both

For many divers the *Hogan* is the pièce de résistance of dives. For advanced recreational divers and beginning technical divers, her 125-foot depth works well. Along with her easy access, divers can experience the metamorphosis of the veteran warship's seventy years on the bottom, from warship to living reef; *Hogan* has taken on the cloak of the sea.

technical and scuba divers. One such Navy target, the U.S.S. *Hogan* (DD-178), was not dispatched to the un-diveable depths of Davey Jones' Locker and is a favorite for visiting and local divers. Located nine miles from Point Loma and just north of the U.S. Mexico border, the *Hogan* has an interesting history.

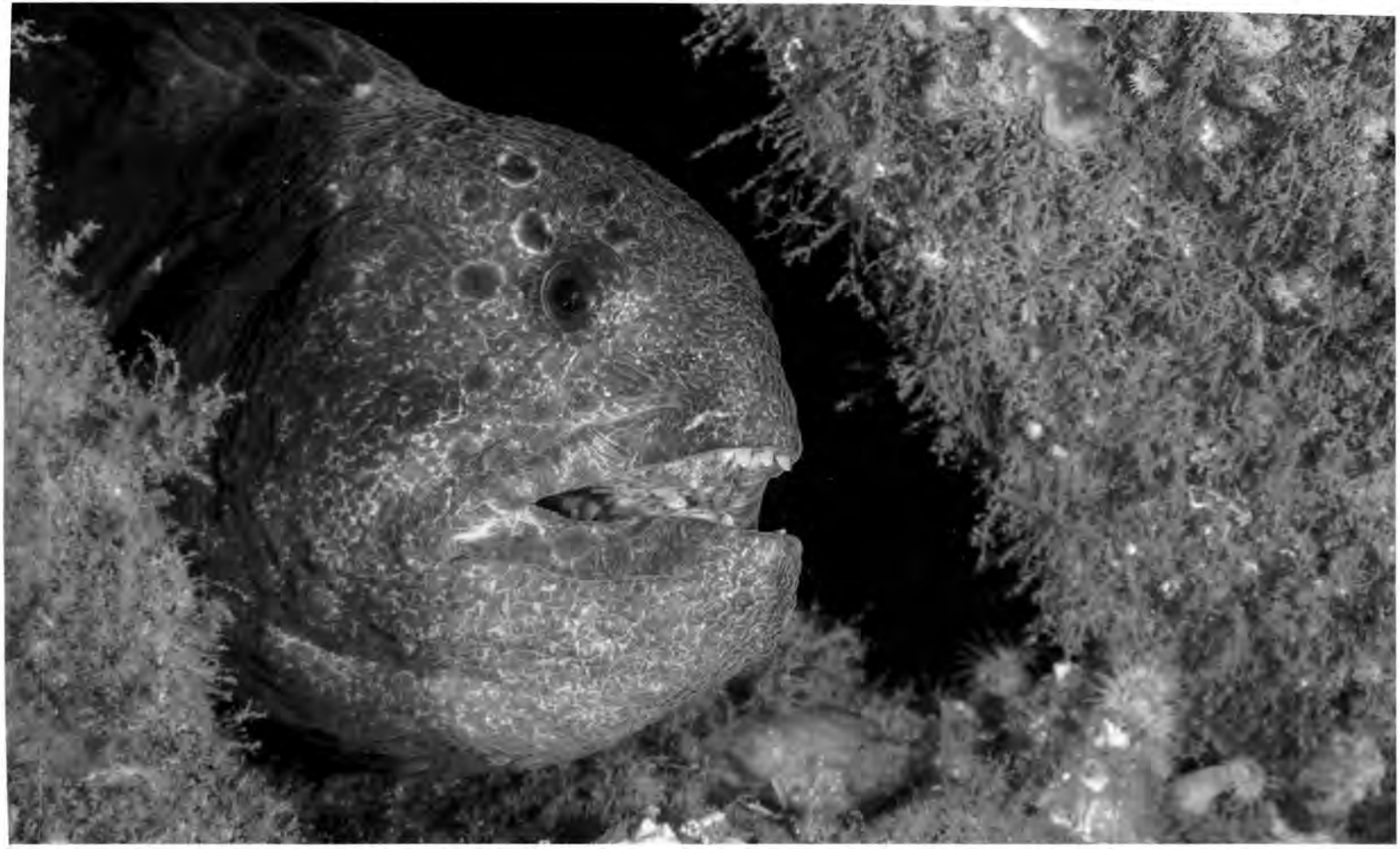
Launched five months and a day after the armistice of World War I, she was too late to participate in that conflict, but on her commissioning on October 1, 1919, and after her shakedown cruises, she joined the Pacific Destroyer Force based in San Diego. From then until May 1922, when she was decommissioned and laid up in San Diego, she exercised with the Pacific Fleet and carried out patrol work.

Some eighteen-years later, with war clouds gathering in Europe, the *Hogan* was recommissioned and reclassified (DMS-6) in August 1940, after conversion to a high-speed minesweeper at Mare Island Naval Shipyard. With the United States' Declaration of War on December 8, 1941, the *Hogan* was assigned to convoy and minesweeping duties initially in the Caribbean and then in the Eastern Atlantic in support of the invasion of North Africa.

In November 1943, *Hogan* crossed the Atlantic, transited the Panama Canal and again joined the Pacific Fleet. In January 1944, *Hogan* departed Mare Island for Pearl Harbor and the western Pacific. From February 1944 until the close of the war, *Hogan* carried out patrol, escort, anti-submarine, mine clearance, shore bombardment and convoy screening duties. Her orders took her from the Dutch East Indies to the Philippines, Guam, the Solomon's, Saipan in the Northern Marianas and Iwo Jima. In March 1945, she departed the Pacific Theater of Operations (PTO) and after a stop in Pearl Harbor, arrived in San Diego on May 3, 1945. For her wartime service in the Caribbean, Atlantic and Pacific, *Hogan* was awarded six battle stars. One month later, the *Hogan* was reclassified as a Miscellaneous Auxiliary ship (AG-105) and was scheduled as a target for bombing tests. Five months later the *Hogan* was sunk during the course of those tests.



U.S.S. *Hogan* (DD-178)
USN Photo from the Author's Collection



Pictured on the inside Front Cover in color, this rarely seen Wolf Eel pokes his head out of the *Hogan's* remains.
From the Author's Collection

For many divers the *Hogan* is the pièce de résistance of dives. For advanced recreational divers and beginning technical divers, her 125-foot depth works well. Along with her easy access, divers can experience the metamorphosis of the veteran warship's seventy years on the bottom, from warship to living reef; *Hogan* has taken on the cloak of the sea. Her once proud structure disarticulated by both the explosive means of her demise and the ongoing water movement of tide and current has become the foundation for carpets and clusters of red, green and brown algae. Bunches of brown (*Muricea fruticosa*), purple (*Eugorgia rubens*) and gold (*Muricea californica*) gorgonians along with the red whip gorgonians (*Leptogorgia chilensis*) festoon the higher portions of the wreck, while strawberry anemones (*Corynactis californica)* crowd every surface that is not already claimed by another plant or creature. Clouds of Blacksmith (*Chromis punctipinnis*), often of such density that they obscure the *Hogan*'s structure, are probably the most common residents on the wreck. Numerous other fish are permanent residents of the wreck as well; lingcod (*Ophiodon elongatus*), sheephead (*Semicossyphus pulcher*), sculpin (*Scorpaena guttata*), kelp bass (*Paralabrax clathratus*) and all manner of rockfish (*Sebastes*) call the wreck home. Without a doubt the most interesting and notable residents are a number of wolf eels (*Anarrhichthys ocellatus).* These homely but curious creatures are more commonly found much farther north and are typically encountered from Central California to Alaska. For at least the last dozen years, a group of these gentle but unlovely critters have made their claim on the *Hogan*'s hulk. Though they typically reside near the remains of *Hogan*'s massive engines, or boilers, like all urbanites, they periodically relocate and the hunt to find their new abode is another part of what makes diving the *Hogan* the interesting site that she is.

Like nearly every ship that makes its final port of call on the coastal seafloor, the *Hogan* has become a vibrant artificial reef. This, in addition to her history and WWII veteran status, makes a jump to the *Hogan* a wonderful experience for any diver fortunate enough to visit the veteran warship.



***S-37 (SS-142)* was a warship built for WWI.**
USN Photo from the Author's Collection

There are numerous military ships and aircraft in San Diego waters and one of the more interesting but lesser known is a submarine. The *S-37* (*SS-142*) is a unique and interesting example of San Diego wrecks as she too was a warship built for WWI with the technology of the period and yet was still in active service during WWII. Unlike the *Hogan*, *S-37* remained in active service for her entire career. Launched in 1919 and commissioned in July 1923, she spent her first year training in fleet exercises in both the Caribbean and along the Pacific Coast. By mid-year, *S-37* and several other submarines in her division



For the duration of her career, *S-37* operated as an anti-submarine warfare training vessel off Southern California. In February 1945, *S-37* was decommissioned and was to be sunk as a bombing target offshore. However, during her delivery to the bombing area, the gallant little sub broke her tow and sunk off San Diego.

were transferred to the Asiatic Fleet and in early November 1924 they arrived in the Philippines. For the next sixteen years *S-37* and her division sisters trained and patrolled in the waters off China, the Dutch East Indies and the Philippines.

On December 8, 1941, after receiving the news of the Japanese attack on Pearl Harbor, *S-37* prepared for her first war patrol and departed the next day. Through the course of several unsuccessful war patrols, the sub experienced numerous equipment and electrical problems that on several occasions thwarted her attempts to attack enemy ships. That changed on February 8, 1942, when early in the evening a Japanese convoy escorted by at least seven destroyers was spotted. Course changes by the transport ships and screening by the escorting destroyers prevented *S-37* from targeting the cargo vessels, so she switched her attack to four of the escorting destroyers. Of the four torpedoes fired, one found its target; the Imperial Japanese Navy destroyer *Natsushio* was blown in half and plunged to the bottom. Despite her two decades-old equipment and technology, *S-37* was the first U.S. warship to sink a Japanese destroyer in WWII. For the impudence of that attack, *S-37* and her crew endured and survived two-and-a-half hours of depth-charge attacks by the remaining destroyers.

After that success, *S-37* continued to sortie on war patrols, but continuous breakdowns and equipment failures frustrated attempts to engage the enemy. This run of bad luck ended some five months later, when on patrol around New Britain, *S-37* found a Japanese transport escorted by a sub chaser. Maneuvering to the target the vintage submarine fired three torpedoes all of which struck sinking the 2,776-ton *Tenzan Maru*. On her last war patrol from mid-August to mid-September 1942, *S-37* and her crew scored against the enemy again, damaging one destroyer out of a column of four. But continuing and worsening electrical and mechanical problems prompted her return (after nineteen years) to San Diego where she underwent a major overhaul in late 1943. For the duration of her career, *S-37* operated as an anti-submarine warfare training vessel off Southern California. In February 1945, *S-37* was decommissioned and was to be sunk as a bombing target offshore. During her delivery to the bombing area, however, the gallant little sub broke her tow and sunk off San Diego. An attempt at salvage managed to raise the Pacific veteran but, problematic to the end, she again managed to escape her towline and drifted to her final port of call in shallow water, just outside the surfline off Imperial Beach. There she rested, the Navy apparently unwilling to expend any more time or effort on the antiquated submersible.

Some thirteen years later, a couple of salvage divers, Frank Ball and Wells Gowdy, while following a tip from a commercial fisherman who had snagged his net on a bottom obstruction, discovered the sub. Stunned and amazed by the discovery of a submarine practically sunbathing on Imperial Beach, they discussed the discovery and came to the decision that the "finder's keeper's" rule applied and they began removing the sub's propellers. After successfully removing both of the sub's props, they tried to obtain legal ownership from the Navy. Though the government did ultimately auction off the sub and she passed through the hands of several private owners over the years, Ball and Gowdy were never successful in their attempts to own *S-37*.

Discovered by sport divers in the 1980s, a number of dives were made on the old warship. Because of her location just outside the surf zone, diving the sub is a very risky business. Calm seas and a high tide are a "must". With the dynamics of



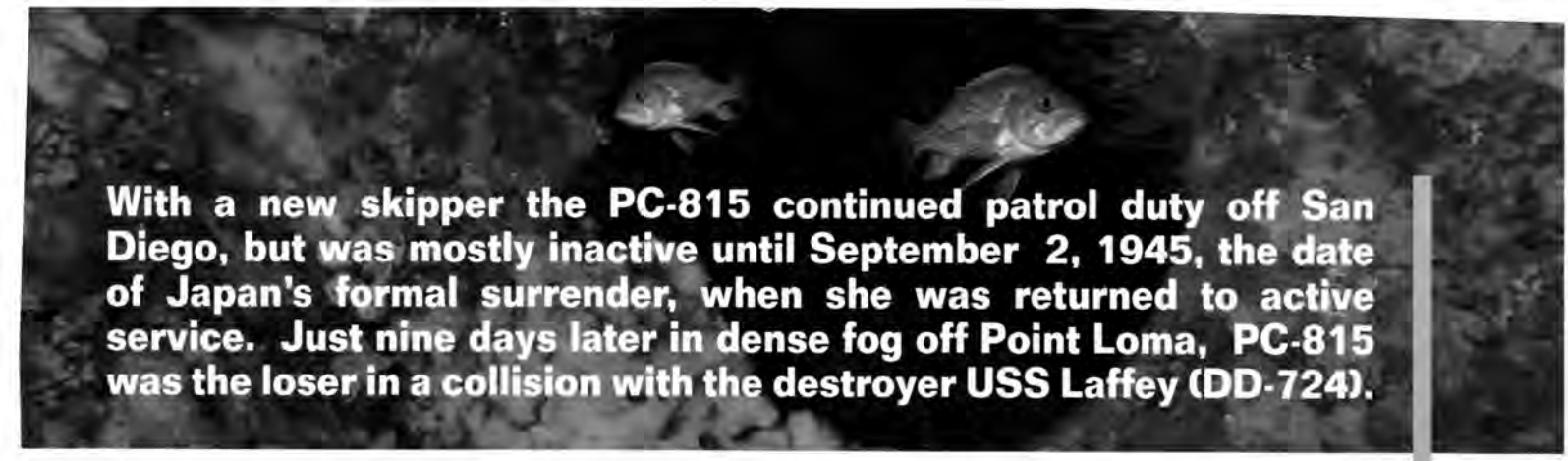
PC-815's career, though short, began and ended with a bang.
USN Photo from the Author's Collection

the area, even a moderate swell prohibits anyone with common sense from attempting to penetrate the sub. Even when sea conditions are acceptable, the sub is often filled with or buried in the ever-shifting sands of Imperial Beach. Another problematic aspect of visiting *S-37* is the water clarity. Being just up the coast from the outflow of the Tijuana River, along with her position near the dynamic surf line, tends to limit the number of good visibility days on the vessel. This restricted visibility, along with consideration of what contaminants from the Tijuana River might be in the water, typically reduces the pool of divers willing to visit the sub.

So she remains today, the only diveable submarine off San Diego. Seemingly easily at hand, but with many caveats to consider before visiting her, *S-37* is indeed a unique part of San Diego's wreck history.

Yet another Navy vessel that attracts divers to San Diego waters is PC-815. Though her structure has been decimated by time and events, her remains provide enough bottom relief to make a very interesting dive. That combined with her "explosive" history make her an attractive dive destination.

PC-815's career, though short, began and ended with a bang! Built in Portland, Oregon, and commissioned in April 1943, PC-815 did a shakedown cruise to Bremerton, Washington, for the installation of depth-charge racks and radar. The commander of this new sub chaser was Lieutenant (j.g.) L. Ron Hubbard, who in later years would found the Church of Scientology. From Bremerton, his orders were to



With a new skipper the PC-815 continued patrol duty off San Diego, but was mostly inactive until September 2, 1945, the date of Japan's formal surrender, when she was returned to active service. Just nine days later in dense fog off Point Loma, PC-815 was the loser in a collision with the destroyer USS Laffey (DD-724).

take PC-815 to her new home port of San Diego. This was not as straight forward an order as it might seem. Off Cape Lookout, Oregon, Captain Hubbard (all ship commanders are addressed as Captain despite their actual rank) became convinced that the crew had discovered several Japanese submarines. Over the next three days with the support of two Navy blimps, two Coast Guard cutters and two additional Navy sub chasers, PC-815 expended nearly three dozen depth charges in her attacks on the alleged subs. The reports that Hubbard submitted reached the desk of Fleet Admiral Chester W. Nimitz, who noted that the commanding officers of all the other crafts and ships involved in the "battle" stated that there was never evidence of any enemy submarines in the area, but there was a known geologic magnetic deposit on the sea floor in that area. Captain Hubbard tried to claim two Battle Stars for the PC-815 over the event. The Navy didn't agree and they were never issued.

In late June at San Diego, her new home port, Captain Hubbard and the PC-815 took part in an offshore anti-submarine training exercise. At the close of the training, Captain Hubbard decided to run the crew through a spur-of-the-moment, live fire gunnery exercise; the site chosen was adjacent to the Mexican-owned Coronado Islands. The discharge of several rounds from the ship's 3 /50 main gun, along with numerous small arms rounds, precipitated an outcry from Mexico and a formal complaint to the U.S. government. This event brought about LTJG Hubbard's permanent removal from command.

With a new skipper the PC-815 continued patrol duty off San Diego, but was mostly inactive until September 2, 1945, the date of Japan's formal surrender, when she was returned to active service. Just nine days later in dense fog off Point Loma, PC-815 was the loser in a collision with the destroyer USS *Laffey* (DD-724). Reported to have been nearly cut in half, PC-815 plunged to the bottom taking one of her crew with her. On September 28, Navy divers set explosive charges on both the forward and aft magazines of the patrol boat as well as on the depth charges she was carrying. On September 29, Navy divers visited the wreck and reported her ordinance destroyed and that she presented no hazard to navigation.

In the 1980s, divers discovered the remains of the unlucky sub chaser. With her initial collision, subsequent demolition and then nearly forty years marinating in saltwater, her once graceful 173' x 23' structure had been reduced to perhaps only ten feet of relief. There are some sections where her steel skeleton is bare and exposed to the sea and easily identified by bright swaths of carroty orange rust. For the most part, nearly every section of the remaining structure is carpeted with purple bryozoan or colorful Corynactis of myriad hues. Thought not as picturesque as other San Diego wrecks, it seems to fill the needs of the local piscatorial population to a tee. All manner of rockfish inhabit the remains of this sub chaser as well as sheephead, lingcod, cabazon, and numerous varieties of bass and perch. The ravaged pile of metal that was once the PC-815 is now a marine life haven and an often sought site for divers to peruse.

Just looking at these examples one might believe that all the government equipment on the bottom off San Diego was marked U.S.N., but that is certainly not the case. In 1952, the U.S. Air Force lost a B-36 bomber off Mission Beach, but the wreckage of this massive, Cold War, strategic bomber lies in nearly 300 feet of water and is dived on infrequently by only the most experienced technical divers.

The U.S. Army Air Force, forerunner of the U.S. Air Force, also lost aircraft off San Diego's shores. One of the most interesting dives to be had is to the



USAAF P-38 Lockheed Lightening
Courtesy of the Author

remains of a USAAF P-38 Lockheed Lightning off La Jolla. Late in May 1943, this aircraft was one of a flight of three Lightnings that departed from North Island Naval Air Station to conduct an early morning coastal patrol and offshore gunnery practice. This aircraft was last in line – Tail-end-Charlie – and in the course of a turn, the prop-wash turbulence from the lead aircraft caused the plane to cant to the right where the wing-tip and propeller struck the ocean's surface. The pilot gained control of the aircraft but quickly realized two things: the aircraft had been mortally damaged and the Lightning would not be able to make it back to the coast, much less to the North Island Air Station. Turning toward the coast, the pilot released the plane's canopy and prepared for a water landing. Calm conditions allowed for as "normal" a landing on water as possible with a land-based aircraft. Once the plane stopped, the pilot abandoned the rapidly sinking plane, inflated his Mae West floatation device and waited for rescue. The pilots of the other two Lightnings, realizing they had a missing man, reversed course and discovered their lost wingman, apparently alright, signaling from the water. They called for Air-Sea Rescue and circled until a Navy crash boat arrived to collect the water-logged Army airman.

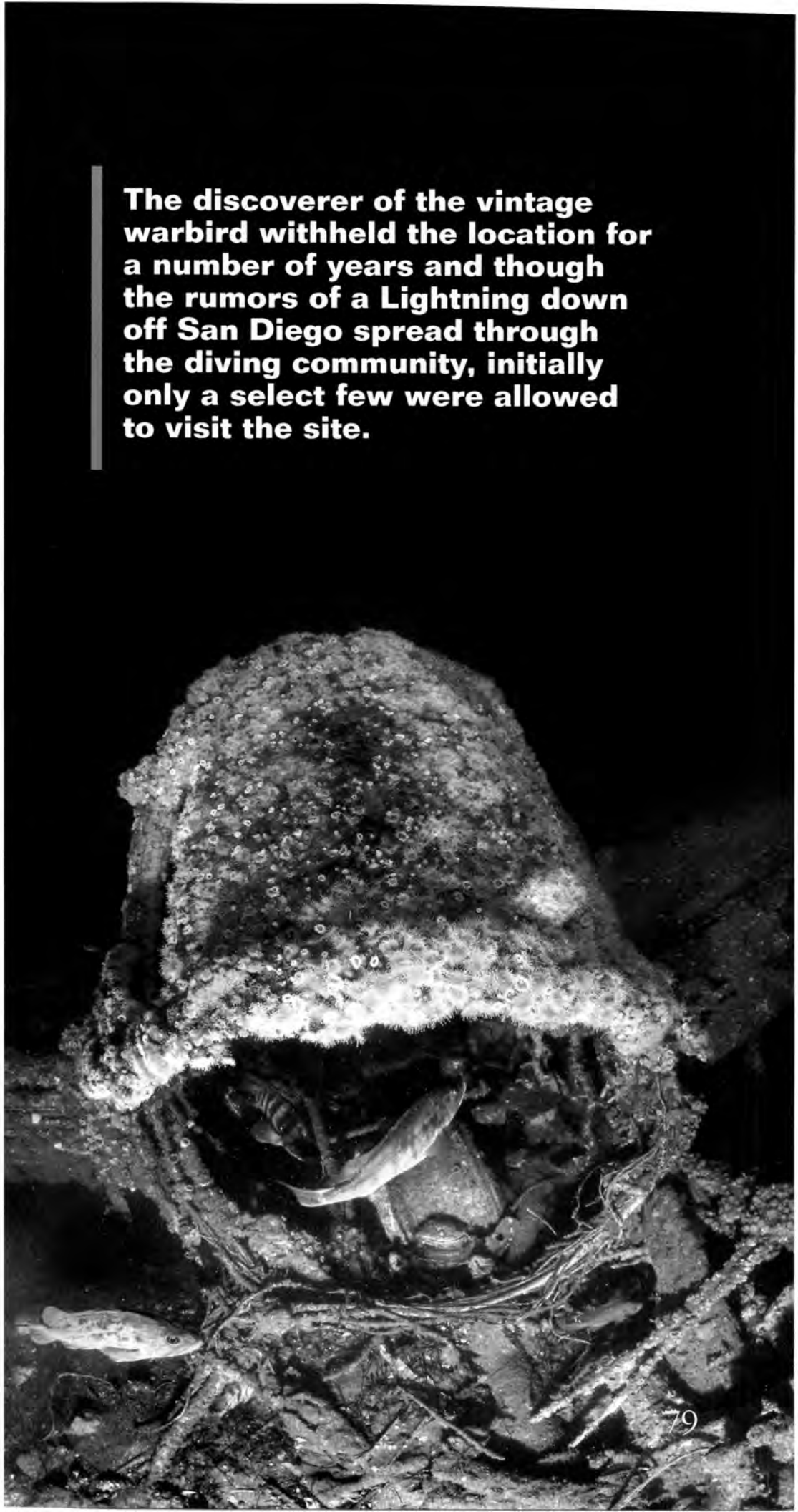
The Lockheed Lightning had been forgotten for over half a century when it was incidentally discovered during a search for a Cessna that went down off La Jolla in the 1990s. The discoverer of the vintage warbird withheld the location for a number of years and though the rumors of a Lightning down off San Diego spread through the diving community, initially only a select few were allowed to visit the site. By the mid- to late-1990s the location of the Lockheed fighter leaked out to the general diving community and some of the local charter dive boats began making trips to the foundered fighter. Currently, trips to the iconic Lockheed fighter are fairly common with all of the local dive boats familiar with the site.

Though she went into the sea intact, her time on the bottom has been hard on the aircraft. The effects of saltwater over time have eroded much of the aluminum structure of the aircraft. Despite this, the Lightning's distinctive twin-engine, twin-boomed silhouette is obvious as one descends to the plane. Perhaps the most obvious items for a visiting diver to see are the Allison V-1710F-17 engines and, farther back on the booms, the distinctive turbo-superchargers that gave the Lightning such incredible high altitude performance. Also remarkably intact

and perhaps made even more noticeable by its veneer of rose-colored Corynactis, is the Lightning's canopy. The red colonial anemones were noted by the divers first visiting the plane and it was commented on in a 1995 article in *Discover Diving*, by Michael Loftus, called "Strawberry Airplanes Forever." Today, divers visiting the remains of this iconic WWII fighter are still dazzled by the colorful carpet of these colonial invertebrates that cloak the aircraft's canopy and much of her remaining structure. Yet another aspect that makes the P-38 a favorite of both local and visiting divers is the presence of a number of wolf eels that call the plane home. There have been more than a few divers who came for the plane, but were seduced by the uncommon visage of these local residents.

As with all ships that go down in the sea, the elements begin to have their way with man's creation. For wooden ships, fastenings corrode and marine borers look on many types of wood as mana from above – a buffet on the bottom. For iron and steel ships, currents, corrosion and electrolysis carry out nearly constant erosion on the structural integrity

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Remarkably intact and perhaps made even more noticeable by its veneer of rose-colored Corynactis, is the Lightning's canopy.
Courtesy of the Author



regardless of the size. Anchor damage from careless anchoring by divers and fishermen also takes a toll on wrecks. This, of course, makes every shipwreck a finite proposition. The initial benefits of a man-made structure being inducted into the oceanic environment come amazingly fast. As a foreign object, particularly one with typically numerous nooks and crannies, it quickly becomes the base for algae and invertebrate life and then in relatively short order, a de facto reef, often more lush and diverse than natural rock structures. But as with all things, shipwrecks have a life span. Because the materials from which they're built rust, corrode or get eaten, the lush oasis that a wreck on the bottom becomes is finite. There are several wrecks whose working life and second career as an artificial reef is way over one-hundred years and some wrecks whose time just as a reef is pushing toward the century mark as well. With this in mind, thoughtful members of the San Diego underwater community set about, in the late 1980s, to establish an area unique to California – an underwater reserve specifically for ships to be sunk as artificial reefs. This area, just off Mission Bay, has come to be known as Wreck Alley. It had its unofficial start in 1985 when the Fish & Game Department gave permission to dump debris, from the Ingraham Street Bridge demolition, off Mission Bay. Established primarily as an

The ex-U.S. Coast Guard cutter *Cyane*, the ex-fish processing ship *Can Am* and, finally, the drug smuggler *Ruby E*, was sold at auction and brought to San Diego.
Courtesy of the Author



It was finally discovered that two sealed compartments from her drug smuggling days had remained intact and it wasn't until additional pumps were placed aboard that the reluctant *Ruby E* finally took her place, ninety feet down in Wreck Alley.

artificial fishing reef, it was soon discovered by local divers and became a favorite dive venue as well. Within a short time the rubble structure had grown a beautiful, dense cloak of various colored gorgonian and Corynactis and provided shelter for large schools of sand and calico bass, along with nearly every type of perch and rockfish to be found in these waters.

Starting from the Ingraham Street Bridge material, the dedicated effort to create Wreck Alley began in 1987 with the placement of the retired one-hundred foot kelp harvester *El Rey*. Her placement, just offshore from Mission Bay, garnered notice not just from the local dive community but also from a good portion of the diving world. On the bottom, in eighty feet of water, the old kelp cutter immediately became a magnet for sea life and divers alike. Local dive charter companies business boomed with the placement of this new attraction.

In the spirit of the moment and to avoid disposal costs, the Port of San Diego offered several derelict vessels that had sunk in San Diego's Back Bay. Among the most significant of these was *Shooter's Fantasy,* a sixty-foot fishing boat that had operated out of one of the local sport fishing docks for several years, before passing to private ownership and ultimate abandonment. *Barge #1,* a sixty-five foot work platform that had lost its owner as well as its battle for buoyancy was another Port of San Diego addition to the alley, along with *Strider,* a thirty-six-foot sailboat. Even though these were smaller vessels, the interest generated in the diving community was significant.

In January of 1988, the Wreck Alley project received an unexpected addition to the site when the fury of a winter storm smashed the Naval Ocean Systems Center (NOSC) Research Tower and put it on the bottom. The tower was erected in 1959 and functioned as a Naval Experimental Lab (NEL) carrying out oceanographic research with the nearby Scripps Institution of Oceanography. The one-hundred foot high structure had already become an artificial reef since its underwater support structure carried nearly thirty years of growth when the winter storm put the platform down. When the storm abated, divers found a new, unanticipated wreck in their backyard.

El Rey's and the other vessels' successful placement was followed in 1989 by the sinking of the 165-foot *Ruby E,* a vessel whose initially honorable work was besmirched at the end of her career only to be reclaimed with her sinking. As the ex-U.S. Coast Guard cutter *Cyane,* the ex-fish processing ship *Can Am* and, finally, the drug smuggler *Ruby E,* she was sold at auction, and brought to San Diego. Plans by the San Diego Tug and Barge Company to convert her into a salvage vessel never materialized and she was scheduled for scrapping. Instead, with the urging of local waterman Al Bruton, San Diego Tug and Barge donated the vessel as a generous contribution to supplement the Wreck Alley project. Sinking of the *Ruby E* proved to be a bit more difficult than anticipated. Placed in position offshore, her seacocks were opened and expectations were high that the ex-cutter, ex-drug smuggler would quickly fill and take her place below. Some six hours later, *Ruby* was very low in the water but stubbornly refused to sink. It was finally discovered that two sealed compartments from her drug smuggling days had remained intact and it wasn't until additional pumps were placed aboard that the reluctant *Ruby E* finally took her place ninety feet down in Wreck Alley.

The crown jewel of Wreck Alley HMCS *Yukon,* a decommissioned Royal Canadian Navy destroyer, did not join her sisters on the bottom off Mission Bay until July 2000. Obtaining the 366-foot long warship came by dint of extended negotiations and

Despite resting on the bottom on her port side, the *Yukon* has become the icon for Wreck Alley and indeed for wreck diving in general in San Diego. In her fifteen-plus years on the bottom she has become the epitome of the environmental, ecological, scientific and financial benefits of placing decommissioned ships on the bottom.

hard work by the San Diego Oceans Foundation and local dive equipment manufacturer Dick Long. Their efforts, along with countless hours of volunteer diverization (the task of cutting access openings throughout the vessel for diver safety), clean up, and preparation of the ship culminated in a less than perfect sinking of the vessel.

Unlike the reluctance shown by her alley-mate *Ruby E*, *Yukon* seemed to be eager to begin her new life as an artificial reef. The sinking was to be a huge Saturday event. In preparation, *Yukon* had been towed and anchored at her sink site earlier in the week and was all ready for the big day. Maybe *Yukon* was shy and didn't like crowds, or maybe she was just eager to get started on her new career, but twenty-five minutes after midnight on the day before she was scheduled to take her final plummet, *Yukon* rolled to port and immersed herself in Mother Ocean.

The reason for the premature plunge was that a number of the diver access openings were high enough above the water when *Yukon* was towed out that they were inundated by larger swells pushed by windy conditions that night.

The fact that *Yukon* didn't sink upright was disappointing, as was the delay in allowing scores of divers to go down on her. This latter issue was because the explosives that were to be detonated to sink her had not been used and the still active explosives had to be removed by Navy divers before the public could meet the new Wreck Alley resident.

Despite resting on the bottom on her port side, the *Yukon* has become the icon for Wreck Alley and indeed for wreck diving in general in San Diego. In her fifteen-plus years on the bottom she has become the epitome of the environmental, ecological, scientific and financial benefits of placing decommissioned ships on the bottom. With her port side laying against the sandy bottom at one-hundred feet, and her starboard side at just sixty feet, she has become a veritable garden of life. The *Yukon*'s starboard hull is a dense garden of Elk Kelp (Pelagophycus porra) that at first glance can be mistaken for a natural reef. Deeper, on the main structure of the ship it is impossible to find a single area bare of life. Wearing a multi-colored coat of Corynactis interspersed with mini forests of snow-white Metridiums, the kaleidoscope of colors and shapes will dazzle the senses. For divers properly trained and equipped, penetration of *Yukon*'s interior passages is available. For most divers though, exploring the myriad shapes and colors of the old warship's exterior is challenge and reward enough.



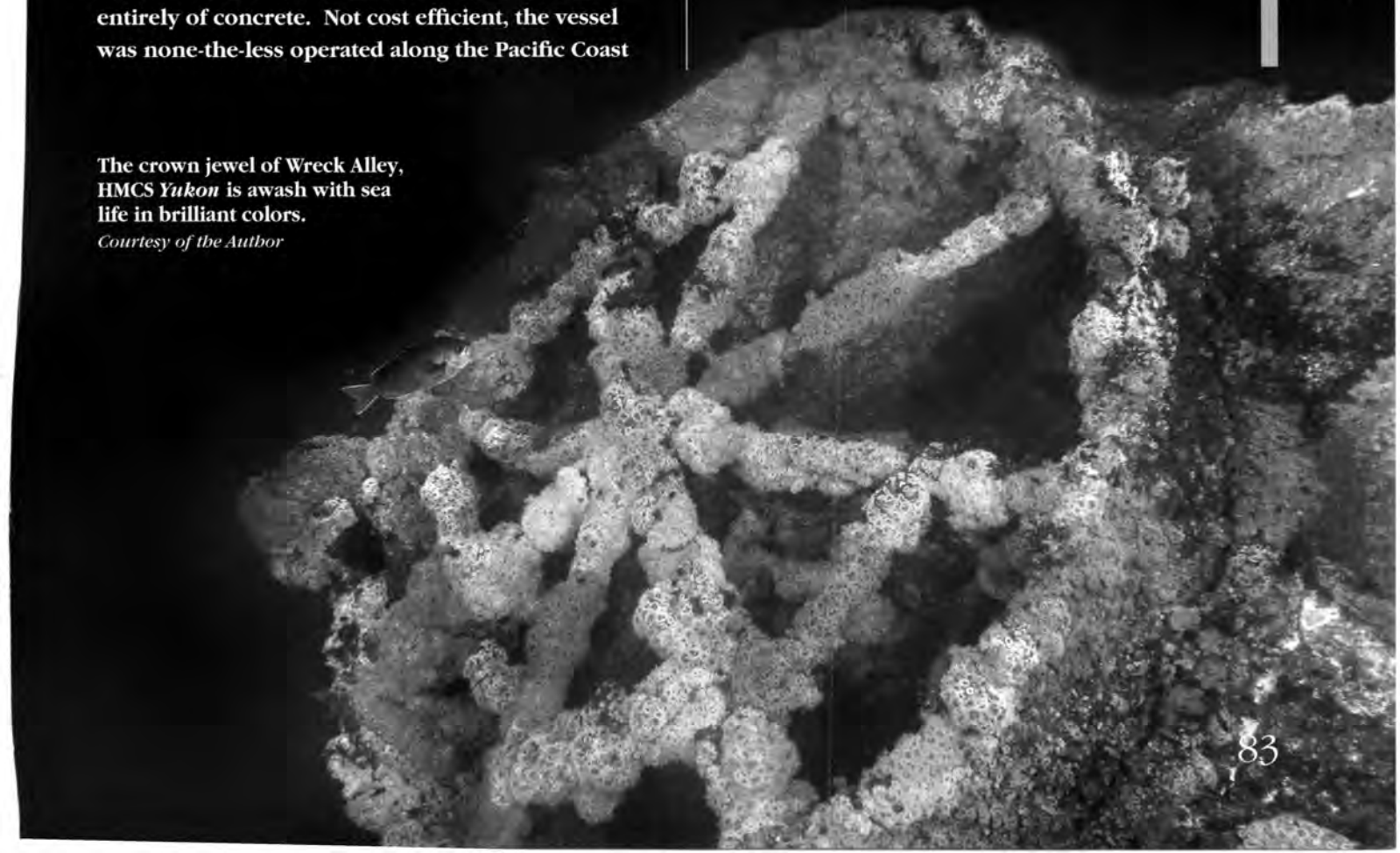
***Yukon* was a decommissioned Royal Canadian Navy destroyer.**
From the Vancouver City Archives, AM1506-S3-3-: CVA 447-9071

As mentioned previously, there are numerous "natural" wrecks – those vessels that went to the bottom whether through design or accident not specifically cleaned and prepared for diver visitation, yet a major portion of San Diego wreck diving activity focuses on Wreck Alley. The benefits of this are that the relatively safe and nearby ships allow first-time wreck divers and students to experience the thrill of diving a sunken vessel. It also dramatically points out the benefits of recycling decommissioned ships as artificial reefs as opposed to scrapping them. As artificial reefs, whether accidentally or intentionally placed, they become living, thriving ecosystems that enhance not only the environment but provide sites for scientific research and typically provide heightened tax revenues to local government through increased small business operations.

The focus of this article has been on wrecks that are the province of divers and to be fair it should be mentioned that there is a wreck of historical significance available to non-divers - the *Monte Carlo*.

The *Monte Carlo* was a government experiment in alternate shipbuilding materials. Launched in 1921 as the tanker *McKittrick*, her hull was built entirely of concrete. Not cost efficient, the vessel was none-the-less operated along the Pacific Coast hauling oil for the Associated Oil Company, until 1932 when she was sold to a group of gambling ship owners. Converted with posh but very functional furnishings and gambling equipment, she was renamed *Monte Carlo* and set out in the offshore gambling, boozing and prostitution trade. Chased and harried by law enforcement in Los Angeles and Orange counties, her owners towed *Monte Carlo* to San Diego in 1936. Their thinking being that as a Navy town, San Diego would provide a constant flow of customers for the gambling tables and joy girls. San Diego authorities, though unhappy about the unwelcome visitor could do nothing since *Monte Carlo*, serviced by a number of fast, comfortable shore boats, was anchored three miles out – just beyond local and state jurisdiction.

As it turned out local authorities didn't have to do anything; the *Monte Carlo* problem was addressed by Mother Nature. On December 30, 1936, a heavy winter storm pounded the Southern California coast. The gale-force winds proved more than the anchors of the gambling ship could deal with and early on the morning



The crown jewel of Wreck Alley, HMCS *Yukon* is awash with sea life in brilliant colors.
Courtesy of the Author

Abandoned by her owners and impossible to remove from her shoreline grave, the *Monte Carlo* remains buried in the sand of Coronado Beach.

Eve, 1936, Monte *Carlo* began drifting to her final resting place – Coronado Beach. By the morning's light the intensity of the storm was revealed. The *Monte Carlo* lay hard aground on the beach, her hull broken and bleeding all manner of furniture and gambling equipment. The locals had a field day collecting such flotsam and rumors were commonly heard that some brave souls had ravaged the surf-wracked gambler and collected fistfuls of silver dollars from the soggy, abandoned slot machines in the hull.



***Monte Carlo* ashore at Coronado Beach, 1936.**
Courtesy of the Author, used with permission from the L Pierson Collection.



Abandoned by her owners and impossible to remove from her shoreline grave, the *Monte Carlo* remains buried in the sand of Coronado Beach. The weight of her concrete hull pulled her deep into the sandy shore, but at certain times of the year, during the lowest tides, it is possible to walk right out to the remains of the unlucky gambling ship and touch a piece of San Diego's local maritime history without even getting your feet wet!

The total number and diversity of ship and aircraft wrecks in San Diego waters is yet to be known. New sites continue to be discovered and small (or large) segments of history continue to be revealed. Though a number of these discoveries are in deep water and made known through evolving technology, it is not always the case. In 2014, a Douglas A-1 Skyraider aircraft was discovered in shallow water off La Jolla, by Dennis D. Burns, Esq., and Doctor Ruth Yu.

For many divers the thrill of visiting their favorite wreck is what life is all about. But just take that experience and apply it to swimming across the bottom and coming across an unknown wreck. The excitement and adrenalin rush over a new discovery is hard to describe and I hope it is a pleasure that divers will experience, sooner or later.

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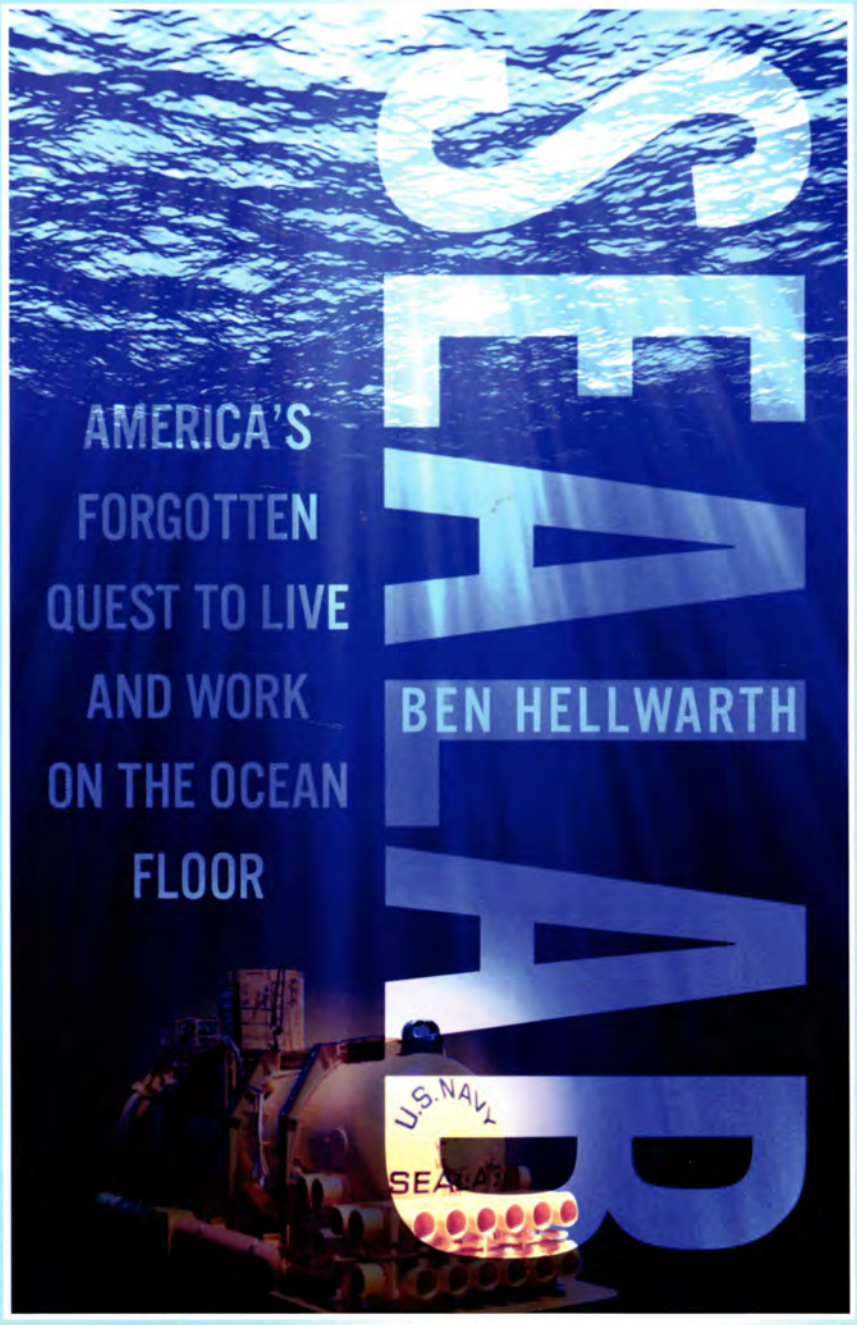
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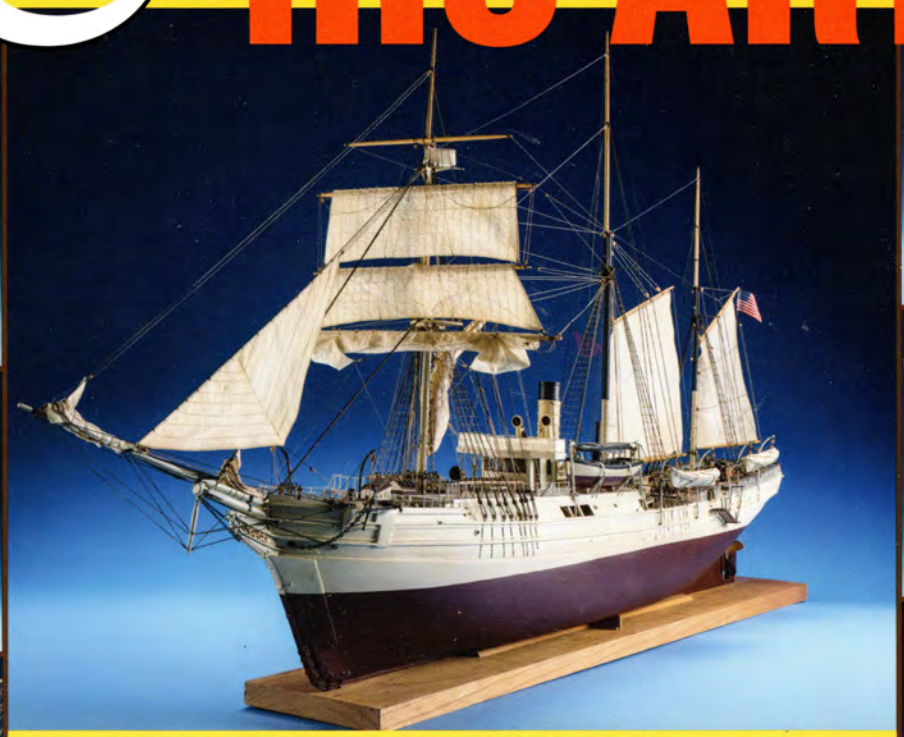
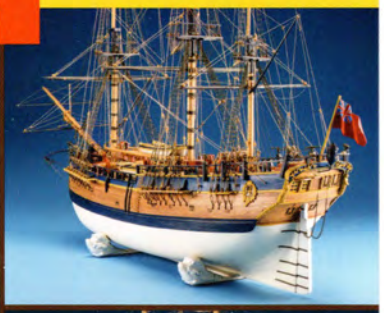
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Vol. 52: 3 & 4,
Summer/Fall 2016













The Collected Works of Dr. William Brown

a special publication from

MAINS'L HAUL

A JOURNAL OF PACIFIC MARITIME HISTORY

STEERING SMALL

A NEW EXHIBIT AT THE MARITIME MUSEUM OF SAN DIEGO EXPLORING THE ART AND CRAFT OF MODEL SHIP MAKING.

All photos by Ted Walton Photography









Over thousands of years, ship models have been used to capture and conceptualize in miniature the tools and technologies that have allowed humans to traverse oceans, seas, lakes, rivers and waterways. Models have also been imbued with a meaning reflecting human attempts to transcend the physical, and to connect with the transcendent. They have become a celebration in scale of technological achievement and artistic expression. They have also been produced for the pure pleasure and enjoyment of crafting greatness in miniature. The Maritime Museum of San Diego invites you to visit its Gould Eddy Gallery on board the ferryboat *Berkeley* and experience a panorama of ship models created by some of Southern California's finest practitioners of this craft, including Dr. William Brown, Robert Hewitt, Vic Crosby, Joe Bompensiero and Joe Frangiosa.

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A Model-Maker & His Art
The Collected Works of Dr. William Brown







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From the Helm

Ray Ashley, Ph.D., President and CEO
Maritime Museum of San Diego

It is sometimes observed that ships are projections in microcosm of the entire world that created them. This is so for a variety of reasons – typically ships are both the most complicated and the most utilitarian objects capable of the societies which produced, constructed, maintained and operated them at great expense, and then set them forth to live or die in the most hostile and consumptive environment imaginable.



Museum President Dr. Raymond Ashley with Dr. William Brown, June 2003.

Though always conceived for a specific objective, ships are also typically the product of prevailing cultural aesthetics – they must be beautiful just as they must be fast, weatherly and strong. In their beauty, they are also shrouded, embellished and governed by layers and generations of traditions, legalities, practice, hierarchy and superstition. They are subjects of fine art, literature, poetry and film. They are the nodes of an ever-evolving large scale technological system – the first such system which spanned the world and the last such system in which people, commodities, ideas and power all flowed in a single package, complete and whole unto itself.

For most of the last three thousand years, the industrial complexes used to build and maintain these ships were among the largest industrial sites of their day, among them also the largest and most expensive possessions of great powers. For instance, there are evidently few contemporary references by fifth-century Athenians to the Parthenon as a masterwork of architecture which would reflect their civilization across time. Rather the Athenians themselves glorified in their fleets of triremes and the vast harbor complex of the Piraeus and viewed their democracy not as a political ideal, but simply the organizational precondition to *thalassocracy* – control of the sea.

Historians have observed that prior to the present era, there have been five great sea powers of history, which also turned out to be the five great democracies



Dr. William Brown at the helm of one of his modeling subjects, the Maritime Museum of San Diego's topsail schooner *Californian*, under the watchful eye of Captain Chris Welton.



Dr. William Brown with one of his pond yachts at El Dorado Lake, Long Beach, May 1976.

ships are discrete distillations of civilization. To some extent, the collection of ships at our Museum is among the most remarkable such distillations of civilization to be encountered anywhere. But no museum collection, not even all the ship museum collections of the world, could aspire to capturing the scale of enterprise and the variety of worlds in microcosm which have long since vanished. That can happen only in art. Some of that art comes to us in painting, some in literature, and some, thankfully, in ship models.

Dr. William Brown is such an artist. When you roam the galleries of our Museum you have the opportunity to voyage to the places Dr. Brown has gone in the course of creating his remarkable body of work. Some of his ships enrich the collections of the Smithsonian and there is a smattering of other fine museums lucky enough to have one of Dr. Brown's models. But in this respect we, and our community, are especially fortunate to be the predominant beneficiary of Dr. Brown's passion, dedication, scholarship and artistry in helping us to tell our story through the extensive and exquisite series of models which populate our Museum. It is thus fitting to present and memorialize this magnificent fleet of ships by Dr. William Brown in an issue of *Mains'l Haul*, each ship the conveyance to past worlds we could not sail to otherwise.

of history. The modern world emerged from the age of exploration by sea. Galileo's founding of modern engineering, indeed in some ways the blueprint for the scientific revolution, took place in a shipyard, and the apogee of aspiration in the European enlightenment focused on navigation and voyaging. More recently, some scientists have argued for the existence of a new geological epoch wherein the *Holocene* has become the *Anthropocene* – defined by the dominating influence of human activity on the climatic and ecological systems of the earth, ushered in by the advent of worldwide trade made possible by the appearance of the oceanic sailing ship.

All of which is to say that



Dr. William Brown with his model of the *Pilgrim*.

A Model-Maker and his Art

Kevin Sheehan, Ph.D., Manager of Collections, Maritime Museum of San Diego

The ship model collection at the Maritime Museum of San Diego numbers over 1,000 individual models. These range in size from the imposing USS *San Diego* (ACR-6) measuring ten feet in length, to miniatures of a less monumental scale just a few inches in size once used for vessel recognition during the Second World War.[1] This collection expresses the art and craft of model-making in its many diverse forms: fully-rigged, full-hull models, Admiralty-style representations, builders' models, sailor-made models, half-hulls, presentation models, ethnographic models, pond yachts, wargaming miniatures, ships-in-bottles, votive models, naval recognition models, and maritime-themed dioramas.[2] Over the years, Museum curators have drawn upon this rich resource to create displays and exhibits illustrating not only local San Diego seafaring heritage but also more universal stories such as the evolution of the ship and the history of the exploration of the Pacific Ocean.[3]

Dr. William Brown's models have become an essential element in interpreting and presenting this maritime past. His impressive collection of scratch-built models numbers some seventy in all, of which more than a dozen are currently on display at the Museum. William crafted this collection over half a century. Strategically positioned throughout the Museum, his models transport the viewer across time and space, from the Nydam boat built as a ceremonial offering in fourth-century Denmark, to the quintessential vessel of exploration – James Cook's eighteenth-century HMS *Endeavour* – to workboats of mid-twentieth-century Southern California, like the kelp harvester *El Rey*. These models, so vastly different in their subject matter, reflect exhibit strategies at the Maritime Museum of San Diego, emphasizing both the general origins and evolution of the ship, as well as the role of specific vessels as protagonists in Pacific and local maritime history. In fulfilling this exhibit strategy, curators at the Maritime Museum have found in William Brown a congenial and avid supporter.



William and Jeane Brown with the *Alma*.

William Brown's skills as a model maker and his particular modeling interests reflect both his Southern California origins and his professional training.[4] William and his twin sister were born in Orange, California, in 1923. Their parents were both immigrants. His father was a cabinetmaker, born in Leeds, Great Britain. His mother, originally from Belfast, Northern Ireland, worked in a munitions factory during the First World War. William grew up in his parents' home in Anaheim. With the United States' entry into the Second World War, he joined the Army. After the war, William went to college courtesy of the Servicemen's Readjustment Act of 1944, also known as the G.I. Bill, and studied dentistry. He and his wife Jeane married in 1949. At the outbreak of the Korean War he enlisted once again, serving as captain. He returned to his practice as a dentist in Long Beach at the end of the Korean conflict. After the war, he continued modeling, a hobby he had first adopted while in High School. William acknowledges that his familiarity with the tools of the dentist's trade, and the dexterity, concentration and attention to detail necessary for their use came in handy as he developed his skills as a model-maker. For a time he and some associates also ventured into maritime industry, running a small boatyard in Redondo Beach. William and Jeane moved to Fallbrook in 1975. At that point, his interest in model-making began to develop further, coupled with the beginning of a long association with the Maritime Museum of San Diego.

William Brown's volunteer services to the Museum were not simply restricted to the creation of superb model ships. He was also active in Museum governance, being elected for two terms to the Board of Trustees. In the early 2000s, he became part of the Museum President's Advisory Council, a position of trust and honor he would hold for more than a decade. Dr. Brown brought to the Museum his years of experience in private practice and his extensive knowledge of maritime history. Beyond offering counsel and advice, his most enduring contribution has been his willingness to share his talents as a model-maker.

By any standards, his output has been extraordinary, both in its consistent quality and the number of models produced. Given the breadth and variety of his work, it is perhaps easier to describe the sorts of subjects that he preferred not to attempt. In his own admittance, the age of mechanized warfare held little interest for him. For the most part he avoided twentieth-century naval subjects. One possible exception is the USS *Monterey* (BM-6) on display at the Maritime Museum of San Diego. Arguably however, the *Monterey* really belongs to the world of the late nineteenth century, rather than the twentieth. With the solitary exception of the Nydam Boat, vessels from Antiquity and the medieval period are not found in William's model inventory.

In William's own words, the theme that encompasses much of his output as a modeler is that of the Pacific Rim. This becomes clear from the contents of this catalog of his work. The stories of such vessels as *Golden Hind*, the Manila Galleon, *Ning Po*, HMB *Endeavour*, *San Carlos*, HMS *Pandora*, USS *Essex*, USS *Cyane*, USS *Hartford*, *Forrester*, *Lady Washington*, and *Californian* are all inextricably linked with the Pacific Ocean. Given William's interest in the maritime story of California and his long-standing support for the Maritime Museum









of San Diego, it is not surprising that a good number of vessels with strong San Diego connections are represented in his collection as well.

If the geographical focus of William's maritime studies allowed his imagination to apply itself to some of the most fascinating vessels ever to have sailed within the confines of the Pacific Rim, the execution of this project displayed not only his consummate skills as a model-maker, but also an eminently practical side to his nature. With wisdom and foresight, William chose to craft his models in a consistent size and scale – mostly 3/16 of-an-inch to the foot – that allow them to be displayed and stored with relative ease and convenience, in both his family home and also in institutional settings.[5]

Scratch-built of wood and other durable materials, and with a consistent historical accuracy based on thorough research, William's models universally merit the title "museum quality." Many of his models can be described as full-hull, taking as their historical inspiration the style of model-making known as Georgian, designed to be as realistic as possible representation of an entire ship.[6] Some of these are fully rigged, with or without sails. From time to time William also crafted models according to a style known as Admiralty or Navy Board. This exacting modeling technique leaves the frames below the lower wales deliberately exposed. With their emphasis on natural wood colors complimented but not overshadowed by discreet coloration of stern features, they are a true celebration of historical research, woodworking and miniaturization.[7] William employed these two styles extensively to depict vessels from the Age of Sail. Beyond sailing vessels, William's other great love was creating models from the Age of Steam, and particularly working boats from the early nineteenth through to the mid-twentieth century. These are invariably full-hull, imitating a style of representation known as builders' models.[8]

Surveying William's impressive output in models, it is obvious he was also drawn to subjects that tell a good story. At times, as in the case of the HMB *Endeavour*, his models convey a truly heroic tale. But even more, William has focused his attention on what some modelers eschew as too mundane, every day, or ordinary. Workboats of every shape and size seem to have fascinated him. These include lumber schooners, ferries, dredges, lightships, kelp harvesters, tugboats, and fireboats. In the world of ship modeling this is indeed a course less steered. William's emphasis on depicting these more utilitarian watercraft was, it can be argued, part of his desire to recount the stories of vessels so vital for the construction, maintenance, and safety of California's maritime industry.

William's models are not only meticulously researched and crafted. They are also crewed. He frequently populated the decks of his models with figurines, and this technique expresses his interest in the working person's narrative he has sought to represent, particularly in his twentieth-century workboats. These miniatures were not added as an afterthought or simply used to impart a sense of scale for the viewer. Rather they are there to emphasize the role of everyday captains, sailors, and engineers in guiding and harnessing the power of these complex maritime machines. Each figure is hand crafted from scratch. Though lacking the precise sculpting and anatomical precision of similar figurines employed today by military miniaturists and train modelers, they nevertheless contain a naïve quality in their execution reminiscent of true sailor-made art forms. In William's estimation they are a vital element in bringing his models to life. It is therefore no surprise that his models find pride of place in the stories told throughout the Maritime Museum of San Diego.[9]

Notes

1 This impressive model of the *San Diego*, in a scale of ¼ inch = 1 foot (1:48) is on long-term loan to the Maritime Museum of San Diego from the Department of the Navy. Sunk on July 18, 1918, she was the only US Navy vessel to be lost in hostile action during the First World War. The cruiser *San Diego* forms an imposing waypoint in the museum's interpretation of the story of the US Navy in San Diego. At the opposite end of the spectrum is the museum's extensive collection of recognition models (1:1200 or 1:1250 scale) used for identification purposes during the Second World War. For further information on these and similar types of models see: Robert K. Liu, *Naval Ship Models of World War II*... (San Marcos: Robert K. Liu, 2010), passim.

2 Because of space restrictions, and the ongoing evolution of interpretive strategies at the Maritime Museum of San Diego, only a relatively small percentage of this collection is on display at any one time. The Museum's library holds an extensive collection of books on both the history of model-making and methods used in the production of models. Various publications exist that detail the essential characteristics of different types of ship model. Among these the reader may consult: Brian Lavery and Simon Stephens, *Ship Models: Their Purpose and Development from 1650 to the Present* (London: Zwemmer / Philip Wilson Publishers Ltd., 1995). For a survey of models related to warships from the Age of Sail, see Brian Lavery's *The Ship of the Line: A History in Ship Models* (Annapolis: Naval Institute Press, 2014). Excellent articles both on the construction of ship models together with research on the vessels they represent may be found in various issues of the *Nautical Research Journal*, a publication of the Nautical Research Guild at: www.thenauticalresearchguild.org

3 For an overview of the functionality of models – particularly ship models – as interpretive artifacts see: Claire Wintle, "Models as cross-cultural design: Ethnographic ship models at the National Maritime Museum," *Journal of the History of Collections* 27 (no. 2, 2015): 242 ff.

4 The following biographic details are contained in a 2016 oral interview with Dr. William Brown, conserved in the Maritime Museum of San Diego's library and archive. Interview with Dr. William Brown, Fallbrook, March 24, 2016. MMSD Oral History Archive, OH00229.

5 For a theoretical discussion of the question of scale in miniaturization, see: Joan Kee and Emanuele Lugli, "Scale to Size: An Introduction," in *To Scale* (Wiley-Blackwell, 2016), passim.

6 Lavery and Stephens, *Ship Models*, 79.

7 For information on the methods used in constructing this type of model, see: John Franklin, *Navy Board Ship Models, 1650-1750* (Annapolis: Naval Institute Press, 1989). For a description of the process of constructing this type of model in a smaller scale see: Philip Reed, *Building a Miniature Navy Board Model* (Annapolis: Naval Institute Press, 2009).

8 Lavery and Stephens, *Ship Models*, 101. Interestingly there are no known half-hull or true waterline models among William's works.

9 While the Maritime Museum of San Diego displays a significant portion of William Brown's models, others have been exhibited in a number of prestigious institutions in both California and beyond. His model of *Pilgrim* is displayed at the Ocean Institute, Dana Point. In the 1980s as Los Angeles Maritime Museum developed its interpretive collection, William's models of the *Bounty*, as well as a First World War era British armed trawler and a merchant brig were acquired by that institution as a basis for what has become its extensive model collection. His models of the *Porpoise* and *Astrolabe* are now conserved at the Smithsonian Institution in Washington, DC. William has also exhibited at the Peabody Museum, Connecticut, Mystic Seaport Museum, Connecticut, and the Miniature Engineering Craftsmanship Museum of Carlsbad, California.






Nydam Boat

Scale: 3/16″ = 1′



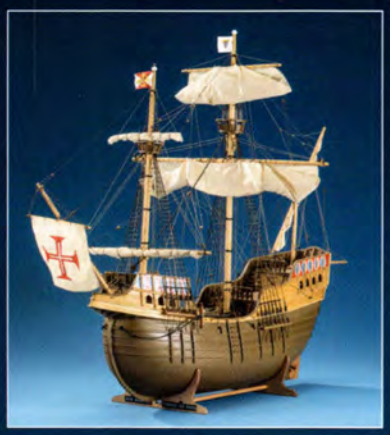
The Nydam Boat, named after the Danish bog in which it was discovered, dates from between 200 and 400 CE. Clinker built, made of oak, and designed for fifteen pairs of oars, it is the oldest known rowed craft in Northern Europe. The boat, likely captured from an enemy, was placed in the sacred bog along with weaponry, tools and clothing as an offering to the victors' gods. It is today preserved and displayed in Gottorf Castle in Germany.

The model of the Nydam Boat was commissioned by curatorial staff at the Maritime Museum of San Diego to form part of a visual narrative composed of models of extant historic vessels. This narrative tells in three-dimensional form the story of the evolution of the ship from its historical beginnings. The model, one of Dr. William Brown's last, is faithfully detailed and crafted with beautiful simplicity. It is also one of the smallest individual modeling projects in his collection of work.



São Gabriel

Scale: 3/8″ = 1′



The *São Gabriel* was a carrack captained by Vasco da Gama on the first Portuguese voyage to India round the Cape of Good Hope. Da Gama set sail in 1497 in the company of three other vessels. His small fleet reached Calicut on India's Malabar Coast in May of 1498. The voyage opened the way for the Portuguese to establish and monopolize the trade between Europe and India for the better part of a century. In the absence of any detailed plans for ships of this period, in order to craft this model William Brown relied on contemporary illustrations of the *São Gabriel* and similar vessels, together with his knowledge of late fifteenth-century Portuguese shipbuilding.







Golden Hind

Scale: 3/16″ = 1′

The galleon *Golden Hind* – originally named the *Pelican* – was launched in 1577. In December of that year, under the command of Francis Drake she set out on a voyage to explore the Pacific and harass the Spaniards. Having captured the Spanish galleon *Nuestra Señora de la Concepción* with her valuable cargo, Drake proceeded along the west coast of the Americas, finally reaching a region he named New Albion, just north of modern San Francisco. From there, having careened the *Golden Hind* and carried out much needed repairs, the English sailed westward across the Pacific. Drake and his crew would eventually circumnavigate the globe, before arriving in Plymouth in September of 1580. Upon her return, *Golden Hind* was moored at Deptford, where she would remain for much of the next century on public display – quite likely the world's first museum ship.







Careening of the *Golden Hind*

Scale: 3/16″ = 1′

In a significant break from his preferred methods – either Admiralty-style or full-hull interpretations – Dr. Brown chose to model the careening of *the Golden Hind* as a cross-section. In this vignette, Drake's crew scrapes and burns marine growth off the lower part of her hull in preparation for her voyage across the Pacific.









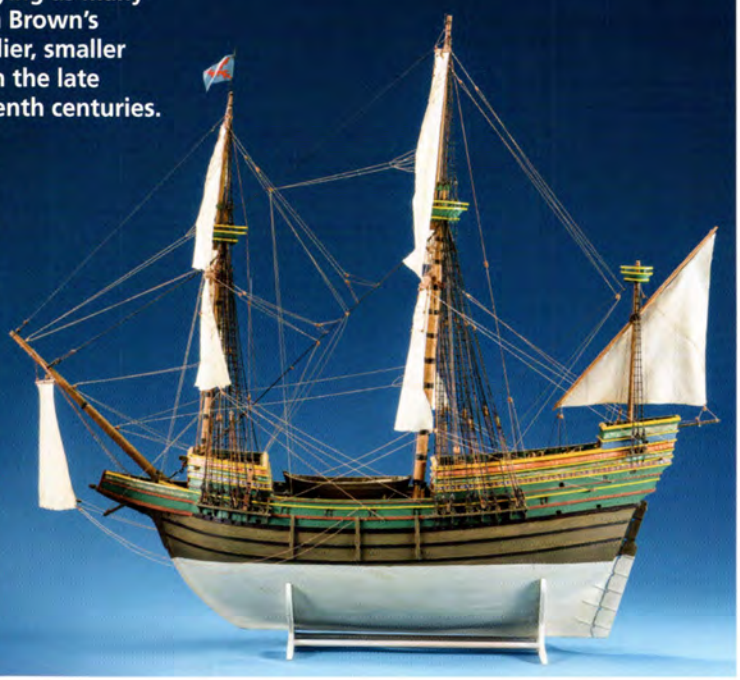
Manila Galleon

Scale: 3/16″ = 1′

settlers, administrators, missionaries and merchants across the Pacific. Many of these galleons were constructed in the Philippines using tropical hardwoods. Because of the lucrative nature of the trans-Pacific trade, the galleons themselves reached immense size for their day. The largest were capable of carrying as many as 1,000 passengers. William Brown's model shows one of the earlier, smaller galleons used in this trade in the late sixteenth and early seventeenth centuries.

The Spanish operated a profitable trans-Pacific trade route between Manila and Acapulco from 1565 to 1815. The annual voyage of what became known as the Manila Galleon between these port cities brought exotic merchandise such as silks and porcelain from China to the Americas and eventually to Europe. The Manila Galleon also acted as a supply lifeline for Spain's colonial outpost in the Philippines, transporting





Dutch Boeier

Scale: 3/8″ = 1′

Dutch Boeiers gained in popularity throughout the seventeenth century as private sailing vessels. They were easy to handle and widely used for recreational boating in coastal regions of the Netherlands. This delightful model is one of the few seventeenth-century subjects attempted by William Brown in his long modeling career. It also demonstrates





two of his favorite devices in modeling: A scratch-built figure guides the tiller, adding a sense of life and proportion to the model; natural wood colors rather than paint bring variety and decoration to this unassuming subject.



HMS *Lyme*

Scale: 1/4″ =1′

The twenty-eight-gun HMS *Lyme* was one of the first true frigates to enter service in the British Royal Navy. The influence of contemporary French ship design is readily seen in her stern gallery, shaped in the form of a half-moon. With a lion figurehead however, she is undeniably British. *Lyme*'s lateen-rigged mizzen mast hearkens back to the naval architecture of the first half of the eighteenth century. In 1760 at the height of the Seven Years' War, she was wrecked off the Baltic Coast of Sweden. In this model Dr. Brown painted the masts and hull to accurately portray his historical subject, rather than rely on the natural coloration of woods. This vessel's complex rigging is expertly accomplished, a true testament to William Brown's modeling.















Launched in the Chinese port of Fuzhou in 1753, the *Ning Po* held the remarkable distinction of being the oldest ship still afloat prior to her sinking in Catalina Harbor in 1938. At one time she was reputed to be one of the swiftest junks on the Chinese coast. Her varied career as merchant vessel, smuggler, pirate ship, prison hulk, floating attraction and movie prop spanned the Pacific.

William Brown's interpretation of this colorful subject was based on photographic sources from the early twentieth century. Of particular note is his intricate hand painting of the junk's decorative stern designs, based on contemporary photographs.

Ning Po

Scale: 3/8″ = 1′









HM Bomb Vessel *Granado*

Scale: 3/16″ = 1′



The *Granado* was launched in 1742. Originally designed as a sloop, she spent the early part of her career in operations against smugglers and privateers. In 1756, with the outbreak of the Seven Years' War, the *Granado* was refitted at Woolwich as a bomb vessel. Two thirteen-inch mortars were mounted in her waist as well as smaller armament for close action defense. To recreate the *Granado* William conducted extensive research. The result is a truly superb example of the art of model ship construction. He inventively adapted the classic Admiralty style to produce a model with a removable upper deck, granting access to the interior of the gun deck, and permitting a closer view of details such as officers' berths and a ship's stove. He candidly describes his trepidation in placing the completed model on his band saw to make the cut. The model uses cherry extensively, with the wales and rails accented in ebony.





HMS *Chaleur*

Scale: 3/16″ =1′

The square topsail schooner *Chaleur* was constructed in New England in the early 1760s. She was purchased by the British Royal Navy in 1764. In modeling the *Chaleur*, William has chosen to depict her as she would have looked in the latter part of her career, with the model varnished rather than painted in order to show the natural beauty of the wood. In imitation of a number of the eighteenth-century rigged models conserved at the National Maritime Museum, Greenwich, William provided the *Chaleur* with rigging and detailed deck fittings while leaving the lower part of the hull unplanked to permit a view of the framing.

HM Bark *Endeavour*

Scale: 3/16″ = 1′

The *Endeavour*, a name synonymous with the British exploration of the Pacific, began her life as a humble collier – the *Earl of Pembroke*, launched in 1764. In 1768 the British Royal Navy purchased her with the express purpose of refitting her for a voyage of scientific discovery to the South Sea. The former collier's commodious hull provided her with ample room for the storage of supplies. Her relatively shallow draft was also considered advantageous for the reconnaissance of uncharted shores. Commanded by Lieutenant James Cook, *Endeavour* reached the east coast of the Australian continent in April 1770. Basing his model on existing plans, illustrations and narrative accounts, William Brown crafted a finely detailed representation of one of the most important vessels in the history of oceanic exploration. James Cook himself, sculpted by William, commands from the quarterdeck.











San Carlos

Scale: 3/16″ = 1′

The *San Carlos*, described in historical sources as a packet boat, was constructed on the west coast of New Spain as part of a small fleet of vessels destined to play a vital role in the Spanish colonization of Upper California. Beset by bad luck and adverse sailing conditions, her first voyage from La Paz to San Diego took 111 days. She reached port with her crew and passengers decimated by sickness. Despite these initial setbacks, the *San Carlos* would go on to explore California's coast and holds the distinction of being the first ship to enter San Francisco Bay and survey its reaches in August of 1775. Dr. Brown based this model of the *San Carlos* on research conducted by Ray Acker and the interpretation of marine artist Gordon Miller. He faithfully reproduced Acker's plans based on Spanish archival sources. Of note in this model is the presence of a tiller to steer the vessel rather than a wheel, and also the mizzen mast made fast to the mainmast, thus giving her the configuration of a snow.







HMS *Kingfisher*

Scale: 3/16″= 1′

HMS *Kingfisher*, a fourteen-gun sloop of the Swan Class, was launched at Chatham Dockyard on July 13, 1770. The *Kingfisher* saw service during the American Revolution and was involved in a number of minor actions and blockades. Faced with certain capture by French naval forces at Narragansett Bay, her captain, Hugh Christian, ordered her abandoned and set on fire. This model of the *Kingfisher* is constructed in Admiralty style, complete with deck fittings, swivel guns and ship's boats. The simple carvings adorning the stern gallery and the finely executed figurehead complement the model's varnished cherry brightwork.













Continental Gunboat *Philadelphia*

Scale: ½" = 1′

Launched in mid-August of 1776, the *Philadelphia* was one of eight gunboats – or gundalows – constructed at Skenesboro. While not the speediest of sailers, *Philadelphia*'s shallow draft made her ideal for coastal action in the Great Lakes region. She was armed with a number of swivel guns mounted on her rails, together with one twelve-pounder and two nine-pounders. Her crew were members of the Continental Army.



Philadelphia sank in an action against a superior British force at the Battle of Valcour Island. In 1935 her remarkably well preserved wreck was discovered in Lake Champlain and she was raised largely intact. Today she is exhibited in Philadelphia at the National Museum of American History. William Brown describes the Philadelphia as one of his favorite models, primarily because of her unusual lines and her historical significance. His model is of a scale slightly larger than his usual preference. The light woods employed in its construction have been preserved with clear varnish, giving the model a rustic quality.

USS *Raleigh*

Scale: 3/16"= 1′

Authorized by Congress as one of thirteen ships for the fledgling United States Navy, the thirty-two-gun frigate *Raleigh* was launched in May of 1776. For the next two years the *Raleigh* operated in the Atlantic before being captured after an extended battle with two British warships. The *Raleigh* was repaired and commissioned into the British Royal Navy, retaining her name. She continued to serve throughout the remainder of the American War of Independence, fighting under a British ensign. Dr. Brown's model of the *Raleigh* is in true Admiralty style. The hull is constructed from cherry, with basswood used for the decking. The painted stern – a method employed in other Admiralty-style models – provides a vivid contrast with the cherry brightwork.









HMS *Diana*

Scale: 3/16″ = 1′



The thirty-eight-gun, fifth-rate frigate HMS *Diana* was launched in 1794. She saw action in the Napoleonic Wars before being sold to the Dutch Navy in 1815. For the model of the *Diana* – executed in a modified Admiralty style – William made extensive use of cherry, one of his preferred woods for this style of representation. This allowed him to feature elements of the interior of the vessel not normally shown in Navy Board models – casks, chests, barrels, cordage and other essential supplies.



Launched in 1779, the sixth-rate *Porcupine*-class *Pandora* saw service during the American War of Independence. Following the cessation of hostilities, *Pandora* was retired from active service. However in 1790 she was chosen to sail to the South Sea to apprehend the surviving mutineers from HMS *Bounty*. Having rounded up the mutineers who had remained on Tahiti, *Pandora* cruised through a number of South Pacific island groups in search of others. She was wrecked on the Great Barrier Reef on August 29, 1791. In this study of the *Pandora*, Dr. Brown has rendered her without rigging or masts. The makeshift prison cell used to contain fourteen of the mutineers during her voyage is shown on the aft-most portion of the quarterdeck.



HMS *Pandora*

Scale: 1/8″ = 1′














Launched in 1799, the *Essex* would serve in the Quasi-War with France (1798-1800), the First Barbary War (1801-1805) and the War of 1812. *Essex* was armed with powerful but short-ranged carronades which would eventually prove her downfall against longer-ranged British guns. During the War of 1812, *Essex* succeeded in inflicting heavy losses on British whalers in the Pacific. At the Battle of Valparaiso in 1814 she was out-gunned, defeated and captured by two British Royal Navy vessels. The British sent their prize to England where she became HMS *Essex*, a troop ship, before becoming a prison hulk at the port of Cork in Ireland.

In this impressive representation of the *Essex*, Dr. Brown combines two distinct styles of model making: A view of the starboard side shows a classic full-hull rendition in the Georgian style; the port side is crafted in Admiralty style, permitting a view of the vessel's interior.

USF *Essex*

Scale: 3/16″ = 1′

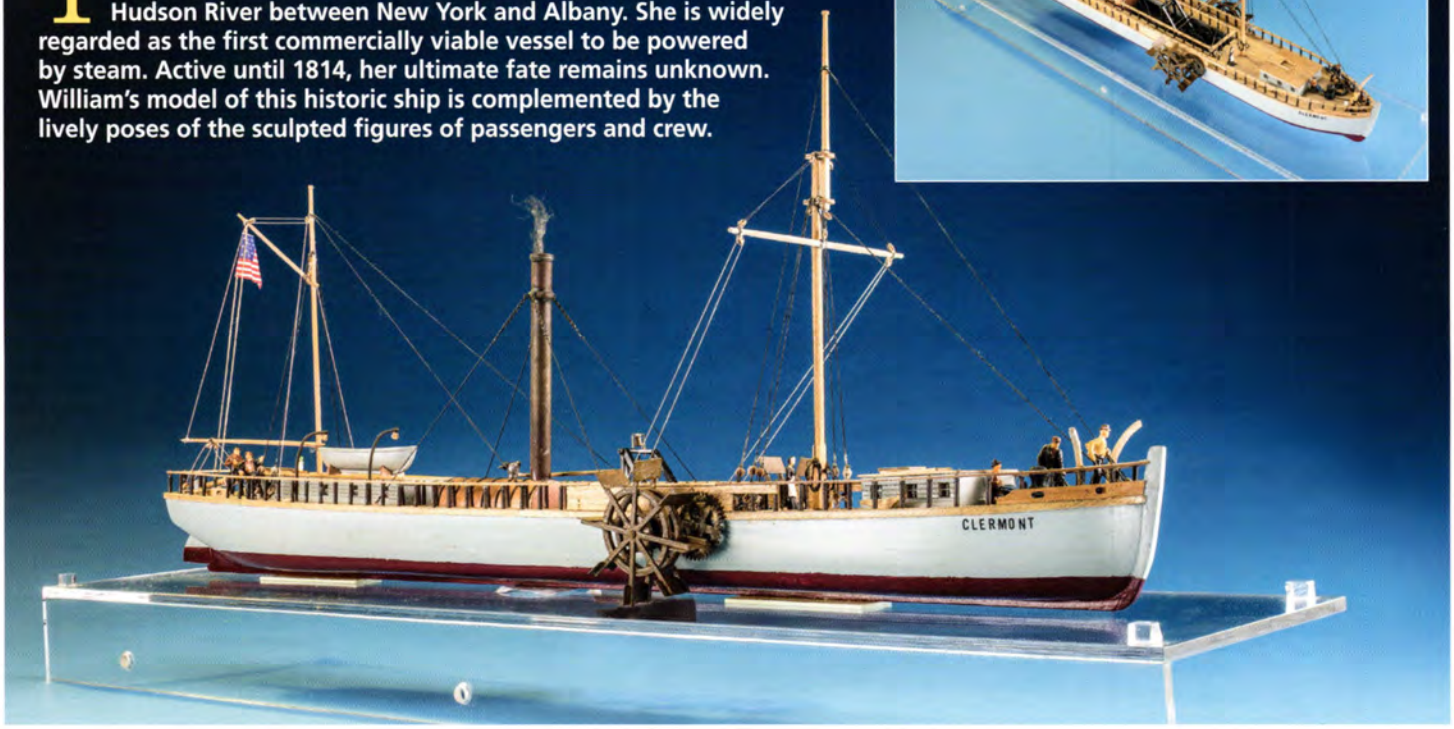


Steamboat *Clermont*

Scale: 3/16″=1′

The *North River Steamboat* – also known as the *Clermont* – was built in 1807. She operated principally on the Hudson River between New York and Albany. She is widely regarded as the first commercially viable vessel to be powered by steam. Active until 1814, her ultimate fate remains unknown. William's model of this historic ship is complemented by the lively poses of the sculpted figures of passengers and crew.









Constructed by Adam and Noah Brown in New York around 1812, the *Prince of Neufchatel* was designed for speed and maneuverability. These characteristics were clearly demonstrated during the War of 1812 when she operated successfully as a privateer in the waters of the English Channel, inflicting heavy losses on British shipping. She was eventually captured in 1814 by three frigates of the British Royal Navy and taken back to England where her hermaphrodite rig was studied with interest by the Admiralty.



Prince of Neufchatel

Scale: 3/16″ = 1′







Leith Smack

Scale: 1/8″ = 1′

In the early 1800s, prior to the arrival of the railway, Leith Smacks provided a relatively comfortable means of traveling from the city of Edinburgh in Scotland south to the metropolis of London. These versatile boats also served as couriers and transport vessels along the eastern British coast well into the nineteenth century.

USS *Vincennes*

Scale: 3/16″ = 1

The USS *Vincennes* was commissioned in 1826 at the New York Navy Yard. She was armed with sixteen 32-pounder guns and two 8-inch shell guns. From 1826 to 1830 the USS *Vincennes* cruised throughout the Pacific, exploring, surveying, and protecting American maritime interests. The *Vincennes* returned to the United States via the Indian Ocean and thus holds the distinction of being the first American warship to circumnavigate the globe. During the Civil War, *Vincennes* assisted in the blockade of Confederate ports in the Gulf of Mexico. Basing his model on available sets of plans and contemporary illustrations, William chose to render the *Vincennes* as she would have looked during her Pacific cruises.





Commissioned at Boston Navy Yard in May of 1838, the *Cyane* was named after a British sloop captured during the War of 1812. With the *Cyane* we see a series of improvements on the design of the USS *Vincennes* of 1826, including a capacity for greater speed and a heavier armament. The *Cyane* saw service in the Pacific throughout the Mexican-American War (1846-1848), raiding ports along the Mexican coast. Her name is synonymous with the United States' possession of the town of San Diego in July 1846. William Brown designed the model of the *Cyane* using the available historical plans of the vessel and painted her in accord with Carlton Chapman's oil painting depicting the disembarkation of Marines from the *Cyane* in San Diego harbor. A view of the starboard side shows the guns run out.









USS *Cyane*

Scale: 3/16″ =1′







USS *Porpoise*

Scale: 3/16″ = 1′





The brig USS *Porpoise* was launched in 1836. In the summer of 1837 under the command of Lieutenant Charles Wilkes, she surveyed parts of the southern coastline of the United States. In August 1838 she joined the United States Exploring Expedition Squadron and traveled to the South Pacific before returning to New York, having circumnavigated the globe. After conducting anti-slavery operations off the coast of West Africa, *Porpoise* was assigned to the North Pacific Exploring and Surveying Expedition. In September 1854 *Porpoise* lost contact with other vessels in the expedition and is assumed to have foundered in a typhoon. William's finely detailed model of the *Porpoise* forms part of the Maritime Museum of San Diego's exhibit explaining the charting of the seas.



Xebecs were a type of swift, lateen-rigged vessel found throughout the Mediterranean from the sixteenth through nineteenth centuries. In the absence of favorable winds they could employ oars or sweeps to increase speed. Their design shows clear influences from Arabian seafaring tradition. Xebecs engaged in coastal trade and on occasion piracy. They were also employed by the navies of some Mediterranean powers, including the Spanish, French, Genoese, and Ottoman Turks. Using vibrant acrylic colors, William Brown captures the essential nature of these vessels. As with all his models, each of the guns is handmade, and based on a single pattern for consistency.



Xebec

Scale: 3/16″ = 1′







In the mid-nineteenth century British officials employed the services of swift, heavily armed revenue cutters along the coasts of the United Kingdom. Their principal task was to enforce customs laws by intercepting smugglers carrying contraband merchandise. William Brown has added life to his model by the inclusion of figures animated in various poses – holding a course at the helm, serving the guns, and standing watch.



English Revenue Cutter

Scale 3/16″ = 1′





Parrott Rifle

Scale: ½″ =1′



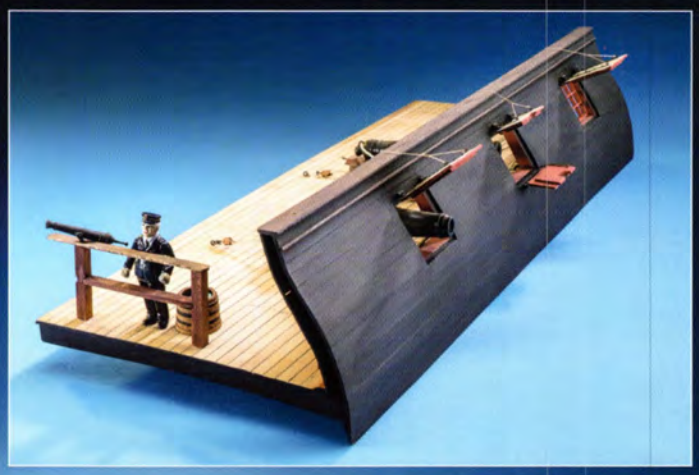
The Parrott rifle was designed and patented by Captain Robert Parker Parrott in 1861, coinciding with the beginning of the American Civil War. Parrott rifles were highly accurate and relatively inexpensive to manufacture, giving them a distinct advantage over other artillery pieces. The 3.67-inch Navy Parrott was developed for use on board Union warships. Smaller scale examples of the Parrott rifle can be seen mounted at the bow of William Brown's model of the USS *Hartford*.

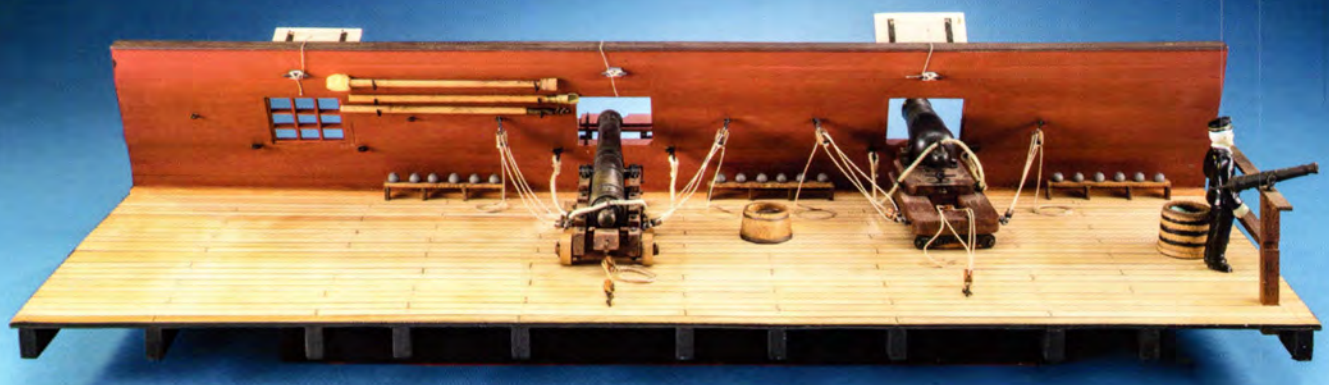
Nineteenth-century gun deck

Scale: ½″ = 1′

This series of models mounted together on a gun deck provides a visual comparison of the principal armament of European navies in the early nineteenth century. The muzzle-loading gun came into extensive use on European warships by the latter half of the sixteenth century. These guns would form the main armament of men-of-war well into the nineteenth century. The carronade, with a much shorter range than the traditional long gun, came into vogue in the late eighteenth century. Vessels armed exclusively with carronades found themselves at a distinct disadvantage in long-range duels at sea. However at close range, carronades were notoriously devastating. Light swivel guns that were mounted on a vessel's rails served primarily in an anti-personnel role. William Brown's modeling of these three weapons in the same scale permits a detailed comparison of their design and relative merits.











The *Bear* was built by Alexander Stephen & Sons Ltd. of Scotland in 1847. This same company also built the Maritime Museum of San Diego's steam yacht *Medea* in 1904. The *Bear* was initially designed as a sealing vessel. Commissioned into the US Navy in 1884, the *Bear* proved her durability in the Arctic by participating in a number of rescues. In April of 1885 she was decommissioned from the Navy and transferred to the Revenue Cutter Service, the precursor of the US Coast Guard. She continued to conduct patrols in the Arctic until 1929, when she was purchased as a museum vessel by the City of Oakland. Her career as a floating museum was, however, short-lived. In 1933 the *Bear* voyaged to the Antarctic with Rear Admiral R.E. Byrd. She was subsequently employed to serve in the Northeast Greenland Patrol until 1941. Finally retired, she sank unexpectedly in 1961 while being towed to Philadelphia for conversion into a restaurant. William's highly detailed model captures the spirit and character of this famous vessel, rendered as she would have looked in her heyday as part of the US Coast Guard around 1912.



USCG Cutter *Bear*

Scale: 3/16″ = 1′







Newsboy was a clipper-bowed merchant brig built in 1854. She was employed in the trans-Atlantic triangular trade route operating between North America, the Mediterranean and the Caribbean in the mid-nineteenth century. Sailing with favorable winds from New York, *Newsboy* carried manufactured items from New England to the Mediterranean. From there she transported wine, oils and fruit to the West Indies. From the Caribbean she returned home laden with rum, molasses and sugar. William named this model after his wife, Jeane.

Brig *Newsboy* (*Jeane B.*)

Scale: 3/16″ = 1′

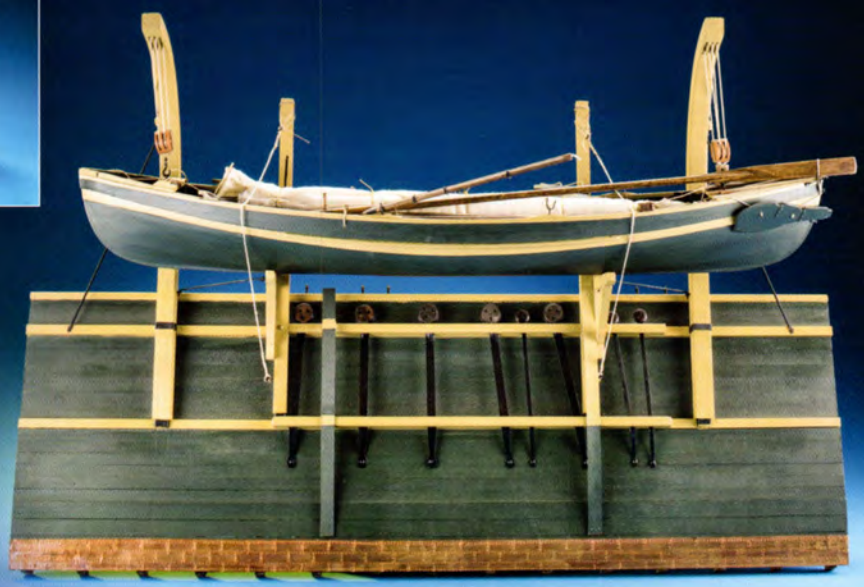


New Bedford Whaleboat

Scale: 1/8″ = 1′



New Bedford whaleboats were designed to be light and fast. Hung at the ready from sturdy davits on the sides of whaling vessels, they could be lowered swiftly. They carried a crew of six, as well as the equipment essential for a successful whale hunt: harpoons, cordage, buckets and axes. These whaleboats were double-ended, allowing them to change direction rapidly. A mast could be stepped with ease, giving the crew the opportunity to rest as they returned from the chase. William's model, done in a slightly larger scale than he usually employs, features not only an accurate rendition of the New Bedford whaleboat, but also the equipment habitually carried on board.



USS *Hartford*

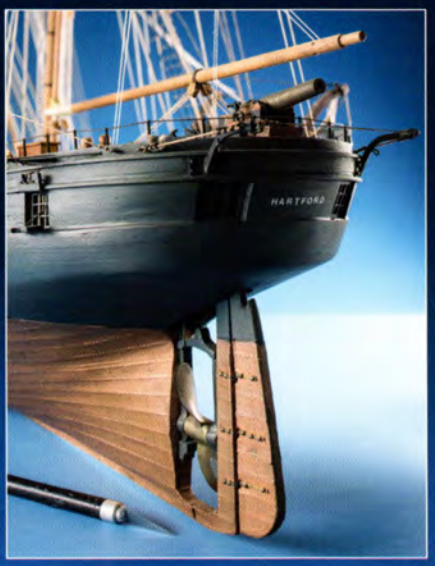
Scale: 3/16″ = 1′

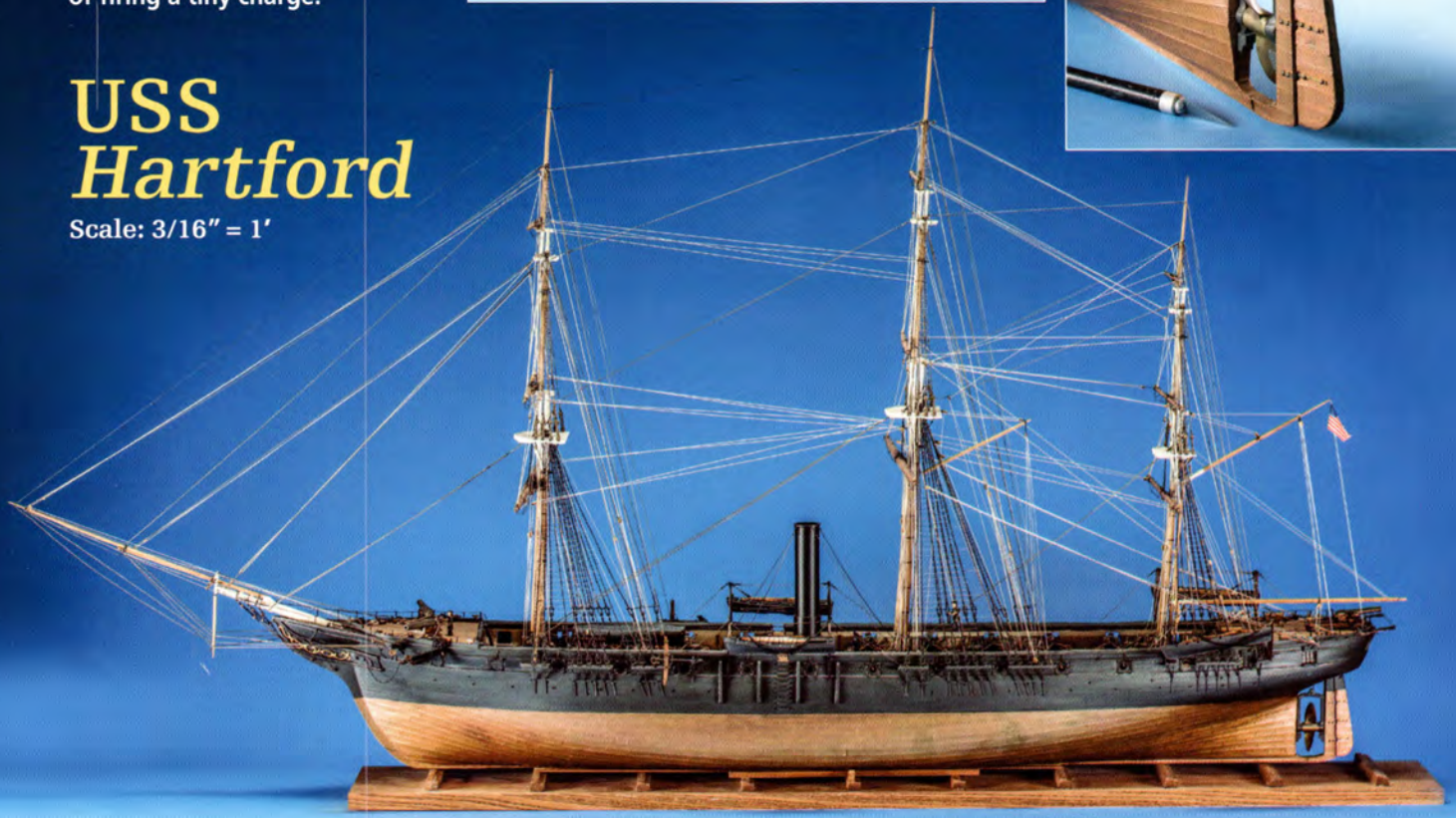
The USS *Hartford* was launched in late 1858 and commissioned into the US Navy the following year. She is a fine example of naval architecture during the period of transition from sail to steam. The advantages of both systems of propulsion are evident in the *Hartford*'s career. On blockade duty and for long voyages, sail was still the most reliable and efficient method of travel at this time. However, in action the maneuverability afforded by steam gave the *Hartford* and similarly powered vessels a distinct advantage. During the Civil War she was Admiral David Farragut's flagship at the battles of New Orleans, Vicksburg and Mobile Bay. In the 1880s and 1890s, she visited the port of San Diego on a regular basis as a training ship. She sank at Norfolk, Virginia in 1956 while awaiting restoration. The *Hartford* is arguably one of William Brown's most impressive models, reflecting thorough historical research and masterful modeling techniques. For years it has caught the gaze of visitors in the Maritime Museum of San Diego's Navy Exhibit. Each of the ship's guns is turned in brass, and is capable of firing a tiny charge.







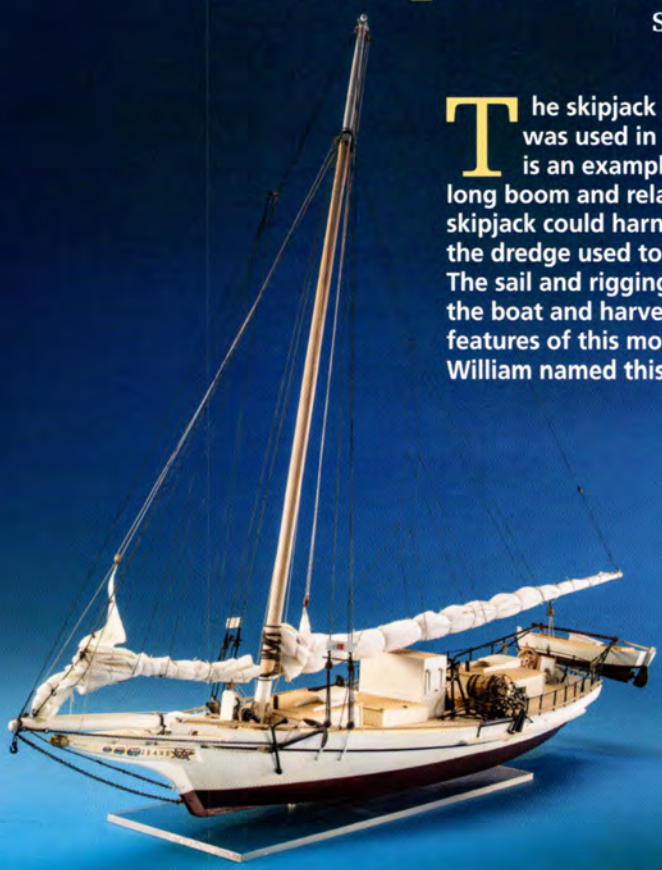


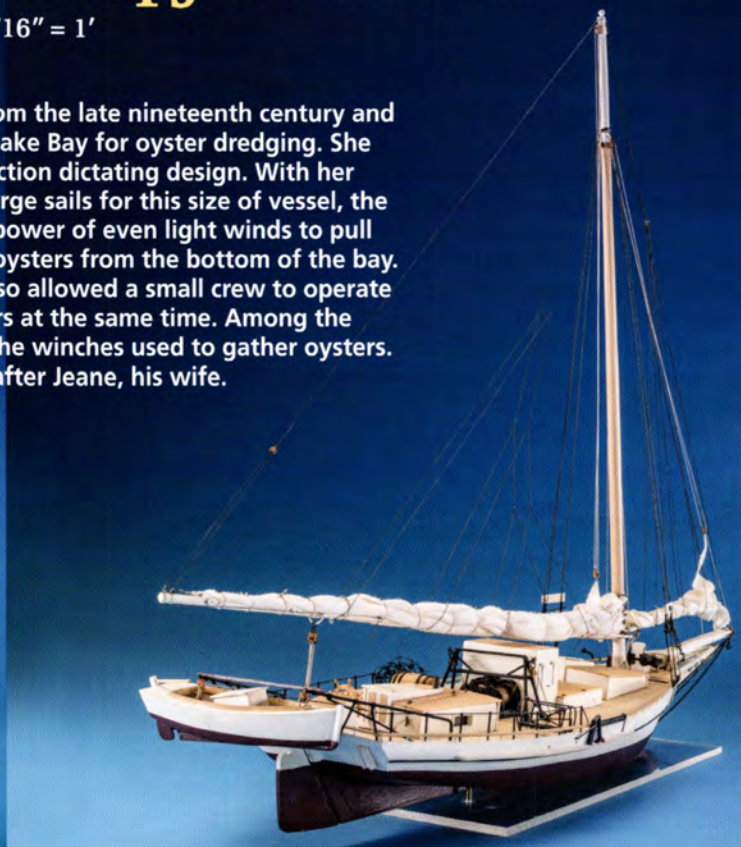


Chesapeake Bay Skipjack *Jeane*

Scale: 3/16″ = 1′

The skipjack dates from the late nineteenth century and was used in Chesapeake Bay for oyster dredging. She is an example of function dictating design. With her long boom and relatively large sails for this size of vessel, the skipjack could harness the power of even light winds to pull the dredge used to gather oysters from the bottom of the bay. The sail and rigging plan also allowed a small crew to operate the boat and harvest oysters at the same time. Among the features of this model are the winches used to gather oysters. William named this model after Jeane, his wife.









Built in New York in 1854, the *Orizaba* entered service in the Nicaragua Steamship Company, and the following year traveled from New York to San Francisco via the Straits of Magellan. Her two large sidewheels powered by steam from a coal-fired boiler were her primary means of propulsion. Nevertheless she was also fitted with masts and sails should the need have arisen for auxiliary power. *Orizaba* holds a special place in the story of the development of San Diego in the last half of the nineteenth century. She made her first voyage from San Francisco to San Diego in 1865. Over the course of the next twenty years, *Orizaba* would ferry passengers to and from San Diego on a regular basis. This model reflects William Brown's keen interest in the part played by work boats and passenger vessels in California's maritime history.

SS *Orizaba*

Scale: 3/16″ = 1′





The iron-hulled *Euterpe* was launched at Ramsey on the Isle of Man in 1863. She is one of the last surviving vessels of her time still intact. Sailing each November under the power of wind alone, she holds the distinction of being the oldest active sailing ship in the world. Initially rigged as a ship, *Euterpe* was designed to carry cargo from British India to the United Kingdom. With the opening of the Suez Canal in 1869, steam-powered vessels became more commercially viable in the India trade, and *Euterpe* became an emigrant ship. In this role she carried passengers from the United Kingdom to New Zealand and Australia. In the late-nineteenth century *Euterpe* changed ownership and function yet again, becoming part of the trans-Pacific trade in lumber and coal. In 1901 she was purchased by the Alaska Packers Association and rigged down to a bark. Her name was also changed to *Star of India*. Each year until the early 1920s she carried fishermen and cannery workers from San Francisco to Alaska, returning with her hold laden with cans of salmon.



Euterpe

Scale: 3/16″ = 1′

In 1926 the *Star of India* was sold to the Zoological Society of San Diego for what was hoped would become the focal point for a new aquarium. The Great Depression and World War II forestalled the implementation of plans to make her into a museum vessel, and it was only in the late 1950s that funding became available to restore her. In 1976 she finally put to sea again. Today she is the centerpiece of the Maritime Museum of San Diego, cared for by a devoted crew of volunteers, professional shipwrights and museum curators.

William Brown has interpreted the *Euterpe* as she would have looked as an emigrant vessel in the 1880s. She is rigged as a ship, and her hull painted with a pattern reminiscent of contemporary warships – a design intended to deter would-be pirates from attack. The model was donated to the Maritime Museum of San Diego by Dr. Brown and is on display on board the *Star of India*.

Gjøa

Scale: 3/16″ = 1′





The *Gjøa* was built in Norway in 1872 and named after the fighting Valkyrie of Viking mythology. In the early-twentieth century, she was purchased by the great Norwegian explorer of the Arctic and Antarctic, Roald Amundsen. After modification, including the installation of a small kerosene-fueled engine and additional sheathing, Amundsen set sail from Greenland, making for the Labrador Sea. From June 1903 to early 1906, the *Gjøa* sailed in the waters of the Arctic, making her way slowly from east to west. Along the way, Amundsen and his crew took extensive surveys and recorded their findings. *Gjøa* eventually reached San Francisco in 1906, to find the city ravaged by earthquake and fire. There she would remain until 1972 when she was returned to Norway.

The *Gjøa* has a sentimental attachment for William. He vividly recalls clambering over a somewhat dilapidated old ship as a boy near Golden Gate Park in San Francisco. Years later, while visiting the Norwegian Maritime Museum in Bygdøy, he saw a now restored *Gjøa* and recognized her as the same vessel he had visited as a child.



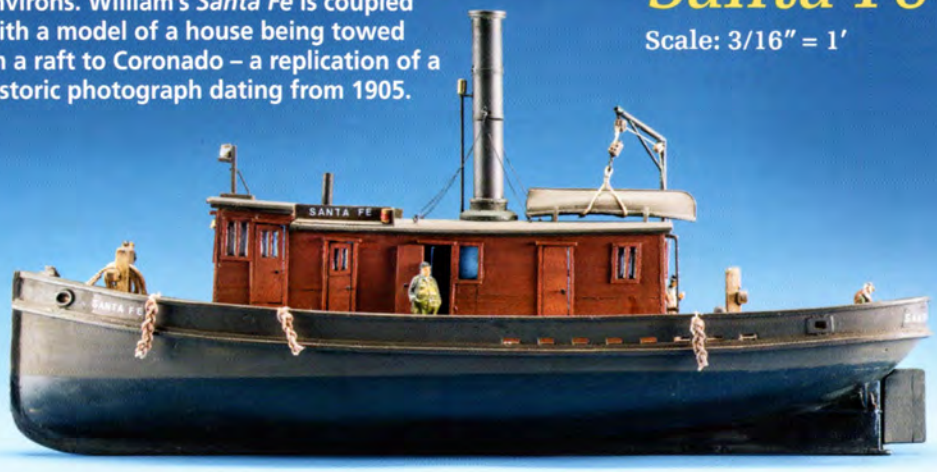


Launched in 1888, the *Santa Fe* was the first tugboat to be built in San Diego, constructed by the Coronado Beach Company. The Chillicothe Iron Works of Ohio supplied her engine and other machinery. *Santa Fe* was operated by Spreckels Brothers Commercial Company until about 1910, after which she was beached on the west side of North Island on a stretch of shoreline known as Whaler's Bight. This charming model forms part of a visual narrative at the Maritime Museum of San Diego, detailing the importance of workboats in the development of the harbor and its environs. William's *Santa Fe* is coupled with a model of a house being towed on a raft to Coronado – a replication of a historic photograph dating from 1905.



Tug boat *Santa Fe*

Scale: 3/16″ = 1′



Coastal Schooner *Lasha*

Scale: ½″ = 1′

In the late seventeenth century, schooners first developed as a distinctive class of vessel in the Netherlands. From the early-eighteenth century their design further evolved along the eastern coast of North America. Swift, agile and with a relatively shallow draft, various types of coastal schooners were employed by privateers, slavers, fishermen, and merchants. The *Lasha* is modeled after the topsail schooner *Eagle* built in Maine. William constructed this pond yacht to a larger scale than most of his models. Precision in workmanship and artistry is not always translated into practicality in sailing and William has some very candid comments about her lack of handling ability on the pond. His mischievous sense of humor is evident in the homeport lettered on her stern: Tibet.









USS *Monterey*

Scale: 1/8″ = 1′

The USS *Monterey* was the only *Monterey*-class monitor, indicative of the fact that her design would soon be superseded by other vessels in the United States' growing steel navy. Combining the protective qualities of armor plating, a low silhouette, and an unobstructed traverse for powerful guns, monitors proved to be formidable vessels in the rivers, bays and sounds of the American South during the Civil War. The *Monterey,* however, was destined to protect American interests in the Pacific and proved to have undesirable sailing properties in the conditions she found herself operating in. In accordance with her patrol duties along the West Coast, she occasionally visited the port of San Diego. In 1898, after the outbreak of hostilities between the United States and Spain, the *Monterey* was sent to the Philippines to provide support for American forces in that region. The *Monterey* is a unique subject in William Brown's extensive catalog of modeling projects: a warship of the Age of Steam rather than the Age of Sail.



Schooner *Forester*

Scale: 3/16"= 1'



The four-masted schooner *Forester* was built and launched in Alameda, California, in 1900. Designed for the trans-Pacific trade in lumber, this sturdy schooner sailed to China, India, Australia and South America, her hold and occasionally her weather deck, stacked with timber from the forests of Washington and Oregon. On her return voyages she carried a variety of profitable cargoes depending on her ports of call, including coal, copra and tropical hardwoods. During her heyday she gained a reputation as a swift and dependable vessel – once sailing from Australia to San Francisco in seventy-five days. Considered outmoded and obsolete by the mid-1920s – a fate she shared with the *Star of India* – the *Forester* was towed to Martinez, moored and used as a tidal breakwater next to the main tower of the Carquinez Bridge during its construction. In 1932 her captain, Otto Daeweritz, beached her on mudflats in Martinez and lived on board in his retirement. In 1975 she burnt to the waterline, ending a chapter in California's maritime history. Her remains can still be seen there today. Her impressive wooden bowsprit is on display at the Maritime Museum of San Diego. William's model of the *Forester* – one of many models he has crafted to illustrate the maritime history of the Pacific Rim – forms part of a diorama showing the off-loading of lumber at the port of San Diego in the early twentieth century.



Scow Schooner *Alma*

Scale: ¼" = 1'

The wooden-hulled scow schooner *Alma* was built in 1891. She was designed to carry bulk cargo in the Sacramento and San Joaquin Delta region. With a flat bottom and a wide beam she was eminently suited for these waterways. At low tide her hull could rest safely on the bottom. The State of California purchased the *Alma* in 1959, and restoration work began on her hull and rigging in 1964. *Alma* was designated a National Historic Landmark in 1988. Today she is conserved at the San Francisco Maritime National Historic Park, and still sails on San Francisco Bay. In William Brown's opinion, this model was one of the best pond boats he ever sailed.







Steam tug *Hercules*

Scale: 3/16″ = 1′





The *Hercules* was built by John H. Dialogue and Sons of Camden, New Jersey, for the Shipowners' and Merchants' Tugboat Company of San Francisco. After launching she sailed to San Francisco via the Strait of Magellan. *Hercules* was initially used as an oceangoing tug, towing large sailing vessels like the *C.A. Thayer* north along the coast of California against prevailing winds. She also assisted in the transportation of log rafts from the Pacific Northwest to ports in Southern California. On other voyages she towed barges to Hawaii and construction equipment to the Panama Canal. In the mid-1920s, *Hercules* operated primarily on San Francisco Bay, moving railroad car floats from Oakland and Alameda to San Francisco. One such car float is now moored at the Maritime Museum of San Diego. Today the *Hercules* is restored, conserved and exhibited at the San Francisco Maritime National Historic Park. William's model of the *Hercules* continues his interest in West Coast workboats and their stories. It is displayed at the Maritime Museum of San Diego together with a model of one of the immense log rafts she towed to that port.







The ferryboat *Estrella* operated on San Diego's harbor in the early twentieth century as part of the Star & Crescent Company. She was built at the San Diego Marine Construction Company, and launched in the spring of 1918. *Estrella* was sixty-five feet long and had two 50-horsepower Frisco Standard distillate engines. A large picture window in the passenger area looked down into the engine room, permitting a view of the engineers working below. She would usually make two excursion runs per day on San Diego Bay, at 10 AM and 2 PM, out to the buoy at the entrance to the harbor. This was called the Bay Trip Deluxe.



Ferryboat *Estrella*

Scale: 3/16″ = 1′



A contemporary of the *Forester*, the steam schooner *Wapama* was likewise closely involved with the Pacific lumber trade. *Wapama*'s wooden hull was constructed on Sauvie Island in Oregon in 1915. Her engine and fittings were added in San Francisco later that year. Along with forty-five cabin passengers and fifteen in steerage, she could carry an estimated 1,000,000 board-feet of lumber. During her early career, the *Wapama* transported passengers and cargo between San Francisco and the Pacific Northwest. From 1930 to 1937 she operated between San Francisco and Los Angeles. Under new ownership, in 1938 she was renamed the *Tongass* and began operating between California and Alaska. Sold for scrap ten years later, she continued to survive despite a series of mishaps. The San Francisco Maritime Museum acquired *Tongass* in the late 1950s, and conservators halted her deterioration for a time by interim restoration efforts. She is destined to be dismantled, and her most iconic elements will form part of projected museum displays. Given *Wapama*'s fate – the last of approximately 235 steam schooners that once plied the waters of the Pacific – William Brown's finely executed model is a poignant reminder of an all but lost era in maritime history.





Lumber schooner *Wapama*

Scale: 3/16″ =1″



Chinese Fishing Junk

Scale: 3/16″ = 1′





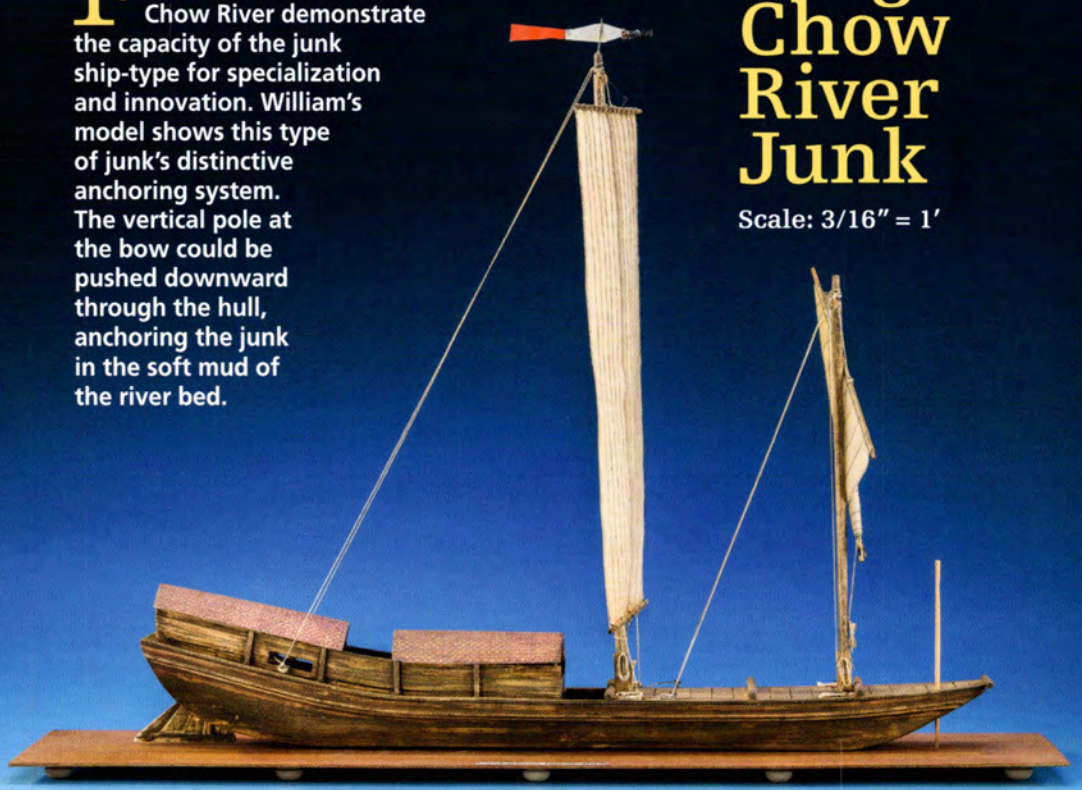


For almost 2,000 years junks have plied the waters of the seas adjacent to the Chinese mainland. Large merchant junks formed part of an extensive trading network, connecting Chinese communities in port cities and trading posts in Southeast Asia, South Asia, and possibly as far as the Swahili Coast of East Africa. An efficient hull design and a flexible sail plan allowed junks to sail close to the wind. Junks fished extensively in Chinese waters and beyond, giving burgeoning Chinese coastal populations access to much needed food sources. William Brown's model of a fishing junk typical of the nineteenth and early twentieth centuries reflects his fascination with their design.

King Chow River Junk

Scale: 3/16″ = 1′

Fishing junks from the region of the King Chow River demonstrate the capacity of the junk ship-type for specialization and innovation. William's model shows this type of junk's distinctive anchoring system. The vertical pole at the bow could be pushed downward through the hull, anchoring the junk in the soft mud of the river bed.







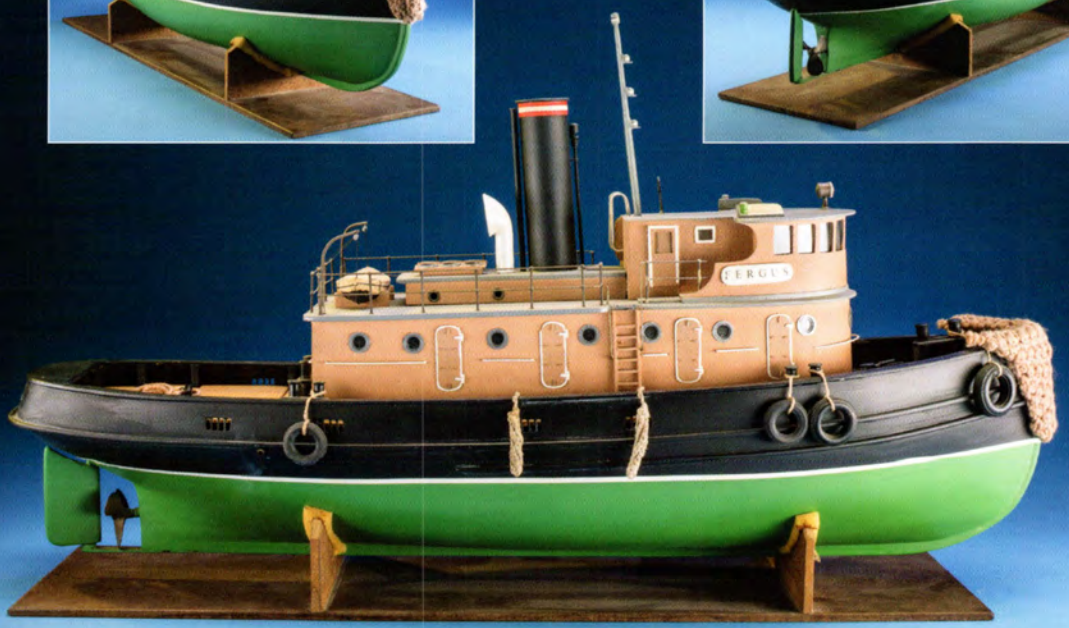
Tugboat *Fergus*

Scale: 3/16″ = 1′

This model of a generic harbor tug reflects William Brown's keen interest in relatively unglamorous ships and boats that are nevertheless vital for the smooth functioning of maritime industries. This radio-controlled model was originally electric powered. William converted it to steam.







Constructed in 1914 in the United Kingdom, the *Eppleton* Hall is preserved today at the San Francisco Maritime National Historic Park. She remains the last complete example of a Tyne-built paddle tug. Distinguished by her two paddle wheels and distinctive smoke stack, the *Eppleton* Hall was originally designed to tow colliers into and out of port. Her twin engines could operate independently, giving her great maneuverability. Sold for scrap in 1967, she was saved thanks to the intervention of Karl Kortum, then director of San Francisco Maritime Museum. Kortum organized her refitting and restoration in preparation for her voyage across the Atlantic, through the Panama Canal and into the Pacific, with her final destination San Francisco. On the way, off the coast of San Diego, she narrowly avoided foundering.

This full-hull model of the tug boat demonstrates two of William Brown's particular interests as a model maker: vessels that are "living" reminders of a bygone age and those with a utilitarian function.





Eppleton Hall

Scale: 3/16″ = 1′







LA Fireboat no. 2, *Ralph J. Scott*

Scale: ¼″ = 1′

The fireboat *Ralph J. Scott* was built in 1925. Also known as Fireboat no. 2, the *Ralph J. Scott* was part of the Los Angeles Fire Department serving the Port of Los Angeles. She is on display today at the Los Angeles Maritime Museum. The scale of 1:48 was a relatively large one for William Brown to take on. Being a radio-controlled pond model dictated its size to a certain extent. A small pump activates the nozzles which are able to shoot water a considerable distance. William fondly recalls the reaction of children and adults alike when he would throw the switch, sending a jet of water in their direction.



Clyde Puffer *Starlight*

Scale: ¼" = 1'

The *Starlight* was built on the Clyde River in Scotland around 1915. Its size was determined by the width of the locks in the Forth and Clyde Canal. Her one-cylinder, non-condensing engine gave a distinctive puffing sound – and hence the name for this type of vessel. The *Starlight* was used in the inter-coastal trade in the Irish Sea, regularly visiting ports in Ireland, Wales and Scotland. The *Starlight* illustrates two aspects of William's modeling interests – working boats and vessels with a distinctive character.







Kelp Harvester *El Rey*

Scale" 3/16" = 1'

The steel-hulled *El Rey* was constructed by Gunderson Bros. of Portland, Oregon in 1946. She joined Kelco's small fleet of kelp cutters that operated in the dense kelp forests adjacent to the shores of California, south of Point Conception. Three hundred tons of kelp could be harvested and transported at one time. Over a working life spanning some thirty-five years, *El Rey* is estimated to have harvested hundreds of thousands of tons of kelp, gathered in the course of 3,600 voyages covering 810,000 miles. *El Rey* continues to fascinate an exclusive group of visitors. In 1987, after cleaning and modification, she was sunk off Mission Beach. Today from beneath the waves she beckons San Diego's diving enthusiasts. William Brown has faithfully reproduced this robust industrial design. While lacking the epic tales associated with some of his modeling subjects, his rendering of *El Rey* is once again a reminder of William's consistent interest with working boats, and the unsung heroes of California's maritime story.





Lightship *Relief*

Scale: 1/8″ =1′

The *Relief* was launched in Camden, New Jersey, in 1904. First anchored off Blunts Reef on the California coast, she was instrumental in saving the lives of 155 survivors from a stranded coastal steamer. She would keep station there until 1930, before becoming San Francisco's lightship. Renamed *Swiftsure*, she is the oldest surviving example of an American lightship with its original marine steam engine. She was decommissioned in 1960 and later purchased by Northwest Seaport and is now preserved as part of that maritime heritage organization's fleet of historic vessels.







Clamshell dredge and barge

Scale: 3/16″= 1′



The harbors of Long Beach and San Pedro underwent significant improvement prior to World War II. Hydraulic dredges deepened these ports, and clamshell dredges – named because of the distinctive shape of their clamshell bucket – were used to construct breakwaters as well as deepen channels. The dredge modeled here by Dr. Brown helped build the Long Beach breakwater during the Second World War. Barges hauled stone from Catalina Island for this purpose. Despite extensive searches William could not locate any plans to build this model, so he used his decades of experience to construct this example from photographic evidence alone.







Californian

Scale: 3/16″ = 1′

Built at Spanish Landing on San Diego's harbor and launched in 1984, the *Californian* is the State of California's official tall ship. This replica topsail schooner is based on the design of the revenue cutter *C.W. Lawrence*, launched in 1848. The original *C.W. Lawrence* was a brig-rigged Baltimore clipper with raked masts. She was tasked with upholding maritime law in the heady days of the California Gold Rush. The *Californian* is part of the Maritime Museum of San Diego's fleet of replica and historic vessels. She sails regularly on San Diego's harbor, and plays an integral role in the Museum's education program. She also cruises periodically to Catalina Island. William Brown's model captures the grace of a vessel designed for speed and endurance.



Lady Washington

Scale: 3/16″ = 1′

The *Lady Washington* was built in Aberdeen, Washington, and launched in 1989. She is a faithful replica of the original brig *Lady Washington*, which left Boston in 1787 as part of the Columbia Expedition. She participated in the fur trade in the Pacific Northwest and also the trans-Pacific trade in tea and porcelain. She was the first American vessel to reach Japan, before being wrecked in the Philippines in 1797. The replica *Lady Washington* is the State of Washington's tall ship, and is managed by Grays Harbor Historical Seaport Authority.







A MODEL-MAKER & HIS ART

The Collected Works of Dr. William Brown

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Nineteenth-century gun deck
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USCG Cutter *Bear*
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New Bedford Whaleboat
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Brig *Newsboy* (*Jeane B.*)
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Chesapeake Bay Skipjack *Jeane*
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Tug boat *Santa Fe*
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The San Diego Ship Modelers' Guild



HMS *Victory*
by Guild member
Robert Hewitt.
Scale 1:480
(1 inch =20 feet)

Model Ship enthusiasts in the San Diego region meet every second Tuesday of the month at the Maritime Museum of San Diego aboard the ferryboat *Berkeley*.

The San Diego Ship Modelers' Guild is affiliated with and supports the mission of the Maritime Museum of San Diego. The Guild warmly welcomes all members and visitors to their meetings. Here members share modelling tips and techniques, mentor new modelers, and display the projects they are currently working on. During the annual Del Mar Fair, members of the Guild staff a booth as part of the Design in Wood Competition. For further information on the Guild, contact the Guild Master at: guildmaster@sdmodelersguild.org or visit the Guild's website at: www.sdshipmodelersguild.org/

As well as assisting with the cleaning and repair of the Museum's model collection, volunteers from the Guild are available to restore privately owned ship models. For further information contact the Curator of Models at the Maritime Museum at shipmodels@sdmaritime.org.



HM *Supply, 1759-1807*
by Guild member
Robert Hewitt.
Admiralty style model,
Scale 1:240 (1 inch =20
feet) LOA 4 3/4"

The Robert and Laura Kyle Chair in Maritime History

Annually, thanks to the generosity of Museum members Robert and Laura Kyle, the Maritime Museum of San Diego hosts a visiting specialist in history. In 2016 we are honored to have Professor Stephen Colston, Ph.D., of San Diego State University as our Chair in History. Steve has supported the Museum in the past by teaching in its summer seminar series "Empires of the Wind" sponsored by the National Endowment for the Humanities. He has recently published a book on the noted California historian Henry R. Wagner. *Imprints on Empire* is available from the Instituto Franklin at http://www.institutofranklin.net/en



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MARITIME MUSEUM
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SAN DIEGO

The Continental Gunboat *Philadelphia*, 1776: one of Dr. William Brown's favorite models.



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