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Wet Suit Pursuit: Hugh Bradner's Development of the First Wet Suit

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In the 100th anniversary issue of *Sunset Magazine*, published May 1998, the “ongoing timeline of major events” says that in 1952 UC Berkeley physicist Hugh Bradner invented the wet suit. This single fact summarizes a more complex story.

In the spring of 1951 Bradner decided to spend some “weekend time” improving the equipment for the navy frogmen. Soon thereafter, he sent ideas and concepts of the wet suit to UC Berkeley physicist, Lauriston C. “Larry” Marshall, who was involved in a U.S. Navy/National Research Council Panel on Underwater Swimmers. In the fall of 1951 the effort to actively develop the wet suit began when colleagues at the Berkeley Radiation Lab joined Bradner in the fabrication and testing of various materials.

At the end of 1949, the U.S. Marine Corps, U.S. Navy, and National Research Council agreed to work together using scientific applications to solve amphibious operational problems. A committee was formed under the chairmanship of UC Berkeley engineer Murrough P. “Mike” O’Brien. Several government panels met to discuss and watch East Coast and West Coast underwater demolition teams in action. Their views were recorded in the Hahn-Bascom-Gerdes preliminary survey report distributed in October 1951.¹ The navy terminology was changing from “UDT’s” to the broader term of “underwater swimmers.” In December 1951, the Swimmer Symposium was held in Coronado, California. This symposium brought together operational, technical, civilian, and military people to discuss mutual problems and ideas. The National Research Council in cooperation with the Italian, French, and British governments consolidated information about the physical, psychological, and physiological effects of underwater blasts on swimmers. At that time, Hugh Bradner, a designer and physicist at UC Berkeley’s Radiation Laboratory, had been working on preliminary calculations on the effects of “absorptions” or reflection of shock waves on unicellular material and was invited to participate.

Bradner already held patents for a number of inventions and clearly had the skills and knowledge to help underwater swimmers and swimmers in general. His goal was

¹Hugh Bradner Papers, 1938-1973, MC16, Box 2, “135, Panel [on Underwater Swimmers] Meetings, 1951-1953.”

straightforward, design a wet suit for the military underwater swimmer. In a letter to Larry Marshall dated June 21, 1951, Bradner wrote that suits do not need to be watertight if thermal insulation is obtained by air entrapped in the material of the suit. The diver does not have to be dry to stay warm. He began testing the wet suit models in the fall of 1951.

Commercial Self Contained Underwater Breathing Apparatus (scuba) was brought to the United States in 1949 when Rene's Sporting Goods in Westwood, California, began selling a new underwater breathing machine called the Aqua-Lung, invented in 1943 by French Navy captain Jacques Cousteau and Canadian engineer Emile Gagnan.

According to Andreas B. Rechnitzer, SIO alumnus and diver, the use of scuba for science began at Scripps Institution of Oceanography in the summer of 1950 when Conrad "Connie" Limbaugh and other graduate students began formal investigations of the kelp beds. At that time, divers were limited to just two sets of equipment-- two regulators, tanks, weight belts, fins, and faceplates. To combat the discomfort from cold waters the divers tried various kinds of clothing (long johns), greasy skin coatings, and surplus air force survival suits. These Scripps divers were among the first to try out the Bradner wet suit at their scuba training classes at the La Jolla Beach and Tennis Club.

Bradner explained in simple terms the difference between the wet versus the dry rubber suit. The wet suit gets its thermal insulation from the many small air bubbles trapped in the material, and hence can stand a small amount of water flow between the garment and the skin. The wet suit was made from a unicellular foamed plastic material such as neoprene, rubber, or polyvinylchloride; while the dry suit was a thin waterproof garment made from heavy rubberized cloth under which the diver wore thick, usually wool underwear. A dry suit that depends on woolen underwear will lose its thermal insulation if water displaces the air in that underwear.

Willard Bascom, an SIO research engineer, recommended that Bradner try a unicellular material made by Rubatex. Bradner developed a foam suit using a material of unicellular neoprene ordered to American Standard Testing Methods specifications and obtained a sample from the Rubatex Division of Great American Industries. When it became clear that the navy would be slow in producing wet suits for their own use, they declassified the design, and encouraged commercial production in 1952. Bradner collaborated with a group of engineers at UC Berkeley on the design of a commercial wet suit using the rubatex material. The engineers formed a company under the guidance of Dave Garbellano, an engineer-physicist at UC Berkeley, called Engineering Development Company (EDCO). Foam plastic materials like ensolite and rubazot were already being used internationally for many purposes, however Bradner was the first person to use the unicellular foam plastic material neoprene for exposure swim suits. It would take several years for EDCO to obtain and develop tougher materials to improve their suit.

EDCO requested navy cooperation to have prototypes of the suit tested in order to produce a suit that would meet their needs. A letter from LCDR Henry A. Gerdes, Office of Naval Research, dated November 24, 1952, to F.B. Allen, BuShips, US Navy, elaborates further:

Dr. Bradner is under contract to AEC. [He has a] sincere interest in the problem of making a satisfactory exposure swim suit for cold water

operations...Because of this interest, he immediately went to work to help the swimmer. During August and September 1952 he was a consultant to a Cooperative Council under the terms of contract N7onr-29140, at which time he proved his ideas for a swim suit. Being under contract to the Government, he was required to disclose anything he might invent, design, etc. in order to protect the Government on patent rights or from royalties. The subject presentation of Dr. Bradner is a disclosure of his work on an exposure swim suit, patentable rights of which are to be determined by a government agency.²

EDCO, Bradner, and others would wait years to hear back from the navy as to whether or not their swim suit was patentable. Although questions remained, the navy found the use of neoprene a novel idea. They felt that while neoprene could afford protection to the swimmer from cold water and underwater blast, it could also increase the possibility of making the swimmer a better sonar target. The navy also felt that the use of materials like neoprene was not new in navy exposure swim suits as work was already being done by United States Marine Corps and Bureau of Supplies and Accounts (U.S. Navy). The navy conceded, however, that as a swim suit this might be a novel idea. They also conceded that the use of neoprene in a form-fitting exposure swim suit coupled with the use of zippers, at the very least, would ease the on and off of swim suits.

In a letter from Walter A. Hahn, Committee on Undersea Warfare, National Research Council, dated November 13, 1952, to Hugh Bradner, Hahn writes:

In San Diego, you asked me to explore Drea and Gerdes' feelings regarding the commercial exploitation of the wet suit plan. Both feel that it will be to the Navy's advantage to encourage small or even large production by commercial manufacturers. If nothing else this might provide the Navy with an opportunity of obtaining a useful item without paying all of the design costs. So go ahead in the suit business, just so long as the government gets their royalty free licenses with respect to patents.³

In a December 8, 1952, letter to Henry A. Gerdes, LCDR, U.S. Navy, Bradner writes:

I want to thank you for sending me the copy of your excellent letter

²Hugh Bradner Papers, 1938-1973, MC16, Box 1, "100. General Correspondence, Diving, 1946-1960, Galambos-Goff, 1956."

³Hugh Bradner Papers, 1938-1973, MC16, Box 1, "101. General Correspondence, Diving, 1946-1960, Hageman-Hahn., 1952."

of November 24, to F.B. Allen. It is completely accurate in every respect, except the date of the initial work on the foam suit. My first record of designs for this suit is in a letter to Larry Marshall, dated June 21, 1951. I do not care especially whether a patent on the suit is ever issued, since a refused application would presumably be just as effective in protecting the government from having to pay royalties. I plan to get someone started to making the foam suits commercially within the next month or two, if all goes well. I do not anticipate any particular difficulty, since I specifically wish to avoid any profit to myself. I don't want to compromise my position of unbiased consultation on swimmers' problems.⁴

Why didn't Bradner set out to make the wet suits for the general public? Bradner recalls that the morality of the time prohibited government employees from profiting financially from their own work. Walter A. Hahn writes to Bradner in December 17, 1952:

I am happy to hear that someone will start making your suits. I do not really understand your complete resistance to benefit financially from the production of these suits, particularly when it is obvious someone will. I personally know of no legal or moral obligation preventing you from making money on the sale of suits to anyone but the U.S. Government. Think it over. Maybe you can be a business man on the side. It seems to me you are certainly entitled to it, for though some of the ideas may not be new, it was you who actually made the suit and demonstrated the validity of this idea.⁵

The government did not prevent the manufacture of the wetsuit. After all, when Bradner's first wet suit model designs were completed the navy gave its approval to public sale and EDCO was formed. Still, the government delayed it, and many years passed without any word from the navy. Finally, on March 15, 1957, EDCO received a letter from M.J. Foran, assistant head, Civilian Damage Control:

The experimental swim suit you forwarded is being returned. Your interest in keeping the Bureau advised of your latest products is appreciated, however, it is not considered in the Navy's interest to test the suit at this time. The Bureau has been working with unicellular materials for some time. A

⁴Hugh Bradner Papers, 1938-1973, MC16, Box 1, "100. General Correspondence, Diving, 1946-1960, Galambos-Goff, 1956."

⁵Hugh Bradner Papers, 1938-1973, MC16, Box 1, "101. General Correspondence, Diving, 1946-1960, Hageman-Hahn, 1952."

unicellular type underwear for use in conjunction with our “standard” swimsuit has already been adopted and work on a wet type suit is underway. Your company will be invited to bid on this item when a satisfactory specification is developed.⁶

Bradner never patented his wet suit. Bradner recollects that he asked that the patent application be passed to the University of California attorneys. It was abandoned when he “foolishly” indicated that he saw no large commercial application. His reasoning was there were only a few hundred divers and surfers in the world at that time. He continued to be interested mainly in suits for frogmen, and eventually frogmen would buy commercial models from EDCO. Bradner, like all innovators, had other projects to pursue. He came to Scripps Institution of Oceanography in 1961, and is professor emeritus at the Institute of Geophysics and Planetary Physics.

The Hugh Bradner papers are at the Archives of the Scripps Institution of Oceanography, UCSD, which also holds the papers of diving officers Conrad Limbaugh and James R. Stewart. These and other collections in the archives document the early history of research diving and scuba. It is hoped that researchers will use these resources to study the introduction of scuba and the history of research diving.

⁶Hugh Bradner Papers, 1938-1973, MC16, Box 1, “100. General Correspondence, Diving, 1946-1960, Goff, 1957-Groves.”



Hugh Bradner and Charlie Townes, Ano Nuevo Island, 1953
[Bradner Photographs and Slides, 1962-1976, 87-11, SIO Archives, UCSD]



John S Foster modeling an early design of the Bradner wet suit, circa June 1953
[Bradner Papers, MC16, Box 2, SIO Archives, UCSD]



Bari Bradner, daughter of Hugh Bradner, 1953. She is wearing a custom neoprene wet suit designed by her father [Bradner Papers, MC16, Box 2, SIO Archives, UCSD]

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EDCO ad in Skin Diver magazine
[Skin Diver, January 1954, Vol. 3, No. 1, p. 21]