HISTORY OF DIVING: SELECTED EVENTS

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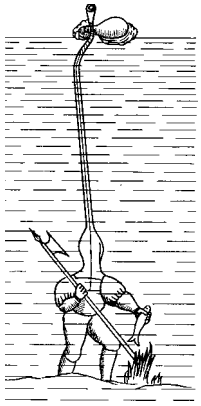
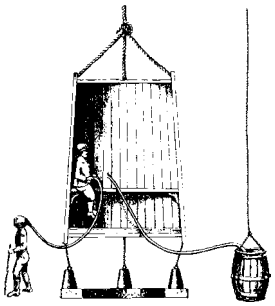
The accumulation of seashell artifacts at prehistoric living sites possibly indicates that food was taken from the sea by divers long before references in recorded history. The earliest records are of Cretan sponge divers (3000 BC) and diving for oyster pearls in China (2200 BC). Military divers were used during the Trojan War (ca. 1194 BC). Reference to military diving activities is made by Herodotus (5th century BC) and in Homer's Iliad (pre-700 BC). Alexander the Great deployed frogmen against the defenses of Tyre (333 BC) and was supposed to have descended in a diving bell himself. Records indicate paid salvors and diving regulatory laws in the 3rd century BC.



Aristotle (4th century BC) writes of the diving bell. Prior to this time all diving was probably done by breath-holding to depths not exceeding much over 100 ft. The diving bell was the dominant diving apparatus for the next 22 centuries, until about 1800. In the late l600s the bell was refined and in 1691 a sizable and sophisticated bell was patented by Edmund Halley. This bell was ventilated by lowering barrels of fresh air, and dives were made to 60 ft for 1.5 hr; divers made breath-holding excursions from the bell.



Halley's Diving Bell

Supplying Compressed Air

By 1770 the elementary hand-operated air compressor provided the next major advancement in diving. This enabled LeHavre (1774) to develop a moderately successful helmet-hose diving apparatus. Surface-supplied compressed air diving developed as the prevalent diving technique by 1800 and was to maintain a virtually unchallenged position until the mid-l950s. A boosting factor to diving in the l800s was the salvage of H.M.S. Royal George. For this operation Augustus Siebe developed and perfected the diving helmet and closed dress in 1837. The Siebe helmet and closed dress were the primary diving apparatus for the working diver from 1837 to the l960s. The present U.S. Navy Mark V Deep-Sea Diving Outfit is only a modification of the 1837 Siebe outfit.

Progress in diving, from 1837 to present, was dependent on two factors: improvement of the air compressor and the study of hyperbaric physiology. The compressor improved rapidly during and following the industrial revolution; however, the study of diving physiology was slow to progress. Paul Bert, in 1978, started to untangle the complexities of nitrogen absorption and elimination, or the bends. The first recompression chamber for treatment of bends was installed to support the cassion workers during construction of the first Hudson River Tunnel in New York (1893). In 1907, based much on Paul Bert's work, John S. Haldane published the first decompression tables for divers.

Scuba

However, the development of scuba did not begin with Cousteau. In 1680, Borelli developed a scuba based on the theory that the diver's hot, exhaled breath could be rejuvenated by cooling and condensing. Needless to say, this unit was not successful; however, this represents a movement toward freeing the diver. Borelli also experimented with the fin and buoyancy-compensating devices. In 1835 Condert published the design of a free-flow scuba, which consisted of a helmet, flexible dress, and a compresses-air reservoir fitted around the diver's waist. This was to have significant influence on the design of future diving apparatus. Rouquayrol (1865) developed a demand regulator system. Although this unit was basically surface-supplied by a hose, it also had significant influence on the development of scuba.

Borelli's Scuba

Rouquayrol's Demand System

In 1878, Fleuss and Davis designed the closed-circuit oxygen scuba, which utilized a chemical carbon dioxide absorbent. This was the beginning of a long list of

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closed-circuit oxygen scuba with the eventual development of the semiclosed circuit mixed-gas scuba by Lambertsen. Yves le Prieur, in 1924, introduced a manual, valved, self-contained, compressed-air breathing apparatus. In 1942, Cousteau and Gagnan developed the demand-type scuba, which is the basic compressed-air scuba used throughout the world today.

Recreational Diving

Sport diving and spear fishing were being practiced in many European countries during the l920s and were introduced into the United States in the late l920s. On the West Coast spear fishermen and Los Angeles County lifeguards ventured into the depths of the Pacific with mask, fins, and spears and *no* thermal protection -- a hardy group to say the least. It wasn't until the early l950s, with the ready availability of compressed-air scuba, that the popularity of sport diving started to accelerate to its present status. In order to appreciate the evolution of undersea exploration and recreation in the United States, one must return to the early years of the late 1940s. Cousteau and Gagnan had developed the *aqualung* in 1943. However, first compressed air aqualung was brought to the United States by Commander Francis Douglas Fane of the U.S. Navy's famed World War II Underwater Demolition Teams in about 1947.

In 1949 a young marine biology graduate student at Scripps Institution of Oceanography, Conrad Limbaugh, acquired an aqualung from Commander Fane and the modern era of scientific and recreational scuba diving begin. A scientific diving program and training course was established at Scripps in 1950. I am told that Bev Morgan, Ramsy Parks, and Al Tillman were among the first to be trained as scuba divers in the new Scripps program. In 1951 these men lead the development of the Los Angeles County Underwater Program and American recreational scuba diving was born. Concurrently, a young man at Woods Hole Institution of Oceanography named David Owen with inspiration from Oceanographer Allyn Vine guided the development on the East Coast. In 1955, David published *A Manual for Free-Divers Using Compressed Air*, one of the nations first scuba diving manuals and considered to be a classic today.

The aqualungs were made available to the U.S. public for the first time by Rene Bussoz in his Westwood Village, California store, *Rene Sports.* In about 1950 (plus or minus a year or two) Cousteau was futility trying to get someone in the U.S. interested in handling his new Aqua Lung. Rene contacted him and Cousteau agreed to sell him 20 Aqua Lungs. Rene soon discovered that no one would fill the French cylinders because they were not ICC rated. Fortunately, they did get them filled on the sly at an unnamed university. In one year Rene had sold only 20 Aqua Lungs. When Cousteau inquired about a reorder Rene's associates apparently advised against it -- declaring: "The U.S. market is saturated."

Shortly thereafter the U.S. Navy begin buying Aqua Lungs and training Underwater Demolition Teams (UDT) in their use. Next, the motion picture "The Frogmen" starring Richard Widmark made the nation Aqua Lung conscious. Aqua Lung popularity and Navy orders soon lead to the formation of U.S. Divers Company (by Rene Bussoz).

During the 1950s a number of clubs, diving councils, and local organizations begin teaching scuba diving and even certifying instructors. The first nationally accredited scuba instructor certification course was conducted by the YMCA in 1959 and that National Association of Underwater Instructors (NAUI) held their first instructor training program in 1960. The Professional Association of Diving Instructors begin issuing instructor certifications in about 1968.

Factors contributing to the growth of sport diving included availability, improvement, and simplification of diving apparatus; an increased number of training programs; publication of the exploits of naval diving groups such as those of the Underwater Demolition Teams (UDT) and SEAL Teams; an increased layman's interest in ecology, oceanography, and related disciplines; and the general increase in need for leisure time and recreational activities.

Scientific Diving

He first recorded scientific dives were made by H. Milne-Edward (Sicily) in 1844. Over the years, many dives of a scientific nature have probably been made by breath-holding and with helmet or bell-type diving apparatus. Engineering survey dives were also made in the 1800s. Geologists, during the late l940s, used deep-sea and shallow water surface-supplied diving apparatus for limited underwater observations. However, as previously stated, it wasn't until l949 that modern scientific diving had its true beginning in the United States. Conrad Limbaugh introduced self-contained scientific diving at Scripps Institution of Oceanography and in 1950 established the first formal scientific diving program and training course. Since 1949, Scripps and the Navy Undersea Warfare Center (formally, U.S. Navy Electronic Laboratory) at LaJolla, California, have had the largest and most active groups of diving scientists in the world. Currently, nearly all research groups studying the freshwater and marine environment utilize divers to various degrees.

US Navy Diving

The beginning of the U.S. Navy diving program is not actually known; however, official records indicate that George Stillson began developing the Navy's program in about l9l2. The F-4 submarine disaster of 1915, which somewhat paralleled the more recent Thresher incident in terms of government and public reaction, apparently

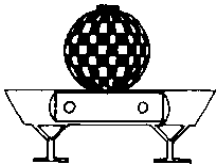
stimulated interest in diving. The first U.S. Navy diving school was opened in 1915, and the Navy's famous Experimental Diving Unit was originated in 1927. Navy helium-oxygen diving experiments began in the l930s and were used extensively in the salvage of the submarine Squalus (1939). During World War II, the great potential of military diving became evident.

The famous USN Underwater Demolition Team had its beginning in the summer of l943. Personnel for this first team came from Navy Construction Battalions, Navy/Marine Scout and Raider Volunteers, and the Office of Strategic Services (OSS). The World War II *Frogman* was primarily a surface swimming reconnaissance and demolition specialist. Diving apparatus was only used on a very limited basis during the war. The first open-circuit scuba was acquired by Commander Francis Douglas Fane in 1947. Navy UDT personnel saw extensive action in Korea and Vietnam.

U.S. Navy SEAL (Sea, Air, Land) Teams ONE and TWO were commissioned by John F. Kennedy on 1 January 1962. This special warfare group was organized and trained to conduct unconventional warfare, counter-guerrilla, and clandestine operations in maritime areas and riverine environments. Diving is only one of many special activities common to SEAL training. SEALs were involved in the Cuban Crisis in 1962 and the Dominican Republic in 1965. However, it wasn't until their Vietnam involvement that began in 1965-66 the SEALs would establish their position among the best of the world's elite forces.

Saturation Diving

Experimentation in living in a hyperbaric environment began in the early l930s. The concept of saturation diving and living in underwater habitats was introduced by G. Bond, a U.S. Navy submarine medical officer. In 1964, the first U.S. underwater living experiment, SEALAB I, was conducted off Bermuda at a depth of 192 ft. SEALAB II and other projects followed as a part of the continuous Man-in-the-Sea Program. Concurrently, Cousteau (of France) conducted the CONSHELF series of underwater living and work programs with a successful 28-day/330 FSW submergence. More recently, the TEKTITE, HYDROLAB, and AQUARIUS programs have provided an opportunity for scientists to utilize saturation diving techniques.



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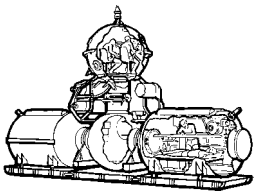
The first commercial saturation diving job was conducted during the summer of 1965 at Smith Mountain Dam in Virginia. These divers at depths of 200 feet for periods up to five days using the Westinghouse *Cachalot* system. The same system was used the following year for the first saturation dive conducted in the Gulf of Mexico at a depth of 240 feet. In 1967 the working depth was extended to 600 feet. Comex divers (France) extended saturation diving to 840 feet in 1970. In 1988 Comex extended hydrogen-helium-oxygen saturation diving to a storage depth of 1706 feet with excursions to 1742 feet. Although divers are technically and physiologically capable of working to these depths, some authorities suggest that the practical working limit for modern saturation diving is 750 feet.

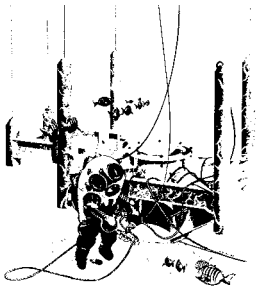
The diving industry was now pushing to greater depths and staying for longer duration. During the 1970s working dives were made to depths exceeding 1000 FSW and experimental chamber dives tested the diver's ability to function in excess of 2000 FSW. The bell/saturation system became the mainstay of the diving industry. New self-contained closed-circuit mixed-gas breathing apparatus was capable of sustaining a diver at depths beyond 1000 FSW for up to 6 hr. The increasing demand for the working diver in the oil industry and offshore construction has opened a new era of diving. During the that decade, the diving industry has made tremendous advancement via commercial, rather than military, influences.



Bell-Saturation System

One Atmosphere Diving Systems

The first Atmospheric Pressure Diving system designs appeared in about 1715. However, it wasn't until the 1920s that Joseph Peress started development of a fluid supported universal joint that would ultimately lead to the development of a successful armored diving suit in 1933. Although successfully used in the 1930s, this suit and concept world lay dormant until the 1960s. In 1968 a British firm recognized the potential significance of this diving system in the offshore petroleum industry and ersuaded Peress to assist in the development of a second suit. The suit/system was named JIM after the first diver to used the suit in the 1930s, Jim Jarret. Jarret used the suit at 150 meters in the salvage of the Lusitania. This concept, the One Atmosphere Diving System, played a



JIM

dominate role in offshore petroleum industry diving throughout the 1970s and 1980s. Dives to more than 1800 feet were now possible without the complex physiological and logistical problems associated with saturation and decompression. Ascent from a dive to 1000 feet now took only a matter of minutes compared to 8 days of decompression previously.

However, increased operational cost, risk factors, insurance, and technological advancement was soon to push saturation diving even a lower priority in operational diving options. The 1980s saw major development in underwater robotics. The Remotely Operated Vehicle (ROV) would challenge both the saturation diver and JIM. As we enter the 1990s, underwater robotics is emerging as the primary underwater work system. Will the diver be replace? Not completely! However, the role that the diver will play in underwater work will never be the same as it was in the 1960s and 1970s. The immediate future holds many advances in diving apparatus, techniques, and physiology that will influence the expansion of research, commercial, sport, and military diving activities.

The history of diving is far too complex and exciting to summarize in a few brief pages. Little known facts such as the 1 December 1937 helium-oxygen dive in Lake Michigan by Max Gene Nohl to a depth of 420 feet can be extracted from medical journals and notations in early textbooks. Nohl used special self-contained helmet-type diving apparatus developed by himself and John "Danger is My Business" Craig and tables perfected by an American diving physiology pioneer, Dr. Edgar End. Any student of diving will find the historical aspects exciting and informative. One must know how we arrived at our present level of knowledge and technology in order to build the future.

Acknowledgements

These accounts of events in diving history may or may not be completely accurate. They are based on information from numerous books and articles as well as verbal accounts by notable individuals from our great diving community.