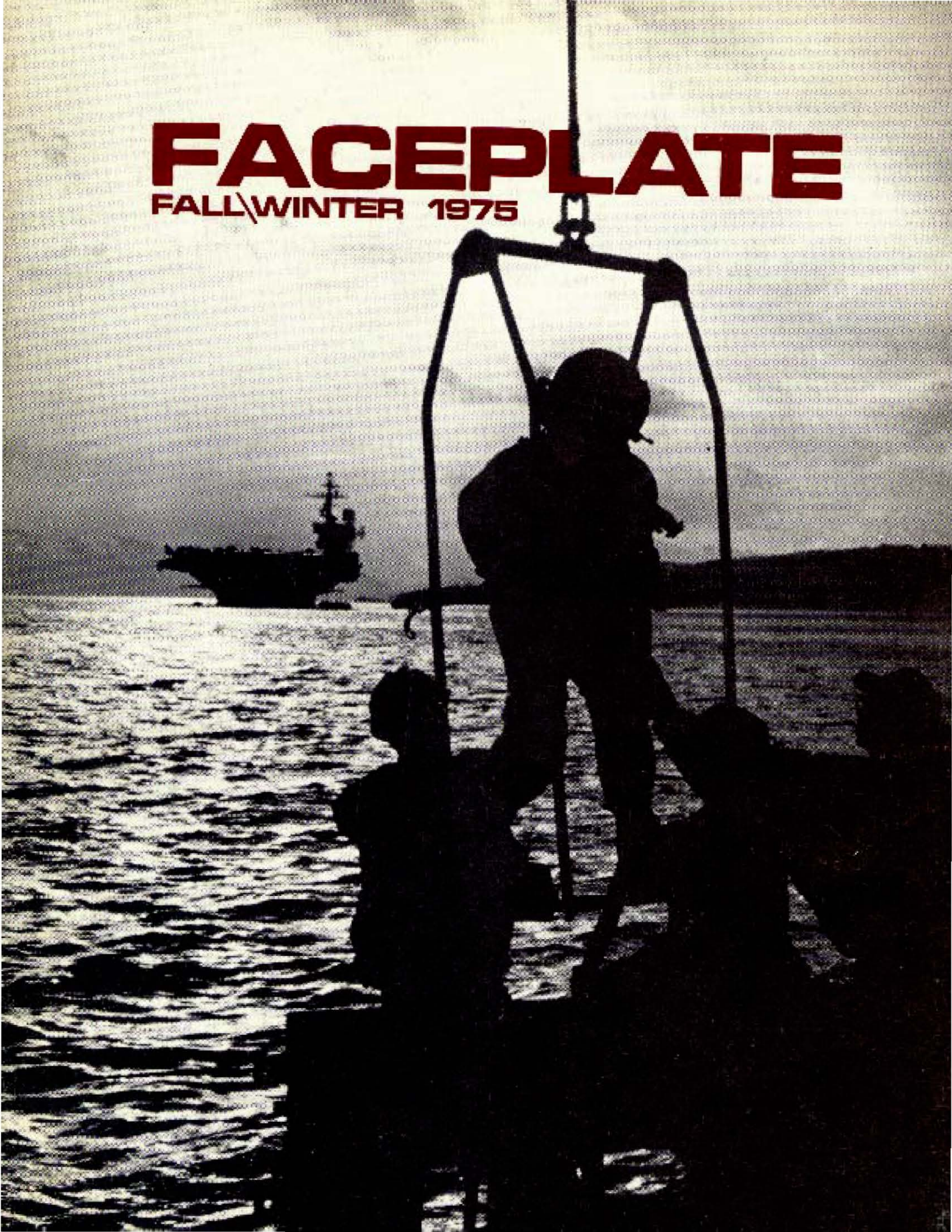
FACEPLATE

FALL\WINTER 1975



FACEPLATE

. . . the official magazine for the divers of the United States Navy.

VOLUME 6, NO. 3

FACEPLATE is published quarterly by the Supervisor of Diving to bring the latest and most informative news available to the Navy diving community. Articles are presented as information only, and should not be construed as regulations, orders, or directives. Discussions or illustrations of commercial products do not imply endorsement by the Supervisor of Diving or the U.S. Navy.

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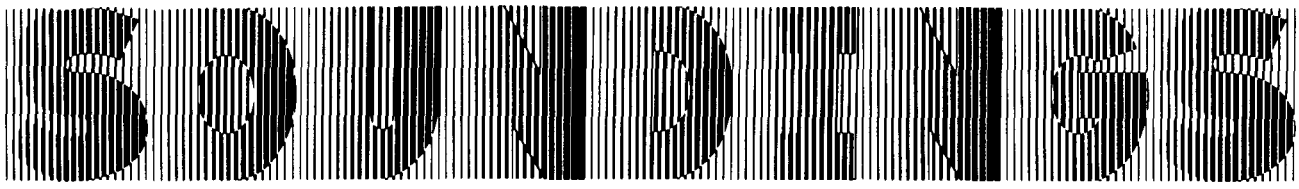
EDITOR-IN-CHIEF
CDR James J. Coleman

ASSISTANT EDITORS-IN-CHIEF
LCDR Martin A. Paul
LT William Hall

MANAGING EDITOR
Joanne L. Wills

ARTIST
Bill Seals

Front cover photo was taken by Mr. Joel Teague, of the SUPSALV Office, during salvops off Naples, Italy.
Inside front cover: Various scenes during SEALAB reunion/Bond retirement. From upper left, clockwise: Mr. J. McCarthy; Mr. W. Eaton (with key to SEALAB 1); CAPT Bond; and Mr. G. Bond, Jr. Center: CAPT Bond. See page 10.



WARNING: In studies being conducted for the Supervisor of Salvage by Battelle Memorial Institute, it has been shown that petroleum product vapors in tanks can be exploded by shooting studs, drilling, and/or by welding to the hull plates. Therefore, it is recommended that extreme caution be exercised when conducting such tasks. To ensure safety, the aforementioned operations should be performed on flooded tanks only. A complete discussion will appear in the future issue of *Faceplate*.

LT EDGAR IS NEW SALVAGE/MATERIAL OFFICER

LT J. Kenneth EDGAR, USN, has assumed the duties of Salvage/Material Officer for Commander Service Squadron EIGHT, Little Creek, Norfolk, Virginia.

LT EDGAR graduated from the U.S. Naval Academy in 1969 and later attended the Naval School, Diving and Salvage and Massachusetts Institute of Technology. Before reporting to his present duty station in July 1975, LT EDGAR was assigned to Norfolk Naval Shipyard, Portsmouth, Virginia, as the Diving and Salvage Officer.

LCDR ADAMS, MSC, USN, RETIRES FROM NSMRL, GROTON, CONN.

LCDR George M. Adams, MSC, USN, separated from the Navy on August 21, 1975. During his 9 years of active service, his duty stations included the Naval Medical Research Institute (NMRI), Bethesda, Maryland; North Texas State University, Denton, Texas; and the Naval Submarine Medical Research Laboratory (NSMRL), Groton, Connecticut. LCDR Adams graduated from the Medical Department Diving Officers course at the Navy School, Diving and Salvage in 1972.

While at NMRI, LCDR Adams became involved in diving during studies associated with decompression table evaluation procedures in preparation for SEALAB III. The fundamental causes of decompression sickness became his principal area of interest. He conceived the Shallow Habitat Air Diving (SHAD) program at NSMRL, during which four manned dives were completed (See *FP*, Summer 1974). The program has significantly expanded air diving limits and has provided additional evidence on the limits of oxygen toxicity in man. LCDR Adams also was associated with the Navy's aseptic bone necrosis survey in 1972.

FACEPLATE REGRETS TO NOTE: LT E.V. "Deacon" Downey died on December 30, 1975. As a USN Officer, his career included such duties as CO of an ATS, Diving Officer on several ASR's (including PETREL and FLORIKAN), and a tour at the Naval Station at Long Beach, California.

CWO2 ROAN RETIRES AT NAVAL SCHOOL, D & S

CWO2 Thomas M. Roan, USN, retired from the Navy on September 30, 1975, during a special ceremony at the Naval School, Diving and Salvage, Washington, D.C. LCDR (CDR Selectee) Anthony C. Esau, Commanding Officer of NSDS, presented CWO2 Roan with a Letter of Appreciation for his service as Air Division and Salvage Division Training Officer at NSDS, the position from which he retired.

During his tour of duty at NSDS, CWO2 Roan proved to be "one of the dynamic forces behind resolving many of the complex and perplexing training problems created by the rapid technological changes that have taken place in the diving Navy."

LCDR MALEC, RN, ARRIVES AT NEDU

LCDR Julian G. Malec, RN, has relieved CDR Bryan Barrett as Exchange Officer at the Navy Experimental Diving Unit, Panama City, Florida.

LCDR Malec joined the Royal Navy in 1959 as a Cadet at the Royal Naval College in Dartmouth. His tours have included serving as sub-lieutenant in HMS ARK ROYAL and as a lieutenant in the Royal Naval Engineering College. He became a specialist in Mine Warfare and Clearance Diving in 1969, and since that time has served as the Executive Officer in HMS IVESTON (a minehunter) and as the Navigating Officer in HMS EURYALUS. After 2 years of duty as a saturation diver and Watchkeeping Officer at the Deep Trials Unit, Alverstoke, LCDR Malec joined the Admiralty Underwater Weapons Establishment in Portland in 1973.

DEEP UNDERSEA PROJECT SUCCESSFUL AT U. OF PENN

The experimental phases of a joint Navy, university, and industry project have been completed successfully at the University of Pennsylvania in Philadelphia. The project, which included a 15-day and a 21-day dive sequence to 1,200 and 1,600 feet, comprised three areas of study: Decompression, physiological studies, and practical underwater work demonstrations. A full discussion of this project will appear in the next issue of *Faceplate*.

LCDR NUQUIST, FORMER XO OF NSDS, RETIRES

LCDR H.S. "Bud" Nuquist, USN, retired from the Navy on August 30, 1975. LCDR Anthony Esau, Commanding Officer of the Naval School, Diving and Salvage, presented a Letter of Commendation to LCDR Nuquist for his efforts as Executive Officer of NSDS from 1974–1975.

While serving in this position, LCDR Nuquist was the director of a 74-man staff and over 100 students. He was also responsible for the management of 10 curricula and the associated instructor guides, tests, and qualification standards dealing with all facets of diving and salvage. LCDR Nuquist's previous duty stations include Training Officer for the Explosive Ordnance Disposal/Diving School (1971–'73), Diving/EOD Exchange Officer with the Canadian Armed Forces (1968–'71), Test and Evaluation Officer at the Navy EOD Facility (1966–'68), and Ordnance and Diving Officer aboard USS HORNET and USS BENNINGTON (1963–'66).

WILBUR EATON RECEIVES 1ST KEN CONDA AWARD

The U.S. Navy Divers Association presented its newly established Ken Conda Award to Mr. Wilbur H. Eaton of the Naval Coastal Systems Laboratory, Panama City, Florida, during the association's sixth annual convention and symposium held recently in San Diego, California.

Established by the U.S. Navy Divers Association to recognize outstanding performance and achievement among divers, the award is a memorial to Mr. Ken Conda, who distinguished himself as a diver from the time he entered the Navy in 1954 until his death in a plane crash in 1974.

Mr. Eaton, a former U.S. Navy diver who has been a civilian employee at NCSL since 1971, has demonstrated continued excellence in diving throughout his military and civilian service career. As either an instructor or participator, he has been instrumental in the development of various types of breathing apparatus, the Mk 2 DDS, the Navy's three open sea SEALAB projects, explosive ordnance disposal, and underwater photography. A saturation diver since 1964, Mr. Faton was a team member with Ken Conda in SEALABs II and III. He is currently assigned as Diving Equipment Specialist in NCSL's Diving and Salvage Department.

VADM Doyle, LCDR and Mrs. LeMoyne.

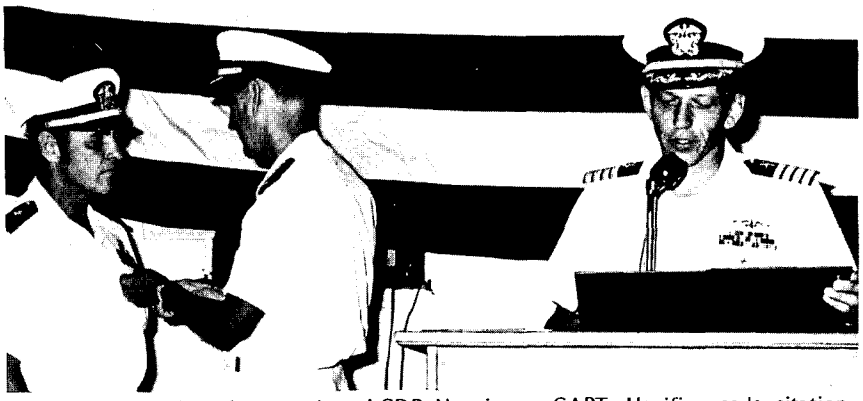
LCDR LEMOYNE RECEIVES MERITORIOUS SERVICE MEDAL

The Meritorious Service Medal was awarded to LCDR (CDR Selectee) Irve C. LeMoyne "for outstanding meritorious service from August 1972 to August 1975," while serving as the Special Warfare Officer on the staff of the Director of Ocean Engineering, Naval Sea Systems Command. VADM James H. Doyle, Jr., Deputy Chief of Naval Operations (Surface Warfare), awarded LCDR LeMoyne the Gold Star in lieu of the Second Award during a special ceremony at the pentagon on October 1, 1975.

During his tour at NAVSEA, LCDR LeMoyne's efforts contributed significantly to the increased material and operational readiness of USN special warfare forces. This included the accelerated service approval of a new family of swimmer delivery vehicles that will provide combat swimmers with a rapid and safe means of underwater transit to and from an objective area. In addition to increasing U.S. Navy participation in Information Exchange Programs with foreign navies, his technical expertise and operational capabilities in Special Warfare operations "led to the development of new tactics and enhanced the abilities of U.S. Naval Special Warfare Forces to carry out their missions safely and efficiently."

LCDR LeMoyne is currently serving as Special Warfare Action Officer for OPNAV at the Pentagon.

LCDR NAQUIN RETIRES



RADM Packer pins award on LCDR Naquin as CAPT Henifin reads citation.

In a special ceremony held on August 1, 1975, LCDR John C. Naquin retired from the U.S. Navy. In addition to a letter of retirement, LCDR Naquin was awarded a Navy Commendation Medal for his "meritorious service" as Head of the Diving, Salvage, and Submersible Systems Branch in the Office of the Chief of Naval Operations, the position from which he retired. Following the introductory remarks of LCDR (CDR Selectee) Anthony Esau, Commanding Officer of the Naval School, Diving and Salvage (where the ceremony took place), the award presentations were made by RADM S.H. Packer, on the Joint Chiefs of Staff, and CAPT E.E. Henifin, Program Director of the Deep Submergence Systems Division.

In his remarks, LCDR Naquin stated that the Navy is "on the threshold of the most exciting 20 years in diving." He emphasized new diving equipment as one element that will result in a more professional diver. He also pointed out the current review in progress on diver pay rates and the study under way to bring about more efficient diving personnel assignments as additional factors toward improving career conditions for the Navy diver.

LCDR Naquin has received numerous awards during his career, including the Legion of Merit in 1974, for his "exceptionally meritorious conduct in the performance of outstanding service" as the USN Diving Exchange Officer to the RN from 1970-1973.

LCDR Naquin's previous duties include Assistant Officer-in-Charge of the Navy Experimental Diving Unit, Officer-in-Charge of Harbor Clearance Unit One, and a tour at the Ship Repair Facility in Guam. He has also served aboard the ships USS LINDENWALD (LSD-6), USS TRINGA (ASR-16), USS WINDLASS (ARSD-4), USS BRIAREUS (AR-2), and USS MISSISSIPPI (EAG-128).

R.A. MURDOCH RETIRES from SUPSALV OFFICE

After a 35-year Federal career with the U.S. Navy, Mr. Richard A. Murdoch retired on June 30, 1975, from his position as Head Engineer in the Office of the Director of Ocean Engineering, Naval Sea Systems Command.

During his career, Mr. Murdoch received letters of appreciation and commendation in addition to the Navy Meritorious Civilian Service Award. He was also awarded the Navy Superior Civilian Service Award in recognition of his significant contributions to the development of improved damage control features on combatant ships, ship and personnel protection systems, and advances in the Navy's diving ability.

CAPT J.H. Boyd, left, congratulates Mr. Murdoch.

The presentation of the Superior Civilian Service Award was based on his role in numerous Navy programs and efforts. At the outbreak of World War II, he was assigned responsibility for accelerating the development of an improved oxygen breathing apparatus.

He was also responsible for developing shipboard washdown and personnel decontamination stations for protection against atomic, bacteriological, and chemical warfare attacks; and he personally participated in the evaluation of these systems on ships during the 1954 Eniwetok atomic tests. Other efforts of Mr. Murdoch's included fog foam systems for aircraft carriers and their later conversion to "dry type," simulated flight decks for training at Navy firefighting schools, the technical aspects of the Monsen lung, and the specifications and initial procurement of the "Steinke Hood" used for submarine escape. Further, Mr. Murdoch was technically responsible for the establishment and administration for the Chief of Naval Operations of a material certification program for life critical elements of all diving equipment.

DEIC: Everything You Always Wanted To Know About Diving Equipment

A small information center was established in February 1968, at Battelle's Columbus Laboratories, Columbus, Ohio, to provide Battelle staff members working on Navy-sponsored diving projects with needed information. Since that time, the operation has grown into the Diver Equipment Information Center (DEIC), sponsored by SUPDIVE with the objective of providing the diving community with rapid access to pertinent literature. The information center is of special interest to Navy diving activities, since it provides useful information on a broad spectrum of diving topics. The Center now has a data base of more than 14,000 documents, including journal articles, books, manuals, patents, conference papers, engineering drawings, specifications, standards, and brochures. The Center maintains a small library of pertinent reference books, subscribes to more than 50 journals, and also has access to the other components of the Battelle library system.

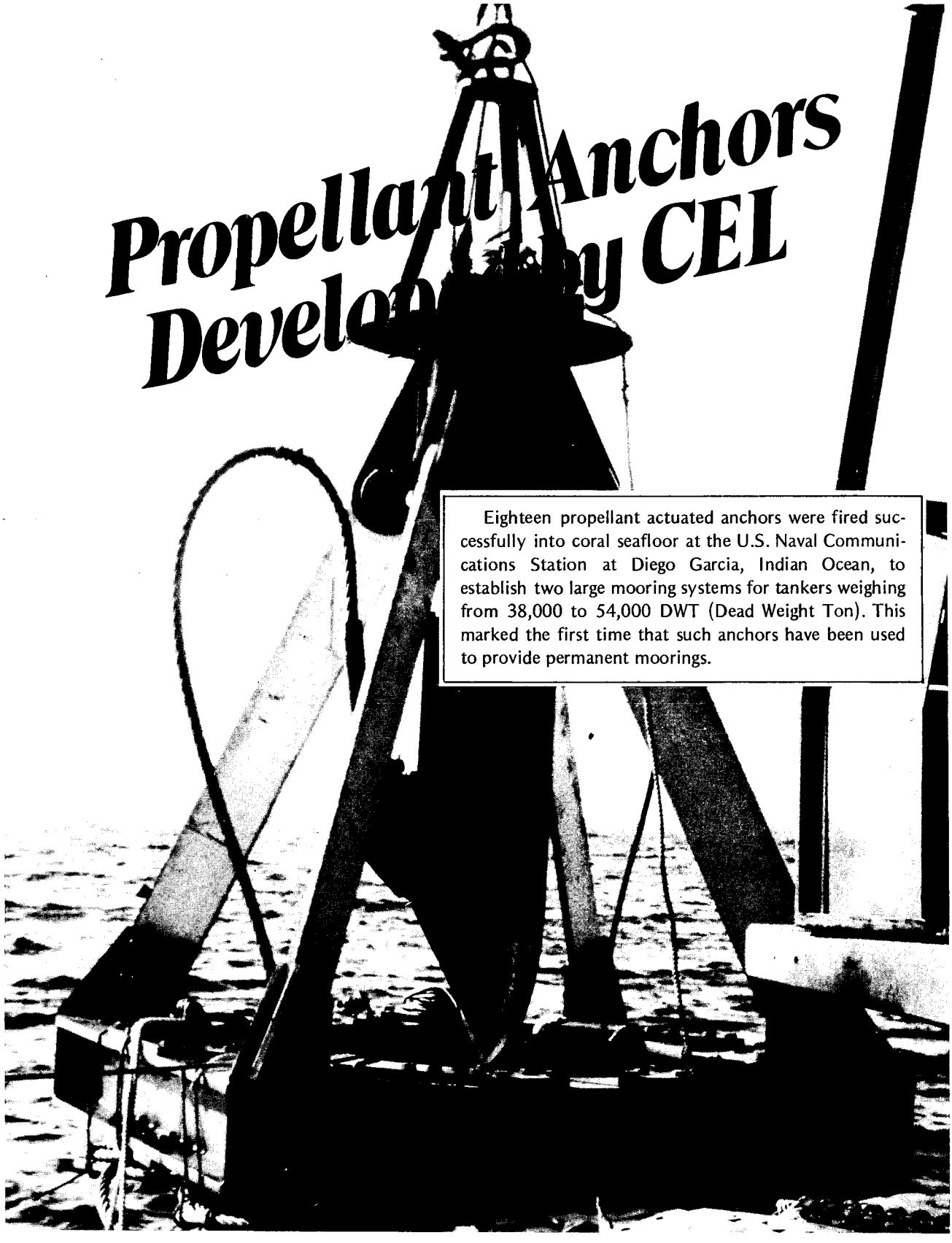
The original scope of DEIC was limited to information on diving equipment. The center includes information on SCUBA and hookah equipment, masks, suits, CO_2 scrubbers, regulators, tanks, breathing gases, power tools, instruments, diver performance, PTC's, chambers, habitats, submersibles, SDV's, and communication equipment. However, the scope is being broadened and refined continually to meet the growing needs of the diving community. Special attention is currently being given to diving equipment and techniques applicable to the offshore industry. In addition, the scope of the Center has been expanded to include salvage and ocean engineering, especially the application of divers and diving techniques to these areas.

The documents contained in DEIC have been abstracted; and the Center's files can be searched by clue word, author, or organization. Since its origin, the Center's services have increased greatly. These services include retrospective searches, preparation of bibliographies, state-of-the-art studies, and location of specific documents. The Center also provides an inter-library loan service to Naval organizations. A monthly current awareness service is provided to Naval organizations upon request and to the general public on a subscription basis through the Undersea Medical Society.

The Center's services are available without charge to the Battelle staff, the Office of the Supervisor of Diving, and outside requestors with the approval of SUPDIVE. Extensive tasks involving the expenditure of considerable time and effort or tasks that require actual technical analysis can be arranged on a contract basis. The Center prepares a monthly accession list, and a thesaurus of terms included in the clue word files of DEIC is maintained and updated annually. A rapport is maintained with other sources of information in the diving field so requestors whose subject area is outside the scope of DEIC can be referred to the proper source of information for their particular need.

Requests for information from DEIC may be addressed to: Diver Equipment Information Center, Battelle Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201.

Propellant Anchors Developed by CEL



Eighteen propellant actuated anchors were fired successfully into coral seafloor at the U.S. Naval Communications Station at Diego Garcia, Indian Ocean, to establish two large mooring systems for tankers weighing from 38,000 to 54,000 DWT (Dead Weight Ton). This marked the first time that such anchors have been used to provide permanent moorings.

The Navy's Civil Engineering Laboratory (CEL), Port Hueneme, California, designed and developed the 100Kx100K anchor (nominal long-term holding capacity in kips, one kip equals 1,000 pounds). After emplacement, each anchor was proof tested to 100,000-120,000 pounds in direct uplift. A few select anchors also were proof tested in excess of 150,000 pounds.

The propellant anchor system was used after conventional anchors failed to provide adequate mooring for tankers. Conventional anchors could not embed properly and perform as designed in coral seafloor; they would frequently drag and had to be reset periodically.

CEL Project Engineers D.G. True and R.J. Taylor served as technical representatives during the Diego Garcia operation, in which 18 anchors were installed in 8 days. Each anchor, a plate-like projectile, weighed up to 1,700 pounds; and each was fired into the coral seafloor to depths varying from 26 to 35 feet. Anchor sizes varied from 2 1/2 feet by 5 feet long to 3 1/2 feet by 7 feet long. The operation also involved the construction of two four-point spread moorings; two anchors were emplaced at each mooring point with the load equalized between each anchor to provide redundancy. Underwater Construction Team One provided the man-power for installing the anchors and building the moorings.

An unusual method of anchor emplacement was successfully used with no major problems during the operation. Crews worked off two YC barges; one was used to fire the anchors, and the other one recovered the piston and test-pulled the anchor. An LCM-8 boat guided the barge carrying the anchor, which was assembled and hanging by crane off the bow. When over an anchor point marked by a surface buoy, the crane rapidly lowered the anchor to the seafloor (within 5 seconds). The projectile was immediately fired into the coral seafloor on command from the control barge. Once the first anchor point was established, the barge was moored; thus, the second anchor could be installed easily. The equalizer, short length of chain, and the mooring buoy were then attached. This operation, which took place in water depths ranging from 50 to 80 feet, was accomplished four times for each mooring site. Of particular significance is that one four-point spread mooring, using the propellant anchor, required less chain and fittings than needed for one conventional anchor mooring leg.

The Ocean Engineering Office of the Chesapeake Division of the Naval Facilities Engineering Command (NAVFAC) made the arrangements for using the propellant actuated anchor in these moorings.

The system consists of a large bottom-sitting launch vehicle, an anchor projectile and associated load line, connectors, and firing control devices.

The total system weighs approximately 15,000 pounds in air. This includes the weight of the launch vehicle, which weighs 12,000 pounds itself. The anchor projectile, firing piston, lines, and miscellaneous small items comprise the remaining 3,000 pounds. The system is designed to operate in 20 to 500 feet of water, although the range could be extended considerably with minimal modification. In addition, the launch vehicle could be reconfigured along the lines of the CEL 20K propellant anchor to provide deep water touchdown firing capability.

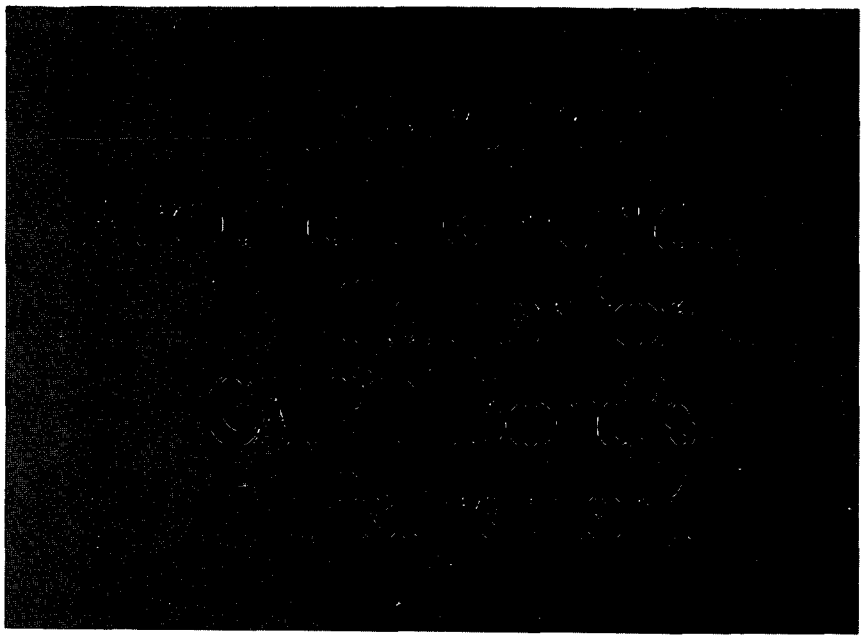
In standard operations, 12 to 16 pounds of smokeless propellant are used, producing a peak gun barrel pressure of up to 35,000 psi and a peak launching force of up to 2.8 million pounds. This causes the projectile and piston (weighing 1,500 to 2,000 pounds) to be accelerated downward, sustaining a peak acceleration of 1,800 G's and achieving a maximum velocity of 350-450 feet per second.

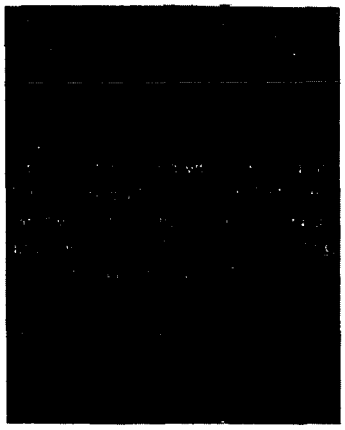
Before an anchor implantment, the system is prepared by muzzle-loading and securing the firing piston and anchor projectile, flaking the anchor load line and piston retrieval lines on the base of the launch vehicle for rapid payout, breech-loading the propellant, and securing the safe-and-arm device in the breech.

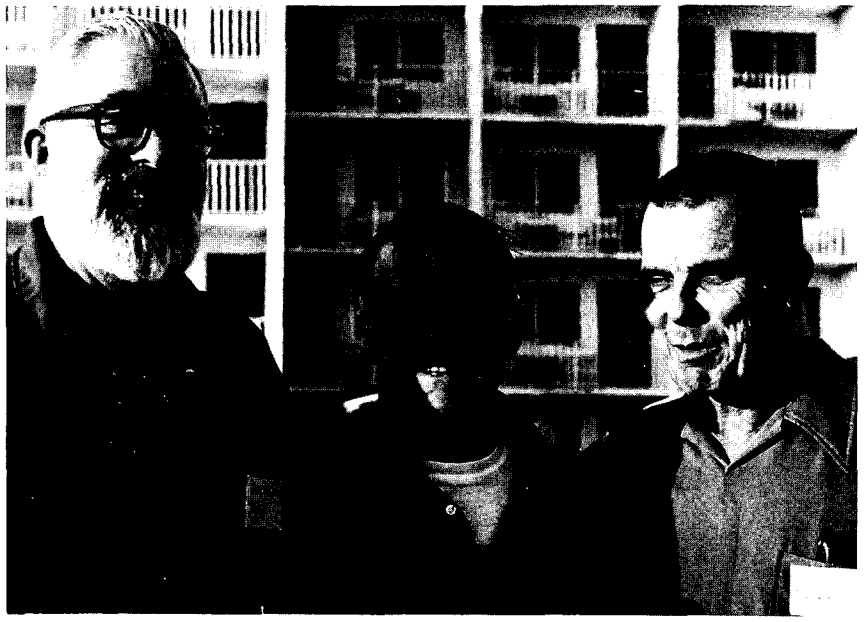
The system is then raised off the workboat deck by crane and lowered to the seafloor, either by crane or by a separate lowering line if desired in deep water. When proper positioning on the seafloor is verified, the system is fired and the projectile is driven into the seafloor. The launch vehicle, piston, and safe-and-arm device are retrieved for reuse.

This anchor is the current version of a large propellant anchor developed by CEL under contract for the Naval Sea Systems Command (NAVSEA). Early development yielded an anchor capable of holding up to 150,000 pounds in coral, but only 50,000 pounds in unconsolidated sediments. Additional work at CEL led to the development of a less costly launch vehicle that was easier to transport and deploy than the early version. Also during that time, a larger version of the successful CEL 20K sediment projectile had been adapted to the 100K anchor. With this type of projectile, the anchor was tested last year in a silt seafloor to more than 230,000 pounds when the main load line failed without dislodging the anchor fluke.

The entire anchor system installed in the lagoon at Diego Garcia is cathodically protected. Abrasion is not deemed a problem since coral is considered softer than the steel and wire rope attached to the anchor. The system should exceed its expected life of 5 years.







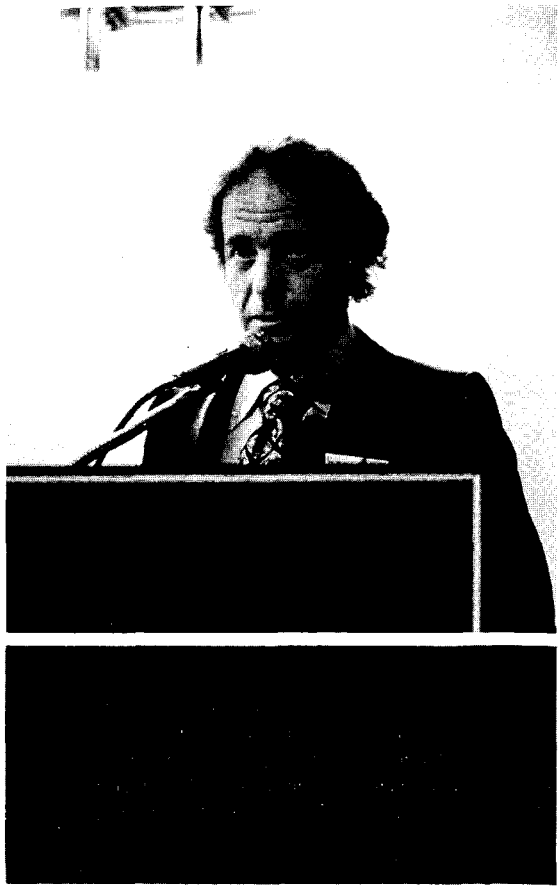
One doesn't acquire the nicknames "Papa Topside" and "Father of Saturation Diving" easily. CAPT George F. Bond, MC, USN, earned them for his outstanding contributions in developing, testing, and proving the concept of saturation diving. During his 21-year Naval career, Dr. Bond became an internationally known authority on the medical/physical aspects of deep ocean diving and prolonged exposure to pressure.

When Dr. Bond retired from military service on December 1, 1975, many of his friends and former colleagues came from cities as far away as Singapore to pay him tribute. In addition to the customary official ceremony, which was conducted at the Naval Coastal Systems Laboratory in Panama City, Florida, a reunion was held for all participants of the SEALAB Program, in which Dr. Bond had served as Senior Medical Officer and Principal Investigator. The highpoint of the reunion activities was the testimonial dinner given in Dr. Bond's honor on November 30, during which several speakers highlighted his career up through SEALAB. Mr. Bob Barth was the master of ceremonies for the occasion; included in the line-up of speakers were CAPT Tex Brewer, Mr. Art Bachrach, Mr. Bob Sheats, Mr. Wilbur Eaton, CAPT Walt Mazzone, CAPT Marty Krepp, Mr. Bob Croft, and Mr. George Bond, Jr. Scott Carpenter, former NASA astronaut and member of the SEALAB diving team, also participated in the post-dinner festivities. He noted that the greatest group of unsung heroes was Navy divers and emphasized that the best part of his career was being a participant in this group. Presentations of various sorts abounded, including plaques from SUPSALV, NEDU, the SEALAB group, and NSMRL, and the key to the habitat of SEALAB 1. Friends from distant places who could not attend sent letters and telegrams, many of which were read during the ceremony.

The official NCSL retirement ceremony on December 1 concluded the 3-day gathering. As is customary, CAPT Bond first conducted a personnel inspection. CAPT R.T. Quinn, Commanding Officer of NCSL, began the proceedings and introduced Mr. Denzil Pauli of the Office of Naval Research, who presented a citation to Dr. Bond from ONR for his outstanding contributions in diving research. Mr. Art Bachrach, from the Naval Medical Research Institute, represented the Undersea Medical Society and announced that that organization's highest award had been awarded to Dr. Bond. CAPT Quinn then read various messages sent from several Naval offices, and presented Dr. Bond with a Certificate of Merit from the Surgeon General of the Navy, an NCSL plaque, and a Certificate of Retirement. In his brief closing remarks, Dr. Bond noted that throughout his 21-year career, he had been rewarded by having extremely good duty stations, emphasizing the point that the one primary element that makes a duty station "good" is the people (both military and civilian) with whom one works. After reading his retirement orders, Dr. Bond was "piped ashore," concluding the ceremony.

George Bond received his Bachelor of Arts and Master of Arts degrees from the University of Florida and his Degree in Medicine and Master of Surgery from the McGill University School of Medicine. After interning at the Charlotte, North Carolina, Memorial Hospital, he established a rural general practice in Bat Cave, North Carolina, where he was the only physician for 6,000 people in a 400-square-mile mountainous area. While there, he established and directed the Valley Clinic and Hospital, the first medical facility available to many of the local residents.

Dr. Bond entered the Navy in 1953. He soon qualified as a diving and submarine medical officer, and subsequently served as Squadron Medical Officer and as Officer-in-Charge of the Naval Medical Research Laboratory in New London, Connecticut. In 1957, he created the Genesis I project, which studied the effects of prolonged pressure on humans. The success of the efforts in this program, which brought Dr. Bond the recognition of the Secretary of the Navy, proved that man could be subjected to pressure in experimental gases over prolonged periods safely. It also resulted in the establishment of the Man-in-the-Sea Program in 1964 as part of the Deep Submergence Systems Project. During subsequent years, Dr. Bond served as the Administrator and Principal Investigator of the Man-in-the-Sea Program in addition to his SEALAB duties. During his duty with the Man-in-the-Sea Program, Dr. Bond provided the



guidance under which divers successfully reached a depth of 1,025 feet in a wet chamber, the first deeper than 1,000 feet.

In the field of submarine rescue, Dr. Bond and his team were the first to demonstrate the feasibility of escape by free ascent from a disabled submarine at depths greater than 300 feet. Dr. Bond has long been an expert diver, and tested many of his new theories himself. At a time when 130 feet was the deepest previous depth for a free ascent and was considered the maximum safe depth, Dr. Bond and Cyril Tuckfield completed a buoyant ascent (with no breathing apparatus) from a submarine downed in 322 feet of water. Dr. Bond is responsible for the early use and adoption of the continuous ascent decompression schedules and the use of no decompression excursion dives from ocean floor habitats.

Dr. Bond was also involved in the development of the University Systems Center in Panama City, of which one of the first courses offered was the "Scientist in the Sea" Program. He brought together the necessary talents and funds to establish this 10-week graduate oceanographic course, which is sponsored jointly by the University System of Florida, the National Oceanic and Atmospheric Administration (NOAA), and the Naval Coastal Systems Laboratory.

Dr. Bond has been honored by many organizations, both military and civilian. In addition to the Secretary of the Navy Commendation Medal with Pendant, Dr. Bond received a Legion of Merit (third highest peacetime award) for his efforts in Genesis I, and Gold Stars in lieu of second and third awards of the Legion of Merit for his work in the SEALAB Program. He was also honored in 1971 with the Undersea Medical Society's *Albert R. Behnke, Jr. Award,* which was established to recognize outstanding achievements in the science of manned undersea activities.

Dr. Bond served as NCSL's Special Assistant for Diving Medicine from August 1970 until his retirement. During this period, he was also the Medical Advisor for NEDU's Ocean Simulation Facility, which tests man and equipment to simulated ocean depths of 2,250 feet. His last assignment in uniform was as Senior Project Medical Advisor for a joint United States, German, and Polish undersea project called "Helgoland." Sponsored by NOAA, the experiment was a saturation diving fisheries study using a German underwater habitat (named Helgoland) that was moored at a 100-foot-depth on the bottom of the Gulf of Maine, 8½ miles off Rockport, Massachusetts.

Dr. Bond's most recent research has been in the field of mixed inert breathing gases that are designed to decrease decompression times for shallow water operations. Having demonstrated the feasibility of this project, he plans to continue to serve the Navy as a consultant in its development.

Photo left shows CAPT Bond receiving gift from CAPT Krepp at SEALAB dinner. CAPT Brewer is shown lower right. Photo below left shows CAPT Quinn congratulating CAPT Bond at ceremony. Photo below shows Mr. Barth (left) introducing Mr. Sheats at SEALAB dinner.

Will Go To 20,000-ft. Depths

Work System

Mr. Norman Estabrook, *Naval Undersea Center*
Mr. Howard E. Wheeler, *Naval Undersea Center*
Mr. Dale Uhler, *Office of the Supervisor of Salvage*
Mr. Donald Hackman, *Battelle Memorial Institute*

The U.S. Navy is developing a deep-ocean work system composed of manipulators and a variety of hydraulic tools integrated to accomplish work tasks to ocean depths of 20,000 feet. The system can be adapted readily to the manned submersibles ALVIN, SEACLIFF, and TURTLE, and to the robot vehicles CURV III and RUWS to extend their work capability. In addition, it can be positioned and controlled by divers or operated by itself from a surface support ship. The system was designed to perform a complete operation on the sea floor without the necessity of resurfacing for tool interchange. Potential tasks include recovery, construction, installation, and repair operations. Low-light level TV cameras with quartz-iodide flood lights augment the vehicle operator's vision for tool exchange and work operations.

Historically, deep underwater work has been performed using submersibles that were not designed for that purpose. This has required extensive modifications to the vehicles and has severely limited the allowable complexity, duration, and overall success of tasks performed. Consequently, the Naval Sea Systems Command, Code 0353, initiated an effort in 1971 under its Deep Ocean Technology Program. The purpose was to develop a modular system of tools and manipulative devices that could be adapted readily to several existing submersibles to extend their working capability and that could also serve as a means of acquiring knowledge of components and techniques for working in the deep-ocean environment. Representatives from the offices of the Chief of Naval Operations, Supervisor of Salvage, major Navy labs, and Battelle Memorial Institute convened to establish performance guidelines for this system. Of particular interest were the characteristics of the tools needed for underwater tasks that are commonly encountered. The guidelines included operational depths to 20,000 feet and utilization for recovery, implantment, salvage, repair, and other operations. Another feature was to achieve adaptability to the aforementioned manned submersibles and robot vehicles with a minimum of vehicle modifications. Two additional guidelines established were remote operation from the surface or operation by divers, and integration of assorted tools, manipulators, and ancillary equipment necessary for the operator to complete a sequential task (e.g., drill, tap, bolt, attach) in a single dive without the need to surface for reoutfitting.

A more refined and comprehensive list of specifications were later formulated to address particular work functions and tool capabilities. In

addition, it was necessary to include provisions for adequate viewing and manipulator access to a frontal work area for each of the support submersibles, good visibility of the tool exchange process, and jettison of the entire package at a single point. A net underwater weight and stability that would be compatible with the parent vehicles was also considered critical. With these requirements in mind, a design was developed for the Work Systems Package (WSP), shown right.

The skeletal structure of the WSP is a simple tubular network fabricated from 5086 alloy aluminum. Its configuration is the result of spatially arranging all major system components to meet the aforementioned requirements and then connecting them with a single strongback. Basically, the problem of adapting to various submersibles with different characteristics was solved by providing an interface plate between the vehicle and the WSP. All components forward of the interface plate remain essentially constant, while mechanical and electrical adaptation to each parent submersible is provided aft of the interface. This substantially reduces the number of modifications that must be made when shifting from one vehicle to another. Also, the interface plate is mounted to the parent vehicle by a single 1-inch-diameter bolt that can be severed by either of two explosively actuated bolt cutters, thereby satisfying the requirement for a single-point jettison capability with redundancy.

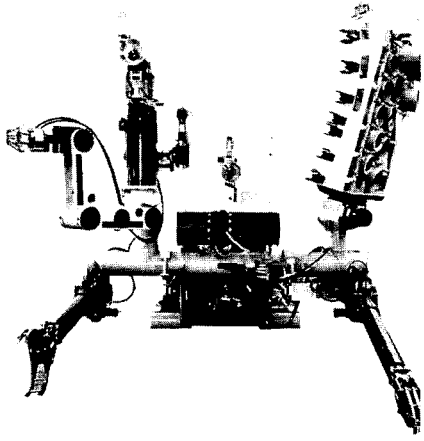
For operations with the submersibles ALVIN, CURV III, and RUWS, a skid mount was devised to avoid stress concentrations on their relatively fragile structures. In cases where it is not desirable to power the system from the parent vehicle, a set of battery packs can be affixed to the skid mount.

It was necessary to reduce the underwater weight of the WSP to make it compatible with the trim capacities of each parent submersible. To accomplish this, blocks of syntactic foam with a 35-pound-per-cubic-foot-density were shaped and mounted on the package and skid structure. The current foam pack is depth-rated to 12,000 feet, but can be replaced with a stronger material when deeper operation is required.

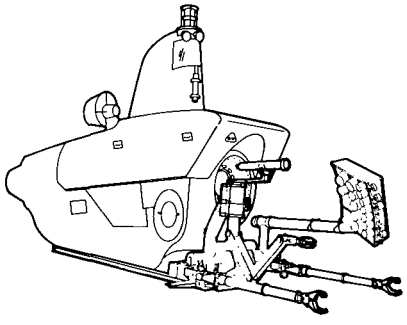
Mounted on each end of the main cross-tube are two simple manipulator or "grabber" arms that can secure and hold on to a work piece for stability or assist the dexterous manipulator work arm. They are hydraulically actuated and can perform six rate-controlled functions, including a 24-inch linear extension. Lift capacity is 250 pounds at 9 feet extension, and grip force is 500 pounds.

The dexterous work manipulator is a seven-function, hydraulically actuated, rate-controlled arm mounted above and to starboard of center. This position, in relation to the normal operator viewing location above center and behind the package, is analogous to the relative positions of right arm and right eye of a human, thus providing some anthropomorphic familiarity to the operator. Lift capacity of the manipulator is 100 pounds with the arm fully extended to 6 feet. Lines from the main hydraulic power unit run to the jaw. The jaw is equipped with quick disconnects that mate with similar connections on the hydraulic tools. This permits hydraulic power to be coupled underwater and transmitted to the tool when it is grasped, without the need for hoses on each tool.

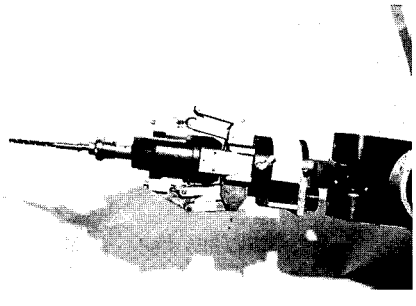
The tools are held by compliant brushes in a tubular aluminum holder, which is positioned opposite the primary manipulator and normally out of the frontal viewing area. The holder can be extended so the tools are extracted or replaced along a radial line corresponding to the manipulator's linear extension capability, thus shortening the time required to perform a tool exchange.



Dexterous manipulator in upper left extracts tools from holder in upper right. Center television camera is used in remote operations. Winch with fairlead snout is adjacent to manipulator shoulder.



WSP as it would appear mounted to manned submersible ALVIN. In an emergency, the entire package can be jettisoned from a single point immediately behind the horizontal cross-pipe.



Low-speed rotary tool held by manipulator jaws. Hoses feed female quick disconnects in jaw that mate with male fittings in back of tool when tool is grasped. Drill bit is held in quick-release chuck.

It was envisioned that the WSP would do the work of divers operating at great depths; therefore, large tools are not included. The tool suit was selected on the basis of work functions required to perform typical underwater tasks such as those encountered in salvage operations. These include debris clearance, hull penetration, lift device attachment, and salvage valve coupling attachment. The tools are divided into three categories: Rotary, linear, and power-velocity (explosively actuated). Hydraulic operation was selected for most of the tools as well as the manipulators and other actuators because of its inherent advantages of precise control, high power density, and insensitivity to depth pressure. The rotary tools, such as the chipping hammer, are powered by small, fixed-displacement piston motors. The linear tools are operated by linear actuators. Both represent a pioneering effort toward a comprehensive underwater tool suit. The power-velocity tools (cable cutter and stud driver) are used in applications where high energy output for short duration is desired. They are simple and easy to operate, but can be used only once during an operation. Consequently, several spaces in the tool holder are reserved for these tools.

Only TV and jettison functions are operated by direct hardwire. The multiplex approach was taken when it was determined that the 110 WSP functions were too numerous to be handled by hardwire through available hull penetrations or umbilical cable conductors on the candidate support submersibles.

Three modes of operator-control over manipulators and tools are possible. The first mode is a waterproof control box for diver operation. The second is a hand-held switchbox for control from a manned submersible. The third is a switch panel mounted in the control console for remote operations.

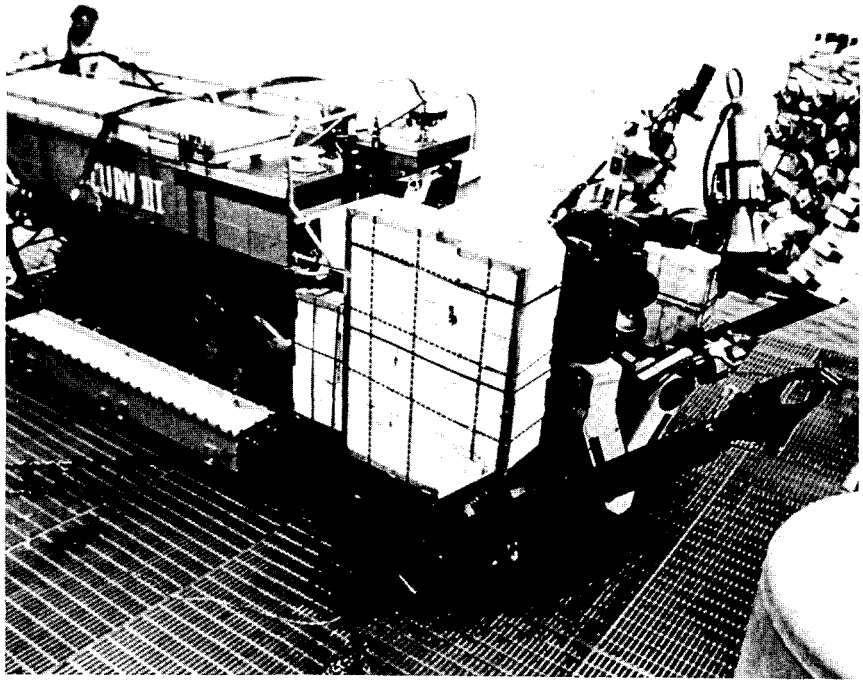
The TV cameras, mounted on hydraulic pan and tilts, are low-light level Silicon Intensified Target (SIT) types, selected to work with the low-power lights to decrease backscatter susceptibility and increase far-field vision.

In-air checkout of the total system, along with pierside tests with diver and remote operation, has been successfully completed. Functional tests have been run using a series of test plates and cables to check the effectiveness of the tools and the tool exchange process. Early results have indicated several areas of potential improvement, particularly in tool exchange.

The individual components of the WSP were selected and arranged to form a versatile, integrated system. The integration of tools and working arms should permit the operator to approach a job with a minimum of foreknowledge. He will be able to work at a specific site for extended periods, exploring various ways of accomplishing the task at hand without bringing the vehicle to the surface for refitting.

The WSP is the first multifunction tool suit and modular work system ever developed for use on a range of manned and unmanned submersibles. It can also be operated by divers. It contains several new innovations in design, and should prove to be an invaluable source of design information and data for use by designers of similar systems in the future. The WSP uses the first tools specifically designed and developed for underwater operation instead of the modified surface tools used in the past.

After several years of experience with the WSP, a second-generation system will be built incorporating the knowledge gained from use of this initial system. In fact, a Navy development program for hand-held diver tools is under way using many of the features of the WSP tool designs. It is likely that through its use by Navy operational units and other specialized ocean engineering groups the WSP will contribute significantly to the effective exploitation of the ocean and its resources.



Above: WSP is shown mounted on CURV.

HCU-2 "Wheels and to Get the

LT G.D. Thomson, USN
Harbor Clearance Unit TWO

What's a SWAT Truck? ...ask HCU-2

In recent years Harbor Clearance Unit TWO, Little Creek, Virginia, has been involved in numerous salvage jobs requiring quick response. Each time, a truck had to be loaded out prior to departure and some item of equipment was always forgotten.

Now, thanks to the many long hours of work and supervision by PNC(DV) Michael B. Greenstreet, USN, HCU-2 has a 2½-ton van permanently rigged and ready to go on very short notice. The van travels with either a 1½-ton equipment trailer or a 22-foot outboard Mckee Craft in tow.

Chief Greenstreet started with a drab, empty 5-ton van that a local Seabee Unit did not use. The truck was outfitted with SCUBA bottle racks, a compressor, equipment lockers, clothes lockers, and three fold down bunks. A 10-hp outboard is also carried inside the truck. A Zeebird Rubber Boat (deflated), spare fuel, oil, fresh water, and outboard gas cans are carried on externally mounted racks. A heater and a hard top were installed, and the cab was insulated. The final touches were painting the van blue and adding an HCU-2 diving insignia to the back. The name "SWAT" truck, taken from the TV series of the same name, started as a joke; but the HCU-2 van, which was built through an HCU-2 self-help program, has already proven itself to be an extremely valuable asset. Now, *divers do it faster!*

Deals" Job Done

A-7D Recovered Off North Carolina Coast

Divers from Harbor Clearance Unit TWO and the Office of the Supervisor of Salvage were called upon last summer to recover the wreckage of an A-7D aircraft from Pamlico Sound, North Carolina. The aircraft crashed approximately 2 nautical miles northeast of Brant Island (an aircraft bombing target) while conducting a routine training mission on July 31, 1975.

The U.S. Coast Guard detachment at Hobucken, North Carolina, immediately launched a search effort and buoyed several pieces of wreckage that had been entangled in the pilot's parachute.

Because of the Air Force's extreme interest in retrieving certain items of the downed aircraft, the Supervisor of Salvage was contacted for assistance, and HCU-2 was tasked with the recovery. SUPSALV Representative Mr. Ron Green and the HCU-2 diving team traveled to Hobucken to plan a search and recovery program to retrieve those items required by the President of the Accident Investigation Board, COL Roger D. Ingvalson, USAF. Operating out of HCU-2's "SWAT" truck, the HCU-2 team consisted of CWO3 Leon E. Ryder, HTC A. Connor, EM1 R.N. Scribner, EM1 T.R. Harvey, EN1 L.O. Trevino, HM1 C.K. Blair, HT1 J.A. Neal, HM1 Wendeborn, and EM2 E.F. Rowland.

The Air Force and Navy teams embarked aboard the Army Corps of Engineers' YSD SNELL on August 4 for recovery operations, while a small boat, Kirby Morgan gear, and various additional equipment were being sent from HCU-2. Recovered wreckage was off-loaded at the Hobucken Coast Guard Station.

The diver search team performed extremely well, but was hampered by sharp debris edges, little or no visibility, and a black, sticky mud bottom. Consequently, the "jack stay" search technique was used from the 5th to the 7th, when sonar assistance was requested to help locate the engine and tail components. SUPSALV tasked its primary contractor, Alcoa Marine Corporation, to provide commercial search assets; and Mr. Bob Kutzleb of Seaward, Inc., and Mr. Harry Reuter, SUPSALVREP, were sent to direct the sonar search operations.

The side-scan sonar was invaluable with the restricted underwater visibility. The engine, portions of the cockpit, tail, and other aircraft debris were sonar-located, buoyed, and recovered in three days. With approximately 88 percent of the aircraft recovered, the search effort was terminated on August 11. In addition to Navy assets, the Air Force, Coast Guard, Army Corps of Engineers, and the Marine Corps Air Station at Cherry Point, North Carolina (which supplied additional Per Diem) contributed valuable support for the operation's success.

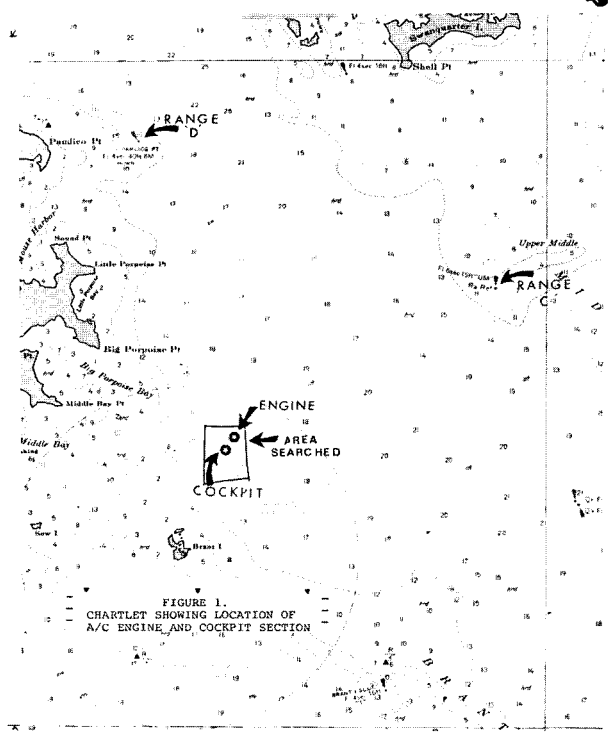


FIGURE 1.
CHARTLET SHOWING LOCATION OF A/C ENGINE AND COCKPIT SECTION

British Di
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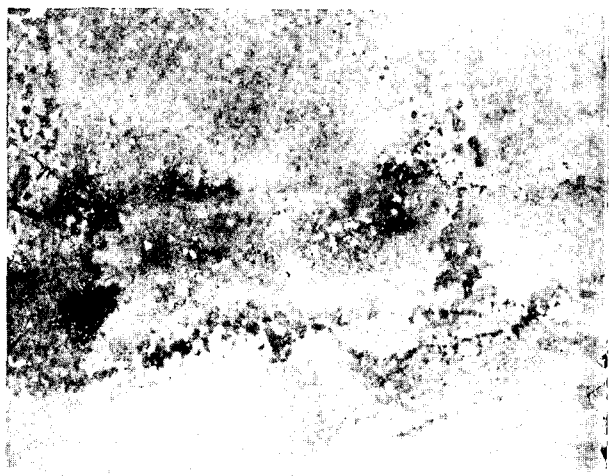

Using the U.S. Navy's Mk 1 Deep Dive System, a British saturation diving team successfully completed a dive to a depth of 990 feet (300 meters). This open sea dive, the deepest ever recorded by a British diving team, was concluded when the divers surfaced on September 16, 1975.

Operating as part of a four-man team with two USN divers, CPO (DV) Chris Ballinger, RN and Ldg (DV) Anthony Pritchard, RN swam out of the Mk 1 Personnel Transfer Capsule to reach the 300-meter depth. U.S. Navy divers MM1 (DV) Jim Leland and BMC (DV) Dan McNeil manned the PTC and decompression chamber, respectively, as their British teammates conducted their record-breaking dive.

The dive was made in the Gulf of Mexico, 75 miles south of Panama City, Florida, during trials by the British Navy of saturation diving tables. The tables had been perfected by United States and United Kingdom personnel at the Naval Physiological Laboratory in Portsmouth, England.

The U.K. and U.S. diving teams have been working together and conducting joint operations with the Mk 1 Deep Dive System in Panama City since June 1975. These last trials were a continuation of a series of saturation dives that included the world record dive of 1,148 feet set on June 18 by three U.S. divers and one British diver. (See *FP*, Summer 1975.)

The United Kingdom divers, under Officer-in-Charge LCDR William Norton, acquainted themselves with the system's equipment and procedures during a familiarization period before actually commencing the dive trials. Communication between the two teams was excellent according to LCDR Norton, who stressed that the key to the good relationship and communication between the two units was the excellent rapport among the divers themselves. Both LCDR Norton and LT Bob Lusty, RN, then Officer-in-Charge of the Mk 1 DDS, also emphasized the importance of the support from the Navy Experimental Diving Unit and the Naval Coastal Systems Laboratory in the success of the British project.

(continued on page 20)


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Set
DDS

Above: Members of the Royal Navy diving team in Panama City. At far left is LT S. Cwiklinski, USN, who relieved LT R. Wells, USN, as USN Exchange Officer with the RN diving team.

Under the command of LCDR Norton, the Royal Navy diving team includes LT R.R. Wells, U.S. Navy Exchange Officer; FCPO (DV) D.J. Clark; CPO (DV) C.J. Ballinger, PO (DV) R. Allen; Ldg (DV) A.R. Pritchard; Ldg (DV) T.N. O'Hanlon; Ldg (DV) C.M. Coldwell; Ldg (DV) P. Miller; Ldg (DV) A. Pauly; Ldg (DV) J.P. Cox; AB (DV) N.B. White; AB (DV) W.B. McGovern; and PO Medical Assistant C.L. Borg. The British team returned to England on September 18.

Above: LT R. Lusty, RN, (left), is relieved by LT R. Page, RN, as RN Exchange Officer with the Mk 1 DDS.
Below: Members of the Mk 1 DDS team.

Comprising the U.S. Navy Mk 1 Deep Dive System's diving team are EN1 (DV) Marion L. Alexander; EN2 (DV) Joseph L. Benoit; HTC (MDV) Richard O. Brady; HMCS (DV) Lowell E. Burwell; HT1 (DV) Bradoc A. Cole; EM1 (DV) Hubert L. English; MN1 (DV) John P. Fair; EN2 (DV) Bruce D. Harkins; MRC (DV) Charles A. Holton; EM2 (DV) John P. Johnston; MM1 (DV) James F. Leland; BMC (DV) Daniel B. McNeil; BM2 (DV) Terry L. Miles; QM2 (DV) Vernon S. Miller; EMC (DV) Jon B. Nelson; BMC (DV) Dee H. Nielsen; HTC (DV) Johnny D. Pitscheneder; ETC (DV) William R. Rhodes; HTC (DV) Robert G. Watkins; MMC (DV) Charles D. Wetzel; MM1 (DV) Jerry L. Winemiller; GMG1 (DV) Dan K. Vanderford; CWO2 Donald R. Roberts; and CPO Victor Humphrey, RN. LT Bob Lusty, RN, was relieved as Officer-in-Charge of the Mk 1 DDS at the conclusion of the dive trials by LT Bob Page, RN, who now takes on this position as the new Royal Navy Exchange Officer with the Mk 1 team. The Mk 1 DDS team also left Panama City on September 18, returning to their home base in Little Creek, Virginia.

USN/RN Meet to Exchange Data

The Information Exchange Program B-12, sponsored by the U.S. Navy Supervisor of Diving, convened for a 2-day conference recently at the Naval Coastal Systems Laboratory in Panama City, Florida. Hosted by NCSL on September 16 and 17, the conference dealt with the latest developments in diving technology, equipment, and systems of the participating nations. Though the IEP B-12 was established for and basically concerns the exchange of information between the United States and Royal Navies, this year's conference also included representatives from Australia and Canada.

In the Royal Navy remarks, CDR A. G. Worsley, RN Superintendent of Diving, and Mr. K. K. Haigh, Officer-in-Charge of the RN Admiralty Experimental Diving Unit, emphasized that their most important progress is in research and development. Haigh discussed the new diving ship the Royal Navy is planning to build, which will be either a newly built ship or a converted merchant ship. He also noted several new items of diving equipment the RN has procured, e.g., a shallow water air set selected from several off-the-shelf models used commercially, a new oxygen set for clandestine operations, and a new breathing rig for Mine Countermeasures divers.

LCDR Ian McConnochie, Royal Australian Navy MCD specialist presently serving as Exchange Officer in Charleston, South Carolina, next discussed general aspects of RAN diving. Though the RAN has no hard hat or HeO_2 diving capabilities, they are active with other underwater equipment. Several of the employed items mentioned included: (1) the semi-closed, mixed gas Draegar FTG; (2) a self-contained, compressed air breathing apparatus, which is used predominantly on ship repair and ordnance location operations (RAN divers are qualified to 60 feet on compressed air only); and (3) surface-supplied breathing apparatus (Hookah), which is used in operations down to 240 feet.

After a showing of the movie, "The Salvage of the SS SIDNEY SMITH," most of the participants attended the surfacing of the Mk 1 DDS, which brought to a close the entire RN/USN dive series, and which included the deepest open sea dives performed by both the United States and Royal Navies.

Other topics of discussion during the conference included OSF System description/characteristics, the Mk XIV Push-Pull Breathing System, Saturation Excursion Tables, the Mk XII Surface Supported Diving System, and a presentation about the Mk 1 DDS Panama City operations.

LT Bob Lusty, RN, former Officer-in-Charge of the Mk 1 DDS Team, discussed the USN's 1,148-foot dive and the Mk 1 operations in general, emphasizing in particular the 100 percent safety record achieved during the project and the leadership and cooperation displayed by all dive participants. LCDR William Norton, RN, described how the British became involved in the operation, stating that the primary goal of the RN/USN dives (for them) was the at least partial acceptance of Royal Navy saturation diving decompression schedules and deep dive equipment. In closing, LCDR Norton noted that the project was "a good example of what the IEP is all about."

The final wrap-up of the IEP B-12 focused on future goals and on where the diving Navy will be in 5 or 10 years and beyond. A closer liaison on future programs, especially in hardware development, was stressed in order to avoid duplication of efforts. This point was detailed further with the opinion that there should be a distinction between the research and the development phases, with separate and independent efforts deemed the most thorough method of research, and then combined efforts in the development phase. The exchange of diving training objectives and techniques between the Royal and United States Navies was also considered.

USN/USAF Complete

SALINAN, ESCAPE Divers Recover Vital F-4J Wreckage

The entire fleet of Navy F-4 Phantom jets was grounded temporarily this past summer for safety inspections following the wreckage investigation of an F-4J that crashed off Cape Hatteras, North Carolina, on April 9, 1975. Involved in the salvage of the downed aircraft was the Supervisor of Salvage, whose search and recovery expertise is often called upon in such operations.

The primary objective established was to retrieve the tail section of the Navy jet. The F-4 pilot (both crewmen had ejected safely) and a ferry boat pilot observed the crash and identified a similar suspect crash site area. However, initial search efforts, conducted by both the USS DIRECT (MSO-430) and divers from the USS SHAKORI (ATF-162), brought negative results.

SUPSALV then tasked Alcoa Marine Corporation and Seaward, Inc., with the side-scan sonar search of the area. During a 6-day search effort, which was hampered by 20- to 25-knot winds, 3- to 4-foot seas, and no bottom visibility, only one false contact was encountered. Harbor Clearance Unit TWO provided the diving team for this search, consisting of LT J.J. Schuler, HTC A. Connor, BM1 J.E. Seaquist, EM1 D.E. Gallagher, and HM2 R.R. Hill.

This first effort was terminated on April 28. However, in June 1975, because of simlar control failures experienced in other F-4 aircraft, the Naval Safety Center requested that a second search be undertaken.

Efforts began on June 9, again aided by SUPSALV's primary search and recovery contractor, Seaward, Inc., and by HCU-2 divers. The five-man team from HCU-2 for this operation consisted of CWO Bill Wilcox, HTC(DV) C.F. Dibbs, BMC(DV) R.D. Cedola, HM1(DV) C.K. Blair, and EM1(DV) R.N. Scribner.

A contact was encountered on June 9, and subsequent diver investigation confirmed that it was aircraft wreckage. Specific identification of the debris, however, was hampered for several days by 2- to 4-knot currents and no bottom visibility. In addition, 80 to 90 percent of the debris was buried in sand. USS SALINAN (ATF-161) was then called on to complete the recovery operation. SALINAN's Commanding Officer, LT R.J. Shade, was tasked as the on-scene commander for this job.

Before departing Mayport, Florida, for Cape Hatteras, SALINAN took aboard additional divers from USS ESCAPE (ARS-6). Upon their arrival at the scene, a survey was conducted of the area marked off by HCU-2 personnel, confirming the previous sea and wreckage condition reports.

Weather conditions improved greatly the next day, though, and, in addition, divers found that considerable portions of the aircraft had been uncovered overnight. Several sections were lifted before dark, but none that was crucial to the investigation. Though the weather and sea had calmed considerably compared to early in the operation, underwater visibility remained poor. This prevented selective recovery of vital sections of wreckage; instead, debris had to be lifted on board as encountered.

The third lift on June 15 brought up the sought-after tail section, which contained all major components necessary for the accident investigation. Because the tail section was recovered, and because sea conditions were once again deteriorating, the investigators terminated the salvage operation. This second search effort involved a total of 32 SCUBA dives by 12 divers. Diving personnel from SALINAN were LTjg S.O. Thorne III, EN2(DV) J.L. Cuchens, and HT3(DV) T.M. Springsteen. ESCAPE divers participating were ENS P.J. Stanton, ENC(MDV) J.W. Hayes, MM1(DV) S.L. Smith, MN3(DV) G.R. Zawacki, and HT3(DV) M.A. Arnett. Average operational depth was 40 feet, with a maximum 2-knot current and 0 to 1-foot visibility.

The investigation of the wreckage recovered during this operation prompted the precautionary measure of grounding all Navy F-4s. The jets have been returning to service as each is inspected and cleared of any control defects.

Aircraft Recoveries...

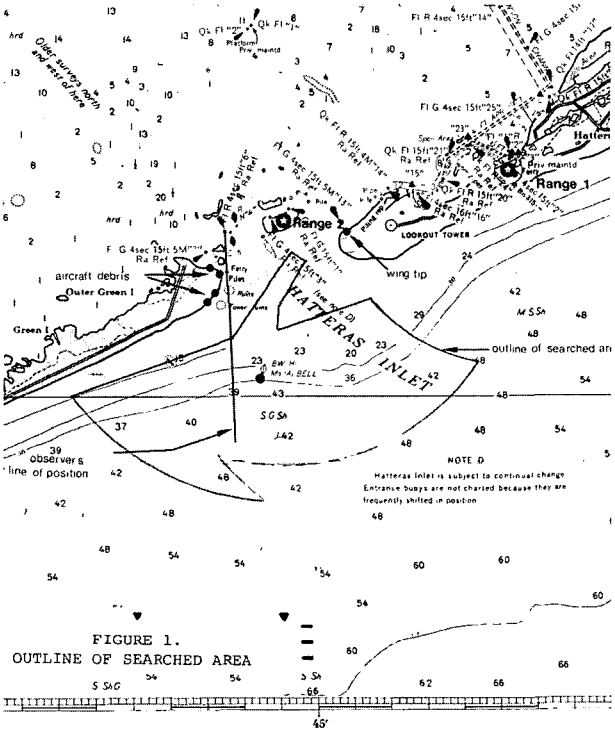


FIGURE 1.
OUTLINE OF SEARCHED AREA

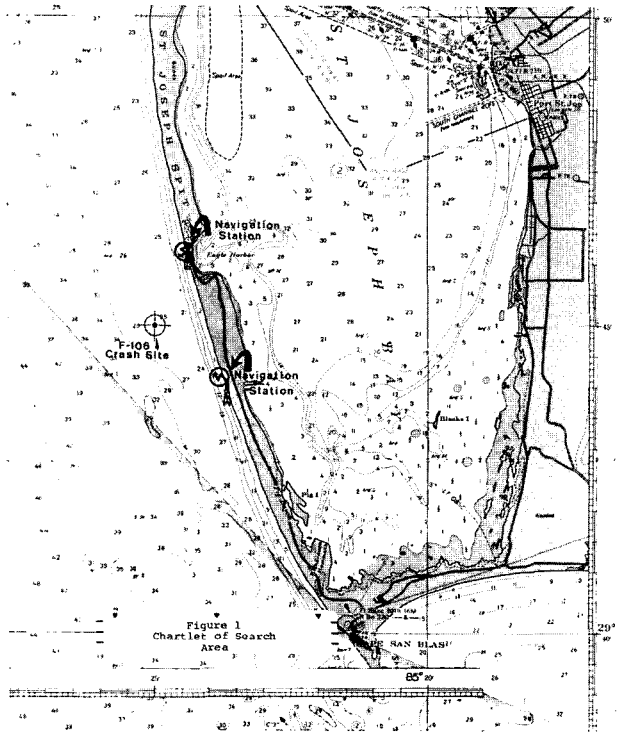


Figure 1
Chartlet of Search Area

F-106 Recovered Off Florida Coast

A U.S. Air Force F-106 aircraft crashed into the Gulf of Mexico on June 6, 1975, while on a scheduled training mission. The pilot, who had ejected safely, reported unexplained problems with engine and tailpipe overtemperatures that impeded safe engine operation.

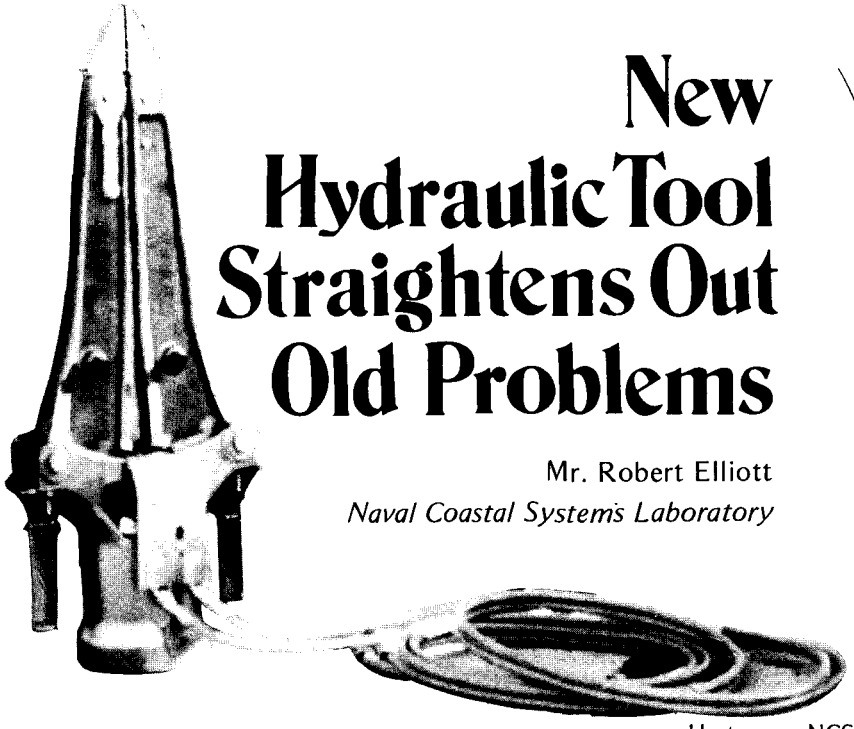
An Accident Investigation Board was established immediately, with COL Peter D. Williams, USAF, as Board President. Although local search efforts were initiated at once, they were unsuccessful in locating the wreckage. The AIB then requested assistance from the Office of the Supervisor of Salvage to locate the aircraft debris for cause investigation.

SUPSALV tasked its search and recovery contractor, Seaward, Inc., to conduct the salvage operation. Seaward representative Bob Kutzleb then joined SUPSALV representative Ron Green in Panama City, Florida, to review with COL Williams all background material and previous efforts concerning the F-106 crash.

The search task proved to be relatively straightforward because of its immediacy to the actual incident (3-4 days), its proximity to shore, an eyewitness observation, and the thorough groundwork done by COL Williams and the AIB.

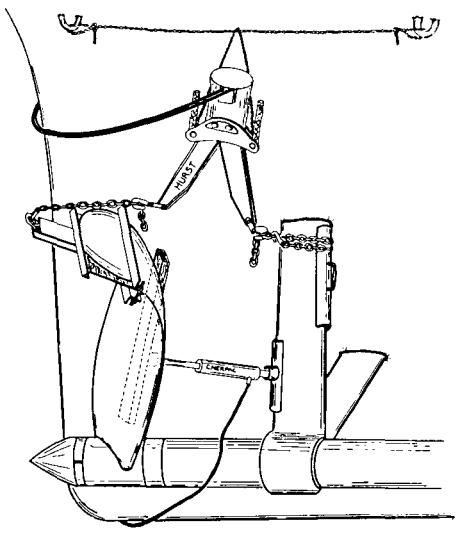
The actual location and recovery of the wreckage was accomplished in 1 day. Having already established shore-based navigational units on the St. Joseph Spit coastline, the search party initiated side-scan search efforts in the suspected crash area, which was approximately 5 miles southwest of Port St. Joe, Florida.

The wreckage was located by sonar after just several hours of search efforts from an 85-foot Air Force rescue boat. The location was then verified by both a helo overflight (requested from Tyndall Air Force Base for visual coverage) and Navy diver investigation. Upon the arrival of an Air Force YSD, a 10-ton self-propelled floating crane, divers commenced buoying wreckage for salvage lift. The engine and associated control equipment required by the AIB were recovered that afternoon without incident, concluding the search operation.



New Hydraulic Tool Straightens Out Old Problems

Mr. Robert Elliott
Naval Coastal Systems Laboratory



Drawing shows Hurst tool in position to straighten blade.

Recently, the Naval Coastal Systems Laboratory Diver Tool Group, sponsored primarily by the Supervisor of Diving, Naval Sea Systems Command, USN, had the opportunity to make an interesting field test with one of the new tools under evaluation. The situation presented itself when the visiting USS RECOVERY (ARS-43) inadvertently bent one blade on her starboard propeller. The blade was bent aft 65° at a point approximately 16 inches down from the tip of the blade. At this point the blade was 30 inches wide and had a maximum thickness of approximately 1-1/8 inches.

A quick underwater inspection by Diver Tool Group engineers indicated that the repair operation would afford an excellent test of the "Jaws of Life" (Hurst Rescue Tool), a new hydraulically-powered tool that can produce 5 tons of force in either direction through a 32-inch stroke. A group planning session generated a plan using the new Hurst Tool, which was then approved by the ship's Commanding Officer.

Basically, the plan called for supporting the blade just below the bend with a hydraulic ram and pulling the blade tip back over into line with the Hurst Tool. A propeller strut, protected with half sections of 3-inch pipe, was used to support the ram and provide the pulling point for the Hurst Tool.

A survey dive was conducted to obtain the measurements necessary to fabricate support hardware in the NCSL structure shop. When the hardware was ready, Diver Tool Group personnel Bob Elliott, John Mittleman, Marty Sheehan, and Wilbur Eaton prepared for the operation with the assistance of BMC(DV) Duke Hartman, NCSL Diving Locker, and HMC(DV) Bud Mills, "visiting fireman" from the Naval Medical Research Institute, Bethesda, Maryland. The straightening gear was placed quickly with no difficulty, but an initial pull indicated some minor adjustments were necessary.

Diving operations began again following another planning session. In 1 hour, the propeller blade was amazingly straight with no signs of cracking. Inspection of the results indicated that at the tip of the blade, the leading edge was quite close to its normal track and the trailing edge was about 2 inches out of track. If the ship had not been scheduled to depart at 4:00 that afternoon, finishing touches could have straightened the blade very close to its normal tracking position.

The ship sent a special "well done" message to the group the next day, stating that they were able to get 90 percent of their rated revolutions per minute out of the repaired screw, without vibration or abnormal cavitation.

The success of this repair task is another example of the usefulness of modern diver tools. The Hurst Tool used in this operation is an off-the-shelf rescue tool that is now being evaluated at NCSL for diver use. With a buoyancy system and a few other possible refinements, this interesting tool will become an even more valuable addition to the diver's bag of tricks.

For further information on this operation or tool, contact John Quirk, Bob Elliott, or John Mittleman at the Naval Coastal Systems Laboratory (Code 710.5), Panama City, Florida 32401, (904) 234-4388, Autovon 436-4388.

Working Diver · 1976

Approximately 600 undersea divers, scientists, and engineers from the United States and abroad are expected to attend the 2-day "Working Diver" Symposium, to be held March 2-3, 1976, at Battelle Memorial Institute, Columbus, Ohio. The symposium is being sponsored by the U.S. Navy's Supervisor of Diving and Office of Naval Research, the Salvage and Diving Committee of the Marine Technology Society (MTS), the Ocean Technology Division of the American Society of Mechanical Engineers (ASME), and Battelle-Columbus.

Specialists from Canada, England, France, Japan, and the United States will present approximately 20 papers discussing topics of current interest to working divers. Subjects include arctic diving expeditions, offshore oil-exploration diving, underwater construction and salvaging, and specialized equipment. A report on the fly-away diving system developed for the U.S. Navy by Battelle-Columbus (see *FP*, Summer 1974) will also be presented. The speakers represent the governments as well as diving equipment manufacturers, diving contractors, and research organizations of several countries.

Sir John Williams, world-renowned salvor, will be the keynote speaker at the symposium banquet. Sir John, who was born in England in 1896, has lived much of his life in Australia. He joined the Australian Navy prior to World War II and directed numerous salvage operations in the southwest Pacific. On behalf of the Salvage Association of Lloyds of London, he has dealt with ships in all areas of the Pacific and Indian Oceans. Since his retirement in 1971, Sir John has continued his involvement in salvage operations and other such enterprises; he is currently engaged in the removal of the QUEEN ELIZABETH from the Hong Kong, China, harbor. (See background at right.)

The symposium will begin with greetings from the U.S. Navy given by the Honorable H. Tyler Marcy, Assistant Secretary of the Navy (Research and Development). The Symposium Chairman is CAPT J. H. Boyd, Jr., USN, Director of Ocean Engineering, Naval Sea Systems Command. Members of the program committee are CDR J. J. Coleman, USN, Supervisor of Diving, NAVSEA; CAPT W. Searle, Jr., USN (Ret.), Chairman, Salvage and Diving Committee (MTS); Dr. Jack Maison, Manager of Structural Research and Ocean Engineering, Southwest Research Institute (ASME); Ms. Betty Alkire, Senior Administrative Assistant, Battelle-Columbus; and Mr. Jerry Henkener, Associate Manager, Equipment Development Section, Battelle-Columbus.

This 5th biennial Working Diver Symposium promises to be as interesting and relevant to all divers as the former symposiums, again providing a highly essential opportunity to exchange opinions and develop new insights into the problems facing today's working diver.

ABOUT THE KEYNOTE SPEAKER (with his excerpts in italic):

Sir John went to sea in 1910, spending the next 10 years primarily in square rigged ships. He rose to the position of Chief Mate of the four-masted barque JUTEOPOLIS and later the full rigged ship WRAY CASTLE, and eventually earned a square rigged Master's Certificate.

I have many American friends and have visited your country on a number of occasions. My first stay (here), however, was somewhat curious. I paid off a three-masted barque in New York. Wages 4 pounds a month and nothing left after a year's voyage, in part due to gambling at poker. Found myself hard-up and slept on the logs then stacked outside Battery Park railings. When near to starvation, signed on as an able seamen and cattleman on a horse ship.

Sir John's first experience of the salvage trade was as an able seaman on the full rigged ship TERPSICHORE, and the famous tugs of their day, STORM COCK and SARAH JOLIFFE.

During World War I, he served as Second Mate of the full-rigged ship ST MIRREN when it was sunk by German shellfire off the north coast of Ireland. He was later aboard the full-rigged ship NEOTSFIELD when it was sunk by shellfire, on the outskirts of the Bay of Biscay.

Seeing what was coming, joined the Australian Navy just before the second World War. No-one else being willing to try, was seconded by the Navy as a private contractor to the Bank of England for the purpose of recovering 8½ tons of gold sunk in the RMS NIAGARA in 438 feet of water, 20 miles off the New Zealand coast. Using an old hulk and gear we made ourselves, 96 percent of the gold was brought to the surface.

In 1941, he became the Executive Director of a salvage corps established by the Australian Government to operate on behalf of the Allied Nations in the southwest Pacific until the end of World War II. It is on record that the salvage corps recovered 600,000 tons of shipping.

As a contractor after the war, Sir John directed the clearance of the Hooghly (India) and Irrawaddy (Burma) Rivers for the governments of those areas in addition to various other salvage work there. During these efforts Sir John writes that he:

Carried Australian divers with me throughout, saving for an admirable American ex-Navy man called Joe Brogan, whom I have tried to get in touch with since but without success. Manned the salvage vessels with Telegu Indians, amongst the most accomplished seamen I have had to do with.

After returning to Australia, Sir John expanded the salvage business in which he was engaged and, on behalf of the Salvage Association of Lloyds and others, he dealt with ships all over the Pacific and Indian Oceans. Sir John then became an underwriting member of Lloyds of London. In 1956, at the request of the Australian Government, he accepted an appointment as the first Chairman of the Australian National Line, which was destined to become a considerable force in world shipping. He retired from the Chairmanship in 1971, after 15 years of service. Since that time, he has continued in salvage and is now involved in the removal of the QUEEN ELIZABETH in Hong Kong Harbor.

New Oil Pollution Abatement Equipment On The Way

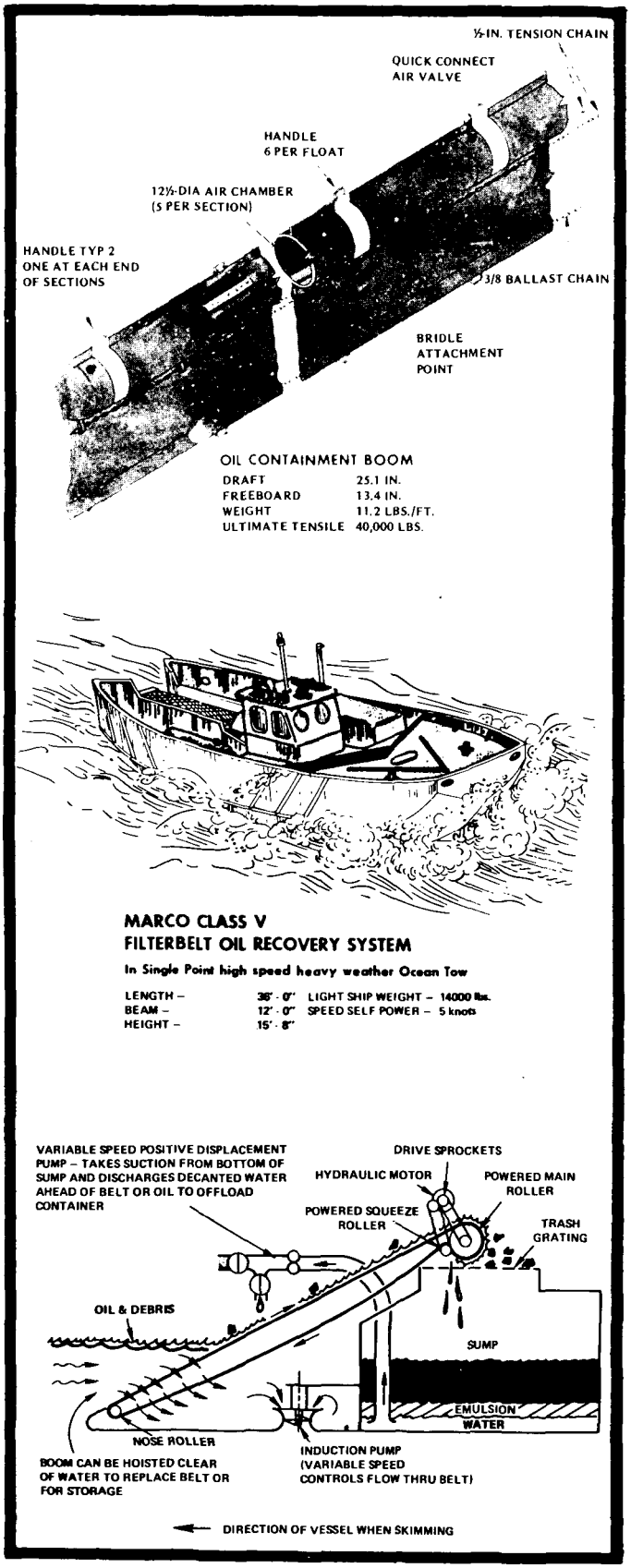
Mr. Joel Teague
Office of the Supervisor of Salvage

The Supervisor of Salvage, USN, is tasked with the assignment of providing technical expertise and equipment for combating major Navy open sea oil spills. In order to ensure a rapid response system on a worldwide basis, necessary equipment must be purchased and stored in strategic locations throughout the world. Oil skimmers, oil containment boom, and large ship fenders are presently being added to the Navy's oil pollution abatement inventory.

The best method to control oil spillage is rapid response and quick containment to prevent spreading. A pneumatic containment boom manufactured by Goodyear Tire and Rubber Company was selected by the Navy as acceptable in meeting this requirement. The oil boom, shown right, is available in 55-foot sections. These sections can be quickly inflated and connected in whatever lengths are necessary to surround and contain spillage from ships, tankers, barges, or any other vessel that may present a potential pollution hazard. The boom material is high strength nylon impregnated with special synthetic rubber that is resistant to weathering, gouging, seawater, petroleum, and abrasions. Dual chain tension members can share loads of up to 40,000 pounds that may be caused by current, waves, and wind without having the entire load apply to the boom material.

Once the oil spill has been contained, the job of removing the oil from the water surface still remains to be performed. The Marine Construction and Design Company (MARCO) has developed a 35-foot oil skimmer that will be used by the Navy in cleaning up open sea oil spills. The MARCO class V skimmer uses an absorbent material called a "Filterbelt," which allows the passage of water but retains oil. The pores in the "Filterbelt" are designed just large enough so that water droplets are not held in the belt by surface tension. Water drains from the belt as it ascends from the surface, leaving the oil to be absorbed in the belt and then squeezed out by the powered rollers and collected in the sump tank (see photo at right). An induction pump that may be operated at various speeds, located under the belt, assists in increasing the amount of oil encountered by providing greater flow-through rates. The pump also helps to eliminate turbulence, which emulsifies and scatters oil.

The MARCO class V is capable of operating under its own power in a transit mode at speeds of up to 5 knots. It may also be towed in a "V" type configuration to funnel oil in toward the skimmer. In the latter case, the spill thickens in front of the skimmer and begins to saturate the belt. When this occurs, the operator can adjust the speed of both the belt and induction pump to obtain maximum recovery capabilities.



The skimmer is constructed entirely of marine grade aluminum. It is designed so that it may be towed both by the bow and by the stern. Towing by the bow end, with the stern end in the oil recovery mode, is recommended for extended and/or rough weather tows. The stern is configured as a catamaran, allowing the filter belt to extend between the hulls and into the water. The oil storage capacity of the MARCO class V is 40 barrels, which can be offloaded at a rate of 200 gallons per minute. The skimmer is powered by a single diesel engine that drives an air compressor, alternator, and five hydraulic pumps. The hydraulic pumps drive the propulsion unit, bilge pumps, offloading pumps, and the filter belt drive. The pilothouse is removable, as are the lights, wiring, and switchboard. This permits the skimmer to be transported on a flatbed trailer or air freighted on a C-5A.

In many oil pollution operations it becomes necessary to moor ships together in high seas to transfer oil from one vessel to another (as in the case of a stranded tanker). To prevent damage in such situations, which may result from the heaving and rolling of the two vessels, the Navy is also purchasing large ship fenders. These fenders, designed and constructed by Ocean Systems, Incorporated, are 8 feet in diameter, 12 feet in length, weigh 2,700 pounds, and have an energy absorption of 338.8 foot-kips at 50 percent compression. The fender is constructed of closed-cell polyethylene foam covered with a nylon mesh and urethane elastomer. All of these materials are resistant to seawater, petroleum products, and most chemicals. Since the fender is nonpneumatic, it will not sink if punctured and can easily be repaired on site.

The Office of the Supervisor of Salvage has already begun to receive fenders, with delivery of skimmers and boom to begin early FY 1976. Operational training will be performed on the complete recovery system, after which the equipment will be available for fleet use during oil spill emergencies. Some of the equipment can be shipped directly to the fleet activity requesting it without operator assistance. Other items, such as the skimmer, may initially require technical personnel support to assure proper operation and maintenance.

With the increase in the number and size of oil tankers, the need for better quality and a greater quantity of equipment for oil pollution control also grows. The Supervisor of Salvage is procuring this equipment to ensure that the Navy will be well prepared to handle any major Navy oil spill quickly and effectively.

Above: GMT3 M. Tierney surfaces after inspecting pier supports.
Below: BM2 G. McMahon, PN2 W. Myers, and Mr. R. McKay provide topside support while LCDR M. Gentle stands by to dive.

JOC Don Richie, USNR-R
RHCU 208

RHCU-208, Jacksonville, Florida, was called upon recently to determine whether the fuel oil off-loading pier at Mayport Naval Station, Florida, was in suitable condition for rehabilitation. Chemically-corrosive electrolysis (electronic-erosion) has begun to wear away the metal of the piers' supports, and local authorities wish to discover whether the combination of barnacle and wave-action, as well as continual immersion, have undermined the structural stability of the main and support members of the pier.

Naval Facilities Engineering Command, Charleston, South Carolina, considered the answers important enough to request that a diving team from RHCU-208 wetsuit-up and gain some practical training while gathering useful information.

Usually, this kind of survey might go unaccomplished because of the unavailability of manpower or funds, or it would be accomplished by active duty divers or commercial divers. If the survey were not accomplished, either unnecessary or insufficient repairs to the 30-year-old fuel dock might have been made.

A specially designed gauge was used by the divers on the 10-inch H-beams to determine the thickness of the pier members at various depths down to 35 feet. The beams had to be "cleaned" before any measuring could begin. Divers used the Jack Brown shallow-water diving apparatus during the survey, which, because of a brisk current, lasted more than 4 hours. The operation was termed highly-successful by NAVFAC, which presently is analyzing the data gained from the group's efforts.

A 4- to 5-knot rip-current, in an area providing 3½-foot tide differential, made the 4-hour survey a study in practical training. Time was a factor, and fast work had to be done to coordinate with the "tide clock."

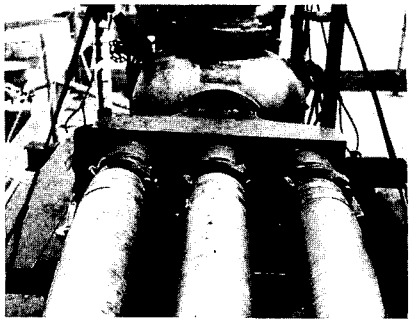
Unit 208 is the only Reserve Harbor Clearance Unit in the southeast United States. LCDR M.G. Gentle, of Atlanta, Georgia, is the Commanding Officer of the Unit, which carries a roster of five officers and 34 enlisted men. In addition to LCDR Gentle, diving personnel on the job included LT Ray Sage, Executive Officer; LT Charles Bigger, Training Officer; LT John Jones, Diving Officer; LT Jim Clancy; GMT3 Mike Tierney; PN2 Bill Myers; and BM2 Gary McMahon. Coxwaining the "dive boat," a steel-hulled LCVP from USS Yosemite (AD-19), was EM2 Bill Fenner. Capt. David Swan, USNR-R, advisor to Reserve Harbor Clearance Units around the country and attached to the senior unit in Washington, D.C. (NAVSEADIVSALV 106), participated as an on-scene advisor. Mr. Bob McKay represented the Southern Division, Engineering Command, NAVFAC.

Ten-Inch Salvage Pump Gets New Plumbing

Mr. Mark Jones
Naval Coastal Systems Laboratory

Above and below: New pump assembly in action.

A new approach to plumbing the 10-inch salvage pump has been approved by the Supervisor of Salvage. The new system greatly reduces the manpower and lifting requirements necessary to set up the standard 10-inch pump.



A suggestion submitted to SUPSALV by HTC (MDV) Gary Magnuson proposed the use of three lightweight, 6-inch suction hoses instead of the single heavy steel and hard rubber 10-inch piping presently used. The suggestion featured a manifold with three connections for lightweight 6-inch suction hoses. This manifold enables rather extensive suction hookups to be made without the use of a crane and permits multihole suctions from the same pump. The improvement will allow the Navy to delete from its ships' inventory a great deal of 10-inch pump suction and discharge piping, thereby saving weight and storage space.

Mr. Earl Baker, of the SUPSALV Office, requested that the Naval Coastal Systems Laboratory, Panama City, Florida, design and test a multi-suction manifold. After designing and fabricating a 3- by 6-inch manifold, NCSL tests proved that the manifold did not hinder the pump's performance. Taking the suggestion one step further, a 3- by 6-inch discharge system was also designed and tested. The same aluminum 3- by 6-inch manifold, which only weighs 75 pounds and costs $750 to build, can be used on either the suction or the discharge side of the pump. When plumbed into the discharge side of the pump, an adapter elbow constructed from existing 10-inch hardware interfaces the manifold with the pump.

Greater capability can be obtained from the new system by inserting commercially available butterfly valves (with 6-inch Roylyn quick-couplings on each side) in one or more of the suction lines. In this way, selective pumping can be achieved or a particular section can be secured if it starts sucking air before the other lines. Also, a single 6-inch line can be used for stripping the bottom of a compartment after major pumping. Of course, when operating with one or two valves closed, the pump has decreased performance. Several valves, at the cost of approximately $190 per assembly, would greatly increase the versatility of a salvage activity's 10-inch pump system. During the preliminary testing, a Dover Corporation (Tulsa, Oklahoma) 6-inch aluminum butterfly valve, model R2040-22A, was used with New Jersey Brass and Aluminum Manufacturing Company (Arlington, New Jersey) 6-inch aluminum flanges on each side. The Roylyn couplings should be available to those commands interested.

During the test and evaluation of the manifold, NCSL had an opportunity to demonstrate its advantages. A distress call was received from a local group requesting assistance to refloat a shrimp boat. It was decided that a pump such as the 10-inch model would be required to do the job. Upon reaching the site, NCSL personnel assembled the new manifold and the 6-inch suction hose by hand, lowered it into the shrimp boat and soon had the boat afloat. This pumping job was accomplished without the use of a crane and with only two people required for connecting and operating the pump. Diving and salvage personnel who have had experience with the 10-inch pump would agree that this task would not have been possible with the standard 10-inch plumbing.

Detailed drawings of the new manifold system are on file at NCSL. Any information concerning the new manifold or the tests can be received by contacting Mark Jones or Bob Elliott (Autovon 436-4388 or (904) 234-4388) at the Naval Coastal Systems Laboratory (Code 710.5), Panama City, Florida 32401.

NSDS will move to Panama City

The Naval School, Diving and Salvage now has official approval to relocate to Panama City, Florida. Effective July 1, 1978, the school will be disestablished as a command in the Washington Navy Yard. It will remain a shore activity assigned to the Chief of Naval Operations, but will be reestablished as a tenant activity at the Naval Coastal Systems Laboratory in Panama City. The new name for the command will be the Naval Diving and Salvage Training Center (NDSTC) its mission will be:

> To train selected officers and enlisted personnel in diving, ship salvage, and submarine rescue, and to perform additional tasks assigned by the Chief of Naval Education and Training.

The move to Panama City merges the functional responsibilities and all resources of the Naval School and a portion of the diver second class and scuba diver training from the Service School Command in San Diego, California. NDSTC will be teaching the same curriculum it has before, but will also provide separate curriculums in 2nd Class Diving School and scuba. This merger is based on continued efforts to provide adequate facilities for existing and planned training requirements with a reduction of operational costs.

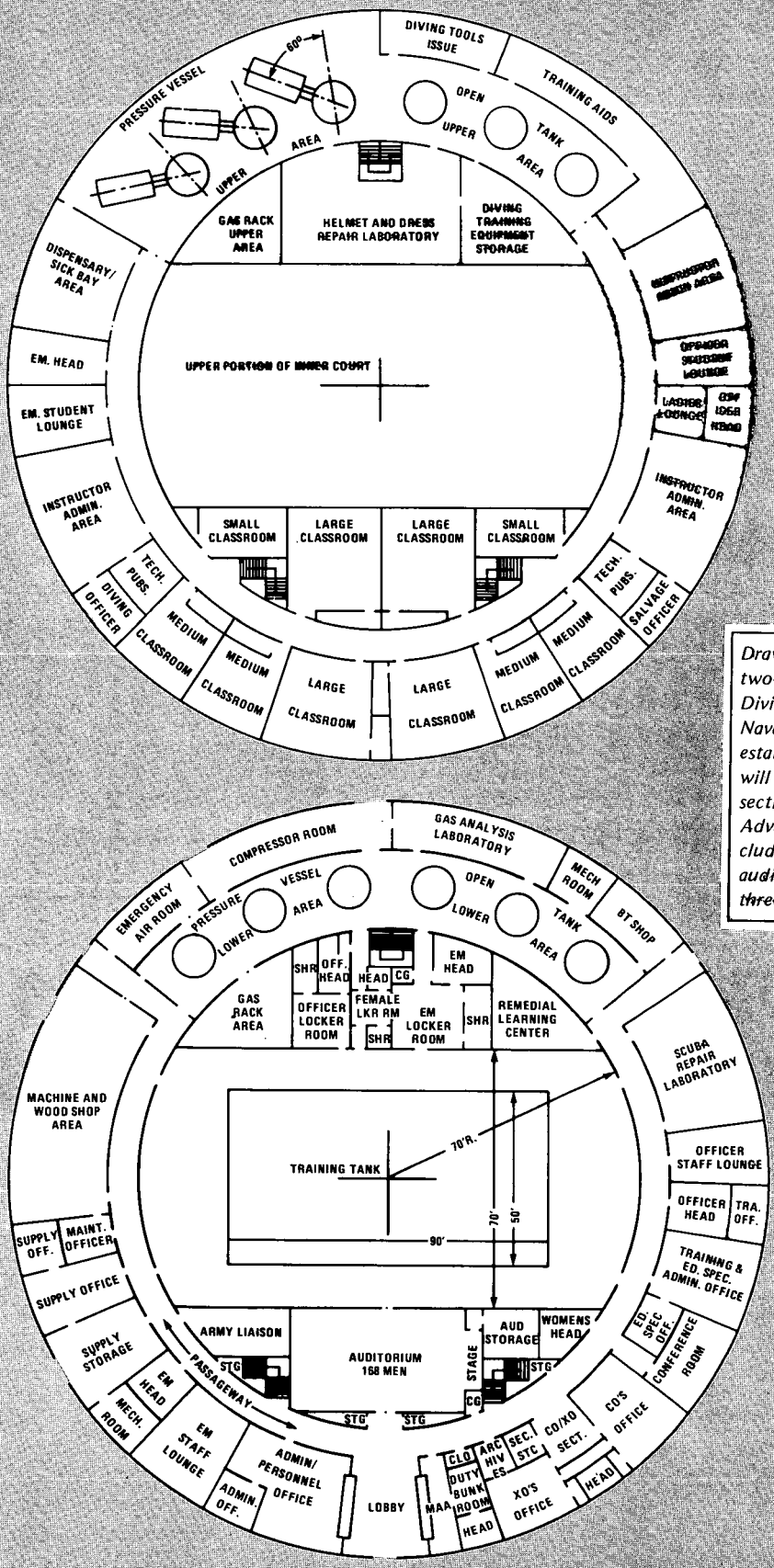
There are several reasons behind the decision to move the Naval School to Panama City. One of the more obvious factors is geographical location. The presence of severe pollution in both the Anacostia and Potomac Rivers and the lack of deep water equal to or greater than 100 feet (which is required for mixed gas diver training) within 64 miles distance compares poorly with the Panama City locale, where excellent water depth, (within 12 miles), and weather conditions exist.

Relocation of the school will also continue the close liaison with the Navy Experimental Diving Unit, which moved to Panama City in 1974. At this new location, the school has the possibility of joint utilization of boats, offshore platforms, the Ocean Simulation Facility, and the diving expertise of NEDU and the Naval Coastal Systems Laboratory.

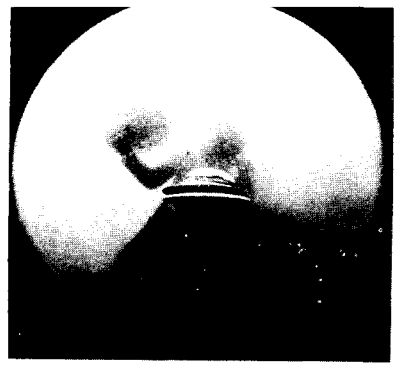
Finally, the estimated one-time cost to relocate the school in new facilities in Panama City is lower than the funds required for the needed repair of the present training spaces and facilities. In addition, real estate is not available in the Washington Navy Yard for expansion, but can be obtained if necessary in Panama City.

Currently in the design and engineering phase, the future Naval Diving and Salvage Training Center will be unique in construction. It will consist of 64 10-foot-wide prefabricated concrete slabs in a circular-looking structure. Using these rectangular-shaped "pieces" will eliminate the need for curved structural members. The new two story facility will feature an indoor training pool, located in the open courtyard area in the center of the complex (see drawing), and an in-house auditorium that will seat 168. Also, the new training center will have three pressure complexes and three open diving tanks instead of the two of each the Naval School presently uses. The staff of the new training center will come from the present school staff, and will consist of 11 officers, 65 enlisted personnel, and 7 civilians.

The Naval School is the only training command authorized to qualify officer and enlisted personnel in all phases of diving, ship salvage, and submarine rescue for the entire U.S. Navy, U.S. Armed Forces, and selected allied nations. Classes are available for deep sea (HeO_2) diving officers, ship salvage diving officers, Diver-First Class, Medical deep sea diving technicians, and Master Divers. The school also provides refresher training for all classes of divers, training of Engineering Duty Officers and Commanding/Executive Officers of diving ships, training for foreign officers and enlisted personnel under the Military Assistance Program, and training for Navy civilian industrial divers.



Drawings show the structural layout of the two-story building that will house the Naval Diving and Salvage Training Center (now the Naval School, Diving and Salvage) when it is established in Panama City, Florida. NDSTC will be a 64-sided facility, with the center section (inner courtyard) open to the sky. Advantages of the to-be-built complex include a large training tank, a 168-seat auditorium, three pressure complexes and three open diving tanks.



EARL LAWRENCE RETIRES AFTER 40 YEARS

After 40 years of service for the US Navy, Mr. Earl F. Lawrence was honored by the Puget Sound Naval Shipyard (PSNS) and the Naval Sea Systems Command at his retirement ceremony on October 7, 1975. RADM F.F. Manganaro, PSNS Commander, presented Mr. Lawrence with a 40-year Certificate of Retirement, signed by the Secretary of the Navy, and a retirement plaque and letter from NAVSEA Commander VADM R.C. Gooding. CAPT Robert B. Moss, Deputy Supervisor of Salvage for NAVSEA, also presented a retirement plaque to Mr. Lawrence from the NAVSEA Ocean Engineering Office, where he spent the latter portion of his career.

Earl Lawrence began his military career when he enlisted in the Navy in 1935. It was only by circumstance that he was assigned to an ASR, and it was there that his love for diving grew. He was first assigned for 3 weeks aboard USS HOLLAND (AS), then to USS ORTOLAN (ASR-5) from 1936-1940 (during which time he attended diving school), and then back to USS HOLLAND from 1940 until his Honorable Discharge in 1941. After leaving the Navy, he joined the Puget Sound Naval Shipyard diving team, a job in which he was involved with numerous advancements in diving.

While an employee at PSNS, he developed an underwater torch that featured lightness, compactness and ease of handling, which is still used by divers. He also designed and outfitted the shipyard's first diving boat and later designed another diving boat still used there.

He transferred to Office of the Supervisor of Salvage in the (then) Naval Ship Systems Command, Washington, D.C., where he became the Head of the Operations Division and the only man ever to hold the title of "Civilian Salvage Master." Though encountering numerous challenges during his years there, he accumulated a perfect success record.

One of the first major projects assigned to Mr. Lawrence was locating and raising the Civil War ironclad TECUMSEH from the bottom of Mobile Bay, Alabama, in 1967. Through research and reasoning into the facts given about the 1863 sinking of the TECUMSEH, he found the ship and was able to clear away enough of the mud to enter the hulk and retrieve the ship's anchor and several artifacts from the officer's wardroom.

Another priority job tasked to him was raising the small, two-man Navy submersible ALVIN, which had been lost while being launched off the coast of Massachusetts in 1968. The Navy spent 10 months trying to raise ALVIN from 5,051 feet of water and failed; but, in a 7-day operation, Mr. Lawrence's team was able to lift the submersible successfully and move it to shallow water where it was then lifted to the deck of the mother ship.

During the operation, he developed a special toggle bar and used the 7-man sub ALUMINAUT to position the toggle inside ALVIN's open hatch. He also personally made several dives when the submersible was raised to 90 feet to position diving slings that he designed himself for the long tow back to shallow water. For his efforts in this operation, Mr. Lawrence was given the Superior Civilian Service Award.

The British lost a two-man submersible in 1,570 feet of water off the coast of Ireland in 1974, with two men aboard and less than 72 hours of oxygen left. (See *FP*, Winter 1973.) After 30 hours, the British requested assistance from the Office of the Supervisor of Salvage, and Mr. Lawrence and CDR (now CAPT) Robert B. Moss, Deputy SUPSALV, were assigned the job. Faced with 40-foot seas and only minutes of air remaining for the trapped occupants, the SUPSALV team successfully raised the mini-sub with both crewmen alive and in good condition. This was the first time a vessel with a crew aboard had been recovered from such a great depth.

One of the most difficult projects tasked to Earl Lawrence was the salvage of the SIDNEY E. SMITH, which sank and broke in two pieces at a critical locale in the St. Clair River in 1972. As Senior Salvage Master on the job, he developed the unique plan of using cofferdams constructed with windows for the divers' entry into the submerged ship, enabling divers to enter the hull with less exposure to the current, which ranged from 8 to 12 mph. Mr. Lawrence supervised all river-borne efforts of the operation and personally conducted essential survey dives in frigid water that had almost zero visibility in addition to its dangerously fast current. His adaptation of new diving and salvage techniques contributed significantly to the success of an operation that most people said could not be done. For his efforts in this crucial operation, he received the Navy Distinguished Civilian Service Award, the highest award available to a civilian employee of the U.S. Navy.

Mr. Lawrence earned numerous honors and awards during his career, including three beneficial suggestion awards for improving an underwater welding holder, improving an underwater burning torch, and improving the Mk V Deep Sea Diving Helmet. His extensive training includes attending the Naval School, Diving and Salvage; U.S. Navy Salvage School; U.S. Navy Underwater Swimmers School; and special courses at Olympic College in navigation, management, and steel fabrication/structural.

Faceplate wishes to extend the best wishes to Earl "Curly" Lawrence at the conclusion of an illustrious career and the beginning of new endeavors in his new home in Bremerton, Washington.

Page 28 (l-r), Lawrence: Checks rigging for tow of ALVIN; emerges from TECUMSEH's wardroom with ironstone plates; and supervises salvops from deck of SIDNEY SMITH. Page 30, Lawrence: Above left, holds planning session for SMITH ops; left, discusses PISCES recovery with CAPT R.B. Moss (left); and, above, accepts retirement plaque from RADM F.F. Manganaro (CO of PSNS).

NEDU REPORTS:

Navy Experimental Diving Unit Report 18-73. *An Evaluation of the Savoie Air Diving Helmet.* S.D. Reimers, H.C. Langworthy, J.K. Summitt.

Abstract: The Savoie Air Diving Helmet, manufactured and distributed by the Savoie Research and Development Company, Inc., of Bouette, Louisiana, was subjected to evaluation testing at the Navy Experimental Diving Unit. The helmet was tested for sound levels and ventilation efficiency using specially built test manikins. It was planned to be tested for diver comfort in a series of 34 manned dives. Since many of the testing methods used were new, a discussion of the procedures used as well as the results obtained is presented. The sound levels existing in the helmet were found to be well into the hearing damage risk levels under all of the conditions tested. The ventilation efficiency of the helmet was found to be generally adequate provided the helmet was supplied with air at sufficient overbottom pressures. The manned test dives were terminated when the first test diver experienced a significant temporary hearing loss following only a 53-minute exposure in the helmet.

Navy Experimental Diving Unit Report 19-73. *Proposed Standards for the Evaluation of the Breathing Resistance of Underwater Breathing Apparatus.* S. D. Reimers.

Abstract: Respiratory impedance is a parameter that has often suffered from less than adequate attention in the development of present day underwater breathing apparatus. The result has been a number of unpleasant surprises when the apparatus have been tested or used in the deeper portions of their operating ranges. A principal factor in the lack of engineering attention to respiratory impedance has been the lack of definitive design standards. A set of definitive engineering-oriented respiratory impedance standards are proposed for use in the depth range of 0 to 1,000 fsw. The standards are consistent with current medical knowledge and are simply stated so they may be easily applied. The test conditions under which the standards are to be applied are also described in detail. Basically, the prepared standards require that the external respiratory work that a diver can be required to do on his breathing apparatus, as measured by mouthpiece conditions, must be less than 0.17 kilogram-meter of work per liter ventilation. The reference pressure to be used in calculating the external respiratory work is identified as the hydrostatic pressure at the level of the 7th cervical vertebra for all types of diving equipment except open-circuit SCUBA regulators. For open-circuit SCUBA regulators, the reference pressure is identified as the hydrostatic pressure at the center-line level of the second stage diaphragm.

Navy Experimental Diving Unit Report 21-73. *Temperature Requirements for the Maintenance of Thermal Balance in High Pressure Helium Oxygen Environments.* E.T. Flynn, J. Vorosmarti, Jr., H.I. Modell.

Abstract: Using a mathematical model of human thermal exchange, the range of environmental temperatures consistent with the maintenance of thermal balance was computed for helium-oxygen dives to depths of 5000 FSW. In agreement with the trend of empirical data obtained during shallower dives, the required environmental temperature increases progressively with increasing depth while the range of acceptable temperatures decreases. The greatest changes occur in the first 1000 feet of descent. According to the model, sweating will become an ineffective means of extending the upper limit of environmental temperature at depths beyond 2000 feet. Conversely, if chamber temperature falls below the lower limit, body temperature will fall at a rate which becomes more rapid with increasing depth. The normal increase in metabolic rate which serves to limit the fall in central temperature during cold exposure will be attenuated at depth due to a higher mean skin temperature.

Navy Experimental Diving Unit Report 23-73. *USN Procedures for Testing the Breathing Characteristics of Open-Circuit SCUBA Regulators.* S. D. Reimers.

Abstract: Military Specifications, MIL-R-24169A (Single-Hose) and MIL-R-19558A (Double-Hose) list the specifications that open-circuit SCUBA regulators proposed for U. S. Naval service must meet. The Navy Experimental Diving Unit is the government agency that tests the breathing resistance characteristics of proposed SCUBA regulators for conformance with the applicable military specification. The procedures and standards used by NEDU in the testing of open-circuit SCUBA regulators and their relation to the appropriate military specifications are described. Also discussed are changes being proposed in those procedures and standards and changes recommended in the Military Specifications themselves.

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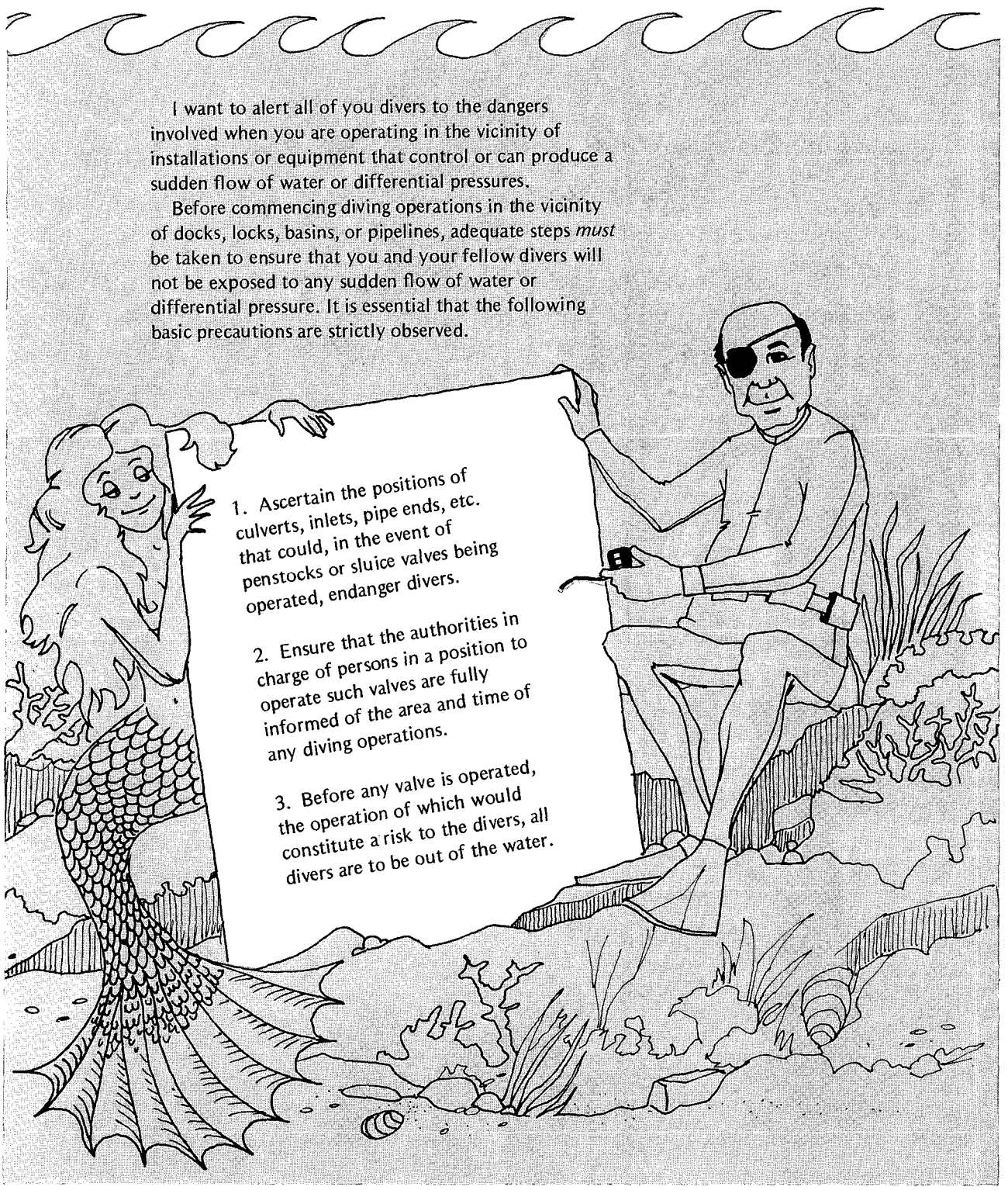

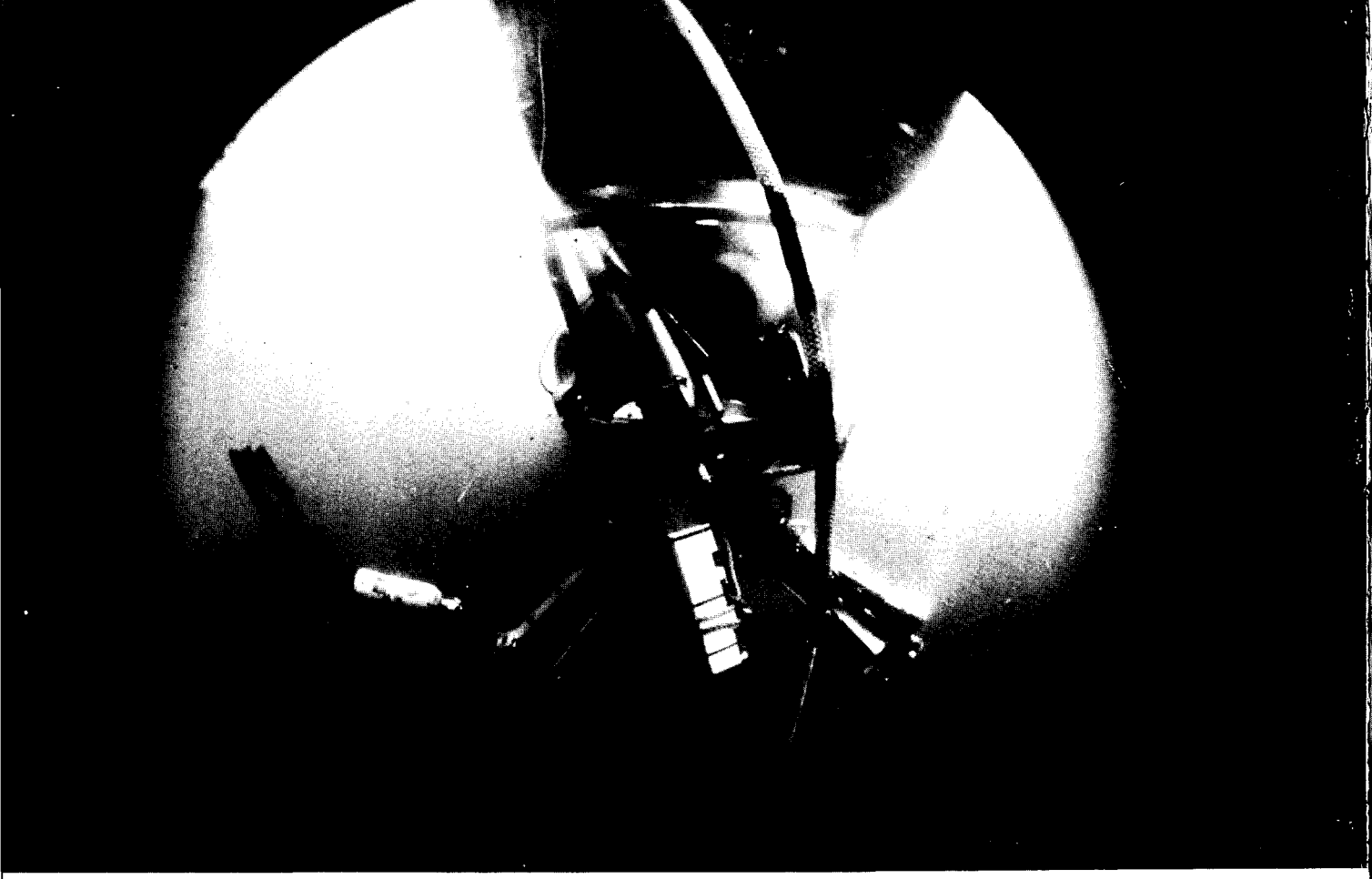

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