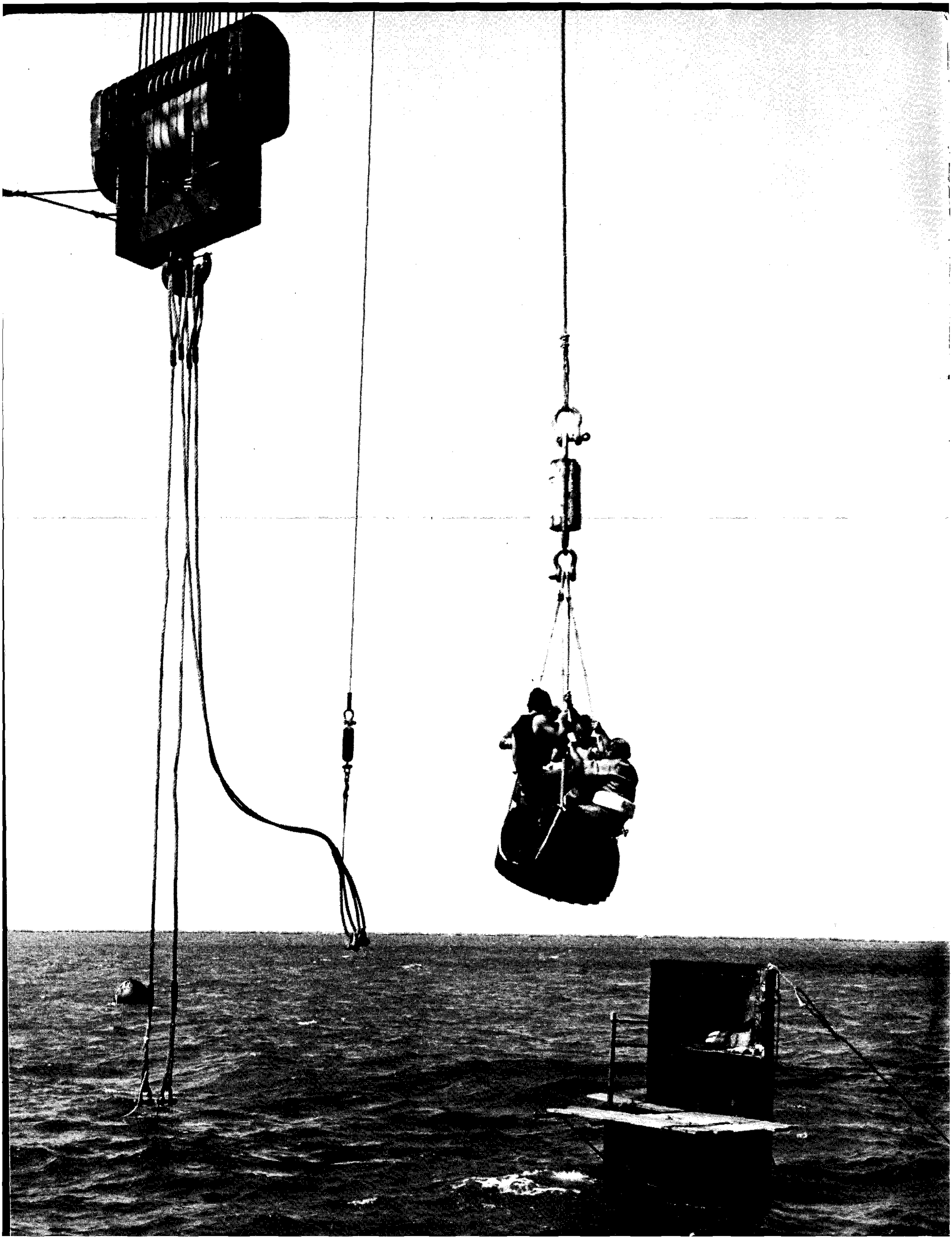
FACEPLATE

FALL 1974



FACEPLATE

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

Volume 5 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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Inside front cover shows divers being transported to diving platform during the MACKENZIE operations.
Story on page 22.

Cover shows the passenger ship MECCA lying in the Suez Canal waterway.
Story on page 16.

MISSED YOUR SUMMER FACEPLATE?

During the printing and affixing of mailing labels for the Summer issue, some addresses were inadvertently left out. Unfortunately, it is impossible to determine who did not receive copies unless you let us know. If you did not receive the Summer 1974 issue, please send a card stating so to *Faceplate*, Supervisor of Diving, Naval Sea Systems Command, Washington, D.C. 20362. *Faceplate* regrets this oversight and will mail your copies to you.

SOUNDINGS

BARGES FOAMED IN VIETNAM

The Supervisor of Salvage was again called upon to "sink-proof" a vessel when the Military Sea Command Far East tasked SUPSALV to implant 120,000 cubic feet of polyurethane foam in eight barges. These barges, each 33 feet by 120 feet long, will be used in Project "Mosquito Net" on an in-country logistic support requirement in Vietnam.

Mr. Jerry Totten was the on-scene SUPSALV Representative during the foaming of the barges, using methods similar to those used in Project End Sweep in early 1973 (see *FP*, Spring 1974). Murphy Pacific Marine Salvage Company was called upon by SUPSALV to furnish Foam Engineers to direct the implantment operations. A local Vietnamese stevedoring company supplied the laborers, several of whom were trained to operate the foam guns.

The foaming of the barges was completed in 3 days, well ahead of the 7 days that were anticipated. The "professionalism, spirit of cooperation, and energetic approach which resulted in this early successful completion" was praised in a commendation message from the Military Sea Command Far East.

MR. WALKER DEPARTS NAVSEA

Mr. James Walker served in various key-role capacities in the Naval Sea Systems Command, Code OOC, for the past 4 years. On August 9, 1974, however, Mr. Walker left his position as Head, Salvage Operations Division to attend graduate school at Texas A&M University, where he will be studying to receive a Masters Degree in Marine Resources Management.

SHIPYARD/TENDER DIVER CONFERENCE ANNOUNCED

SUPSALV will sponsor a Shipyard and Tender Diver Conference at the Naval Coastal Systems Laboratory, Panama City, Florida, in January (tentatively January 7 and 8) 1975. All Navy Shipyard, S.R.F., and tender diving activities may send representatives, and all other personnel interested in shipyard, S.R.F., or tender diving are invited.

Proposed areas of discussion will include but not be limited to diver tools, hull and sonar dome cleaning, inspections, zinc changes, cofferdams and blanks, shallow water diving gear, propeller changes, and underwater painting.

Contact John Mittleman or Bob Elliott at the Naval Coastal Systems Laboratory, Code 710, Panama City, Florida 32401, Autovon 436-4388 or 436-4386, for additional information or to make recommendations regarding the conference. Also, notify NCSL to let them know who will be attending. Although SUPSALV cannot sponsor attendee travel costs, all shipyards, S.R.F.s, and tenders are urged to send representatives.

NEW ASSISTANT OFFICER-IN-CHARGE AT NEDU

LCDR Martin A. Paul, USN, joins NEDU as the New Assistant Officer-in-Charge this Fall 1974.

LCDR Paul served aboard several submarines and completed Academic and Operational Nuclear Power School before being selected to the Limited Duty Officer Program in 1960. Subsequently, his career included serving on AS- and ASR-class ships, and attending Deep Sea Diving and Salvage School. After graduating, his primary duties aboard ASRs included Executive Officer, Navigator, Engineering Officer, and Communication Officer. In 1969, LCDR Paul was assigned Director of Escape Training at the Escape Training Tank, New London, Connecticut. His next tour was as the Commanding Officer, USS CHANTICLEER (ASR-7). LCDR Paul comes to his new position at NEDU from Commander Submarine Development Group ONE, San Diego, California, where he served as Diving Division Officer, O-in-C of the Tactical Operations Group, and O-in-C of the Deep Dive Training Detachment.

LCDR RINGELBERG COMMANDS NEDU DET., PANAMA CITY

LCDR Jack M. Ringelberg, USN, has assumed the duties of Officer-in-Charge of the recently established NEDU Detachment in Panama City, Florida.

A graduate of the New York State Maritime College, LCDR Ringelberg served several tours aboard destroyers and aircraft carriers during his early Naval career. He then enrolled in post-graduate studies at the Webb Institute of Naval Architecture, where he received a Masters Degree in Naval Architecture. After attending the U.S. Navy School of Diving and Salvage, LCDR Ringelberg participated in and directed salvage operations in the Philippines, Vietnam, and Korea while assigned to the Ship Repair Facility in Subic Bay, Philippines, where he served as Docking, Diving, and Salvage Officer. He comes to his current position from duty as Fleet Salvage Officer, Commander Service Force, Atlantic.

NEDU REPORTS

Navy Experimental Diving Unit Report 9-73. *Evaluation of U.S. Diver's Co. Modified Conshelf VI and Conshelf XI Conversion to Conshelf XII Open-Circuit Regulators.* T.W. Cetta.

Abstract: U.S. Diver's Co. submitted conversion kits to convert Conshelf VI and XI to Conshelf XII for evaluation and approval for service use. The modified Conshelf VI and Conshelf XI, (Conversion to Conshelf XII) were found acceptable for service use.

Navy Experimental Diving Unit Report 10-73. *Evaluation of the Advanced (SWINDELL) Helium-Oxygen Diving Helmet.* S.D. Reimers, H.C. Langworthy, J. Hesket.

Abstract: The Advanced (formerly Swindell) Model 3610 Mixed Gas Diving System manufactured and distributed by the Diver's Exchange, Inc., of Harvey, LA, was subjected to evaluation testing at the Navy Experimental Diving Unit. The Model 3610 System consists primarily of a Model 3000 Mixed Gas Helmet used with a neckseal and a Model 3700 Back Pack Scrubber. The system was tested for sound levels and ventilation efficiency using specially built test manikins. It was tested for diver comfort in a series of 20 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 into the damage risk levels under many of the conditions tested, but not so far as to preclude use of the system provided the appropriate precautions are taken. The ventilation efficiency of the system was found to be generally adequate for diving in the depth range of 0 to 300 fsw, provided the gas supply pressure is maintained at sufficient levels. The system was regarded by the divers as generally more comfortable than the standard USN $He-O_2$ diving outfit. Nonetheless, diver complaints of helmet and jock strap discomfort became common at work rates approximating moderate work.

Navy Experimental Diving Unit Report 11-73. *Evaluation of the Prototype General Electric Model 1500 Sensor Controlled, Closed-Circuit, Mixed Gas, Underwater Breathing Apparatus.* LCDR T.L. Hawkins, USN, EMCS(DV) T.C. King, USN.

Abstract: The GE MOD 1500 UBA (General Electric Model 1500 Underwater Breathing Apparatus) is a prototype, closed-circuit, mixed gas, diving apparatus independently developed by the General Electric Corporation in response to established operating requirements of Naval Inshore Warfare tactical swimmers. The design goal was to have the UBA meet and/or exceed a desired six (6)-hour gas and CO_2 absorbent life support cycle.

This project was conducted to determine that the prototype units could meet the design goals and to determine equipment operational capabilities and limitations with respect to general areas of: Operational performance, compatibility to existing fleet equipment, reliability (such as could be determined), maintainability, and human engineering considerations. A total of 197 hours/48 minutes bottom time was logged in the conducting of these tests.

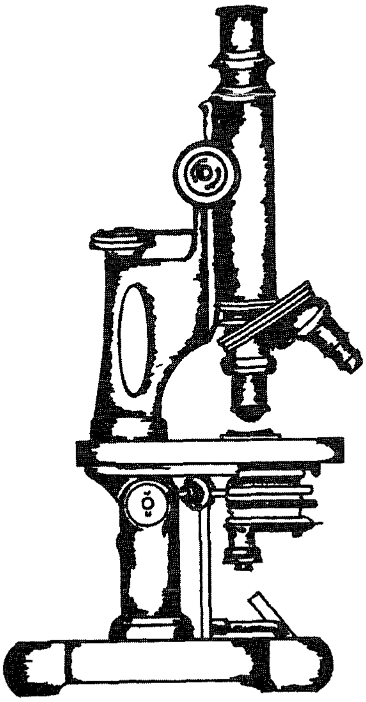
Tests were conducted by the Officer-in-Charge, Navy Experimental Diving Unit, during the period 15 January – 24 May 1973. Tests were conducted at Indian Head, Maryland; Roosevelt Roads, Puerto Rico; and Little Creek, Virginia. LCDR Thomas L. Hawkins, USN, and EMCS Thomas C. King, USN, were the NAVXDIVINGU Project Directors. LT James E. Harper, USN, and BMCM C.J. (Corney) Leyden, USN, were the NAVINSWARLANT Project Officers. Operations were conducted utilizing the services of Commander, Naval Inshore Warfare Command, Atlantic; Commanding Officer, Explosive Ordnance Disposal Facility; and the Naval Inshore Warfare Detachment, NAVSTA, Roosevelt Roads, Puerto Rico.

General results of the tests indicate that the prototype equipment is potentially satisfactory for employment by Naval Inshore Warfare Forces. However, several failures were encountered with the equipment which were considered critical in nature, primarily in the electronic design, and should be corrected prior to any further test or procurement action by the Navy.

Two separate, but similar prototype units were tested, both having the same inherent functional characteristics. Physical construction of the individual units was varied through "modification update," and differing operational characteristics were noted. For test and reporting purposes, the nomenclature assigned to the equipment was MOD 1500 ALFA and MOD BRAVO.

These research reports have been issued by the Navy Experimental Diving Unit, Washington, D.C. Non-DOD facilities desiring copies of reports should address their requests to National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151. The charge for each report is $2.00. DOD facilities can obtain copies from the Defense Documentation Center (DDC), Attn: DDC-TSR-i, Cameron Station, Alexandria, VA 22314.

Survey Underway on Bone Necrosis



LCDR George M. Adams, MSC, USN

Naval Submarine Medical Research Laboratory

While diving is considered a reasonably safe endeavor, knowledgeable participants maintain an awareness of various potential hazards. The unexpected occurrence of decompression sickness on a "safe" decompression table is an everpresent possibility; the enhanced possibility of decompression sickness from deeper and/or longer dives is well documented. Air embolism from improper exhalation while surfacing is always possible. Barotrauma with resultant ear and/or sinus involvement is also a constant possibility in any dive. While these possibilities are always present, they are all therapeutically manageable if adequate planning and precautions are taken.

There are diving problems that are not always recognized. Hearing loss and deafness have been recognized as possibilities that are under investigation for understanding, management, and prevention. The long-term consequences of central nervous system involvement in diving accidents are also of increasing concern. Currently being evaluated are the possible effects of diving on a diver's bones.

Bone abnormalities with the characteristics of aseptic bone necrosis or dysbaric osteonecrosis have been found in divers throughout the world. A survey for the presence of bone abnormalities, as determined by X-ray techniques, has been in progress in the U.S. Navy for a number of years. In accordance with recent requests from the Diving Research Branch, Naval Submarine Medical Research Laboratory (NAVSUBMED-RSCHLAB), a number of active duty divers have been and are being surveyed radiologically for the presence of bone abnormalities. Various facts are gradually becoming evident from this survey.

Bone abnormalities consistent with the characterization of dysbaric osteonecrosis or aseptic bone necrosis have been found in some active duty divers. The exact percentage of cases is not yet known, but the occurrence of disabling bone abnormalities appears to be quite low (less than 0.45 percent). One or more incidents of decompression sickness do not seem to predispose the diver to the occurrence of bone abnormalities; nor does a diver's age appear to be related to the occurrence of this condition (within the normal age range of divers). No apparent correlation between the occurrence of bone abnormalities and the diver's NEC designation has been established for NEC's 5311, 5342, 5343, and 8493. These conclusions are based on preliminary data and will require additional input for verification. The causative factors that lead to the occurrence of bone abnormalities are not known at this time.

The effective pursuit to understand this subject is a task utilizing many Navy resources. Direction and guidance in the medical management of existing problems is a function of the Bureau of Medicine and Surgery. An active survey to establish a true incidence of this condition and to understand causative factors has been assigned to the NAVSUBMEDRSCHLAB at the Submarine Base, Groton, Connecticut. Objective diving data is supplied by the Naval Safety Center via the OPNAV Form 9940 input. Consultation services are provided by many facilities, including the National Naval Medical Center and the Armed Forces Institute of Pathology. In addition, an international group of experts is actively involved in finding the best possible approach to understanding and managing this problem.

The participation of many individual divers, the cooperation of various commands and activities, and the continuing involvement of many facets of the U.S. Navy's biomedical research program are directed toward the safety of the individual diver in his duties. Doubtless there will be discussion and concern among Navy divers coincident with this official activity; rumors may circulate in various quarters about a variety of possibilities. To ensure an adequate presentation of reliable information, periodic status reports will appear in *Faceplate*. The purpose of these efforts is to assure participants that diving remains a safe endeavor, if standard precautions are observed.

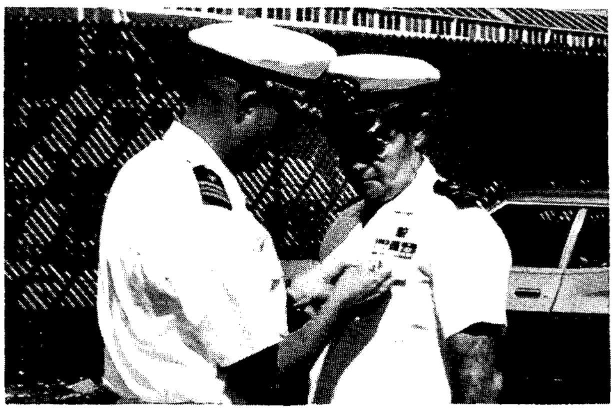
LCDR Whitaker Retires

In a special ceremony at the Navy Experimental Diving Unit on August 30, 1974, LCDR Edson Whitaker retired from the U.S. Navy after 27 years of service.

LCDR Whitaker retired from his position as Assistant Officer-in-Charge of NEDU, a post he had held since October 1970. "For meritorious service in the outstanding performance" of this duty, LCDR Whitaker received the Meritorious Service Medal, which was awarded during the ceremony by CDR Colin Jones, Officer-in-Charge of NEDU.

The citation noted that during this 4-year period, LCDR Whitaker "managed the most extensive overhaul ever attempted on NEDU's two man-rated hyperbaric complexes, and directed the effort that resulted in NEDU becoming the first hyperbaric facility to obtain U.S. Navy certification." LCDR Whitaker's "expert managerial skills and technical expertise have helped maintain the Navy Experimental Diving Unit as the Navy's primary technical agent in the diving field." In addition, he also played a major role in the U.S. Navy's Information Exchange Programs.

In addition to several citations presented to LCDR Whitaker, a special Certificate of Appreciation from the U.S. Navy was awarded to Mrs. Lois Whitaker by CDR Jones.



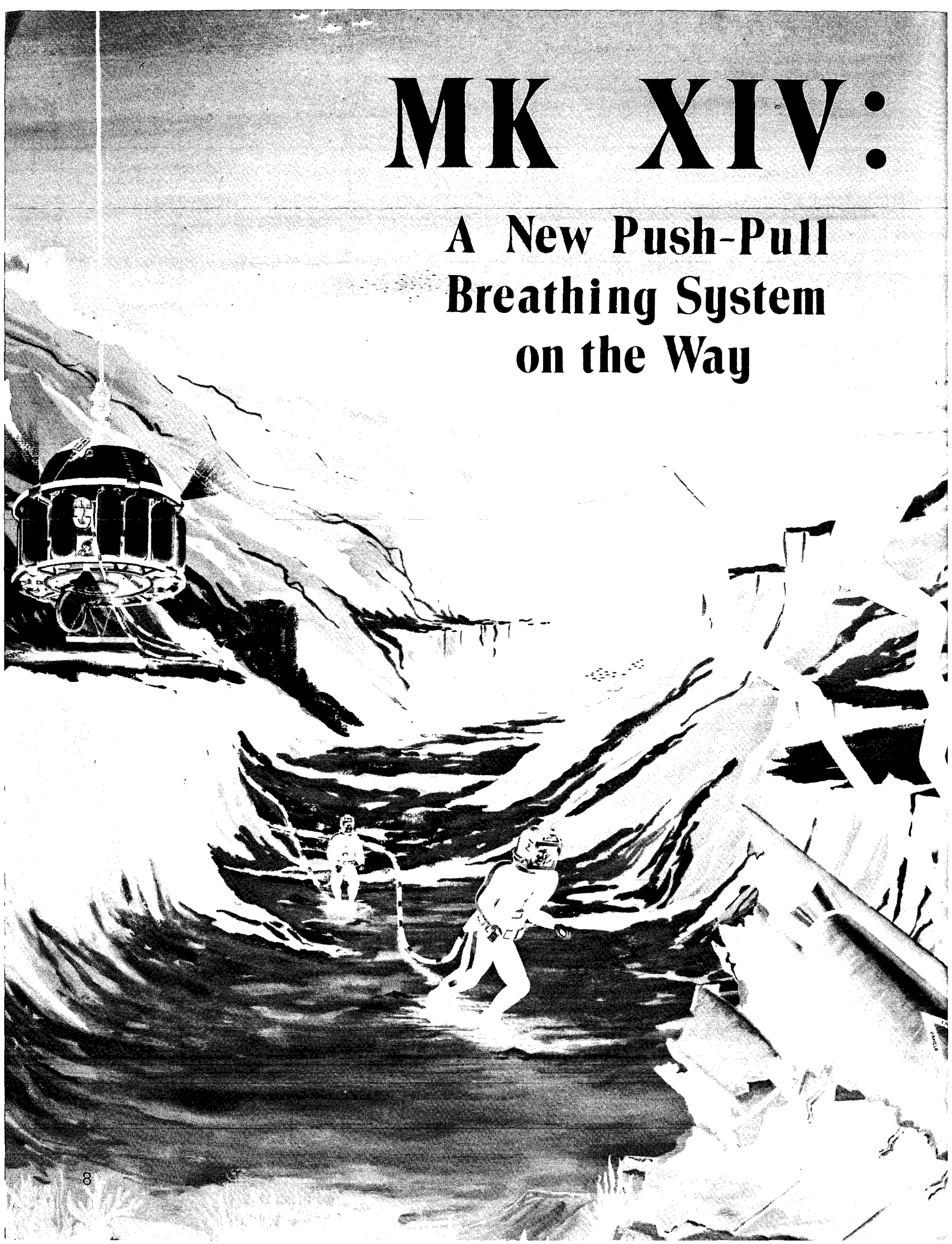
CDR Jones awards commendation medal to LCDR Whitaker.

LCDR Whitaker's naval career summary includes Boatswainmate 1st Class (Diver), 1947-1959; Warrant Officer (Diver), 1959-1960; and Ensign through Lieutenant Commander (Diver), 1960-1974. LCDR Whitaker served a majority of his tours aboard AS- and ASR- class ships after attending the U.S. Naval School, Deep Sea Divers in 1950-1951. Prior to becoming Assistant Officer-in-Charge of NEDU, he had held the post of Training Officer, Naval School of Diving and Salvage.

Faceplate extends to its former Assistant Editor-in-Chief, LCDR Whitaker, best wishes in his new endeavors.

MK XIV:

A New Push-Pull Breathing System on the Way



LCDR Bryan Barrett, RN

Navy Experimental Diving Unit

Although for centuries man has been designing and redesigning underwater breathing equipment, he has not yet fully conquered three major obstacles: Time, cost, and reliability.

The problem of time arises from the lengthy decompression process that must follow a dive. Today, however, the time problem has been virtually eliminated by saturation dive techniques.

But the problems of cost and reliability still persist. The major expense of deep dives stems not only from the price of the equipment, but from the tremendous cost of operating it. The cost of helium and the massive logistics effort required to get it to the diver cause operating expenses to skyrocket. The reliability of most current diving systems is severely limited by their complexity. Furthermore, they tend to burden the diver with complicated operating procedures as well as large equipment to carry.

At the Navy Experimental Diving Unit in Washington, D.C., a new underwater breathing system is being developed that to a great extent does away with the expense and logistic problems of maintaining the diver's helium supply. The system, designated the Mk XIV, is a push-pull apparatus that reuses helium; no gas is exhausted into the water as the diver breathes the atmosphere of the Personnel Transfer Capsule (PTC) itself. The Mk XIV will also eliminate the problems of system complexity, for simplicity of design is a primary design consideration.

Currently the U.S. Navy uses either of two diving equipments when exiting from a PTC, the closed-circuit Mk 10 or the open-circuit demand system, the band mask.

The closed-circuit, self-contained system makes the diver independent of the PTC except for communication and hot water umbilicals. Its major disadvantage is its complexity. The system includes separate bottles of helium and oxygen, sensors to measure the partial pressure of oxygen, and an electronics package to control the addition of O_2, all mounted on the diver's back. The massive diver-carried equipment is not only unwieldy and restrictive, but also difficult to set up and don in the confined area of the PTC.

The second system currently used by the U.S. Navy, and by many commercial diving companies, is the band mask system, which does have the advantage of simplicity. Diver-carried equipment is small, comfortable, and easy to don in a PTC. It is a demand system, however, and requires a bail-out bottle. Also, as with any face mask or oral-nasal mask, communication capabilities are impaired. Its major disadvantage, however, is the waste of helium. The cost of the gas itself and the logistics of getting it to the diver are quite substantial.

A push-pull system, such as the Mk XIV, overcomes the shortcomings of both these systems. It operates on a very simple principle: Atmosphere from within the PTC is pumped out to the diver and is sucked back through a separate hose. The already existing PTC Life Support System provides the oxygen makeup and CO_2 scrubbing, eliminating bulky diver-carried equipment. Exhaled gas is returned to the PTC for recycling, so virtually no helium is lost.

The conservation of helium and the reduction in logistics are fundamental advantages of the push-pull system. One diver working reasonably hard at 1,000 feet requires between 60 and 70 standard cubic feet of helium per minute. Considering the price of helium, keeping that diver on open-circuit at 1,000 feet costs more than $500 per hour in gas alone. The Mk XIV, since it conserves helium, would pay for itself during one prolonged deep operation.

Compared to existing systems, then, the Mk XIV offers savings in helium and simplified diver-carried equipment. It costs less, is more reliable, and allows a longer PTC bottom time per dive.

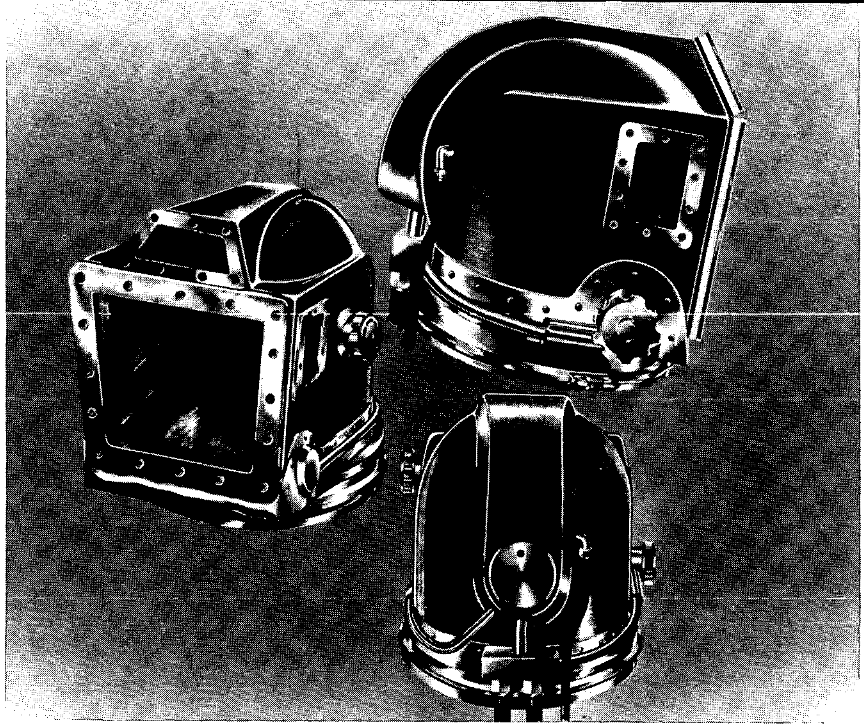
The operational requirements of the Mk XIV are part of a major U.S. Navy research and development program directed primarily toward submarine rescue. Basically, the Mk XIV is designed for use with the Mk II Deep Dive Systems (DDS) of the two ASRs, USS PIGEON and USS ORTOLAN. The equipment is being designed to be used at a depth of 1,000 feet, allowing two divers to go 33 feet above the PTC, 100 feet below it, and up to 250 feet out horizontally.

In designing diver equipment to satisfy these operational requirements, three different commercial system concepts were considered as a basis for further development. The first was a demand regulated system. In this equipment, a pump supplies medium pressure gas to a demand regulator, which operates on the inlet side exactly like a SCUBA second stage regulator. As the diver exhales, the regulator opens a second valve that allows another pump to draw the gas back to the PTC. The system terminates in a Kirby Morgan Clamshell, but can be used with any band mask system.

A free-flow helmet system was also tested. It has an inner custom fitted helmet, exhaust valving set into the side, and a modified oral-nasal mask, using the neck dam as a form of breathing bag. A diver-carried form of accumulator handles the exhaust side.

Originally, the inner hat was to be molded from a cast of the diver's head, fitting well enough to eliminate the need for a helmet jock. This system had the advantage of requiring small gas flows to provide adequate CO_2 ventilation than conventional free-flow helmets, but it was rejected because of technical and financial risks.

The third system considered was a conventional free-flow helmet with a back pressure regulator and return hose and pump. Although the system in its present state could not meet completely the Navy's operational requirements, it was selected as the concept to be used in the development of the Mk XIV because of the safety, simplicity, and comfort of the free-flow helmet. Another determining factor is that it is within the present technical state of the art.



Artist's concept shows three views of proposed Mk XIV helmet.

The equipment of the Mk XIV consists of the following four subsystems: The Pump Package, the PTC Control Station, the Umbilical, and the Helmet. The existing life-support equipment of the PTC, of course, adds an essential fifth subsystem.

The *Supply and Return Pump Packages* are mounted outside the PTC; one package for each diver. Supply and Return Pumps consist of four small Metal Bellows positive displacement pumps jointly driven by a 3 h.p. motor. Each pump package can produce a gas flow of 6 actual cubic feet per minute at 90 psi over PTC ambient pressure. Gas entering and leaving the pumps flows through volume tanks to reduce pressure fluctuations.

The *PTC Control Station* is a panel mounted inside the PTC. It regulates the activity of the pumps and monitors supply and return gas pressures, hot water supply, diver depth, and inspired gas. An emergency gas supply can be fed directly into the diver's umbilical in the event of a pump malfunction.

The third equipment subsystem, the diver's *Umbilical*, has three basic parts: Gas hoses, hot water hose, and electrical cable. Two 1/2-inch gas hoses, supply and return, carry gas between the helmet and the pumps. The hot water hose provides 3.0 gallons of water per minute at 110° F to heat the diver's suit and his inspired gas. The electrical cable, which consists of 14 cores, transmits monitoring signals to the PTC Control Station. The cable also provides two-way communication between diver and PTC and between diver and topside.

Gas flows through the supply hose into the right side of the *Helmet* through a needle valve of high flow capacity. It flows out the left side of the helmet through a safety valve to a back pressure regulator. When helmet pressure exceeds ambient pressure by a given amount, the regulator allows the gas to pass through to the return pumps. If the return pumps fail, the diver can open a manual exhaust valve and operate the helmet on open-circuit. The lower rim of the helmet clamps to a neoprene neck dam harnessed to a conventional hot water suit.

The emphasis for diver-carried equipment has been on simplicity, reliability, and minimizing bulkiness. By employing divers on the design team at every stage, a diver-acceptable equipment should result. While the Mk XIV is designed primarily for the Mk II DDS, it will be adaptable to any existing deep-dive system, including the Mk I DDS.

Project Manager for the Mk XIV system development program is LCDR Bryan Barrett, RN. Working with him on the project are Mr. Tom Cetta, Project Engineer; BM1(DV) Bob Holloway, USN, Assistant Project Manager; and Mr. Ray Bentz, NCSL Project Engineer.

The present status of the Mk XIV system is that detailed design work is just being started on the components. The first items of hardware will arrive in early 1975, and the prototype system should be assembled and undergoing testing by May 1975, at NCSL, Panama City, Florida.

Aerial view of NCSL.

NEDU Relocates to Panama City

The Navy Experimental Diving Unit moved into the landward side of Building 214 in the Washington Navy Yard in 1927 to centralize Navy diving efforts. Now, some 47 years later, NEDU is once again relocating to newer facilities in the interests of technological advancement. Panama City, Florida, is the destination, where NEDU will be a tenant activity at the Naval Coastal Systems Laboratory (NCSL).

As a field activity of the Naval Sea Systems Command, NEDU performs in-house diving and diving systems development, testing, and certification of systems, including biomedical and physiological testing, work in gas mixtures, and decompression. Trained Navy volunteer divers provide the manpower around which NEDU personnel have built one of the most active undersea programs in the world. By combining the talents of Navy divers, diving officers, submarine medical officers, technicians, engineers, and administrators, NEDU has been able to extend substantially the depth and duration of Navy diving. The tremendous advances already made in diving technology and the future expectancies are, in fact, the primary reasons for NEDU's relocation to the more modern facilities at NCSL.

Current NEDU facilities at the Washington Navy Yard include two man-rated hyperbaric chambers with associated gas systems, data acquisition systems, a research laboratory, shops, and a photographic laboratory. Each chamber system includes a recompression chamber, an

Below: NCSL's Diving Locker.

Below: Control room for hyperbaric complex.

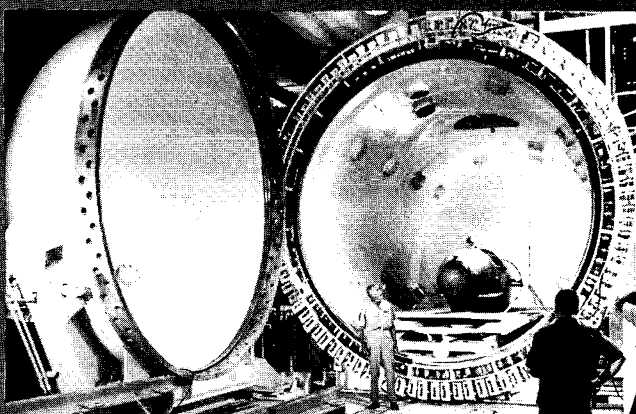
igloo, and a diving tank; but the chambers are limited to a maximum simulated depth of 1,000 feet and a minimum temperature of 70°F, capabilities that are now considered inadequate for anticipated development tasks. Capabilities that NEDU will acquire at NCSL include a complex of interconnected chambers that permits simulating depths to 2,250 feet of seawater, with a temperature range of 29°F to 90°F. All chamber compartments can be operated independently at different pressures and with different gas mixtures.

NCSL, a major research and development activity of the Naval Material Command, is one of the Navy's primary laboratories devoted to the task of conducting research, development, testing, and evaluation in providing solutions to naval problems. Originally commissioned as the U.S. Navy Countermeasures Station in 1945, the laboratory underwent several redesignations before it was established as the Naval Coastal Systems Laboratory in February 1972. NCSL is presently under the leadership of CAPT Robert T. Quinn, who serves as the Commanding Officer of the base.

NCSL occupies 650 acres in northwest Florida on a site that has easy access to the Gulf of Mexico and offers a wide variety of environmental conditions. The Bay of St. Andrew, the Gulf of Mexico, and the Apalachicola River basin serve as principal testing grounds in the immediate area.

The mission of NCSL is "to be the principal Navy research, development, test, and evaluation center for the application of science and technology associated with military operations carried out primarily in the coastal region, and to perform investigations in related fields of science and technology."

To carry out this mission, NCSL maintains in-house research and development capabilities for the following Navy and Marine Corps systems, subsystems, and technologies: Coastal technology, inshore warfare, acoustic countermeasures, mine and ordnance countermeasures, amphibious operations support, and naval diving and salvage support. Efforts in diving and salvage are concentrated on swimmer delivery vehicles, life-support systems, large object salvage, man in the sea programs, and



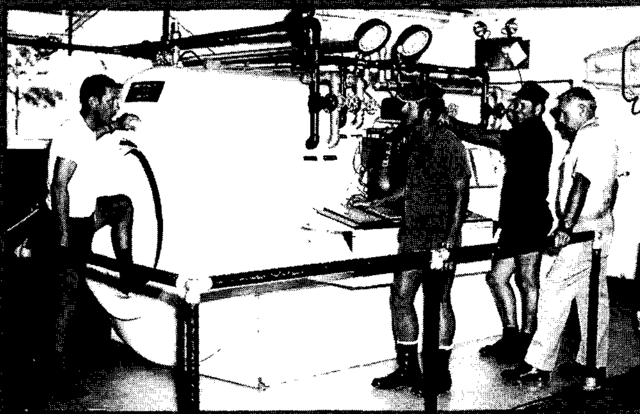
Photos at left, top to bottom: Wet chamber section enroute to NCSL; aerial view of OSF, showing NCSL in background; wet chamber, opened, during installation; view of dry chambers, which sit atop the wet chamber in new OSF complex.

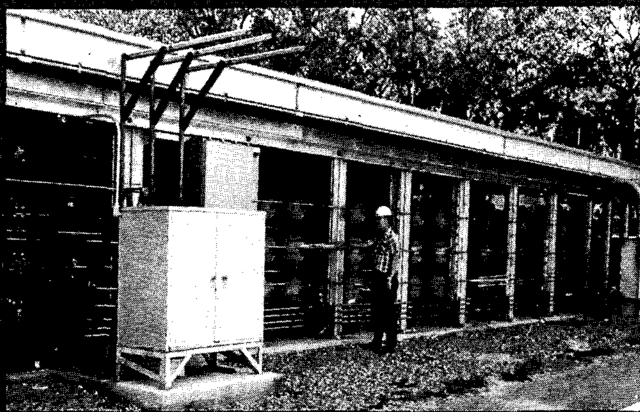
human performance studies. Two offshore platforms, in 60 and 100 feet of water, and underwater optical and radio tracking ranges are several facilities available to support naval diving development. In addition, NCSL has diving locker support for 50 divers, with recompression chambers; a model towing basin; a magnetic range; an underwater acoustic test facility; complete marine shops; dock and dockside support, including small craft; a computer center; and the Ocean Simulation Facility (OSF), which will be the largest and most modern hyperbaric facility available to the U.S. Navy. The Ocean Simulation Facility and the Experimental Diving Facility, a laboratory support building for the OSF that is presently in the design stages, will be the primary home base installations for NEDU personnel.

Already established at the OSF is LCDR Jack Ringelberg, USN, the Officer-in-Charge of the NEDU Detachment, Panama City. (See Soundings, p.4.) Also on duty for NEDU at NCSL is LT Joe Criscitiello, MSC, USN. LT Criscitiello, though assigned as the Supply and Fiscal Officer, is currently serving as the Acting Assistant Officer-in-Charge. The first civilian employee to be officially transferred from the Washington Navy Yard staff is Mr. Tom James. Effective August 15, 1974, Mr. James continues as the NEDU Equipment Specialist at the Panama City facilities.

The NEDU transition basically will be completed in three shifts. Thus far, six permanent enlisted billets have been reassigned to the OSF, with five personnel already ordered to report. In November 1974, 10 additional enlisted billets will have been relocated. The remaining personnel at the Washington NEDU, with the exception of those completing their tours in Washington, will be reporting to the NEDU Detachment, Panama City, in January 1975. Additional plans for the OSF include manned certification dives for the hyperbaric chamber complex, scheduled for late January or early February 1975.

Additional information on the relocation process will be published as events occur. The Ocean Simulation Facility and progress on the construction of the Experimental Diving Facility will be discussed in upcoming issues.

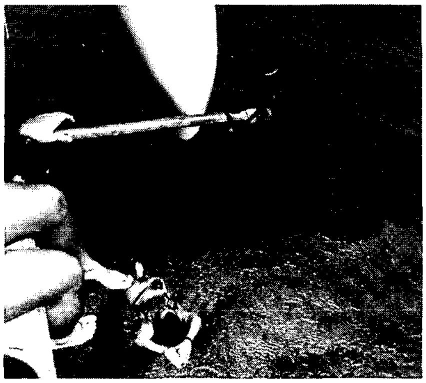




Photos at right, top to bottom: Double-lock recompression chamber is inspected by HMC(DV) White, PH3 Davis, EN1(DV1) Cole, and BMCS(MDV) Morris in Diving Locker; helium stowage tanks are located behind OSF; RADM Dietzen, CDR Jones, LCDR Ringelberg, Mr. Johnson, and LCDR Ridgewell, CF, listen to Mr. Odum during on-site assessment of NEDU transition; and Mr. Noble, RADM Dietzen, CAPT Bond, and CAPT Quinn inspect Hydrospace Laboratory facilities at NCSL.

Kampfschwimmers Visit *SEAL TWO*

LCDR Thomas L. Hawkins, USN
Navy Experimental Diving Unit



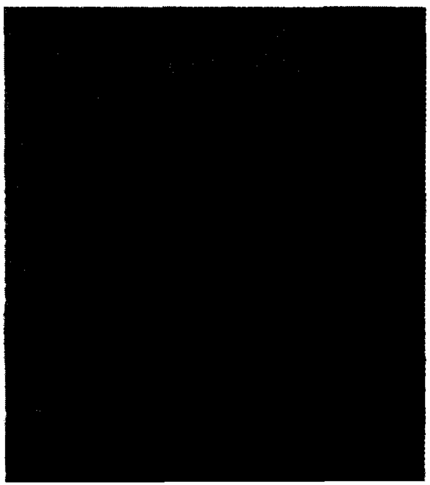
Top right: German divers swimming the Mk 10 UBA. Above: German diver drops from helo during cast and recovery operation.

Photos by Combat Camera Group, Atlantic

Twelve navy combat swimmers from the Federal Republic of Germany participated in a program of exchange training in the United States with the officers and men of SEAL Team TWO in April 1974. SEAL TWO is located at the Naval Amphibious Base, Little Creek, Virginia, and is commanded by LCDR Robert A. Gormly, USN. Two German Navy officers and ten enlisted personnel came to America as participating representatives of the Kampfschwimmer Kompanie, based in Eckenforde, FRG. German Kampfschwimmers have assigned missions and tasks similar to those of U.S. Navy Special Warfare Underwater Demolition Team (UDT) and Sea-Air-Land (SEAL) Team combat swimmers. They also perform explosive ordnance demolition type missions.

The combined scope of the SEAL training program was designed to provide the Kampfschwimmer personnel with a complete overview of Navy Special Warfare land, air, and waterborne operations, equipments, and techniques. The majority of training was conducted by SEAL TWO personnel, and included training lectures, operational instruction, and practical performance of procedures encompassing the entire spectrum of Navy Special Warfare operations.

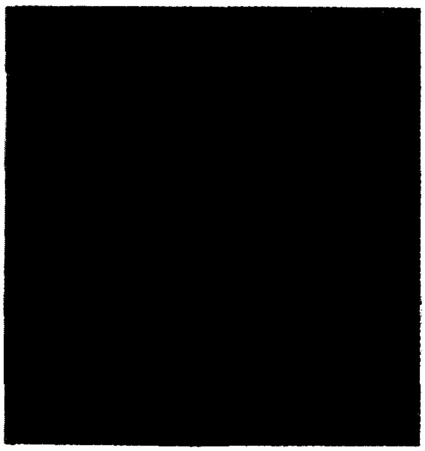
Above: GM1 Johnson, USN, and German divers prepare for Mk 10 dive. Below: German diver climbing helicopter ladder during waterborne recovery operations.



The first portion of the Kampfschwimmer training program involved an introduction to SEAL land warfare mission techniques and equipments. Training was conducted at the SEAL TWO auxiliary training facility at Camp A. P. Hill, located in Virginia. SEAL instructors presented indoctrination lectures on a wide variety of weapons and ordnance items including the M16 rifle, M60 machine gun, the AK47 rifle, sniper rifles, shotguns, and other related equipment. Ordnance training included instruction and actual use of various mines, demolition charges, and cutting and firing devices. The formal instruction culminated in practical application and use of American equipments, using SEAL operational techniques in both day and night operations.

The second portion of the Kampfschwimmer training program was conducted at the Naval Inshore Warfare Task Unit, Roosevelt Roads, Puerto Rico. During this phase the Kampfschwimmers were instructed in the use of both existing and advanced diving apparatus, submersible vehicles, various diver-carried subsystems, and USN waterborne methods of operation. Personnel were trained in the use of the Emerson and Mk VI SCUBA and the Mk 10 Mod 5 SCUBA. Other in-water operations included actual pilot operation of the Mk VII swimmer delivery vehicle, active and passive target location using the AN/PQC-2 hand held sonar, and extensive underwater demolition emplacement operations. The Kampfschwimmers also participated in air operations involving parachute delivery to objective target areas and helicopter cast and recovery-in-water operations without the aid of parachutes.

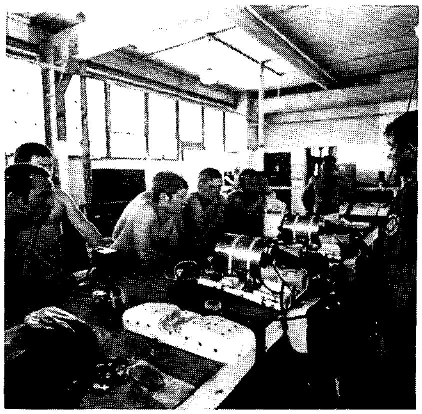
Extensive support was provided throughout the exchange training program by the Naval Inshore Warfare Command Atlantic, Operational Testing Department, the Naval Inshore Warfare Task Unit – Caribbean, the Navy Experimental Diving Unit, VC-8 Roosevelt Roads, and the Atlantic Fleet Combat Camera Group. LTJG Robert C. Mabry, USNR, was the SEAL TWO Officer-in-Charge of the training program. RM2(DV) Michael E. Fletcher of SEAL TWO was the primary interpreter assigned to the project.

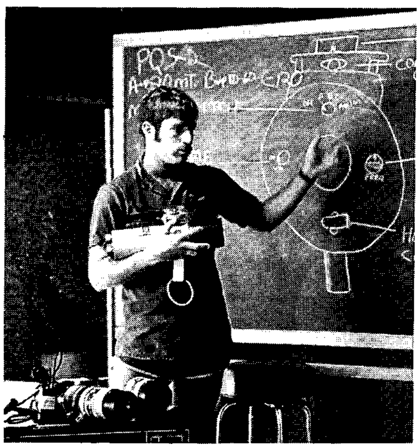


Above: German diver using PQS-2 sonar. Top center: EMCS King, USN, instructs German divers in use of Mk 10 UBA. Center: BM3 Montgomery, USN, instructs class in use of AN/PQS-2 sonar.

It was not strictly a working trip for the Kampfschwimmers. During the 4-week program, the German visitors attended social functions in the homes of several members of SEAL TWO. They each also had the opportunity to spend at least one day in colonial Williamsburg, Virginia; San Juan and other areas of interest in Puerto Rico; and at St. Thomas in the U.S. Virgin Islands.

Although the majority of the training program was tailored toward American combat swimmer equipment and techniques, the daily joint operations also provided a forum in which divers from both countries could exchange ideas on the differences and

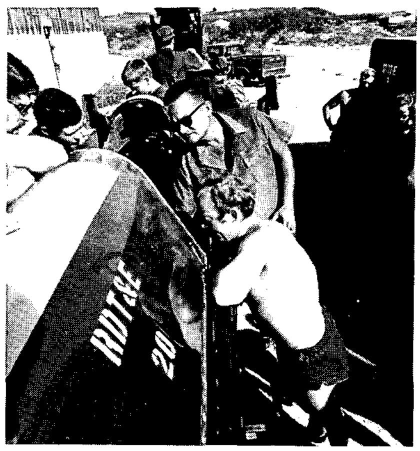




Above: LTJG Nolting, FGN, lashes detonating cord to underwater obstruction.

similarities in the performance of various tasks. In addition, the entire program provided a means of promoting and strengthening the continuing friendship that has been developing between the two countries and military organizations over the past several years.

LCDR Gormly deemed the exchange training program a tremendous success. Recommendations and plans are being formulated to expand and continue the exchange program both

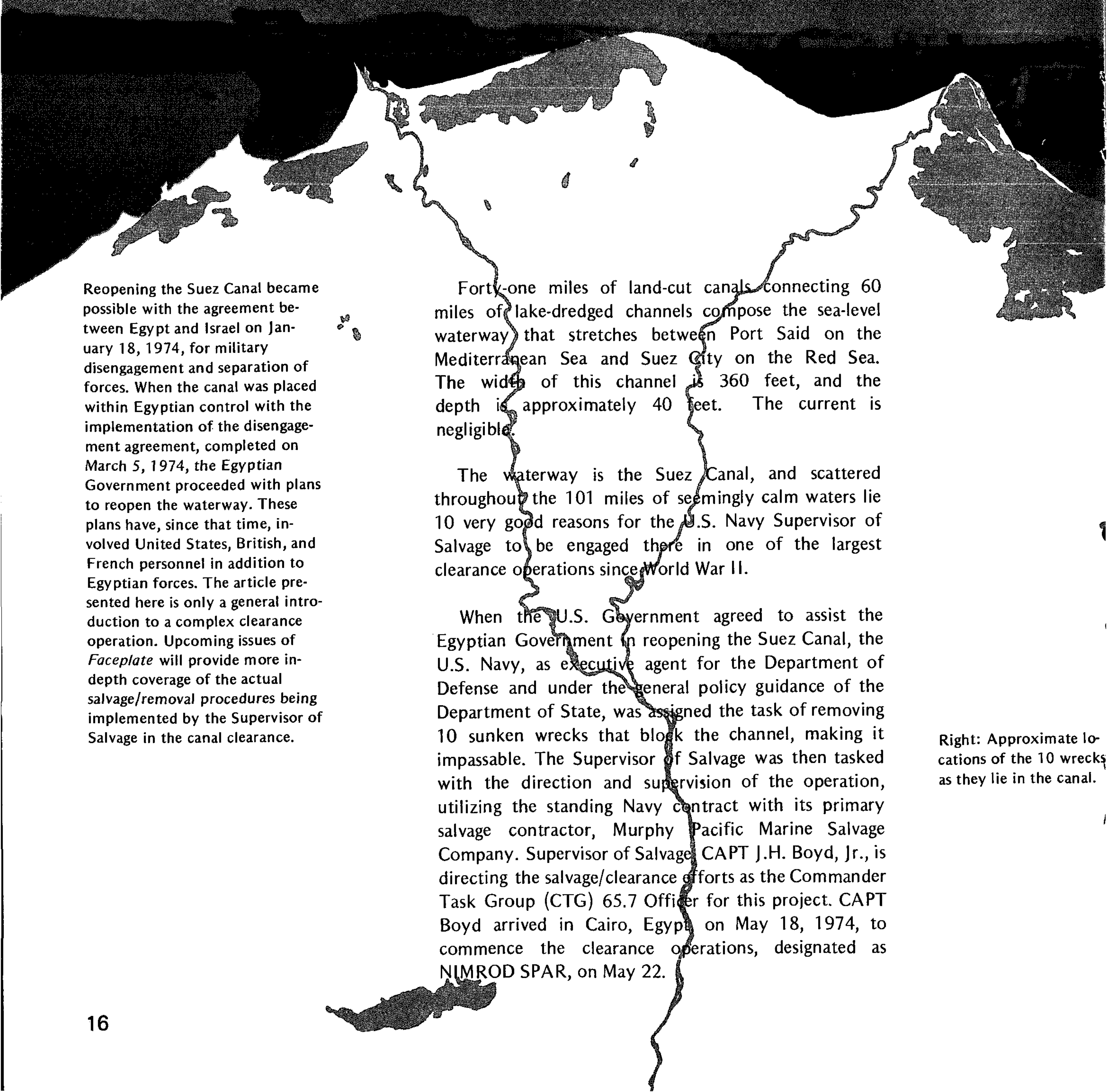


Left: RM2 Fletcher, USN, (dark glasses), translates demolition instructions to German divers. Above: BMCM(DV) Leyden instructs Germans in operation of Mk VII SDV.

in the United States and the Federal Republic of Germany. The exchange program was sponsored through the Chief of Naval Operations and the Navy Military Assistance Advisory Group – Germany.

SUEZ CANAL:

A Massive Exercise of Clearance Expertise



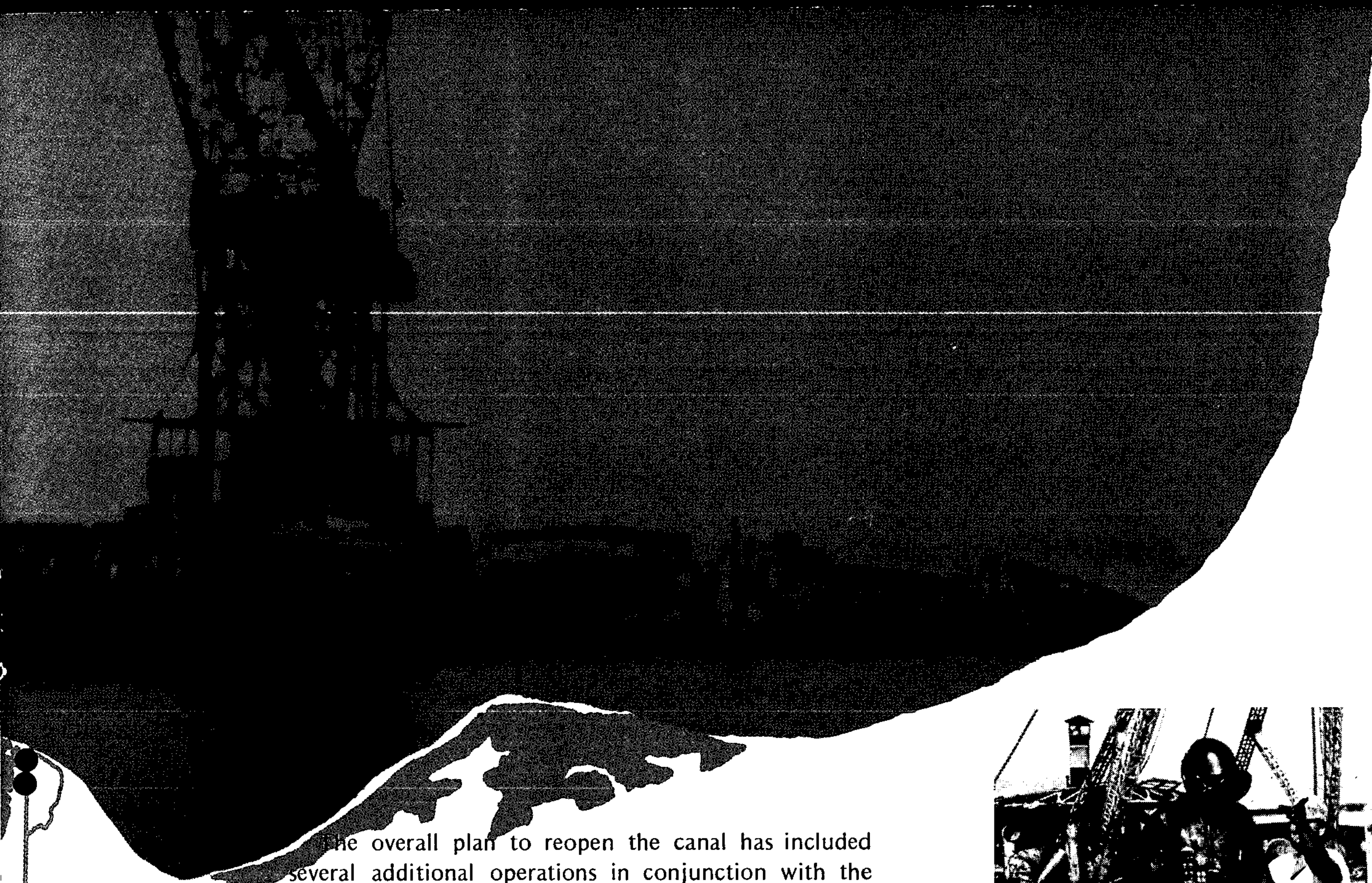
Reopening the Suez Canal became possible with the agreement between Egypt and Israel on January 18, 1974, for military disengagement and separation of forces. When the canal was placed within Egyptian control with the implementation of the disengagement agreement, completed on March 5, 1974, the Egyptian Government proceeded with plans to reopen the waterway. These plans have, since that time, involved United States, British, and French personnel in addition to Egyptian forces. The article presented here is only a general introduction to a complex clearance operation. Upcoming issues of *Faceplate* will provide more in-depth coverage of the actual salvage/removal procedures being implemented by the Supervisor of Salvage in the canal clearance.

Forty-one miles of land-cut canals connecting 60 miles of lake-dredged channels compose the sea-level waterway that stretches between Port Said on the Mediterranean Sea and Suez City on the Red Sea. The width of this channel is 360 feet, and the depth is approximately 40 feet. The current is negligible.

The waterway is the Suez Canal, and scattered throughout the 101 miles of seemingly calm waters lie 10 very good reasons for the U.S. Navy Supervisor of Salvage to be engaged there in one of the largest clearance operations since World War II.

When the U.S. Government agreed to assist the Egyptian Government in reopening the Suez Canal, the U.S. Navy, as executive agent for the Department of Defense and under the general policy guidance of the Department of State, was assigned the task of removing 10 sunken wrecks that block the channel, making it impassable. The Supervisor of Salvage was then tasked with the direction and supervision of the operation, utilizing the standing Navy contract with its primary salvage contractor, Murphy Pacific Marine Salvage Company. Supervisor of Salvage, CAPT J.H. Boyd, Jr., is directing the salvage/clearance efforts as the Commander Task Group (CTG) 65.7 Officer for this project. CAPT Boyd arrived in Cairo, Egypt, on May 18, 1974, to commence the clearance operations, designated as NIMROD SPAR, on May 22.

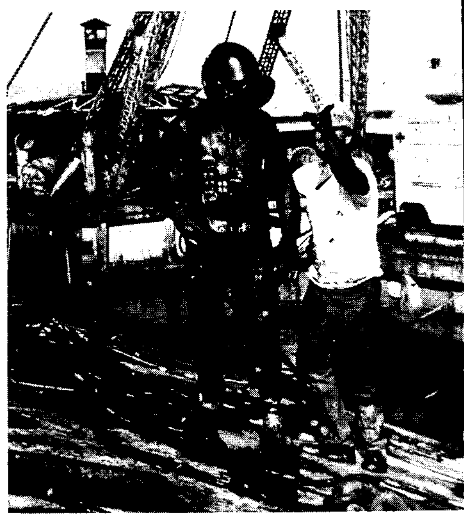
Right: Approximate locations of the 10 wrecks as they lie in the canal.



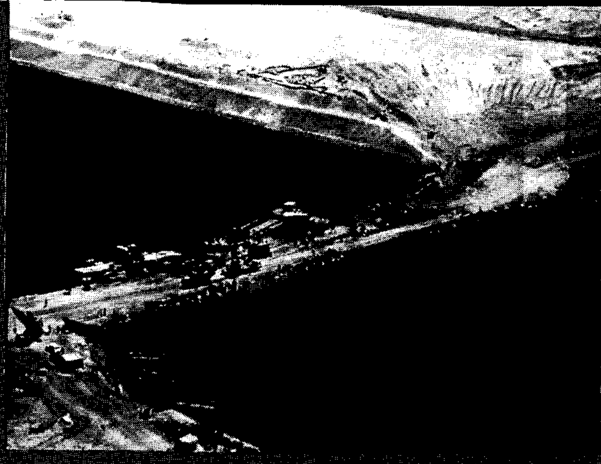
The overall plan to reopen the canal has included several additional operations in conjunction with the primary task of canal clearance.

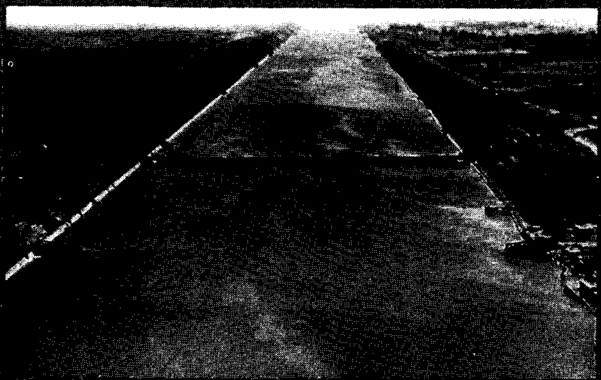
The first, designated NIMBUS STAR, involved conducting minesweeping operations to ensure that any sea mines that had been placed in the canal and its approaches were removed. It entailed the use of helicopter-towed sleds and surface minesweeping ships. The airborne mine countermeasure units used the RH-53D helicopter to tow the Mark-105 hydrofoil sled, which has both a magnetic and acoustic sweep capability. USS IWO JIMA (LPH-2) was the platform used to support the airborne mine countermeasure operation. IWO JIMA also provides administrative, logistics, and medical support. It further serves as flagship for Commander Task Force (CTF) 65 and provides the required communications facilities.

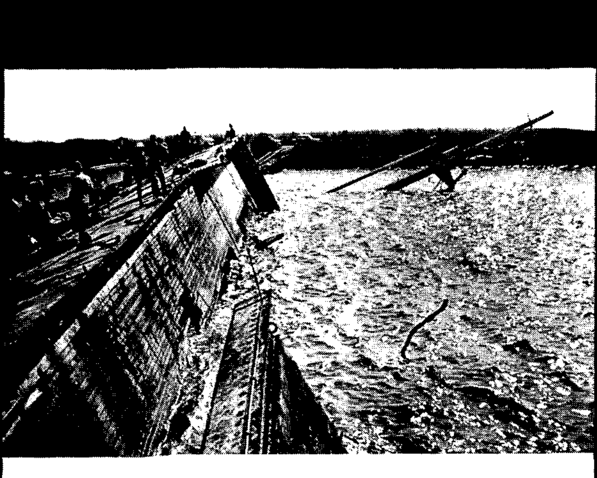
The second effort, NIMBUS MOON, concerns the removal or disposal of unexploded ordnance such as bombs, shells, land mines, or other types of explosives that might be in the canal water (NIMBUS MOON Water) or along the banks (NIMBUS MOON Land). Though U.S. personnel were actively engaged in NIMBUS STAR, they are serving only in a training and advisory role in both of the NIMBUS MOON phases. The actual physical detection, removal, and disposal of unexploded ordnance are being performed by Egyptian and United Kingdom personnel.



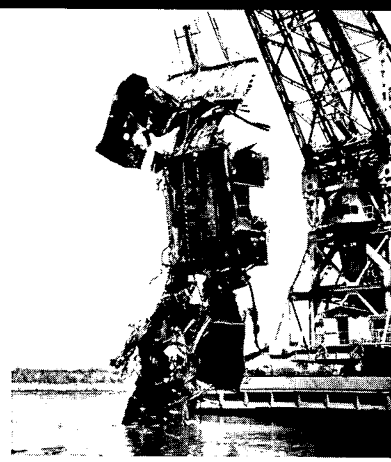
Photos show two diving scenes during the MECCA removal operations.







Left, top to bottom: Removal of Deversoir Causeway; pontoon bridge across canal; top posts of Dredge KASSAR show above water line at bottom of photo; close-up deck view of sunken MECCA. Right: Wreckage being lifted by 80-ton crane.



The clearance of unexploded ordnance within the canal in the NIMBUS MOON Water phase was commenced on May 1, 1974. The Egyptian divers have been trained by U.S. Navy EOD personnel, and they are working in conjunction with the Royal Navy Fleet clearance diving team. U.S. Navy minehunting forces have been working north, up the canal, while the three-ship Royal Navy surface minehunting group has been searching south from Port Said. Each group will then double-check the other's finding when they pass in the canal.

Clearance of ordnance along the canal banks (NIMBUS MOON Land) commenced concurrently with the minesweeping effort. As in the Water phase, actual land clearance operations are performed by Egyptian personnel, who are provided with U.S. equipment and trained by U.S. Army EOD experts.

In order to effectively manage the canal clearance operations, a mine countermeasures task force, Task Force 65, was established under the command of RADM Brian McCauley, Commander, Mine Warfare Forces, to conduct on-scene operations. RADM McCauley, who also directed U.S. minesweeping operations off North Vietnam, was relieved on the final day of the NIMBUS STAR minesweeping effort in early summer by RADM Kent Carroll, who now serves as Commander Task Force (CTF) 65. Task Force 65 is a component of the U.S. SIXTH Fleet, commanded by VADM Daniel Murphy. CTF 65 coordinates and supervises all phases of the canal clearance operation, including NIMBUS STAR, NIMBUS MOON, and NIMROD SPAR. It is an intricate project of interdependent programs. The progress of NIMBUS STAR and NIMBUS MOON has had and still has a direct bearing on the salvage schedule of NIMROD SPAR, because working areas around each wreck and adjacent land areas must be cleared before clearance operations can begin.

MECCA lies in foreground, with SCA crane located behind it. Right: Wrecks are listed as they lie in the canal, north to south.

NIMROD SPAR involves the removal of 10 sunken obstructions that make the canal impassable. In addition to calling in its primary salvage contractor, SUPSALV is using two heavy lift craft (YHLC 1 and 2) and two 1,000-ton Bugsier shear-leg cranes (leased out of Bremerhaven, Germany) as its primary assets in the canal clearance.

The 10 wrecks lie in various positions and depths from one end of the canal to the other. Several pontoon bridges and an earth causeway are also scattered down the waterway, and are being removed in conjunction with the major clearance operations.

Each wreck presents a unique situation; however, two of the structures have additional considerations that must be taken into account when removal plans are formed, the concrete CAISSON and DREDGE 15.

The concrete CAISSON, located approximately half-way down the canal, threatens to be somewhat more difficult to remove than most of the other wrecks. The CAISSON has a continuous crack around its girth at mid-length, and it quite possibly could break in two unless a precise balance of buoyancy and weight is maintained. In addition, it lies 93° from upright, which is not enough to contain a sufficient air bubble to complete overturning it to a position from which it would float upside down without massive patches to retain air.

DREDGE 15 is the only structure for which the Suez Canal Authority (SCA) has hopes of rehabilitation. Inspection of this vessel revealed that it was sunk just by the opening of valves alone, without use of explosives; therefore, there is less structural damage than in the other wrecks. The main problem in salvaging DREDGE 15 will be to right the vessel from its current 90° orientation without causing major damage.

CARGO ISMAILIA

ATTITUDE – SIDE
WEIGHT – 1000 TONS
SIZE – 345' X 44'

PASSENGER SHIP MECCA

ATTITUDE – SIDE
WEIGHT – 4600 TONS
SIZE – 438' X 60' X 50'

DREDGE 23

ATTITUDE – SIDE
WEIGHT – 1600 TONS
SIZE – 191' X 40'

TUG MONGUED

ATTITUDE – UP
WEIGHT – 1200 TONS
SIZE – 165' X 32'

DREDGE KASSAR

ATTITUDE – UP
WEIGHT – 1200 TONS
SIZE – 125' X 44'

CONCRETE CAISSON

ATTITUDE – SIDE
WEIGHT – 3800 TONS
SIZE – 203' X 44' X 40'

DREDGE 15

ATTITUDE – SIDE
WEIGHT – 2000 TONS
SIZE – 200' X 44'

TANKER MADG

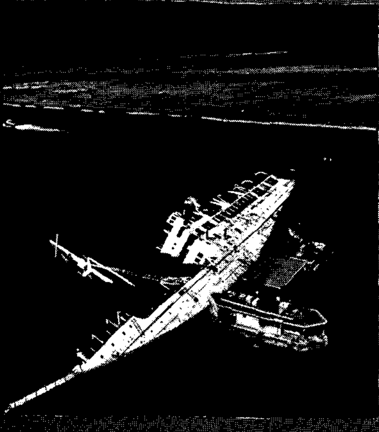
ATTITUDE – SIDE
WEIGHT – 2400 TONS
SIZE – 358' X 48'

TUG BARREH

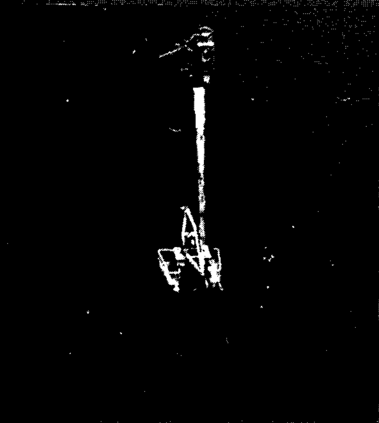
ATTITUDE – UP
WEIGHT – 1200 TONS
SIZE – 165' X 32'

DREDGE 22

ATTITUDE – UP
WEIGHT – 1500 TONS
SIZE – 175' X 41'

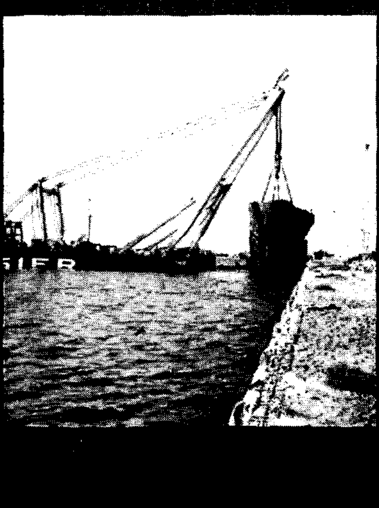


Aerial view of passenger ship MECCA blocking Suez Canal. Work barges are right of ship.



Dredge KASSAR, lying east-west with a list of 30° to the port side. KASSAR lies immediately west of tug MONGUED, halfway down the canal.

Tug BARREH rests in an almost completely sunken position in southern end of the Suez Canal.



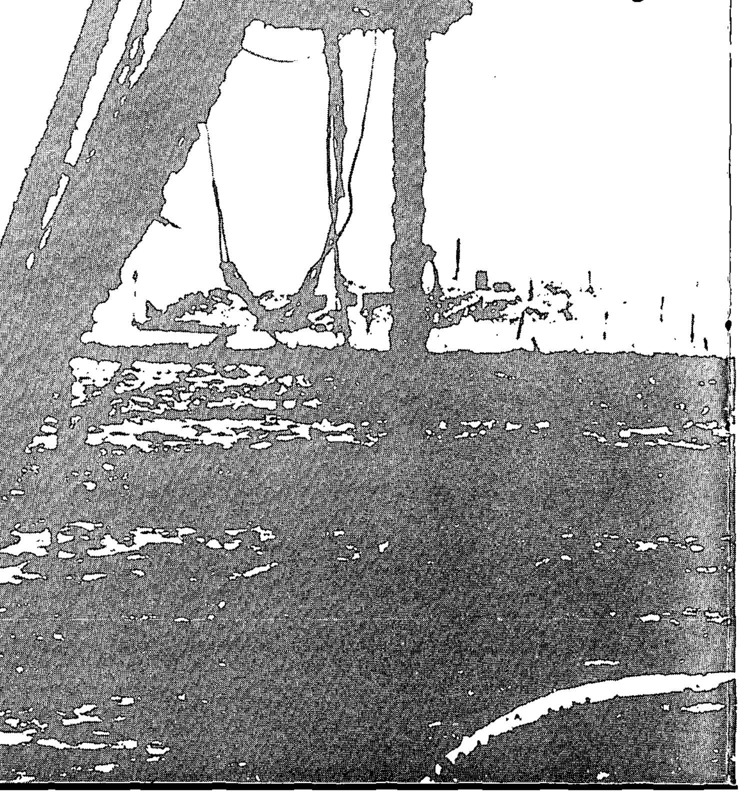
Bow of ISMAILIA is shown being lifted by 1,000-ton shear-leg crane, THOR, onto the bank dump area along the canal.

The overall clearance plan calls for the two Bugsier cranes (THOR and ROLAND) to begin removal operations in the northern end of the canal, while YHLC 1 and 2 commence their lifting in the southern half. Both sets of equipment have arrived in their respective starting locations.

Cutting began on ISMAILIA and MECCA at the end of May, using both oxy-arc and explosive methods. The decision to use explosives on the comparatively small ISMAILIA was based largely on the grounds that it would provide ideal training for those divers unfamiliar with explosive cutting. The experience gained there will be invaluable on the much more difficult work to come on other wrecks, where explosives must be used. Both the bow and stern sections of ISMAILIA were lifted at the end of August and placed on the designated bank dump area by the Bugsier crane THOR. An 80-ton crane belonging to the SCA has also been employed for lighter lifts.

The YHLCs proceeded from Suez City to the tug MONGUED on August 26, in preparation for the first "whole ship" lift. After successfully depositing the tug in the Great Bitter Lake wet dump area on September 12, the heavy lift craft moved to their next operation, the lifting of the dredge KASSAR.

The canal clearance operation has been, and continues to be, a complex task. At the present stage, a December 1, 1974, date has been established for project completion and demobilization. In the upcoming issues, *Faceplate* will be expanding on the salvage/removal procedures that are now being implemented.



Sunken Dre… From Busy Shipping Channel

Explosive cutting during removal operations.

The U.S. Supervisor of Salvage was called upon once again to use its salvage and oil pollution expertise, in this case to clear a vital ship channel and prevent an imminent pollution incident that was threatening the surrounding waters.

The hopper dredge A. MACKENZIE, owned and operated by the U.S. Army Corps of Engineers, was involved in a three-vessel collision in the Houston ship channel just off Galveston, Texas, while performing maintenance dredging in the approach channel, upbound, on April 24, 1974. The MACKENZIE suffered major damage in the starboard quarter and, within 20 minutes, sank to the bottom. The current in the channel caused the dredge to turn crosswise as she sank, blocking the north half of the only shipping lane to the port of Galveston, Texas City, and Houston. Fortunately, all 54 crew members of the dredge escaped the incident, with only four minor injuries reported. The other two ships involved, the small research vessel IDA GREEN and the Norwegian chemical tanker BOW ELM, both sustained bow damage but continued under their own power to nearby repair facilities.

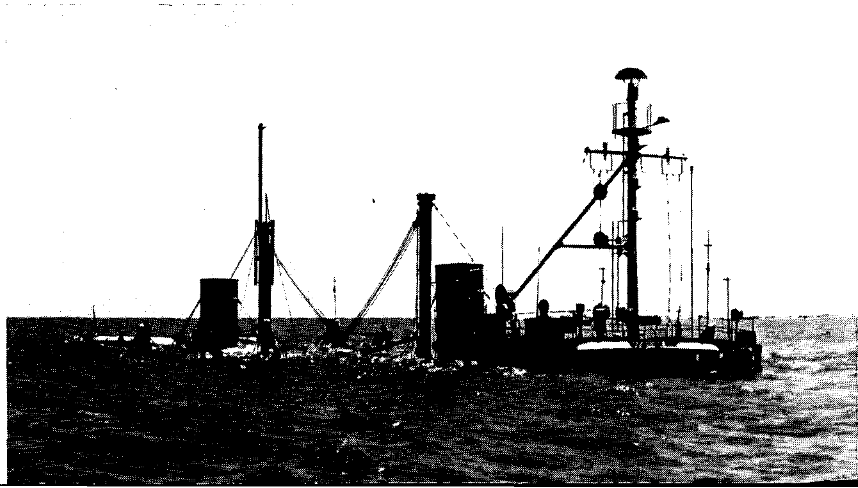
The MACKENZIE sank in a nearly upright position in 42 feet of water, athwart the east half of the 800-foot-wide main ship channel. Ship traffic continued on a limited basis through the south half of the channel and through a temporary bypass in the anchorage area to the north. Nevertheless, the hulk of the MACKENZIE constituted a serious navigational hazard to the heavy concentration of ships serving this highly industrialized area of Texas.

On May 7, 1974, the District Engineer of the U.S. Army Corps of Engineers in Galveston, Texas, officially requested salvage assistance from the Navy Supervisor of Salvage. SUPSALV was tasked to remove the dredge from the navigation channel as quickly as possible, with minimum risk to personnel and surrounding environment, utilizing assets available through the Corps of Engineers, the Navy, the Navy's primary marine salvage contractor (Murphy Pacific Marine Salvage Company), and subcontractors as necessary.

A wreck-in-salvage plan was adopted as the most expedient and appropriate for the successful completion of the channel clearance operation. SUPSALV's MACKENZIE Project Manager, Mr. James Walker, and Murphy Pacific's Salvage Master, Captain Cyrus Alleman, arrived in Galveston on May 5 to finalize the operational plans. Colonel Don McCoy, District Engineer, and Mr. James Bissell, MACKENZIE Project Engineer, represented the Army Corps of Engineers in the operation. Mr. Walker was later succeeded by LCDR Charles Bartholomew, USN, Assistant for Salvage for SUPSALV.

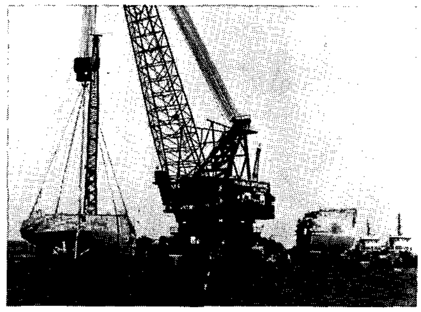
A work barge was prepared and anchored in place over the wreck on May 7, and divers began detailed inspections of the damage before commencing vessel cutting and recovery operations. By this point, MACKENZIE had settled 2 or 3 feet and water was washing the top of the

MACKENZIE rests on bottom of Galveston Channel after a three-vessel collision.



Left, left to right: LCDR Chuck Bartholomew and Jim Walker, SUPSALV Project Managers, with Mel Cotter of Technical Explosives, Inc., inspect explosives.

Right: The 360-ton stern section is lifted by DB-2 crane, to be placed alongside bow on barge.



bridge, which previously had stood above water. All diving operations performed were surface supplied, using band masks or Desco-type hardhats with wet suits. Take-home bottles were also worn when divers worked within the wreck.

On May 10, the U.S. Navy's 17-ton oil skimmer arrived from Boston, Massachusetts, commencing the oil pollution abatement phase of the MACKENZIE operation. While the buoys used to help secure the oil containment boom were anchored in place by the Coast Guard, work continued on the removal of all top hamper.

The wreck, while being encircled with the oil boom, was slowly being cut into pieces that could be handled by the 50-ton crane on the work barge. MACKENZIE's two stacks had been cut and converted into diving platforms and were used as cofferdams, permitting diver access to the inside of the dredge. One of the first sections removed was the drag tenders' quarters, which was cut loose by divers and secured to the crane slings.

Weather conditions secured diving operations on several occasions throughout the salvops. Winds were estimated upwards of 50 knots, with the accompanying high tides adding to the difficulties. Currents ranged up to 4-1/2 knots at the wreck site. Weather permitting, though, the salvage crews worked 24-hour days, 7 days a week, to remove every piece of the ship from the channel and eliminate the danger to navigation as soon as possible.

Underwater cutting on the hulk thus far in the operation had been conducted using oxy-arc equipment. On June 1, though, after special precautions were made to ensure minimum environmental damage, the site was ready for the first detonation of shaped demolition charges. Using a mix of both oxy-arc and explosive techniques, the cutting/salvage operations progressed, following a salvage plan to remove the MACKENZIE's hull in eight 200- to 500-ton sections during three major lifts. Approximately 7,000 pounds of tubular cutting rod and 1,850 pounds of C-4 explosives were used during the salvage operation. Large lifts involved the use of 2-1/4-inch die lock beach gear chain, which was reeved through heavy structural members in each section. Divers then shackled the chain end links to the derrick lifting slings. During all major lifting operations, shipping was restricted to the south half of the main channel to prevent passing ships from hitting the 1,700-foot-long anchor cables of the large offshore derrick barge, Movible DB-2.

On June 24, Movible DB-2, with its 600-ton "Whirley" crane, arrived in Galveston for the first lift. The 300-ton bow section was the first major section to be rigged to the derricks' cables. The lift was delayed temporarily because one of the 2-1/2-inch lifting cables had a partial failure. Working into the night, the lift was rerigged, and the bow was partially lifted out of the water. Workmen went aboard the bow to remove the anchor chain and anchor hoists and jetting pumps were used to wash sediment off the section to reduce its weight. The stern section lift was also delayed when a partial failure of the 2-1/4-inch chain was detected. After rerigging, the 360-ton stern section was retrieved from the channel bottom and was placed alongside the bow on a scrap barge.

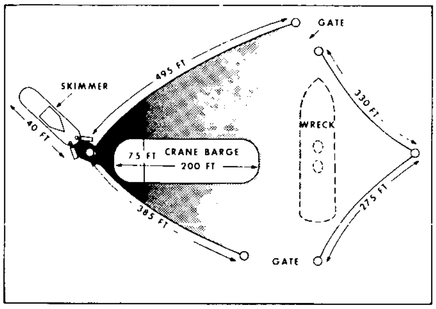
The difficulties encountered in salvaging the bow and stern sections resulted in the decision to make longitudinal cuts along five of the remaining six sections. Each section would then be lifted in two increments, increasing the remaining number of lifts to 11. The lighter sections were deemed necessary to provide reserve lifting capability to compensate for rigging limitations, heavy mud accumulations, and the possibility of structural involvement with adjacent sections. This decision was proved to be sound when the second (involving four lifts) and the third (with seven lifts) phases were completed in 17 and 28 hours, respectively, without problems.

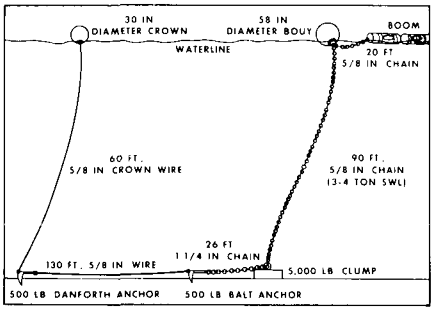
After the final section was salvaged on August 20, divers spent an additional week conducting a thorough inspection and cleanup of the channel bottom. Salvops were terminated successfully on August 30, and the Army Corps of Engineers commenced their preparations for opening the channel to all shipping.

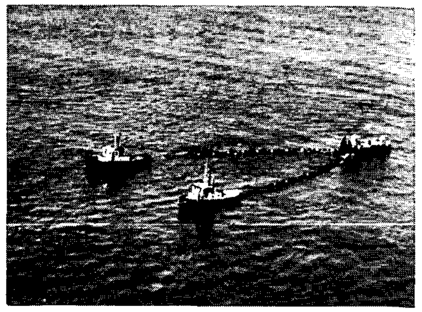
OIL POLLUTION ABATEMENT

Mr. William A. Walker
Office of the Supervisor of Salvage

The Supervisor of Salvage had also agreed to provide the pollution abate-







ment services to the Army throughout the MACKENZIE removal effort. Much of the vessel's 29,000 gallons of on-board diesel fuel escaped when the vessel sank. The remaining fuel and 3,400 gallons of lube oil remaining in the sunken vessel presented the threat of continuing pollution in the channel as the removal operation began.

The MACKENZIE pollution abatement plan included deploying oil containment boom around the salvage site and maintaining a self-propelled oil skimmer in standby at the site. Remaining diesel fuel would be pumped from the sunken vessel into a fuel barge positioned alongside the salvage platform. The numerous small lube oil tanks were to be blanked-off and removed intact as the clearance operation progressed. The boom and skimmer would remain in operation as required throughout the removal effort to deal with any residual oil that might escape during the cutting or lifting efforts. Throughout formulation and implementation of the pollution abatement plan, on-scene Army and Navy representatives maintained close liaison with the U.S. Coast Guard, state and federal environmental protection agencies, and the news media.

SUPSALV Representative Mr. Richard Asher designed and supervised the installation of the boom and the mooring system required to hold the boom in position against the strong tidal currents. In the initial configuration (illustrated above), 1,485 feet of Clean Water offshore boom was employed. Later in the operation, though, a slightly different configuration included one 300-foot leg of Bennett offshore boom.

The oil containment boom was positioned to direct (or funnel) escaping fuel or lube oil to a single point for collection by the skimmer under whatever the prevailing current conditions were. The two boom "gates" were necessary to permit crew boat and tug access to the salvage platform (crane barge), as shown above left.

The tremendous forces generated by the swift tidal currents against the boom necessitated continuous maintenance of the system following initial installation. Even with constant supervision, though, 25 sections of the 40 sections of 55-foot boom installed were damaged to some degree, 10 of these beyond repair. Five of the six mooring legs, initially consisting of a single 500-pound anchor and a 5,000-pound clump anchor, failed to hold in the sand/clay bottom. The addition of a second anchor where space permitted (see illustration above) improved the holding power, as did the employment in one case of a single 3,500-pound anchor and 6,000-pound clump. Following periods of particularly heavy tidal currents, however, it was still necessary to haul one or more of the mooring legs back into position using the appropriate crown wires.

The Navy's JBF "DIP 3003" skimmer (see *FP*, Summer 1974) was operated with the "sweeps" deployed to funnel oil and surface debris into the skimmer. When necessary, a wide path was "swept" by towing the skimmer behind two boom legs in a "V" configuration, as shown above.

The MACKENZIE's fuel tanks were successfully offloaded on May 17 and 18, with no fuel escaping to threaten the environment. The salvage/removal operation proceeded smoothly, with only an occasional spill of several gallons of the residual fuel or lube oil remaining in pipes or trapped within certain compartments. These oil spills, released during cutting operations, were recovered by the Navy skimmer.

By mid-July, following the first series of heavy lifts and extensive explosive cutting in the machinery spaces, it became evident that the MACKENZIE no longer presented the threat of even a minor pollution incident. On July 18, demobilization of the pollution abatement system began.

The removal of the A. MACKENZIE did not present Navy and contractor pollution abatement personnel with an incident that fully tested their on-scene containment and collection system. Much valuable knowledge and experience was gained, however, particularly in handling and mooring the containment boom under swift current conditions. The SUPSALV pollution abatement branch also had the opportunity to evaluate recently procured boom systems and a prototype open-ocean skimmer. Lessons learned in Galveston should prove extremely valuable in increasing Navy preparedness for future oil pollution incidents.

USS GRASP Recovers F4J Aircraft in Subic Bay

LCDR Robert Hillis
Commanding Officer
USS GRASP (ARS-24)

A successful deep water aircraft salvage recovery was accomplished recently by USS GRASP (ARS-24), using a combination of the USN Mk 1 diving rig and bottom-scanning sonar equipment. On June 4, 1974, a Marine F4J aircraft crashed in Subic Bay, Republic of the Philippines. The pilot and radar operator ejected safely prior to the crash, but recovery of the wreckage was desired by the Marine Corps for accident analysis investigation. USS GRASP (ARS-24), on standby salvage duty at Subic Bay, was tasked by CTF 73 with the recovery.

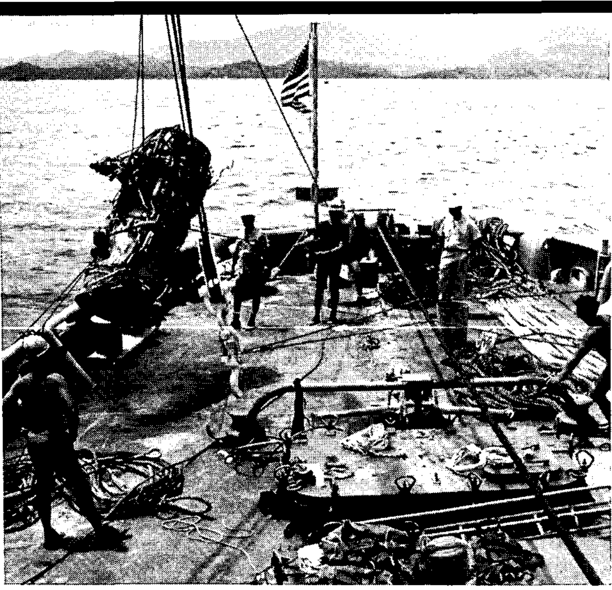
Salvage of the aircraft wreckage was complicated by the lack of specific information regarding the crash location and by water depth in the general area, which averaged 150 feet. Only rough estimates by two sailors at opposite ends of the runway at Cubi Point were available to establish the point of impact of the aircraft.

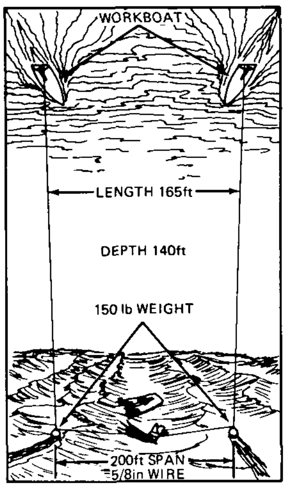
In recognition of the problems presented by the water depth and the large area to be searched, GRASP requested authority from the Chief of Naval Operations to dive the new USN Mk 1 Diving Mask to 150 feet using a come-home bottle but not the roving bell, which was unavailable in the area. Simultaneously, CTF 73 initiated action to have a bottom-scanning sonar with the supporting equipment and technicians flown to the scene.

The area in which the aircraft wreckage was expected to be located exceeded 2 square miles; thus, diver search in 150 feet of water was impractical. A weighted drag wire was suspended from the two GRASP workboats, and on June 6, dragging operations were initiated. Dipping sonar helicopters from Helicopter Squadron FOUR at Cubi were also brought in, but were unable to locate the aircraft wreckage. On June 8, however, the aircraft tail section was snagged by the drag wire.

GRASP then assumed a two-point moor over the tail section wreckage and commenced diver recovery operations using the Mk 1 rig (for which the requested waiver had been received from CNO). The full worth of the Mk 1's ease of suiting up and maneuverability in the water became obvious after the tail section was recovered. The attributes became even more important when subsequent dives in the vicinity revealed only small scattered debris, indicating that the wreckage was strewn over a considerable area. The number of search dives conducted using the Mk 1 far exceeded those that would have been possible with the cumbersome Mk V diving rig.

Since the bottom-scanning sonar had not yet arrived on the scene, dragging efforts were continued while diver search was also conducted in the area of the tail section recovery. GRASP relaid the two-point moor several





Top: Wreckage is placed on GRASP's fantail. Left: Artist's concept of underwater dragging operations. Right: Diver returns from wreckage search.

times to expand the area the divers could investigate. Bottom visibility was poor, varying from 0–10 feet during the search. Under these conditions, the inefficiency of this method of search was frustratingly obvious, and efforts to obtain the bottom-scanning sonar search equipment were accelerated by CTF 73. To impede the operations further, Typhoon Dinah was threatening the Philippines, and on June 10, GRASP was forced to break moor and prepare for departure. Operations could not then be resumed until June 13, because wave and swell action in the bay precluded accurate diving decompression stops. On June 15, the civilian contractor technicians and bottom-scanning sonar finally arrived at Subic.

The scanning sonar equipment consists of a sonar "fish," a paper recorder readout device, and radio navigational transponders used for precise location information. The power source for the equipment is made up of 12-volt portable wet cell batteries. The "fish" was towed by a GRASP workboat, with the readout device set up in that same boat. The complete system is quite small, light, and easily portable. Only two transponders were required for this search. Approximately 24 hours were necessary to put the system in operation.

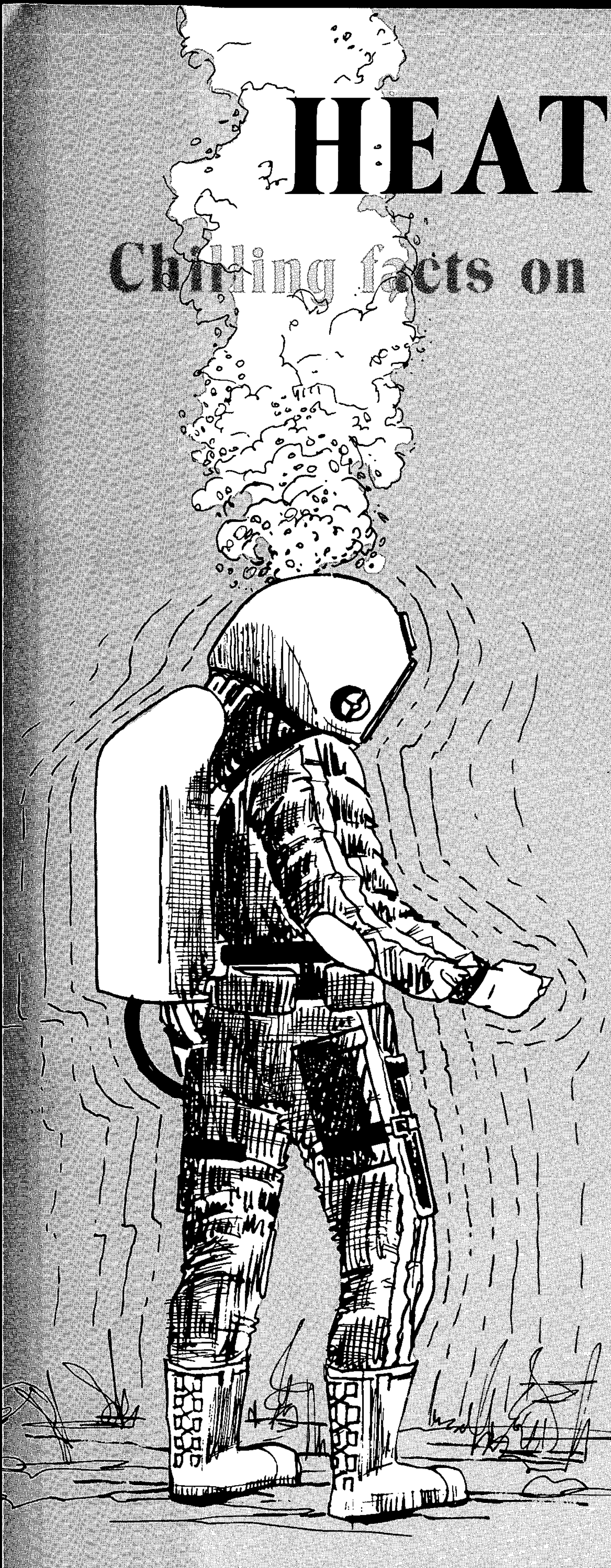
Meanwhile, since the diving operations had been resumed on June 13, GRASP divers had recovered additional aircraft wreckage; but the bulk of the wreckage still had not been located. The divers did locate the bulk of the remaining wreckage on the morning of the 16th, however, before utilizing the scanning sonar. The bottom-scanning sonar became operational that afternoon and in a matter of hours confirmed that GRASP was moored over the remaining wreckage, so that further search would not be necessary. Considering the bottom visibility and other environmental conditions affecting diver search procedures, this was valuable information.

Using the Mk 1 mask, GRASP divers successfully recovered all the aircraft wreckage necessary for an Accident Investigation Board analysis. Forty-eight Mk 1 dives were conducted, using 56 hours and 48 minutes, during which no diving accidents were experienced. Average bottom time was 70 minutes, at an average depth of 142 feet. The Mk 1 Diving Mask did prove its usefulness at depths below 130 feet without using the roving bell; however, had the bottom-scanning sonar been available at the commencement of the operation, a week of laborious search would not have been necessary. Instead, the recovery could have been completed in a matter of days. The bottom-scanning sonar demonstrated a tremendously impressive capability to quickly "read out" a bottom and precisely locate the desired object.

The successful completion of this operation, considering the numerous impediments, did show that the combined use of the USN Mk 1 diving rig with bottom-scanning sonar equipment offers the prospect of easier, quicker, and more efficient deep water aircraft salvage recovery in the future.

HEAT LOSS IN

Chilling facts on exposure to cold . . .



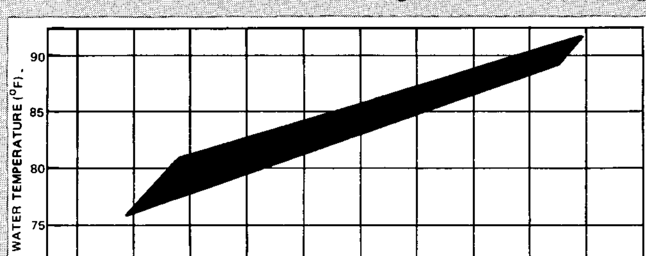
CDR William Spaur, MC, USN

Navy Experimental Diving Unit

In addition to decompression considerations, thermal problems arising from exposure to cold water or cold helium-oxygen pose the major consideration in operational dive planning and the major occupational hazard for divers. In fact, being uncomfortably chilled at the end of a dive has almost become an accepted condition for divers. Knowledge of the characteristics and the quantity of heat loss may be as important as the consideration of the decompression tables. A repeat dive without complete rewarming could have serious dangers, just as repeat dives have had on previously absorbed inert gases that have not been given off during the surface interval.

Cold Water Exposure

The rate of body heat loss in water is many times greater than in air because of the difference in the specific heat of water and air and the thermal conductivity of water. The accompanying graph illustrates an approximate water temperature that would cause the same amount of heat loss experienced in cold air; e.g., an unprotected diver experiences the same heat loss while diving in 80°F water as he would standing unclothed in 42°F air. Few would go outside in a bathing



DIVERS:

suit when the temperature was 42°F, yet divers consider 80°F water very comfortable. A water temperature of 91°F is required to keep a resting man at a stable temperature, neither gaining nor losing heat.

The ability of the body to tolerate cold environments is due to natural insulation and the body's built-in means of heat regulation. Usually, the body temperature is thought of as being 98.6°F, but in fact the temperature is not uniform throughout the body. It is more accurate to consider the body with an inner core, where a constant or uniform temperature prevails, and a superficial region, through which a gradient exists from the core temperature to the body surface. Over the trunk of the body, the thickness of the superficial layer may be approximately 1 inch. The extremities become a superficial insulating layer when their blood flow is reduced to protect the core.

Maintenance of core temperature within fairly close limits is important in the maintenance of normal organ function, especially in regard to the heart and brain. The simplest way to consider the temperature "system" is to think of the human body as having a certain amount of stored heat with gains and losses of heat added or subtracted. The temperature of the core will remain constant when the gains and losses are equal.

Changes in this stored body heat are made primarily through three mechanisms. First, there is a relatively small and constant basal metabolism to which the heat production associated with physical exercise or shivering is added. Severe exercise may increase heat production 20 times the basal level. Shivering is a special form of muscular activity aiding the body in maintaining its core temperature during exposure to cold; at its maximum, it may produce approximately five times the heat of the basal metabolism. The second factor affecting the body's core temperature is heat loss to the environment, which occurs by radiation, conduction, and convection, methods by which any warm object loses heat to its cooler environment. The third method is heat lost through evaporation from the skin and the evaporation of water to moisturize the air drawn into the lungs.

The insulation between the body core and the environment normally involves three components for a diver. The first is the surface layer of the body. The built-in insulation of the body depends largely on subcutaneous fat. When the limbs are under physiological control protecting the body from heat loss, the length of the limbs insulates the extremities from the core. The second element is a layer of air, helium-oxygen, or water that is trapped on the surface of the skin. The third component is a layer of clothing, which may be thermal underwear, foamed neoprene, or rubberized canvas. Nearly all practical forms of external insulation depend upon air which, with its low specific heat and heat capacity, approaches the ideal provided it is immobilized. Thus, the physiological function of protective clothing or suits is to trap and immobilize air both in the fabric and between its layers. The temperature gradient from the diver's skin to his protective clothing may be diminished or even made positive by heating. Electrically heated underwear or circulation of hot water through the suit are methods of adding heat to the diver.

Once in the water, man becomes largely dependent on internal mechanisms to limit the loss of body heat if no supplemental heating is provided. Any variations in the effectiveness of these mechanisms, which would be of minor importance in air, lead to great differences in the ability of different people to maintain heat balance in water.

Heat loss through the superficial layer is lessened by the reduction of the blood flow in the skin. This automatic, cold-induced vasoconstriction (narrowing of the blood vessels) lowers the heat conductance of the superficial layer and acts to maintain the heat of the body core. Unfortunately, vasoconstrictive regulation of heat loss has only a narrow range of protection. When the extremities are initially put into cold water, the usual vasoconstriction occurs and the blood flow is cut off to preserve body heat. After some time though, the blood flow increases and fluctuates up and down for as long as the extremities are in cold water. As vessel dilation occurs and heat loss increases, the body temperature falls and may continue falling even though heat production is increased by shivering. This effect, called *cold vasodilation*, occurs only in water colder than 50°F and appears to be caused primarily by direct cold paralysis of blood vessels in the skin. Protective clothing is beneficial in this instance because it's insulating properties may keep the skin temperature sufficiently above the surrounding water temperature to prevent or delay cold vasodilation.

Much of the heat loss in the trunk area is transferred over the short distance from the deep organs to the body surface by simple physical conduction, which is not under any physiological control. Most of the heat lost from the body in moderately cold water, therefore, takes place from the trunk and not from the limbs. Heavy-set men lose much less heat from the trunk than do thin men because of the insulating properties of thick subcutaneous fat.

Normally, exercise increases heat production and increases body temperature in dry conditions. Paradoxically, however, exercise in cold water may make the body temperature fall more rapidly. This is not caused by just the water movement around the subjects, but also by the increased blood flow into the limbs during exercise. Continual movement makes the limbs more closely resemble the internal body core rather than the insulating superficial shell. Shivering is a muscle activity that in effect is similar to exercise; it increases heat production but also increases the susceptibility to heat loss in cold water. These two conflicting effects result in the core temperature being maintained or increased in warm water and decreased in cold water. Maximum shivering will just maintain heat balance in an average subject in a water temperature of approximately 60°F.

A diver must understand that to increase his heat production three or four times by shivering requires an equivalent increase in oxygen consumption. Further, the minute ventilation of the lungs must also increase by the same magnitude. If a diver is breathing 12 liters of air per minute at rest in the water and he becomes chilled and his heat production must increase three times to compensate for his chilling, then his respiratory ventilation will have to increase to 36 liters per minute. In this example, the diver would have the same air consumption at rest keeping warm as he would have had if he were performing moderate work in warm water.

If a man with no thermal protection at all is suddenly plunged into very cold water the effects are immediate and rapidly disabling. There is a sudden inspiratory movement followed by a period of increasing respiratory rate and an increasing tidal volume. The breathing is rapid, with breathing control involuntary, so the swimmer cannot coordinate his breathing and swimming movements. This lack of breathing control makes survival in rough, cold water very unlikely. In freezing water, collapse from exhaustion occurs within 1 to 15 minutes, depending somewhat on the fatness of the swimmer.

If the water is not too cold, or if the diver has some thermal protection, vasoconstriction prevents body heat loss, maintaining the core temperature for some time. If the water temperature is below 50°F, however, vasodilation starts even in heavy-set men, and the blood flow bypasses the body's superficial insulating shell. As blood again flows in large quantities to the cold extremities, it causes a dramatic loss of insulation, and the body temperature falls rapidly.

All of these factors weigh against the diver, with the rate of heat loss depending on the severity of his exposure. Even his natural insulation and the body's own protective functions give way to especially cold water. The diver's thinking ability becomes impaired, and the effect of this impairment on the use of his hands and other motor functions may prevent him from choosing and executing the best procedures to complete his task. In some cases, his survival may be at stake.

Helium-Oxygen Exposure

The heat requirements of divers exposed to helium-oxygen atmospheres at great depth are most easily understood after considering the problems of immersion in very cold water, because the capacity of a helium-oxygen environment at great depth to conduct heat away from the body is similar to that of cold water. In air, it has been found that man prefers to have a skin temperature of 93°F, but can tolerate a fairly wide range of air temperatures. When exposed to helium-oxygen atmospheres at depth, a diver tolerates a very narrow temperature range and prefers an ambient temperature of only a few degrees different from the preferred skin temperature, much higher than that in air. For a diver who has not had experience in a helium-oxygen environment, a similar high convective heat loss and discomfort can be simulated in air with a very high wind speed.

The solution to the problem of body heat loss to the helium-oxygen atmosphere is entirely within the area of engineering. Comfortable temperatures must be provided for the diver at all times. Even small drops in the temperature at great depths cause extremely high convective-conduction heat loss and represent a threatening drain of body heat. Thus, deck decompression chambers, personnel transfer capsules, and any other pressurized chamber where operational requirements or an accident require divers to spend time exposed to helium-oxygen atmospheres at depth must be heated. Also, these pressurized chambers must provide a warm haven for a diver who may have been chilled while working in the water.

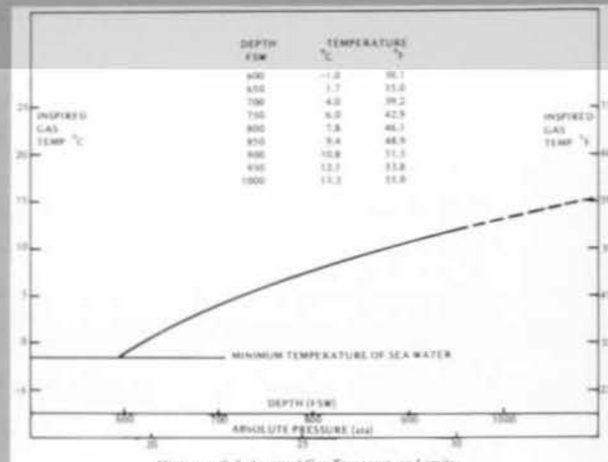
Respiratory Heat Loss

Studies have demonstrated that breathing cold helium-oxygen at great depth has two important aspects: (1) rapid loss of body heat, and (2) acute respiratory difficulty. It has been found that divers who breathe helium-oxygen mixtures at depths greater than 600 feet in cold water are exposed to severe thermal stress.

The heat balance equation is the same as when the diver is in cold water; but in a helium-oxygen atmosphere, the respiratory heat loss becomes more important. Even if the diver's skin is kept warm by a warm helium-oxygen atmosphere or a warm hot water suit, in spite of exercise there is excessive body heat loss when cold gas is breathed at depths greater than 600 feet. This results in a rapid drop in body temperature and progressively severe, incapacitating shivering, which begins in the chest and spreads throughout the body. More heat is lost through the respiratory tract than is produced by the high metabolic rate during exercise.

The second problem with breathing cold gases at great depths is acute respiratory distress. When subjected to cold gas, divers respond with immediate, copious respiratory tract secretions that are disabling. Typically, within the first minute of very cold gas breathing, excessive saliva begins to form, followed by copious nasal discharge. Then because of cooling in the chest, shivering begins in the chest muscles and spreads outward uncontrollably. Breathing becomes difficult, and there is a definite feeling of cold in the chest. As the shivers develop in the jaws and neck muscles it becomes difficult to hold a mouthpiece. Obviously a diver cannot remain in the water with these symptoms.

Minimum safe inspired gas temperatures for use in deep diving have been established and appear in the new U.S. Navy Diving Manual. The established limit for minimum safe inspired gas temperatures for operational dive planning and underwater breathing apparatus certi-



Minimum Safe Inspired Gas Temperature Limits.

fication in the U.S. Navy is shown in the chart above. This limit specifies the minimum temperature of breathing gas delivered to a diver at each depth, with the assumption that all other measures to keep the diver warm (e.g., hot water suit) are being taken. The level of respiratory heat loss at these depths and temperatures is considered tolerable with some degree of safety; however, it must be pointed out that temperatures of only 3° to 6°F colder are considered hazardous. Even at the minimum temperatures, exposure has been discomforting to the point of distraction and task performance deterioration. Therefore, these temperatures must be considered minimum from a safety standpoint, regardless of the bottom time, work rate, or other factors.

When using a system that does not heat the breathing gas, it can be assumed that the gas will be at ambient water temperature, and the minimum safe inspired gas temperature curve sets a limit on diving depth in a given water temperature. When using or designing underwater breathing apparatus, the curve specifies the minimum temperature to which the gas must be heated at depth to lessen the hazard of respiratory heat loss. Inspired gas temperatures higher than the minimum are desirable whenever possible to increase the safety and comfort of the divers.

Effects of Heat Loss

The signs and symptoms of dropping body core temperature from the first noticeable effects to death are listed on page 30. It must be remembered, though, that there are sudden, acute effects from both immersion in cold water and from breathing very cold gas at deep depths that have their onset immediately and independently of a dropping core temperature.

Core Temperature °F	Symptoms
98.6	Cold sensations
	Skin vasoconstriction Increased muscle tension Increased oxygen consumption
97	Sporadic shivering suppressed by voluntary movements Gross shivering in bouts Further increases in oxygen consumption
	Uncontrollable shivering
	Voluntary tolerance limit in laboratory experiments
	Voluntary exposure limit of the AMA
	Mental confusion Impairment of rational thought Drowning possible Decreased will to struggle
93	Loss of memory Speech impaired Sensory function impaired Motor performance impaired
91	Hallucinations, delusions, clouding of consciousness
	In shipwrecks and survival experience—50 percent do not survive
	Shivering impaired
90	Heart rhythm irregularities Motor performance grossly impaired
88	Failure to recognize familiar persons Shivering stopped
86	Loss of consciousness No response to pain
80	Death

Treatment

The best treatment for a cold diver is indisputably preventive. Unfortunately, diving will always be undertaken in operations where adequate thermal support may not be provided. The cold diver may become irrational, confused, collapsed, or unconscious. The diagnosis of hypothermia (low core temperature) is easy is suspected; the problem arises when there is some accompanying suspicion of a diving accident. The cardinal sign is coldness of the skin. In mild cases, when the diver would be considered only chilled, treatment is still important if diving operations are to continue. Since the cause of the problem is a fall in the body's core temperature, the treatment is to reheat. People with immersion hypothermia severe enough to cause confusion or unconsciousness may die unless rewarming is started immediately; medical assistance should not be waited for before beginning treatment. Active rewarming, if it is started soon enough, can revive a person whose heart and respiration have been completely stopped by hypothermia.

The most efficient and the quickest way to rewarm a diver is with a hot bath at a temperature between 104° and 111°F, or as hot as the hand can stand. In severe cases of hypothermia, the speed of rewarming is important and a hot bath is the only efficient way. The next alternative is to dry the subject and provide him with warm clothes or blankets and a warm room.

In cases involving confusion or more severe symptoms, the treatment of hypothermia must rewarm the core as quickly as possible because of a phenomenon known as the "after drop." As the man is reheated, cold blood is shunted into the body core and the core temperature continues to drop during the first 10 minutes or so. Thus, the patient may initially get worse before recovering.

It is particularly important not to give any alcohol to the cold-exposed person because it causes man's heat regulatory mechanism to become unstable. Alcohol after exercise and then followed by cold immersion entirely suppresses the metabolic response to cold. Alcohol is probably a common precipitator of death in cold-exposed people.

When is reheating complete? Studies have shown that men invariably reported feeling warm again very soon after they stopped shivering, when rewarming was apparently less than half complete. There is one simple indicator that a rewarming procedure has been carried on long enough, the onset of sweating. In repetitive diving with cold exposure, perhaps the rule should be that the diver must be rewarmed to the point of sweating before his next dive.

No matter how well trained a diver may be, exposure to cold water and/or cold helium-oxygen at depth can be hazardous and, if not treated quickly and adequately, fatal.

The Old Master...

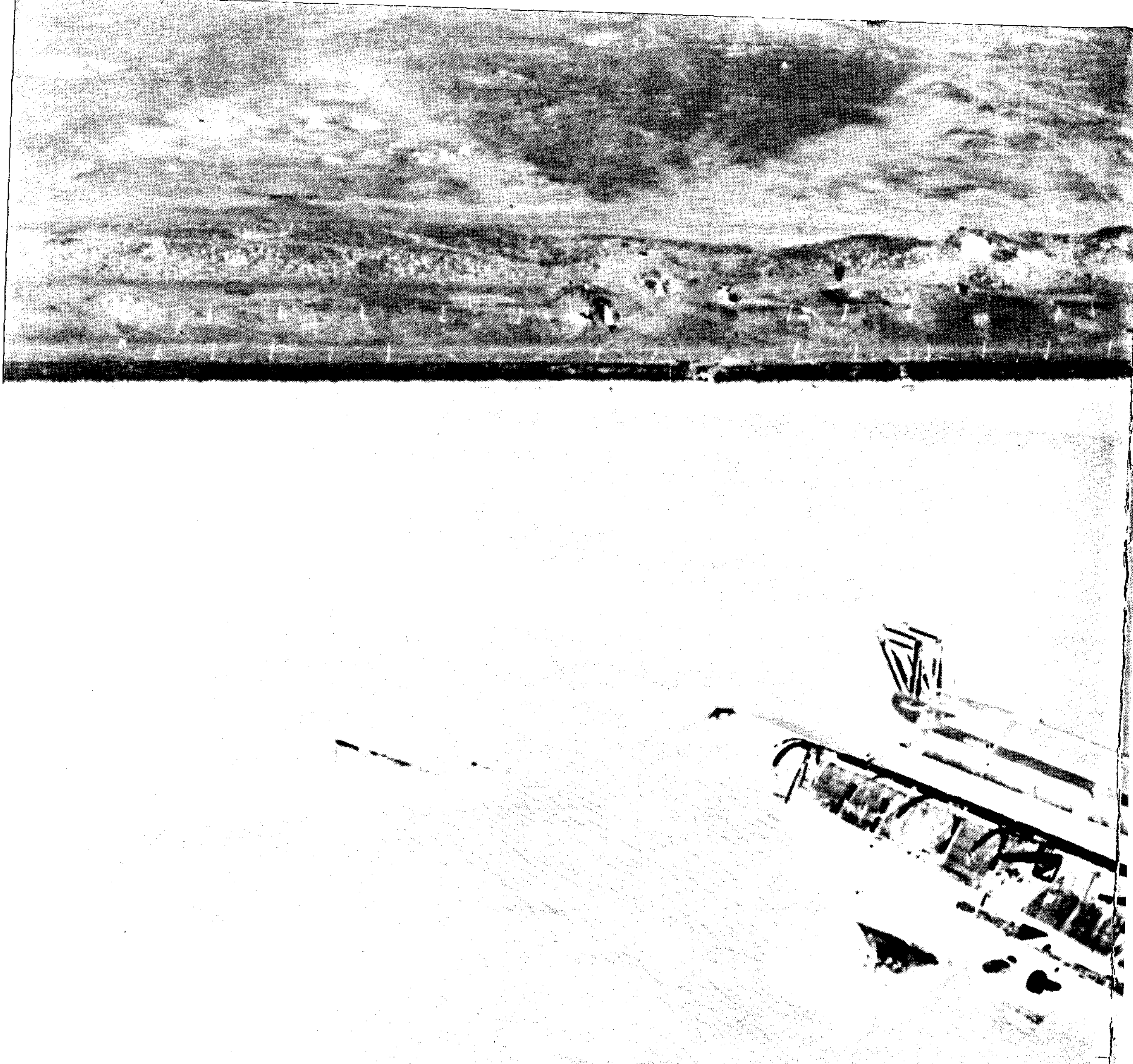
I'm hanging the doctor's shingle out again this issue to prevent saturation divers from experiencing needless discomfort. Did you know that the external ear canal infection known as "otitis externa" is probably the leading cause of diver sickness in saturation diving? In Navy Experimental Diving Unit saturation dives, sickness caused by this malady far exceeded that of decompression sickness or other medical problems related to diving.

Since mission and decompression requirements dictate long periods in a hyperbaric environment, both the severity and duration of the infection are increased once symptoms do develop. During saturation dives, the disease often progresses to the stage at which pain caused by jaw movement and the extreme soreness of the external ear and regional lymph nodes make the use of a mouthpiece or full face mask almost impossible.

A little prevention here will save you from a lot of suffering! LCDR Ed Thalmann, MC, USNR, developed a preventive program at NEDU that works extremely well. It has been used successfully in numerous saturation dives, including the U.S. Navy's 1,600 - foot saturation dive in May 1973. (See *FP*, Fall 1973.) Thus far, the incidence and severity of ear infections occurring during dives in which this procedure has been used is far lower than the usual experience. In addition, no adverse effects from the irrigating solution were found in any of the participants.

LCDR Thalmann's program consists of irrigating the ear canals with a "2 percent acetic acid in aluminum acetate" solution as follows: With head turned to one side, one ear canal is filled with solution, allowing the solution to remain in the canal for 5 minutes. This procedure is then repeated in the other ear. When the solution runs out of the ear canal, a towel may be used to dry the outer ear; no special drying procedure is necessary. The routine, which should begin 2 days before compression and terminate upon surfacing, must be performed each morning, evening, and following each immersion in water (or after the last dive of the day if making frequent dives). This procedure may not prevent ear infections in all cases, but experience to date has been very encouraging. One fact is definite, your chances of getting an ear infection are certainly lessened by following this routine.

LCDR Thalmann has documented his research in NEDU Report 10-74: "A Prophylactic Program for the Prevention of Otitis Externa in Saturation Divers."



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