THE FACEPLATE

DEEP SEA DIVING SCHOOL
EXPERIMENTAL DIVING UNIT

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FACEPLATE

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THOUGHTS & COMMENTS of the OinC

COMMANDER C. H. HEDGEPETH, USN

This issue of FACEPLATE was put together especially for the Third Symposium on Underwater Physiology, jointly sponsored by the Office of Naval Research and the National Academy of Sciences and held in Washington from 23 to 25 March. I would like to take the opportunity of this column to extend a cordial welcome to all participants in the Symposium and to invite them to the Open House at the Naval Diving Center which we have scheduled for Thursday afternoon.

In the pages of this issue we have attempted to detail something about the history and mission of the Experimental Diving Unit and the Deep Sea Diving School. It was designed to give a comprehensive insight into what we are doing here and what has been done here in the past. Our job, simply stated, is to support diving in the U. S. Navy. The issue has been put together with the Symposium participants in mind, but it will also be given its routine distribution to our readers in the fleet.

U.S. NAVAL SCHOOL DEEP SEA DIVERS

BY LCDR Albert P. FESTAG, USN

The mission of the U.S. Naval School, Deep Sea Divers, is to train officers and men of the military services of the United States and of friendly foreign nations in the theoretical and practical aspects of diving techniques. It is the only school of the U.S. Navy staffed and equipped to teach all diving techniques in current use, including especially helium-oxygen deep sea diving.

The diving training facilities of the Deep Sea Diving School are probably not duplicated anywhere else in the world. The backbone of the instruction lies in the full time instructor staff of 8 officer and 22 enlisted divers. Six of the enlisted instructors are Master Divers, the remainder are all First Class Divers. There are 36 other enlisted support personnel to run the offices, shops, compressors, and diving craft of the school.

The School has two open tanks, ten feet in diameter and twelve feet deep, for initial evaluation dives and for basic instruction in underwater tools and mechanics. There are also two chamber complexes with a working pressure of 350 p.s.i. (equivalent to a 785 foot depth of sea water) for simulated training dives. Each contains a wet tank, an access chamber, and a recompression chamber. These working depths could be easily extended to 1,000 feet if necessary in the future.

The School also uses six diving craft for training divers in the Anacostia and Potomac Rivers. The YFNX-9 is a converted 500 ton covered lighter (non-self-propelled). It contains two classrooms, helmet and dress repair shop, SCUBA locker, toolroom, spare parts storeroom, and washroom facilities. It also has four diving stations each equipped to handle two divers simultaneously. The other craft are the YDT-5, a converted minesweeper, the YSD-39, and the YF-336. The latter three craft are fully equipped for sustained diving operations and have accomodations and messing facilities onboard. All are equipped with a single lock recompression chamber. An LCM and LCPR are available for diving boats in SCUBA training operations.

Courses given at the Deep Sea Diving School include the 26 week Deep Sea Helium-oxygen Diving Officer, Diver First Class and Medical Deep Sea Diving Technician Courses, the 16 week Ship Salvage Diving Officer Course, the 8 week Engineering Duty Officer Course, the 8 week Medical Officer Course, a 10 week course for Prospective Commanding Officers and Executive Officers of Submarine Rescue Vessels, the 8 week Diver Second Class Course, the 8 week Industrial Divers Course, a 5 week course for Prospective Commanding Officers and Executive Officers of Salvage Ships and Fleet Tugs, a 5 week Master Diver Evaluation Course, and a 2 week course for Medical Department Officers in the "Recognition and Treatment of Diving Casualties".

The average student enrollment at the Diving School is about ninety persons. In addition to personnel of the U.S. Navy the present student group includes members of the U.S. Army, Air Force, and Coast Guard as well as personnel from the navies of Canada, Ceylon, China, Colombia, Greece, Korea, Spain, and Turkey.

The Staff at the Deep Sea Diving School represents 450 years of Navy Experience and 314 years of Diving Experience.

TWO COURSES FOR MILITARY MEDICAL OFFICERS

A special two week course in "Recognition and Treatment of Diving Casualties" is given for Medical Department officers twice annually at the Deep Sea Diving School. In ten days of classroom instruction the course reviews the application of physics, physiology, and medicine in an environment of increased pressure. The curriculum includes instruction in respiratory and circulatory physiology, nitrogen and inert gas narcosis, the hazards of anoxia and high pressure oxygen poisoning, the theory of decompression, the use of the Navy Standard Decompression Tables for air and for artificial breathing mixtures, and the cause, prevention, and treatment of air embolism and decompression sickness. Instruction is also given in the maintenance and operation of compression chambers, the techniques of resuscitation in the treatment of near-drowning, and the hazards of encounters with various marine life.

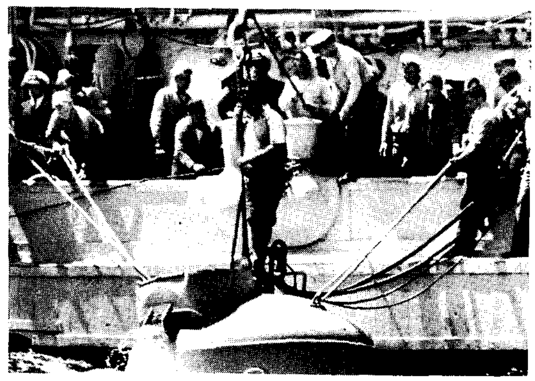
This course is designed for medical officers who have been assigned to duty near activities such as Naval Shipyards which have a recompression chamber and who may be called upon to treat cases of decompression sickness. It has also been attended recently by flight surgeons of the Navy and Air Force in connection with compression treatment of aviation "Bends". The course is suitable for Reserve Active Duty for Training and is a component of the 5 year program for training of Reserve Submarine Medical Officers. Attendance at the course is limited to military officers. Recent clases have included several officers of the Medical Service Corps, but the course is not suitable for enlisted personnel.

The Medical Diving Officer course, a separate course, is eight weeks in length and is also given twice annually at the Deep Sea Diving School. This is the only course approved for complete diving training of Medical Department officers and is essential for initial qualification as a Medical Diving Officer. Student Medical Diving Officers are given instruction in all types of diving equipment used by the U.S. Navy and perform qualification dives with each apparatus in addition to an expanded presentation of the subjects listed for the two week course. Liaison is maintained with the University of Pennsylvania, Johns Hopkins University, the National Institutes of Health and the Public Health Service, and the National Naval Medical Center for specialty guest lectures in fields relating to diving and diving physiology. Students are instructed in the theory and mathematics of inert gas saturation and desaturation and in computation of decompression schedules. The course is designed to train medical officers for billets which require them to participate in operational diving and for others such as Submarine Squadron Medical Officer who is responsible for medical supervision of diving from the Submarine Rescue Vessel (ASR) of the squadron. The course has also been utilized for training of officers in medical research billets and recent classes have included, in addition to medical officers, specialists in the fields of physiology, psychology, radiobiology, microbiology, and veterinary medicine.

When the USS MISSOURI (BB63) was aground in 1950 KITTIWAKE and her sister ASRs played an important part in refloating her. ASR crew members made literally thousands of dives performing tasks that included tunneling with high pressure hoses, placing explosives, and running pontoon wires and chains. When the MISSOURI finally was freed KITTIWAKE was one of the ships that towed her clear.

Captain WORKMAN introduces regular guest lecturer, Dr. C. J. LAMBERTSEN of the University of Pennsylvania, to a group of Medical Department officers in the semi-annual Medical Diving Officer course.

SQUALUS RESCUE



& SALVAGE

The McCANN Rescue Chamber arrives on the surface with seven members of the submarine SQUALUS crew. This was part of the Navy's most successful rescue and Salvage Operation.

In May 1939 the USS SQUALUS sank in 240 foot of water while on a test dive. Using the then new technique of Helium-oxygen diving and the McCANN rescue chamber, thirty-three lives were saved.

The SQUALUS was subsequently refloated, repaired, recommissioned and operated extensively in the Pacific Theater of War in World War II as the USS SAIL FISH.

U.S. Navy Divers working under the most trying conditions and with equipment developed at the Experimental Diving Unit were instrumental in this rescue of personnel and submarine salvage.

KITTIWAKE established another record in 1959 when her submarine rescue chamber descended to a depth of 705 feet. In April 1964 KITTIWAKE sent her chamber to a depth of 768 feet where the operators made a watertight seal on a mock-up submarine hatch.

COMMENDATION

In the list of SEALAB decorations in the last issure of FACEPLATE the name of LCDR Roy E. LANPHEAR, USN was omitted. LCDR LANPHEAR was awarded the Navy Commendation Medal for his tireless and effective work as on-site commander for the SEALAB I project. He is now Commanding Officer of the USS TRINGA (ASR-16).

CURRENT RESEARCH IN DIVING IN THE U.S. NAVY

BY CAPT R. D. WORKMAN, MC, USN

The increasing importance of man's underwater capabilities from a military standpoint has been recognized and supported in the U.S. Navy by an expanded research effort at laboratories under management of the Bureau of Ships and the Bureau of Medicine and Surgery and by the support of research programs by the Office of Naval Research, together with its joint sponsorship with the Special Projects Office of the Sea Lab I and II experiments. These efforts are directed toward realization of the goals of the Navy's Man-in-the-Sea Program to establish man's ability to work in the open ocean down to continental shelf depth for as long as desired, and to determine the ultimate depth-time limits to man's ability to work on the ocean bottom, provided he has available to him all the ancillary equipment, gas mixtures, pharmacological agents, etc., that can be of help. **There** are many **medical**, physiological, psychological, and technological problems associated with attaining these objectives. A brief overview of the work in progress in the U.S. Navy to meet these goals will be presented here.

In an effort to extend diving depth and duration, the U.S. Navy Experimental Diving Unit has been evaluating the ability of the diver to work productively for two hour periods at increasing depth with increments of depth change of 50 feet. Work consists of swimming at 0.8 knot, lifting a 70 lb. weight to a height of 30 inches 10 times per minute, and disassembly and reassembly of a pressure regulator. Helium-oxygen mixtures are breathed from a surface supplied Mark VI semi-closed gas apparatus with about 1 to 1.3 ATM. PO_2 at the working depth. Decompression has simulated transfer from the submersible decompression chamber (SDC) at the first decompression stop, and has been by both the continuous ascent and stage techniques.

The helium-oxygen mixture is breathed until the 80 foot level is reached, when air breathing begins. Starting at a depth of 30-40 feet, oxygen breathing is alternated with periods on air, with 5 foot increments of depth change being used. Successful dives employing this method have progressed to a depth of 300 feet, with 15 hours ascent time required. It is considered that the ratio of productive work to decompression time is more favorable for such dives than those with shorter bottom time. Risk to the diver is less, and comfort during decompression improved by this method.

The Mark VI apparatus has worked effectively and is conservative of gas usage, less than a cubic foot of gas being used per minute independent of depth. It is intended to extend the depth to that feasible for the diver to work. Adequate diver communication remains unsolved, primarily due to unavailability of a suitable full-face mask with oronasal mask of low dead-space. A new type of flat canister has been developed at EDU for use in these dives and found to have less breathing resistance at 400 feet than the cylindrical canister of the Mark VI at the surface. It will be tested for working dives of these depths and duration.

A considerable number of dives have been made to evaluate a closed-circuit constant oxygen partial pressure, mixed-gas SCUBA. Oxygen sensing and control is by means of a temperature-compensated polarographic oxygen electrode with suitable electronic circuitry and battery power supply. Working dives of a range from 300 feet - 20 minutes to 70 feet - 220 minutes have been made to demonstrate depth and duration capabilities. Separate inert gas supply for helium and nitrogen permit switching of the inert gas fraction of the mixture during the dive and decompression. A series of minimal decompression dives, and those with duration permitted by 15 minutes decompression, using nitrogen-helium inert mixture and PO_2 of 1.3 to 1.6 ATM., are presently being evaluated with this apparatus. Significant extension of dive duration is observed over that when helium-oxygen alone is used.

In a effort to define decompression procedures for saturation dives on helium-oxygen for the Sea Lab Program, exposures of 24 hours at 300 and 400 feet have been carried out in the wet-dry chamber complex with 0.5 ATM. PO_2 in a helium atmosphere being breathed by two subjects on each exposure. Work was performed by the divers with Mark VI semi-closed mixed gas apparatus used in the wet chamber during the exposure. Oxygen control in the atmosphere was by means of polarographic oxygen electrode sensors activating solenoid supply valves CO_2 removal was by means of a fan-driven unit containing canisters of Baralyme. Continuous ascent decompression was employed at a rate of 11 minutes per foot (6 hours per ATM.) following an initial decrease of 1 ATM. pressure. Three watch sections of attending personnel were required for the exposure period and 49 and 67 hour ascent periods for these dives.

A decompression procedure for use of helium-oxygen in the Mark VI mixed gas SCUBA to permit repetitive dives to a depth of 200 feet has been developed. The repetitive dive procedure provides a system by which the diver can determine the necessary increase in decompression time for successive dives, based on the amount of excess inert gas in body tissues upon completion of previous dives. The amount of decompression required is decreased by the time interval at the surface between dives. A method for use of oxygen decompression at 30 and 20 foot water stops is also provided. Over 400 single and repetitive open sea dives from 66 to 200 feet have been performed without decompression sickness or oxygen toxicity occurring during use by operational personnel.

With growing awareness of difficulties encountered in recompression treatment of severe cases of bends, and the grossly inadequate decompression now characterizing the sports diver casualty population applying to USN recompression facilities, evaluation of a new treatment procedure has been undertaken at EDU, Pearl Harbor, and New London. Oxygen breathing at 2.8 ATM. (60 feet) is utilized to:

(a) Expose bubbles to maximal stable inert-gas elimination gradient with minimal bubble surface area reduction.
(b) Insure maximal tissue reoxygenation, and:
(c) Avoid inert gas saturation of both injured and healthy tissues.

A period of 30 minutes of oxygen breathing following the relief of all symptoms is employed before continuous ascent at FPM to a depth of 30 feet. Additional oxygen breathing, with short breaks for air breathing, follows at this depth to gain additional effective and safe oxygenation of tissues, and insure complete bubble resolution before surfacing at 1 FPM. Eighty-nine cases of decompression sickness have been managed with the oxygen recompression approach. Complete effectiveness has been achieved in 90% of all cases treated, 57% of which were classed as serious symptoms in which Treatment Tables 3 or 4 would have been required. When a treatment regimen was used in which a minimum of 30 minutes of oxygen breathing at 60 feet, followed by 60 minutes ascent to the surface with oxygen breathing continued, the failure rate in serious cases was only 3.7%. Approval for fleet use of this method will be requested.

Other significant studies in progress at EDU include effects of increased pressure upon ventilatory adequacy and performance impairment. In these studies the interrelated effects of density, PO_2, PCO_2 and the specific inert gas, i.e., nitrogen, helium, argon and neon, have been evaluated during exercise and rest.

Development of a circulating chilled water cooling system, using the water to rotate the air circulating fans, has been completed and installed in EDU chambers. This system eliminates electric motors as a possible source of fire ignition in the chamber. An extra fan is used to circulate the chamber atmosphere through an installed carbon dioxide canister for closed chamber atmosphere use. The chamber electrical system is being completely redesigned to eliminate electrical spark hazards.

The Office of Naval Research supports basic research projects in underwater physiology and in operational applications through its joint sponsorship of the Sea Lab Project with the Special Projects Office of the Bureau of Naval Weapons. Basic research projects supported at various universities include studies of oxygen and carbon dioxide effects, inert gas narcosis, pulmonary ventilation under conditions of increased pressure while breathing various gas mixtures, solubility of the inert gases in biological fluids at increased pressure, and combustibility risks of various inert gas-oxygen atmospheres under pressure conditions.

Sea Lab I completed successfully a 11 day exposure at 193 feet in an underwater station, from which four Aquanauts performed a wide variety of tasks. Sea Lab II demonstrated the capability of three successive teams of divers to perform useful work during exposures at 204 feet for two weeks each in water at a temperature of 50 to 56° F. CDR Scott CARPENTER, USN, was team leader and subject for the first month in the undersea station, and LT Robert SONNENBERG, MC, USN, was a subject during the first and third two-week periods. The subjects participated in many studies of diver performance, including salvage projects and evaluation of suits for protection against cold water exposure.

The Bureau of Medicine and Surgery has active projects in underwater physiology in its laboratories at New London and Bethesda. The Submarine Medical Center was the site of the early closed-chamber synthetic atmosphere studies in men and animals of Project Genesis, which preceded the present Sea Lab Project. Work is in progress there to evaluate the effectiveness of various recompression procedures to resolve intra-arterial cerebral air emboli in dogs. Color photography of injected air bubbles through an intracranial window is used to follow the subsequent reestablishment of brain circulation as bubbles are dissolved during pressure exposure. In cooperation with EDU, a computer program has been developed by Dr. George MOELLER, Head, Human Engineering Branch, to make possible the rapid calculation of complex decompression schedules. A series of air excursion dives of diver subjects to various depths following saturation exposure at a 35 foot level, with direct return to 35 feet, have been completed successfully by Captain Walter MAZZONE, MSC, USN, in support of requirements of the Sea Lab Project.

At the Naval Medical Research Institute, Captain Edward BECKMAN, MC, USN, has evaluated the requirements of divers for thermal protection in cold water exposures. A number of suit combinations have been developed to improve insulation and supply heat to the diver. Some of these systems were tested in the Sea Lab II Operations. A number of saturation exposures of large dogs to air or helium-oxygen with minimal decompression have been performed to determine the range of susceptibility to decompression sickness, the exposure time required for complete saturation with the inert gas, and the efficacy of various recompression treatment procedures in cases of decompression sickness resulting. An extension of this study is presently evaluating the risk of decompression sickness occurring in the animals exposed to reduced atmospheric pressure after surfacing from saturation exposures at less than the maximum depth from which direct surfacing is possible. This simulates dives made in mountain lakes, and flying some hours after diving.

Other projects at NMRI related to diving include mechanisms, pathology and protective drugs for oxygen toxicity in animals, studies of inert gas narcosis at a cellular level and in effects on performance of animals, and effects of pressure on chemical reactions in biological tissues.

The preceding description of diving research in progress in the U.S. Navy is not complete, but only reviews some of the effort made in the last several years to advance the state of the art in diving to be implemented in new diving systems throughout the U.S. Navy.

EXPERIMENTAL DIVING UNIT

BY CDR W. R. LEIBOLD, USN

The U.S. Navy Experimental Diving Unit (NAVXDIVINGU) was moved to the Washington Navy Yard from the Bureau of Mines, Experimental Station, Pittsburgh, Pennsylvania in 1927. At the present time, NAVXDIVINGU is a Bureau of Ships Field Activity and is charged with the responsibility to perform experimental work in connection with diving and other related matter, conduct development and testing of diving suits, face masks and associated equipment, and to develop diving methods and procedures relative to diving.

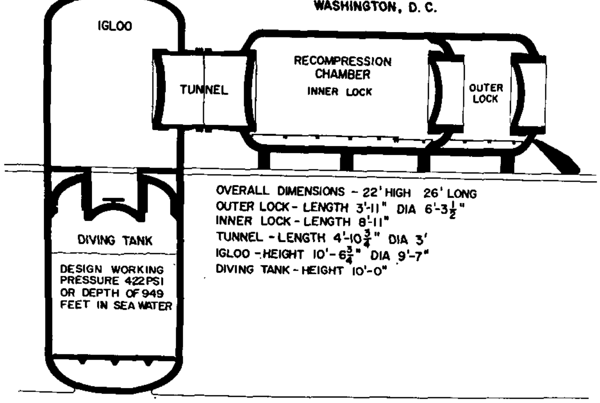
This is further broken down into specific tasks and functions which are too detailed for this article. Suffice it to say that the mission has not changed appreciably over the years, but the emphasis placed upon various areas for investigation has and does change from time to time. The end product of NAVXDIVINGU is the U.S. Navy Diving Manual (NAVSHIPS 250-538), and the equipment now being used by the Operating Forces of the U.S. Navy.

The present active projects at NAVXDIVINGU covers the entire field of diving. We are engaged in technical evaluation of several types of advanced and sophisticated SCUBA equipment, portable air compressors, depth gages, communication equipment, face masks and mouth pieces, etc. In diving physiology, we are conducting experiments to determine the proper use of multi-inert gas, synthetic breathing mixtures, extending our knowledge of carbon dioxide elimination, finding more efficientmethods of decompressing after exposure to high pressure and the means of decompressing after the human body has become completely saturated with inert-gas on a very long dive.

The basic equipment used for our work consists of two wet/dry pressure vessels. Each is made up of a water tank approximately ten feet deep, with a dry lock on top and facilities for locking personnel into or out to connected recompression chambers. Tanks and chambers have a simulated working depth in salt water of 1000 feet.

At present, the staff assigned consists of seven officers, twenty-eight enlisted men, four civilian engineers and one secretary. Three of the officers are medical officers who are specialists in diving physiology, and twenty-two of the enlisted personnel are experimental divers who are volunteer human subject for the experiments. All hands, except clerical personnel, are qualified divers and participate in various phases of the work as required.

FIGURE 1.
DIVING FACILITIES
AT
U.S. NAVY EXPERIMENTAL DIVING UNIT
WASHINGTON NAVY YARD
WASHINGTON, D. C.



HISTORY OF EDU & DSDS

BY R. A. MURDOCH

and

LCDR R. C. BORNMANN, MC, USN

Records do not clearly show the origin of diving in the U.S. Navy. At the beginning of the 20th Century there was a Naval Diving Organization although few dives were in excess of 60 feet. The majority of divers were Gunner's Mates. Instruction in diving was given to all Seaman Gunners who were physically qualified (regardless of intelligence, courage, or desire one officer complained), and the Diving Manual of 1905 was a section of the Handbook for Seaman Gunners. Diving Officers were Warrant Gunners or an occasional Gunnery Officer. The most famous examples would be Gunner STILLSON of the U.S. Navy and Gunner Catto and Lieutenant DAMANT of the Royal Navy.

The work of Dr. HALDANE and the Admiralty Committee on Deep Diving in 1907 established the world's diving on a modern foundation. Gunner G. D. STILLSON, a warrant officer of extraordinary competence, was familiar with this work as well as with the reported diving experience of other European countries. In 1912 he was placed in charge of an Experimental Diving Station at the New York Naval Shipyard and in the following two years he carried out a thorough assessment of diving techniques, equipment, and personnel. His report of 1915 is the fundamental document of diving in the U.S. Navy. An up to date Diving Manual was published at this time, and a separate Diving School was established at Newport, Rhode Island (Open to Carpenter's Mates, Shipfitters, and special mechanics as well as to Gunner's Mates).

In 1915 Gunner STILLSON with Passed Assistant Surgeon George R. W. FRENCH and their diving team from the Experimental Diving Station were sent to Honolulu to assist in the salvage of the submarine F-4. The Diving School at Newport was disestablished with World War I and its personnel were formed into an overseas salvage division which was sent to France and rendered valuable service in salvage operations there.

In the early 20's research carried out at the Experimental Station of the Bureau of Mines (Department of the Interior) at Pittsburgh, Pennsylvania, indicated that helium-oxygen mixtures might be advantageous for use in diving. In 1924 a diving team was sent out to Pittsburgh by the Navy to determine the feasibility of this technique. Experiments with animals were successful, so in 1927 this Experimental Diving Unit was transferred to Washington and established at the Yard as a permanent field activity of what is now the Bureau of Ships.

The sinking of the submarine S-51 in 1925 and of the S-4 in 1927 evoked a strong public reaction against the lack of adequate rescue techniques and the attendant loss of life in these disasters. President COOLIDGE established a Board of Experts in 1928 to examine the situation and recommend improvements.. In 1925 only 20 Navy divers were qualified to dive deeper than 90 feet, and only six civilian divers on the East Coast were willing to dive 132 feet to the S-51. Captain Ernest J. KING (later Fleet Admiral), formerly the Commanding Officer of the Submarine Base at New London and also Commander of the Salvage Force for the S-51 and S-4 salvage, recommended that a Diving School be established at the Washington Navy Yard in conjunction with the Experimental Diving Unit to permit expeditious application of approved experimental findings in the standard training curriculum. The recommendation was a characteristically brilliant one, and the reciprocal interchange of information between the two activities has been an important facet of their operation in the last 38 years.

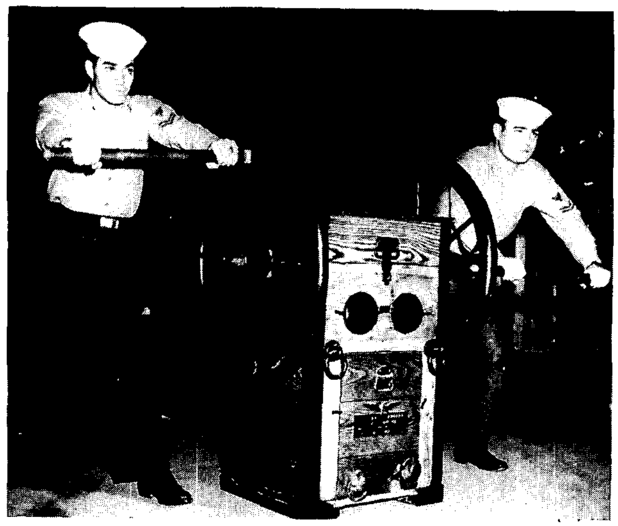
In July 1928 Lieutenant Henry HARTLEY was installed as first Officer in Charge of the U.S. Naval School, Deep Sea Divers. Chief Gunner C. L. TIBBALS was the Officer in Charge of the Experimental Diving Unit. They had been together in the salvage of both S-51 and S-4. The first commissioned officer to qualify at the Diving School was Lieutenant C. B. MOMSEN, stationed at the Bureau of Ships with Commander A. I. McKEE and Lieutenant Commander A. R. McCANN.

A great deal of fruitful work was accomplished in the following decade. The Submarine Escape Applicance (Momsen Lung) was developed. The McCANN Submarine Rescue Chamber was developed. Work continued on the deep sea helium-oxygen diving system and dives were made to 500 feet at the Unit. When the USS SQUALUS sank in 240 feet of water in 1939 all 33 survivors were rescued from entrapment with McCANN Chamber and the helium diving system was used successfully in the subsequent salvage operation.

In 1942 the Unit and the School were moved (across the slip of marine railway) to the building of their present location. The pressure complexes were constructed by the Norfolk Naval Shipyard, barged to Washington, and installed in the partially finished building. The rest of the building was then completed around the tanks.

The disastrous fire and subsequent capsizing of the USS LAFAYETTE (former liner NORMANDIE) in February 1942 led to the decision to salvage her and ultimately to the establishment of the U.S. Naval School, Ship Salvage, at Pier 88 in New York. Thousands of divers were trained for duty overseas during this long salvage operation and after its completion the School was transferred to Bayonne, New Jersey. In the summer of 1957 the School was disestablished at Bayonne and integrated into the Deep Sea Diving School.

An engineering survey made in 1963, subsequent to the loss of the USS THRESHER, indicated that the present pressure facilities could, with rather minor modifications, be upgraded to provide a depth capability of 1,000 feet. These improvements have already been initiated at the Experimental Diving Unit. An earlier study had investigated the feasibility of relocating the Deep Sea Diving School and the Experimental Diving Unit out of the Washington area, either together or separately. This move was determined to be neither practical nor economic. All present programs accordingly call for an expansion and improvement of facilities at the present site. The Department of Defense decentralization policy did have an impact however in 1964 when two of the civilian engineers from the former Diving Branch of the Bureau of Ships were transferred to the Experimental Diving Unit and became the nucleus of present Engineering Department.



This Air Pump was last used in diving in the U.S. Navy in 1
1946

DIGITAL COMPUTER APPLICATION IN DIVING

BY ENS THOMAS E. BERGHAGE, USN

Starting the first of April of this year the Experimental Diving Unit (NAVXDIVINGU) will be using an IBM 360 digital computer to analyze diving information. The information for analysis will include fleet diving logs (NAVSHIPS 1000), diving accident reports (NAVMED 816) and NAVXDIVINGU Experimental dives.

The first attempt at a continuing systematic analysis was undertaken by Doctor RIVERA in 1962. Doctor RIVERA instituted a manual card analysis system (Mc Bee Keysort) for analyzing the diving accident reports (NAVMED 816). This type of analysis system is very good for small sample studies where data is limited to two or three hundred cards. Even then, however, the time required for manual extraction of data is prohibitive when compared with the new computer methods.

Because of the extensive time involved and increased amount of data available (NAVMED 816's numbered over 1000) Lieutenant DOLL devised and instituted a machine card coding system in 1964 whereby selected information from each decompression sickness accident report was punched on a single machine card. This system eliminated the possible errors due to manual data extraction and mental computation.

Now a further expansion of this machine card analysis project is being undertaken. The IBM 360 computer, with random access disk storage, will provide economic handling of a greater amount of data. In keeping with this greater capability the NAVXDIVINGU is now coding information from the following sources:

Fleet Diving Logs (NAVSHIPS 1000)

Two machine cards are being coded and punched on dive recorded in the fleet logs. From these cards, information on geographical location of dive, water and bottom conditions, depth of dive, bottom times, equipment used, type of work done, decompression used, outcome of dive, etc. will be used to determine what type of diving is being done by the fleet.

Diving Accident Reports (NAVMED 816)

The number of machine data cards for a accident report is being expanded to six cards. The information on the six cards will then be recorded in disk storage packs to avoid sorting problems. Using six cards will allow for a complete detailed description of each accident including accidents other than decompression sickness.

NAVXDIVINGU Experimental Dives

All dives made at NAVXDIVINGU are now being coded and punched on machine cards for later analysis. Present coding is being done on four cards.

(a) Dive Description
(b) Apparatus Evaluation
(c) CO_2 Build Up
(d) O_2 Reading

As this system becomes more sophisticated more cards will be added.

It is anticipated that this new application of digital computers will provide the diving navy with both theoretical and practical information for expanding man's conquest of the sea. YOU CAN ASSIST IN THIS EFFORT BY SENDING THE EXPERIMENTAL DIVING UNIT INFORMATION ON ANY DIVING ACCIDENT YOU HAVE COGNIZANCE OF.

PRESSURE COMPLEXES

BY LCDR J. HARTER, USN & LT E.H. SHIPP USN

Four pressure complexes are installed at the U.S. Navy Diving Center for use as research chambers and for training purposes. Two of the units are property of the Experimental Unit and the remaining two serve the Deep Sea Diving School.

The complexes were designed and constructed by the Norfolk Naval Shipyard in 1942. They were barged to Washington, D.C. and placed in their present locations in building 214 of the Washington Navy Yard as the building was being erected.

Each unit consists of a wet diving tank 10' high and 9' 7" in diameter with an upper hatch closure 48" in diameter that seals with pressure from the wet tank side and connects to an upper igloo structure 10' 6 3/4" high above the wet tank to provide a lock in capability to the wet tank in case of emergency, a 4' 10 3/4" long by 3' diameter tunnel connects the igloo with a double lock recompression chamber which has an inner lock 8' 11" long by 6' 3½" in diameter and an outer lock 3' 11" long.

A typical dive routine using deep sea diving gear in the wet tank would be as follows:

a. The divers dress and breastplate are put on outside the igloo entrance door.

b. Diver enters igloo and shoes, weight belt and helmet are put in place, all checks completed, ready to dive.

c. Diver is lowered into wet tank through hatch opening on stage which is raised and lowered by an air driven winch located in overhead of igloo and operated only from within the igloo.

d. After the diver is lowered into wet tank the upper hatch is shut and dogged.

e. The dive is commenced by admitting air into the space above the water level in the wet tank.

f. During the dive all evolutions are controlled and can be observed from an operating station outside the wet tank. Four glass ports are in the tank hull at eye level.

g. Ascent and control of surfacing is accomplished by venting the air pressure to the atmosphere. All decompression stops are completed with the diver in the water.

h. After the wet tank reaches the surface the upper hatch is opened and the diver brought back into the igloo on the stage.

In the event of emergency requiring tenders assistance in the wet tank they would enter the igloo and be pressurized to the depth of the wet tank. The hatch closure then opened and free access would be provided.

The above system is modified for experimental dives at EDU. In this case the divers enter the water in the wet tank and the door to the igloo entrance from outside is closed and the hatch between the igloo and wet tank left open. The wet tank and igloo are both pressurized to depth required for the dive. While the dive is in progress the recompression chamber and tunnel is taken to the depth of the dive. When the bottom time is completed the pressure in the entire complex is reduced to the pressure for the first decompression stop. The divers enter the igloo from the wet tank by ladder and transfer to the inner lock of the recompression chamber. This dive profile simulates a submersible decompression chamber dive with transfer to a topside chamber.

The four complexes were designed for a maximum working pressure of 350 psi. The two units at EDU have recently been overhauled and modified and now have a maximum working pressure of 422 psi. The EDU units have air conditioning, facilities for simulating approcimately 38,000 feet of altitude and piping systems and various components for precise control, measuring and sampling of gases for research work. A new electrical system incorporating circuitry for instrumentation required in research, test and evaluation projects is being designed. This system is expected to be installed in the chambers at EDU by 1 January 1967

USS KITTIWAKE ASR 13

Submarine rescue vessels are named for sea birds. This ship was named for the Kittiwake Gull, the most oceanic of all gulls. Many Kittiwake Gulls Marked in the Murmansk area of Northern Russia have been found in Newfoundland indicating a vast travel range.

The USS KITTIWAKE (ASR13) is a 2,000 ton vessel built from the keel up as a submarine rescue vessel. Authorized 17 December 1943, the keel was laid January 5, 1945 at Savannah Machine and Foundry Company, Savannah, Georgia. Her launching took place on July 10, 1945 and the commissioning a year later. The construction and outfitting was made possible through the generous contributions of the citizens of Taunton, Massachusetts.

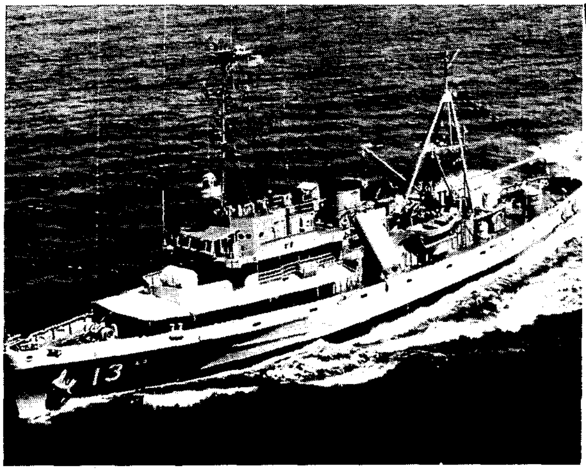
As a submarine rescue vessel, KITTIWAKE carries a McCann Rescue Chamber capable of removing crew members from a disabled submarine while the submarine is on the bottom. The rescue chamber, with a capacity of eight passengers, weighs about 11 tons and has an operating depth capability of 850 feet. By means of cables and hoses, it is supplied with air, lights and communications from the KITTIWAKE. The rescue chamber is divided into three compartments, one for the operators and passengers, and two for ballasting with air or sea water.

The lower compartments, which is open to the sea, is fitted with a rubber gasket around the bottom, and contains a reel or large spool which is driven by an air motor. If a submarine becomes disabled, it can release either one of two large buoys which rises to the surface trailing a stainless steel wire, the lower end of which is attached to the escape hatch on the submarine. The buoy is taken on board the KITTIWAKE where the upper end of the wire is threaded onto the reel inside the rescue chamber. Then after adjusting water ballast in the rescue chamber until it is 1,000 pounds positively buoyant, the operator reels in the wire cable causing the rescue chamber to pull itself down onto the submarine's escape hatch. By using air pressure to blow the water out of the lower chamber and then venting it off to the atmosphere, a watertight seal is effected thus enabling the crew of the submarine to be transferred safely.

In order for the KITTIWAKE to hold herself in position over the disabled submarine and operate the rescue chamber, the ship lays a four point moor utilizing four, 20 foot long, 5,000 pound cylindrical buoys, four 4,000 pound anchors, and over 9,000 feet of 3/4 inch chain. The moor is dropped to form a large square, free of the ship which then maneuvers into the center and makes fast to the buoys. To secure in this moor the ship's small boats run 7 inch nylon lines, of which we carry approximately 7,200 feet, out to the buoys usually located some 1,200 feet from the ship. With the end of these nylon lines on the ship's four powerful sweep reels, KITTIWAKE can put herself in any desired position.

In addition to the rescue chamber and mooring equipment the KITTIWAKE carries a multitude of diving equipment consisting of shallow water masks, aqua lungs, deep sea diving helmets, helium oxygen diving equipment, two recompression chambers and four large capacity air compressors ranging from 400 to 3,000 psi. KITTIWAKE's complement of 90 officers and enlisted men includes four diving officers and twenty-five enlisted divers who are capable of diving to depths greater than 500 feet and performing a wide variety of tasks including welding and burning under water.

On 21 April 1949 C. M. PRICKETT, Gunner's Mate First Class, breathing a mixture of helium and oxygen from KITTIWAKE"s gas banks made a dive to 501 feet thereby establishing a new worlds's record for open sea diving.



MASTER ON DUTY

Kenneth W. WALLACE, BMCS(DV), USN

Entered Navy on 15 February 1943 was assigned to Amphibious Beach Battalion. Participated in the invasion of Normandy at Omaha Beach. Returned Stateside 1944. Was inside the "Bull Pen" at Treasure Island awaiting transfer into the Pacific when "Tojo" called it quits. Returned to civilian life early December 1945 to make my first million dollars.

After my very unsuccessful endeavor as a civilian, in 1950 the Navy let me back in, also back into PHIBLANT aboard the USS MELIPHEN (AKA-61). Attended Second Class Divers School, Bayonne, New Jersey in 1951. I graduated from DSDS in 1952 and was sent to USS SKYLARK (ASR-20). I remained on SKYLARK until 1956 when I was transferred to the Torpedo Range, Newport, R.I., to complete a normal tour of shore duty. 1958 I attended Salvage Cross Training at DSDS and was ordered to USS PENOBSCOT (ATA-188). 1960 found me in Charleston, S.C., as pre-commissioning crew of USS PROTEUS (AS-19). This duty will long be remembered. Next to my present station, I consider it a high point in this chosen career. While serving aboard PROTEUS I was made Master Diver in 1961. In 1962 I was transferred to my present station, Experimental Diving Unit. The good Lord willing, I intend to transfer to the Fleet Reserve in the coming year. This time I plan that million dollar differently. The first million is too hard to come by, so I think I'll work on the second million first.