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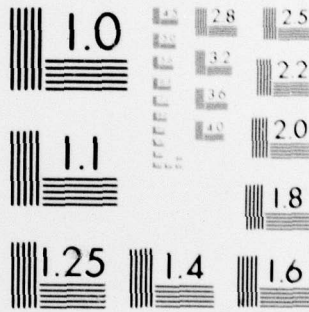
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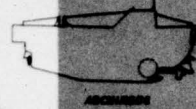
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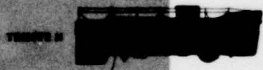
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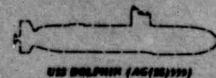
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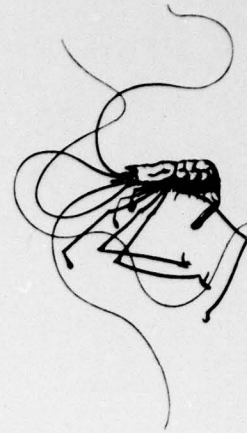
deep submergence program

A pictorial history of the
major *in situ* marine environmental
investigations carried out aboard the
bathyscaph TRIESTE and other
underwater vehicles.

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ON THE COVER: A pioneer in deep-sea operations, the U.S. Navy Electronics Laboratory is contributing its know-how to the development of new second-generation, deep submersibles such as ALVIN by furnishing reliable communication, navigation, and environmental sensing systems. NEL has also been designated as the lead laboratory for the research phase of the proposed research submarine USS DOLPHIN (AG(SS) 555).

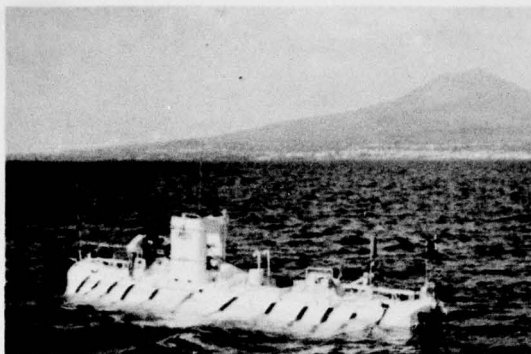


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PREFACE This report summarizes the scientific efforts of the Deep Submergence Program at the Navy Electronics Laboratory, San Diego, California. Since its inception in 1958, the program has been vitally concerned with development of techniques, instrumentation, and vehicles to fulfill its assignment - research of the marine environment, from the continental shelf to the abyssal sea floor.

While NEL's primary interests are in relating applied research data in marine acoustics, biology, geology, and physical oceanography to antisubmarine and submarine warfare projects, the Deep Submergence Program has also added significantly to man's basic knowledge of the ocean sciences. ↙

After TRIESTE
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underwater
in preparation
and the others



The Tyrrhenian Sea off Naples, Italy, was the site for bathyscaphe evaluation dives funded by the Office of Naval Research during the summer of 1957. Objectives: *in situ* studies of the deep ocean environment and appraisal of TRIESTE's capabilities as a deep-diving research vehicle. The tests proved successful, and a research program using TRIESTE was recommended by the scientists and military personnel involved.



TRIESTE was purchased by the Office of Naval Research and assigned to the Navy Electronics Laboratory in September 1958. The vessel is berthed and serviced at NEL's waterfront area, shown here. NEL was selected because of the Laboratory's program and achievements in many types of underwater studies; the presence of nearby deep-water diving sites; the year-round favorable weather and sea conditions; the excellent support facilities; and the proximity of other oceanographic research centers.

After TRIESTE's arrival at NEL, a carefully planned series of scientific dives and tests began in the Loma Sea Valley and San Diego Trough, where depths of 4100 feet were reached. New data were obtained on bottom water currents, marine organisms, bioluminescence throughout the water column, and topographic features of the sea floor. Underwater-sound experiments were also successfully conducted. In preparation for Project Nekton, TRIESTE's float was lengthened and the observation sphere and instrumentation were improved.



The deepest underwater observations ever made by man were achieved during Project Nekton from November 1959 to January 1960. Equipped with a stronger, specially constructed observation sphere, TRIESTE made preliminary dives to 22,540 feet off Guam.

Climax of the Nekton series was the record dive in the Challenger Deep, 200 miles southwest of Guam. TRIESTE descended 35,800 (± 500) feet to the deepest known point in the oceans to find a uniformly flat sea floor composed of white, extremely fine material. A flat fish sighted on the bottom provided dramatic proof that the abyssal depths could support higher forms of life. For their historic achievement, the major participants received presidential citations.

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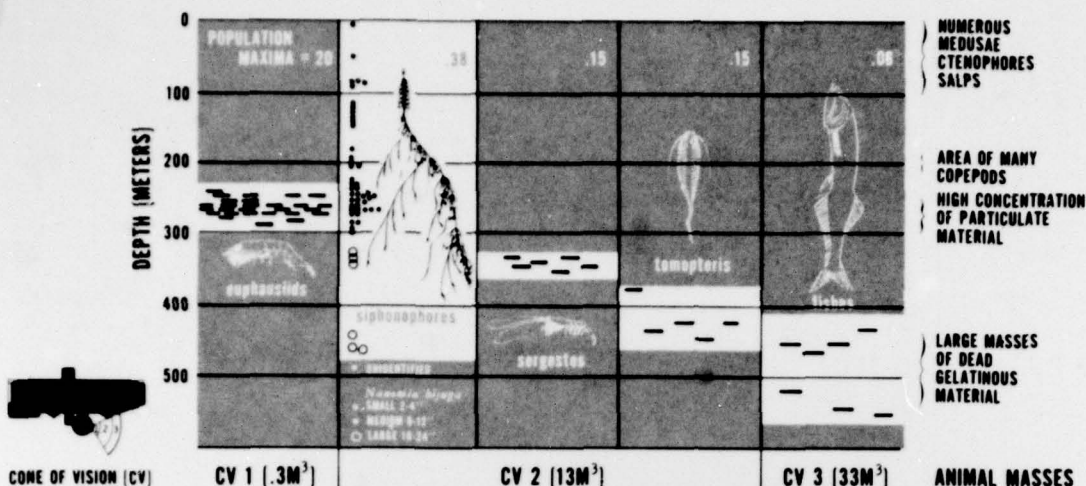


Project Nekton II in the Guam area (June-July 1960) saw TRIESTE outfitted with a Nansen water bottle rack attached to her stern for experiments relating sound speed to temperature and salinity throughout the water column. Also aboard were delicate instruments for measuring gravity (a bottom gravity value $-g$ of 978.9331 cm/sec^2 was found at a depth of 7498 feet). Thus the bathyscaph demonstrated her worth as a versatile and stable platform from which very precise measurements could be taken.



A series of bathyscaph dives in the San Diego area in 1962 resulted in sufficient new data for nineteen formal reports on BUSHIPS-assigned problems. In acoustics, for example, the first *in situ* measurements of sound velocity and attenuation were made in bottom sediments deeper than 100 feet. Sound velocity and attenuation probes attached to TRIESTE (right), pierced the sea floor and measured sound travel time over a 1-meter path, 46 centimeters below the water-sediment interface.

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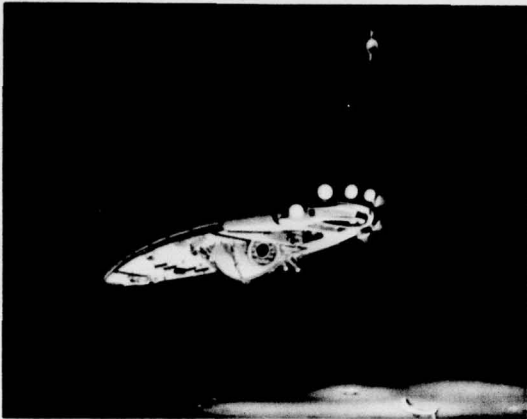
Biological studies during 1962 revealed concentrations of marine animals in distinct layers. Chart shows depth and daytime vertical distribution of dominant organisms as observed from TRIESTE in dive 103, 20 July. Rate of descent was relatively constant. Pigmentation and size of animals played an important role in determining population density.



Sea floor topographic investigations by TRIESTE, in the 1962 series, revealed extremely steep slopes off San Diego, unchartable by echo sounder, and established the occurrence of submarine erosional features and processes. Other bottom studies determined the distribution and stability of sediment types. Pulsating deep-sea currents were observed and recorded for the first time. Simultaneously, transducers and other environmental sensing instruments were tested at various depths.

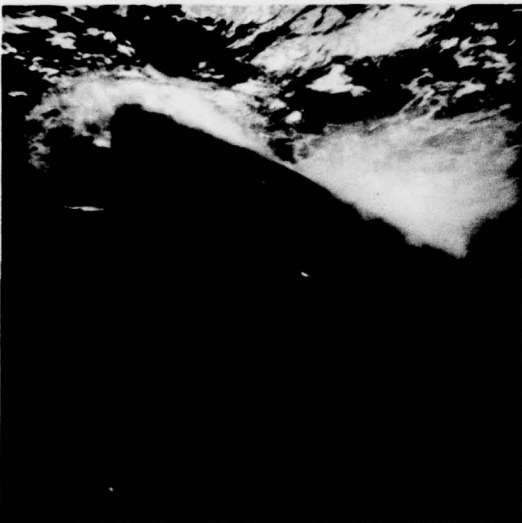


The bathyscaph's unique ability to survey the deep-sea floor led to her use in the search for the nuclear attack submarine THRESHER, lost in the Atlantic Ocean off Boston on 10 April 1963. Techniques developed for replenishment-at-sea helped TRIESTE maintain round-the-clock operations. Wreckage later identified as belonging to THRESHER was found and photographed in 8200 feet of water. The bathyscaph's mechanical arm retrieved copper piping and a fitting. TRIESTE was the only vessel in the nation capable of operating at the depth the wreckage was found.



Late in 1963, TRIESTE's operational characteristics were greatly improved by addition of a completely redesigned float, constructed at Mare Island Naval Shipyard. The new float features recessed shot tubs and observation sphere. Other changes increase bottom time and payload by one-third, and permit operations in much higher sea states. The new craft was dedicated TRIESTE II, at NEL on 17 January 1964.

A series of eleven test and scientific dives off San Diego occupied the period February to March 1964. New acoustical, biological, and geological data were obtained. After the last dive, the bathyscaphe "shipped out" for the Atlantic where she made a detailed visual and photographic survey of the THRESHER debris area. Search and inspection techniques developed in this series will be of great assistance to the Navy in improving the operations of manned, deep-search vehicles of the future.



While TRIESTE II was on the East Coast, NEL scientists participated in an ONR-sponsored probe of the Puerto Rican Trench. Lamont Geological Observatory, Hudson Laboratories, NEL, and French scientists, carried out biological and geological studies aboard the French Navy bathyscaphe ARCHIMEDE, shown above. Deep-sea operation of sonar and navigation systems were also investigated. Gravity measurements and rock samples taken may help explain the origin of the elongated trench which reaches the greatest known depth in the Atlantic Ocean -- 30,180 feet.



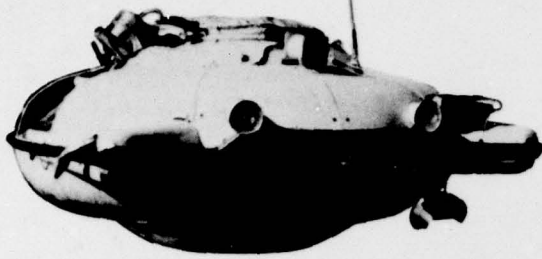
Early in 1965, TRIESTE II extended the study of the continental shelf off Southern California to sea-floor depths as great as 13,000 feet. From the bathyscaphe's observation sphere, determination of factors affecting sound speed and reverberation throughout the water column, measurement of the acoustic and physical properties of the ocean floor, and other research is being carried out in support of antisubmarine and submarine warfare programs.

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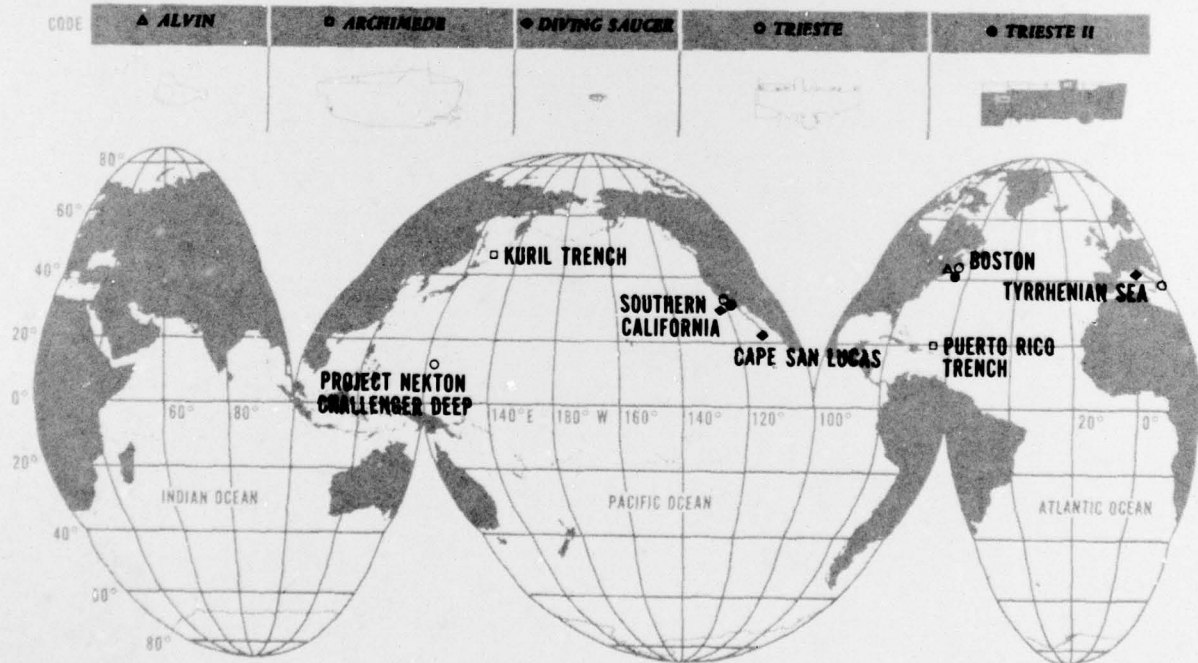
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Intermediate depths to 1000 feet are also being intensively examined by NEL geologists, biologists, oceanographers, and acousticians, with this leased, highly maneuverable, jet Diving Saucer. A 6-month study of the continental shelf began in November 1964, in cooperation with Scripps Institution of Oceanography, Naval Ordnance Test Station, Naval Missile Center, Pacific Missile Range, and the Navy Underwater Sound Laboratory. The investigations ranged northward to Point Mugu, California, and southward to Nayarit, Mexico, east of the tip of Baja California.



A segment in the sea's food chain is viewed from the Diving Saucer in La Jolla Canyon. After spawning, squids die and are consumed by bottom organisms. Here, a flat fish (center, left) feeds on a dead squid.



The future NEL Deep Submergence Program will continue to reflect the immediate and long-term needs of the Navy for detailed, accurate knowledge of the marine environment. To provide this information NEL combines competent scientific guidance and methods with the latest advancements in underseas technology. World map shows areas in which NEL scientists and technical personnel have participated in deep *in situ* marine environmental studies.

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