

XII. STROBOSCOPIC RESEARCH

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One of the main purposes of our stroboscopic work is the application of the electronic flash to many aspects of ocean research. In addition to participating directly in the expeditions noted in the following paragraphs, this group has contributed equipment and engineering information to many other organizations – Harvard University and the Woods Hole Oceanographic Institute, several French projects, and U. S. Navy groups including the Naval Research Laboratory at San Diego, which currently is preparing to make dives with the Picard bathyscaphe. As a result, the underwater camera and flash have recently been used in many parts of the world, including the Atlantic, Pacific, and Indian Oceans, and in the Mediterranean Sea.

Underwater cameras and flash attachments have been adapted to several kinds of packaging in order to meet the various applications (1) and to withstand the overwhelming undersea pressures. During one of the National Geographic Society's expeditions in the Mediterranean in connection with the research ship CALYPSO and the French bathyscaphe, several different camera operations were accomplished (2, 3). The sonar-controlled camera, that is, a camera, an electronic flash lamp, and a sonar device, all suspended on a cable, was used successfully in photographing the ocean bottom. This camera was also adapted to ride on a sled (devised to travel over the floor of the sea) and to take pictures automatically every 15 seconds. In order to obtain information about sea life and, in particular, the composition of the scattering layer, the basic

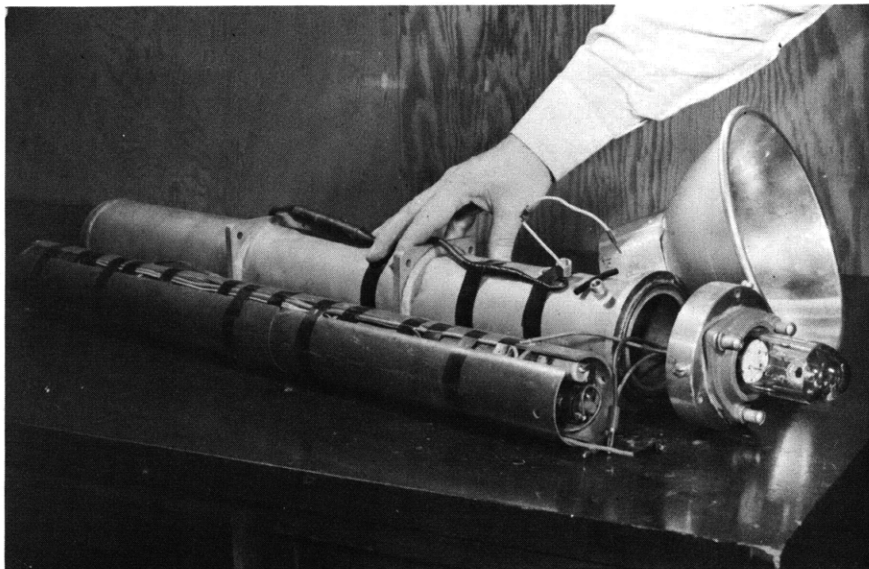


Fig. XII-1. Camera and flash used on exterior of bathyscaphe F.N.R.S. III.

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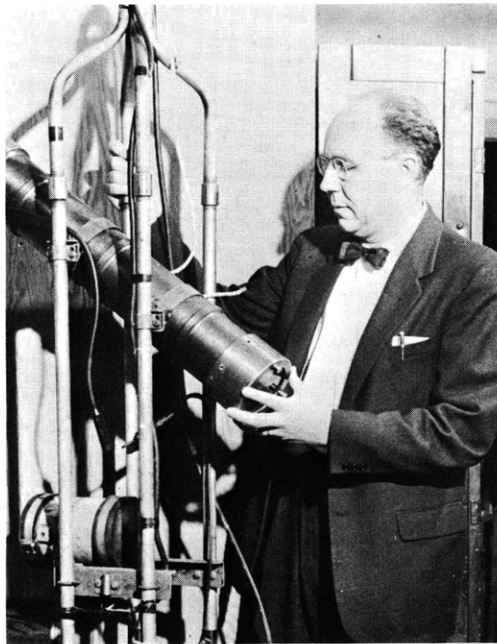


Fig. XII-2. Camera and electronic flash mounted for use at water depths of 4 1/2 inches in Romanche Trench.

camera and flash unit were adapted for close-up operation at any depth down to 6000 feet; this camera takes almost life-size pictures of minute marine organisms.

The deep-diving bathyscaphe, the French submarine F.N.R.S. III, commanded by Lt. Cmdr. Georges S. Houot (4), has made it possible to send men and cameras 13,000 feet or more to the bottom of the ocean. The underwater camera and several electronic flashes (see Fig. XII-1) were mounted on the exterior of the bathyscaphe and were operated by a push button near the viewing port inside the observer's sphere. The bathyscaphe allows the observer to direct, control, and select his pictures of the depths.

During a more recent expedition (5), the CALYPSO was taken to the Romanche Trench, a crevasse 25,354 feet deep off the Mid-Atlantic Ridge, near the equator, halfway between Africa and South America. There, the CALYPSO was anchored in almost 5 miles of water and the camera and flash equipment (Fig. XII-2) was lowered into this crevasse to produce two views of the ocean bottom. The crushing weight of the water at a depth of 4.5 miles (5.5 tons per square inch) cracked the lens guard, which was a glass plate 1.5 inches thick. Fortunately, pictures had been obtained, and no water seeped through the crack to damage the camera.

During the past summer a motion-picture camera was tested for the first time at sea depths of approximately 4000 feet in the Mediterranean. The operation took place from the decks of the CALYPSO, which was under the command of

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Capt. Jacques-Yves Cousteau. The camera, which was modified especially by Bell and Howell to hold 400-ft reels, was packaged for deep-sea operation in 0.5-inch thick stainless-steel pipe. The power for the camera was supplied by four 6-volt dry-cell batteries, assembled with the camera unit. The electronic flash equipment was packaged in a separate steel casing. The flash tube was mounted in heavy Pyrex tubing, and the cavity around the tube was filled with oil. Because continuous operation is necessary with a motion-picture camera, excessive heating was expected, and the oil was inserted to conduct the heat from the tube to the Pyrex casing and thence to the sea water. The flash (5 watt seconds) was activated 20 times per second by 24-volt silver cells (nickel-cadmium cells also have been used) that operated a dc motor generator to produce 800 volts. The complete assembly was lowered from the deck of the ship on a single cable to depths of 4000 feet or more. The films obtained are being processed and edited, and as far as can be determined at present, the results are extremely encouraging.

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References

1. H. E. Edgerton and L. D. Hoadley, Cameras and lights for underwater use, SMPTE J. 64, 345-350 (1955).
2. H. E. Edgerton, Photographing the sea's dark underworld, National Geographic Magazine, Vol. 107, p. 523 (April 1955).
3. J.-Y. Cousteau, Diving through an undersea avalanche, National Geographic Magazine, Vol. 107, p. 538 (April 1955).
4. G. S. Houot, Four years of diving to the bottom of the sea, National Geographic Magazine, Vol. 113, p. 715 (May 1958).
5. J.-Y. Cousteau and B. Littlehales, Calypso explores an undersea canyon, National Geographic Magazine, Vol. 113, p. 373 (March 1958).