The Deepest Dive

Recent experiments show that humans can function at depths not thought possible

BY SUSAN WEST

Without even putting toe in water, three men recently set a deep-sea diving record of 2,250 feet. The "dive" was actually the third in a series of simulated deep dives conducted at the Duke University Medical Center in order to determine the best combination of breathing gases and compression and decompression rates that will allow humans to work efficiently at great depths in the ocean. The simulated depth reached during the 43-day experiment is more than twice that currently considered practical; the experiments may open new possibilities for industries, such as offshore oil production, salvage operations and seabed mining, that use deep-sea divers.

Divers are currently limited to depths of 1,000 to 1,200 feet because of High Pressure Nervous Syndrome (HPNS), a debilitating combination of tremors, vomiting, fatigue and lapses of consciousness that was described more than a decade ago by Peter Bennett, director of the F.G. Hall Laboratory for Environmental Research where the experiments are being conducted. The syndrome is believed to be caused by the compression of cell membranes in the nervous system due to the tremendous underwater pressures. This compression, Bennett found, is counteracted by nitrogen gas, which causes the membranes to expand. Nitrogen, however, is usually eliminated from divers' breathing mixtures because of its narcotic effect at depths greater than 150 feet. But Bennett suggested that the right amount of nitrogen—just enough to balance between the two effects—might allow divers to hurdle the depth barrier caused by HPNS.

In 1979, with funding from the National Institutes of Health, the U.S. Navy Bureau of Medicine and Surgery, the Shell Oil Co. and Oceaneering International, Bennett began to test his hypothesis. He first used a breathing mixture that included 5 percent nitrogen added to the usual helium and oxygen and a relatively fast compression rate of about 12 hours to reach 1,509 feet. As Bennett expected, the 5 percent mixture was not sufficient to counteract HPNS, so the next simulated dive used 10 percent nitrogen and the same compression rate. The divers functioned so well under those conditions that the dive was extended to 2,132 feet, a record at that time (SN: 4/12/80, p, 232). In a variety of performance tests, however, the divers showed fairly large drops in efficiency on the first day at 1,509 feet. While the decline was not detrimental, Bennett thought it may be due to the rapid compression rate. The most recent experimental dive, begun on Jan. 23, therefore used the 10 percent nitrogen mixture and a rate of compression twice as slow as that of the previous experiment.

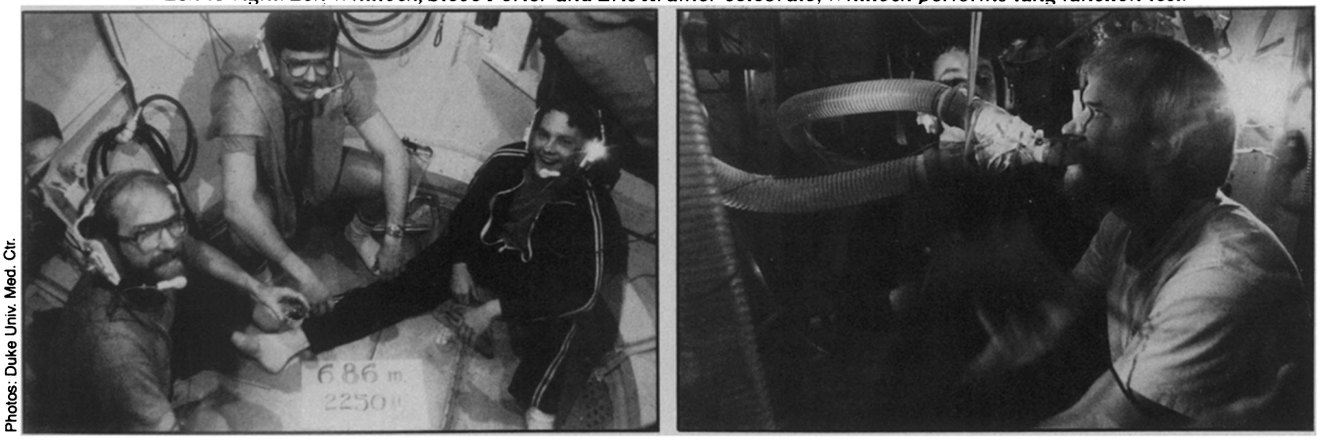
Dive director Peter Bennett checks the divers' progress.

It took seven days for the pressure within the 8-foot-diameter steel chamber to reach the equivalent of 2,132 feet. After four days at that level, the divers, Steve Porter, Len Whitlock and Eric Kramer, were compressed to the record-setting 2,250 feet where they remained for 24 hours. By that time, all the divers had become "mouth-breathers" because the density of the atmosphere in the chamber was more than 16 times that at sea level. Even the little bit of champagne with which they toasted their success had lost its fizz under the tremendous pressure.

Crucial to the experiments was the performance of the divers on a variety of dexterity and intellectual tests. At set intervals, the divers took arithmetic tests and performed such tasks as picking up ball bearings with tweezers and placing them in a tube of the same diameter or disassembling and reassembling devices. Venous blood samples were taken regularly, brain waves were monitored and reflexes were measured. When the divers reached "bottom," lung function tests were performed, which consisted of pedaling a stationary bicycle while respiratory measurements were made. The pedaling, says Bennett, was "maximum work effort"—what might be demanded in an emergency situation for a deep-sea diver. On all the tests, says Bennett, the divers performed "impeccably" and without the sudden drop in efficiency at 1,509 feet.

On Feb. 4, the divers began their 31-day "ascent" at the excruciatingly slow rate of five feet per hour. Twice the divers experienced mild "bends"—pain caused by gas bubbles that form in the blood and joints—and the pressure was increased and oxygen added. The divers emerged March 6 "in a fit and healthy condition." What remains, says Bennett, is to reduce the period of recompression. □

Left to right: Len Whitlock, Steve Porter and Eric Kramer celebrate; Whitlock performs lung function test.



Photos: Duke Univ. Med. Ctr.