HYPERBARIC TESTS FAVORABLE

Neon for deep diving

The depths of the oceans are inhospitable to man, just as much so as, say, outer space. The problems are primarily physiological: For each 33 feet increase in depth of water, the ambient pressure increases by one atmosphere and the pressure of the gases breathed has to be proportionately increased to prevent implosion of the lungs. Gases behave in strange ways under the high pressures. Nitrogen becomes a potent narcotic at 200 feet depth and divers are so stoned on nitrogen at 500 feet they can't function at all.

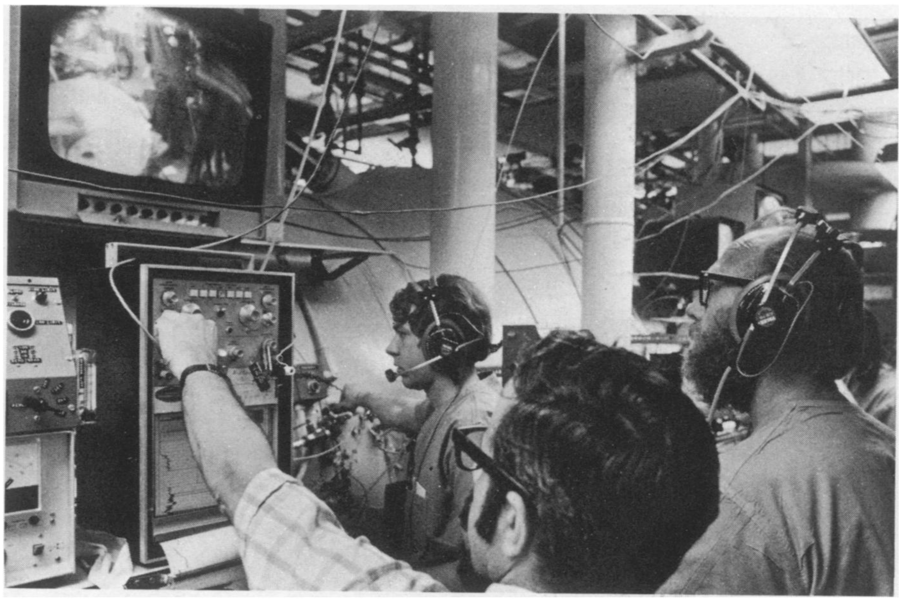
Helium has been the traditional substitute for nitrogen at great depths. But it has a lot of drawbacks, too. Reserves of helium are limited. And helium is such a low-density gas that it seriously interferes with voice communication by divers in habitats under the sea. In addition, there is evidence that respiratory heat loss via the low-density helium is so great that it exceeds heat produced by the body—and thus may sharply limit deep dives (SN: 6/26/71, p. 437).

Work at the University of Pennsylvania's Institute for Environmental Medicine this summer indicates that another inert gas, neon, may turn out to be a major new nitrogen substitute. The "divers" in the experiments—who were taken to a simulated depth of 1,200 feet in hyperbaric chambers—were still in the process of decompression this week, but Dr. Christian J. Lambertsen, director of the institute, says the preliminary results look good.

The four subjects, says Dr. Lambertsen, incidentally set a new record for saturation diving in hyperbaric chambers: They stayed at a simulated depth of 1,200 feet for six days. When neon was substituted for helium at the 1,200-foot depth, the density of the gases breathed became equivalent to breathing helium at 5,000 feet, he added.

The reason for this increased density is simple enough. Helium has an atomic weight of 4.0026, while neon's is 20.183, and it is neon's greater density that lends it some of its advantages for diving.

For instance, scientists and divers have long been familiar with the "Donald Duck" effect of breathing helium-containing gases; sound waves in helium travel at a different rate than in other gases and thus the voices of helium-breathing divers are squeaky and nearly unintelligible. "With neon," says Dr. R. W. Hamilton of Ocean Systems Inc., a participant in the Pennsylvania experiments, "voices still sound sort of squeaky, but for anyone used to voices under helium, they are far easier to understand."



Bill Gilliss

Dr. Lambertsen (right) observes television monitor during hyperbaric tests.

Another advantage of neon—although not one that figured in the Pennsylvania experiments—is that it has considerably lower heat conductivity than helium. "So far our results on this are subjective," says Dr. Hamilton. But he believes they are valid. "One diver in cold water told us while using neon it was the first time he had ever felt warm under these conditions."

The main purpose of the Pennsylvania tests was to compare the physiological effects, or "dose responses," of nitrogen, helium and neon. The four subjects encountered no problems with pulmonary function with the neon, except that at 1200 feet, when they exercised strenuously on stationary bicycles, they had difficulty drawing enough of the dense neon into their lungs. They were breathing the neon through face masks, and it was a simple matter to remove the masks and begin once again to breathe the ambient helium-oxygen mixture in the hyperbaric chamber.

As for narcotic effects of neon, earlier experiments had established that down to 600 feet, they were minor, roughly the same as with the nearly non-narcotic helium. The Pennsylvania tests suggest the effects do not increase significantly at 1,200 feet. The four men undergoing the tests were Ronald Billingslea, a university basketball star; Thomas R. Liebermann, a university soccer player; and Timothy J. Carson and Steve Kowal, recent graduates.

Probably the greatest single hazard of deep dives, and especially of saturation diving, is the "bends," precipitation of bubbles of dissolved gases in the blood and tissues. It is to avoid the bends that some nine days were spent bringing the Pennsylvania subjects back up to atmospheric pressure. Once the body is saturated with gases at high pressure, there is no safe way to reduce the ambient pressure quickly.

Although the Pennsylvania experiments were not designed to prove it, Dr. Hamilton says there is now a considerable body of evidence that neon is far better than either helium or nitrogen for avoiding the bends. "This is because of a complicated combination of factors, such as diffusivity of the gases in tissues," he explains. This may make it a better diluent for oxygen on long space flights than the presently used nitrogen.

Another advantage of neon is its easy availability. It can be distilled from liquid air with relative ease; although the resulting product is impure—it contains some helium—it is perfectly suitable for diving, says Dr. Hamilton.

But no gas will eliminate the bends entirely. And this may remain a prime obstacle to deep dives in the real ocean—as opposed to hyperbaric chambers. If a diver living in an undersea habitat and saturated with gases at ambient pressure moves very far away from the habitat it is only at great risk. Should his equipment fail him and he cannot get back to his habitat, he has to either drown or surface. If he surfaces rapidly from any substantial depth, he is almost certain to die of the bends. □

TO OUR READERS

A strike of printing plants that began last week in Washington just a few hours before we were due to go on the press caused such extensive delays and difficulties that we have combined the Aug. 28 and Sept. 4 issues to make this single, expanded issue. It contains virtually all the news and articles planned for both issues. Normal schedules will resume next week.

—Ed.