US ARMY SOLDIER SYSTEMS CENTER
Protecting Those Who Serve

THE WARRIOR

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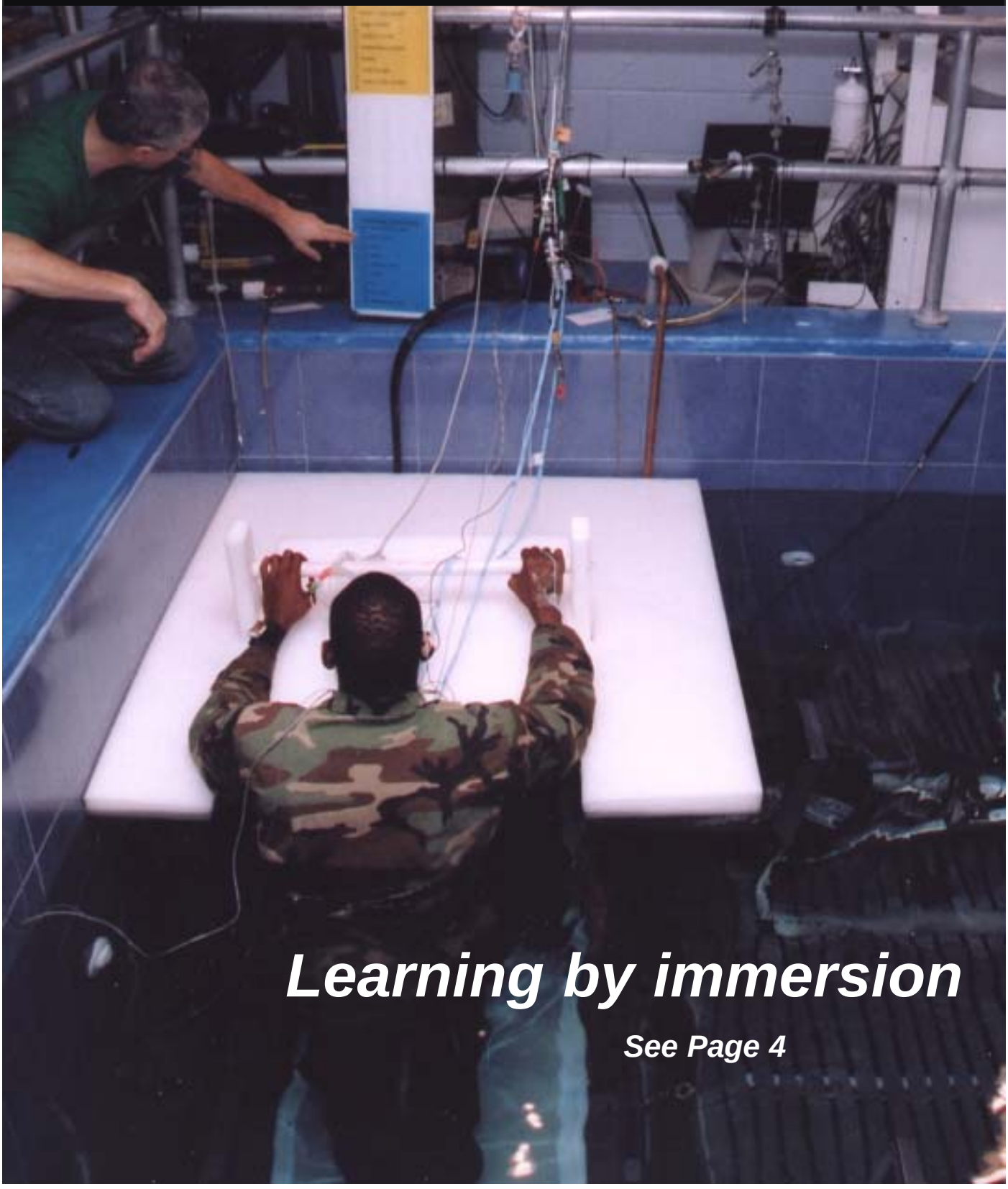

Learning by immersion

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Pvt. 2 Sacorah Tillman, a human research volunteer, focuses on a cognitive task while walking on a treadmill in the Water Immersion Laboratory tank at USARIEM. The treadmill can be adjusted to reflect varying depths soldiers encounter while wading through a swamp. (Warrior/ Underhill)

Soaked

Water Immersion Lab measures responses to heat, cold

By Curt Biberdorf
Editor

If the 14-foot depth of the Water Immersion Laboratory tank at the U.S. Army Research Institute of Environmental Medicine (USARIEM) seems excessive, there's a good reason for it.

"Visitors are always surprised at how deep it is, but once (the water) gets to temperature, we can keep it at that temperature within a few tenths of a degree," said John Castellani, a research physiologist in USARIEM's Thermal and Mountain Medicine Division. "That's the benefit of a deep tank."

Researchers at USARIEM, located at the U.S. Army Soldier Systems Center in Natick, Mass., have been using the laboratory to evaluate human responses to cold or hot environments for a variety of studies since the USARIEM building was constructed in 1968. Renovated in 2000, the lab's premier feature is its 10-foot by 10-foot stainless steel tank filled with 10,000 gallons of chlorinated water.

Besides water depth, the facility is unusual for its ability to test humans exercising on a single underwater walking treadmill or with two cycle ergometers while sitting on accompanying bolted-down stainless steel chairs.

Each type of exercise machine is independently operated and raised or lowered on separate platforms into water with an operational temperature range of 41-122 degrees F, although the majority of human exposures in test protocols range from 59-104 degrees F. Each cycle ergometer has a moveable plate system to adjust to individual leg length, and resistance is adjusted by attaching or removing fins to the wheel.

Human research volunteers are connected to a data acquisition system, a computer nearby on the platform that surrounds the tank, to measure and record physiological status.

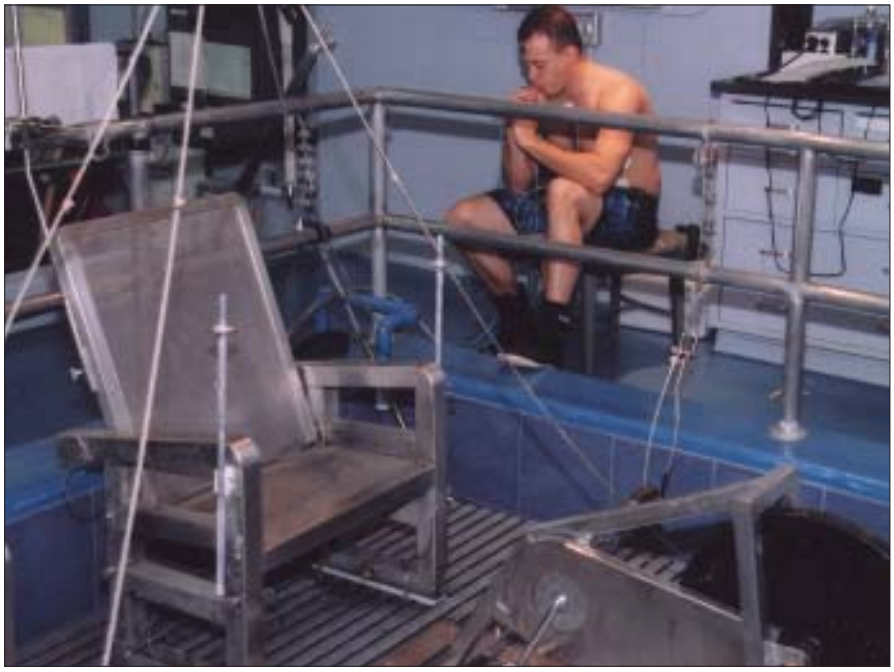
Work in the facility has been wide-ranging. The lab helped validate the core body temperature pill against conventional methods of measuring body temperature. Sometimes the exercise equipment is untouched, as with one nutrition study where the human research subjects sat still in the water.

Nearly five years ago, a commercial hot tub was acquired as a rewarming pool to help test subjects raise their body temperature quickly after soaking in chilly water, and the cold is what research has focused on in recent years.

"We're interested in how hypothermia affects humans," Castellani said. "This facility works out well because it gives you a great place to recreate a cold or cold-wet environment."

Water takes away heat 25 times faster than air, which makes it easier for researchers to reduce core body temperature without risking a cold injury that could occur in an air chamber, he said.

Motivation in studying hypothermia was spurred after four Army Rangers died while going through Ranger school at Eglin Air Force



Pvt. 2 Lance Casey, a human research volunteer, fills a tube with saliva before entering the Water Immersion Laboratory tank. Casey was participating in a sedentary cold exposure evaluation to test the affect of tyrosine supplementation on cognitive performance during cold stress. (Warrior/ Underhill)

Base, Fla., in 1995. Scientists used the water immersion lab along with the climatic chambers to pursue research on how cooling affects performance.

A repeated immersion study in 1996-1997 simulated what happens when a soldier enters the water for two hours at a time and then emerges, three times per day. By the second and third immersion, researchers learned that body temperatures decreased because the test subjects couldn't shiver as well.

Researchers also used the facility in studies to learn if exercise fatigue causes thermoregulatory fatigue. Human research volunteers exercised or remained motionless in the water, which was then followed by cold air exposure. Those exercising and fatigued had a lower body temperature because they could not keep their body heat in as well.

"The idea is to feed data into our cold (temperature) models. We're trying to add fatigue factors into the existing model, which is now good, but we're building on it," Castellani said.

The treadmill, a relatively new addition, is helpful because it can simulate wading in a swamp, which is more realistic than the cycle, said Castellani. Researchers can vary the treadmill speed, water temperature and, by raising or lowing the platform, vary the water depth to test responses at different points along the body.

A study that has just begun is looking at how long people can stay in water at different depths and temperatures. A second part of the study will take hypothermic human research volunteers into a cold chamber to test their cognitive and physical performance through a series of Special Operations Command tests.

"We don't have much information on this at the temperatures and depths we're looking at," Castellani said. "We've been able to understand that stressors soldiers undergo cause a degradation on thermal regulation. That information will help us design better physiological models."

Ultimately, the idea is to be able to predict under what conditions a soldier declines in performance and may become a casualty, he said, giving troops the information to make the right decisions and avoid harm.

Warrior/Underhill

Pvt. 2 Lance Casey, a human research volunteer, indicates he is still OK while sitting on one of two stainless steel chairs lowered into the Water Immersion Laboratory tank. Water temperatures for this study dipped into the 50s.