

Christian Lambertsen

Invented scuba gear for combat

It was summer 1940 in Cleveland, Ohio. Christian Lambertsen was wearing a breathing mask and standing beside a canary and dog inside an airtight chamber. With the local press and fire department in attendance, the medical student was to demonstrate his own invention: a Lambertsen amphibious respiratory unit, an early version of scuba gear (self contained underwater breathing apparatus).

Lambertsen already had successfully shown its underwater capabilities. Now he would show that it could protect against a hazardous atmosphere. Oxygen was removed from the chamber and replaced with cyclopropane, a flammable anaesthetic gas, according to Richard D Vann, a diving historian and professor emeritus in anaesthesia at Duke University school of medicine in Durham, North Carolina. The canary, as expected, fell unconscious from its perch, then the dog, then, unexpectedly, Lambertsen. Firefighters broke into the chamber to rescue the unconscious inventor. The problem, Professor Vann said, was that cyclopropane had penetrated the latex breathing bags.

Innocence, ignorance, and confidence

Professor Vann, later a friend of Lambertsen, said that the inventor described the event as a shining example of “the innocence, ignorance, and confidence of youth” and as proof that “he had nine lives.” Indeed, Lambertsen flirted with death on several occasions during diving tests in the 1940s as he doggedly improved his invention.

After the chamber demonstration, Lambertsen returned to the University of Pennsylvania School of Medicine. The second world war was raging in Europe, and it became increasingly clear to him that his invention, which did not emit bubbles underwater, could be used for covert military missions into enemy territory.

Professor Vann noted that Henry Fleuss of the United Kingdom obtained a patent in 1878 for the first self contained breathing apparatus, but added that Lambertsen’s enhancements were important improvements that allowed divers to “conduct hard work without becoming unconscious.”

“He definitely was the father of the field of combat divers in the United States,” Professor Vann said. “And he built on his early work in a 70 year career that extended human environmental physiology from depths as great as 500 metres to the vacuum of space.”

Christian James Lambertsen died recently at home, in Newton Square, Pennsylvania, aged 93. He was born on 15 May 1917 in Westfield, New Jersey, and was raised in nearby Scotch Plains.

He spent summers at the nearby Atlantic shoreline, becoming an expert swimmer. After earning an associate degree at a junior college, he won a scholarship to Rutgers University in New Brunswick, New Jersey, earning a bachelors degree in 1939.

At medical school that September one of his classes was respiratory physiology, where students learnt about oxygen and carbon dioxide by doing exercises such as breathing hypoxic gas to unconsciousness and conducting breath holding contests to feel the effects of hypoxia and hypercapnia, Professor Vann said.

Lambertsen applied this knowledge, first experimenting underwater using a bag for rebreathing supplied with fresh air from a bicycle pump above. Carbon dioxide accumulation in the bag was a problem that he solved by inserting a small scrubber used in anaesthesia equipment.

Lambertsen’s physiology professor, UK native Henry Bazett, was interested in the experiments and asked for additional parts from the Cleveland anaesthesia equipment supplier. The company offered Lambertsen a summer job at \$30 a week to construct an “underwater breathing apparatus for lifesaving.” Lambertsen accepted and improved on his earlier version, with the face mask connected to a scrubber that removed carbon dioxide from his exhaled breath into a flexible bag, allowing him to recycle his breath with added oxygen from a tank. The apparatus was successful underwater but failed the chamber test.

In 1941 he published a paper in *JAMA* describing the potential life saving uses of his invention (1941;116:1387-9). A trip to Washington by Lambertsen and Bazett to show the invention to the

navy was a flop. Lambertsen persevered, shifting his focus from life saving to military application, requiring a major redesign shown in 1942. The army’s Office of Strategic Services, the predecessor to the Central Intelligence Agency, was interested. After earning his medical degree in 1943, Lambertsen was assigned to the office’s maritime unit to improve his apparatus and train swimmers to use it.

After the war, Lambertsen joined the University of Pennsylvania’s department of pharmacology. In 1948 he helped train new elite underwater demolition teams, later to be called navy seals (“sea, air, and land

teams”). In 2000 the seals honoured him with the title “father of US combat swimming.” Also in 1948 Lambertsen converted an abandoned altitude chamber into a positive pressure thermal laboratory, which became a global magnet for physiological research in undersea and aerospace environments. In 1968 he became the founding director of the university’s institute for environmental medicine, retiring in 1987, but remaining active as distinguished emeritus professor of environmental medicine.

Lambertsen, cofounder of the Undersea Medical Society (now the Undersea Hyperbaric Medical Society), was a medical adviser to NASA, the navy, the air force, the National Oceanic and Atmospheric Administration, and other organisations. Lambertsen, whose wife, Naomi, died in 1985, leaves four sons.

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Ned Stafford

Christian Lambertsen, professor of environmental medicine (b 1917; q Rutgers University, New Brunswick, NJ, 1943), died on 11 February 2011 from renal failure.

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