

## Nello Pace

Scientist adventurer Nello Pace, who climbed Himalayan peaks to find out how the body reacted to high altitude and pioneered the study of the physiological effects of weightlessness, died on 17 June at his home in Berkeley, California, of prostate cancer. A Professor Emeritus of Physiology at the University of California at Berkeley, Pace was 78.

Pace specialized in environmental physiology, which he once defined as the "study of all the discomforts known to man". To do this, he endured many of the discomforts himself, climbing Himalayan peaks to study the effects of low oxygen levels on humans, travelling to Antarctica to record the effects of subfreezing temperatures, and even serving at a front-line M.A.S.H. unit during the Korean war to study combat fatigue. He also pioneered the study of weightlessness and its effects on the body. One of few experts in the field of gravitational physiology in the 1960s, he served as a consultant to NASA and conducted some of the first studies of weightlessness on orbiting monkeys.

His numerous studies helped prepare for human spaceflight, and laid important groundwork for studies of disease and the effects of ageing. "Fifty years ago physiology involved study of how the normal body functions under normal conditions", said Paola Timiras, Professor of Physiology at UC Berkeley and a long-time colleague of Pace. "He was the one who insisted modern physiology must look at what happens under all conditions, including space."

Pace's most enduring interest was high altitude physiology. To study it, he spearheaded an effort to build a high-altitude laboratory on White Mountain in California. He directed the White Mountain Research Station, the highest permanent year-round research laboratory in North America, for 27 years.

From laboratories at 5000 feet in Bishop, California, at the 11 000-foot level, the 12 500-foot level and the 14 246-foot summit of White Mountain, he conducted numerous studies of the effects of low oxygen, and encouraged experiments in fields such as biology, physics, astronomy, botany and zoology. There he and colleague F. Duane Blume developed a respirator that was used by climbers in a 1971 ascent of Mount Everest. In 1983, the research station laboratory at 12 500 feet on Mount Barcroft was named the Nello Pace Laboratory in his honour.

Pace was born in Richmond, California, on 20 June 1916 and grew up in San Francisco's Mission District. On graduation from Mission High School in 1932, he entered UC Berkeley, where he obtained a BS in chemistry (1936) and a PhD in physiology (1940). After a brief stint at the Medical College of Virginia, he joined the Navy at the outbreak of World War II. During four years of duty, he helped set up the US Naval Medical Research Institute in Bethesda, Md., and headed its physiology facility. During this time, he studied diving and aviation medicine, as well as the effects of heat, survival after shipwreck, and carbon monoxide poisoning. He subsequently was officer in charge of a Navy team conducting a radiological survey of Nagasaki and Hiroshima after their destruction by atomic bombs.

Pace returned to UC Berkeley in 1946 to work on medical physics at the Donner Laboratory and joined the physiology department faculty in 1948. Recalled to active duty during the Korean War in 1952, he studied combat stress among front-line troops.

He chaired the Berkeley department of physiology/anatomy from 1964 to 1967, and retired in 1977.

It was during those latter years that he delved into all aspects of the body's response to extreme conditions. In 1954, he served as chief scientist on an ascent of the world's fifth highest peak, Makalu on the border between Nepal and Tibet, to determine the effects of hypoxia or low oxygen levels on human performance, and led an International Physiological Expedition to Antarctica in 1957-58 as part of Operation Deepfreeze III to study how the body adapts to extreme cold.

In the 1960s, he was one of the most prominent scientists in the fledgling field of gravitational physiology, and was a founding member of the International Society for Gravitational Physiology. He was one of the principal scientists collecting data on a pigtail macaque sent into satellite orbit in 1969 for 30 days on a "Primate Mission" called *Biosatellite 3*. His primary interest in the flight was the impact of weightlessness on the distribution of fluids in the body as well as mineral loss in the urine and changes in muscle mass. It remains a mystery today why astronauts suffer from muscle atrophy and the accumulation of fluids during even short times in space.

Even after his retirement, he continued his studies of weightlessness, as an experimenter

with the joint USA/USSR *Cosmos 1129* Biological Satellite Mission in 1979-80. As recently as 1985 he collaborated on a study of high gravity and its effects on bone mass, employing rodents and rabbits that lived for five weeks in a centrifuge. In his retirement, he founded the Galileo Foundation in El Cerrito, California, to support annual meetings of the IUPS Commission on Gravitational Physiology and to publish the proceedings. From 1987 until his death, he served as president and director of the foundation which provides important financial assistance to Eastern European and Russian scientists wanting to attend meetings in the West, and for young American scientists eager to attend meetings held in Europe.

Pace served on numerous panels and committees of the National Academy of Sciences, NASA and the US Public Health Service, and chaired the panel on gravitational biology of the Committee on Space Research (COSPAR) for many years.

His honours included the Yuri Gagarin Medal of the USSR Federation of Cosmonautics (1990), a Docteur Honoris Causa from the

University of Bordeaux in France (1993), the Cavaliere Ufficiale (Order of Merit) from the Republic of Italy (1976), and a Founders Award from the American Society for Gravitational and Space Biology (1990). He was an honorary fellow of the California Academy of Sciences, a fellow of the Aerospace Medical Association and the American Association for the Advancement of Science, and a member of organizations ranging from the American Alpine Club to the Undersea and Hyperbaric Medical Society. He also was an active member of the French Club (Cercle de l'Union) and Bohemian Club of San Francisco. As an indication of his broad interests, he once compiled an English-Sherpa-Tibetan vocabulary (published in 1960) that for many years was the only Sherpa dictionary in existence.

Nello Pace is survived by his wife, Mary Jo de Rouhac Pace of Berkeley, daughters Susan Rossi of Oakland and Cynthia Barber of Union City, and grandchildren Carla and Dino Rossi and Brian and Robert Barber.

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