

## Ulrich Cameron Luft—A Pioneer in Altitude Physiology

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Ulrich Cameron Luft (1910–1991) was an authority in the field of altitude physiology and aerospace medicine. He was born in Berlin on April 25, 1910. He was the son of a German teacher and a Scottish mother. He visited his relatives in Great Britain in 1914, but could not come home because of the outbreak of World War I and was separated from his parents until 1920.<sup>1</sup>

Luft studied medicine at the Universities of Freiburg, Munich, and in Berlin until receiving his M.D. in 1935. Then he worked as a Resident in Internal Medicine and Pathology with the well-known aviation pathologist Franz Buechner in Freiburg.<sup>2</sup> He developed a small hypobaric chamber which he used for his guinea pig subjects. His medical thesis was on “Experimental Pathology of the Hypoxia Effects on Organs” (“Irreversible Organveraenderungen durch Hypoxaemie im Unterdruck”).<sup>11</sup>

While he was a student in Munich, Ulrich Luft became acquainted with the physiologist and mountaineer Hans Hartmann, who was the Chief of Physiology at the Aeromedical Research Institute in Berlin. Hartman had previously worked with Max von Frey and Hubertus Strughold in Wuerzburg, Hermann Rein and Theodor Benzinger in Goettingen, and Heinz von Diringshofen in Berlin, who together ran the leading German aeromedical laboratories in the early 1930s.<sup>9</sup> In 1937, Hartmann invited Luft to participate in a field trip to Nanga Parbat in the western Himalayas of Pakistan (8125 m/26,657 ft) as a research physiologist and team physician.<sup>17</sup> The German Air Ministry was involved as they were interested in finding ways to acclimatize pilots to high altitude so as to raise the “ceiling” of pilots in unpressurized planes. The expedition ended tragically: Luft was the only survivor as he was working at the base camp when a deadly avalanche buried 16 expedition members and their Sherpas. One of the seven team members was Hans Hartmann.<sup>1,8</sup>

In 1938, the next expedition was under the lead of Paul Baue. Luft selected Bruno Balke to assist him in the medical research. This involved cardiovascular, respiratory, and hematological studies on all climbers, as well as measurements on acid secretion in the stomach while at high altitude. In addition, individual tolerance to the acute exposure of high altitude in a low-pressure chamber was determined before and after the expedition. The data obtained on the mountain at altitudes up to 25,000 ft led to the conclusion that given enough time at intermediate altitudes, the human body could adapt adequately up to 20,000 ft for a period of many weeks.<sup>1,8,15</sup> The scientific findings of both



**Fig. 1.** Ulrich Cameron Luft as a university lecturer in Berlin.<sup>2</sup>

expeditions to Nanga Parbat were published in three articles on hypoxia and cold effects in the early 1940s:<sup>9</sup> “Physiological Observations on Nanga Parbat 1937–38,”<sup>8</sup> “On the Use of Oxygen Apparatus on Himalayan Expeditions,”<sup>12</sup> and “Cold and Cold Protection in High Mountains.”<sup>13</sup>

Luft also worked on high altitude acclimatization for high altitude flights in nonpressurized aircraft at the laboratory on the Jungfrauoch (3400 m/11,154 ft) in 1938 and 1939.<sup>3</sup> This adaptive effect was very important for cabin personnel in unpressurized aircraft at the time and would become of even more vital importance during World War II.<sup>7</sup>

In late 1938, Luft joined Strughold’s Aeromedical Research Institute in Berlin as a research physiologist and was in charge of the Laboratory for Altitude Physiology.<sup>1</sup> In 1942, Luft earned his Ph.D. in Physiology and became the Assistant Professor of Physiology and Medicine as a member of the faculty at the University of Berlin (**Fig. 1**). His thesis was “High Altitude Acclimatization.” In 1941 he married his colleague, Alice Hentzelt.<sup>1,2</sup>

In 1939 he was required to undergo military training but returned as a researcher with civilian status to the Luftwaffe’s Aeromedical Research Institute headed by Dr. Strughold. He also served as a consultant to the German military on thermal stress and nutrition. Luft was later deployed to the southern front in North Africa to support the

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Luftwaffe's efforts in matters related to heat stress. He was then posted to the Russian Front in early 1943 in matters related to special nutrition in the cold for the besieged 6<sup>th</sup> Army in Stalingrad.<sup>1,17</sup>

Research continued on the conservation of the acclimatization effects for high altitude by the use of repeated altitude chamber exposures: "Increasing Altitude Tolerance via Acclimatization and Low-Pressure-Chamber Training for flights up to 13,000 m without Pressurized Cabins."<sup>12</sup> In 1943 the Luftwaffe introduced courses in high altitude acclimatization for flying personnel (Hoehenanpassungslehrgaenge) and ordered 40 mobile altitude chambers for operational use in active wings to conserve the acclimatization effects. The military medical requirements also focused Luft's research on rapid decompression, the diffusing capacity of the lung, and the duration of consciousness at altitude, which was mandatory to know for personnel in unpressurized aircraft (time of useful consciousness).<sup>1,6,14,16</sup>

Luft and his superior, Hubertus Strughold, never joined the Nazi party. To our knowledge Luft never was involved in any unethical medical experiments in World War II. However, the entire German scientific aeromedical community was informed about unethical medical experiments that occurred at the Dachau concentration camp in 1942 by attending the "Nuremberg Cold-Conference" in October 1942.<sup>4,5,7</sup>

After the end of World War II, Luft started a private medical practice in the Soviet occupied zone of Berlin. Here he was interrogated by the Russians, who wanted to know where Strughold was located.<sup>4</sup> Late in 1945 Luft was called upon to reopen the Physiological Institute at the University of Berlin as the acting director and to reorganize the teaching and research program.<sup>2</sup> He continued in this position in the Russian Sector of Berlin until April 1947. At that time, he received an offer from Col. Harry Armstrong to take up aeromedical research with the U.S. Army Air Force.<sup>1</sup>

Under "Operation Paperclip", Luft was appointed to the School of Aviation Medicine (SAM) at Randolph Field, TX, USA. In 1950 he was joined by his former Nanga Parbat colleague Bruno Balke, who joined the SAM team on his suggestion. Balke was put in charge of the Physical Performance Lab. He stated at the time that regular physical exercise contributed to the adaptation of space conditions (weightlessness).<sup>4</sup>

Luft was a researcher at SAM until 1954, when he was asked by Randolph Lovelace to head the Department of Physiology at the Lovelace Clinic for Medical Education and Research in New Mexico.<sup>1</sup> His research interests continued to center around the effects of oxygen deficiency. He contributed in a variety of fields, including oxygen equipment design and the testing and selection of the first

Project Mercury astronauts.<sup>10</sup> The Mercury astronaut Phase II selection process occurred at the Lovelace Clinic in New Mexico in 1958 and involved the intense medical and physiological testing of 31 astronaut candidates (7 were ultimately selected).

Luft became an Aerospace Medical Association Fellow in 1964. He retired in the early 1980s and died on November 23, 1991, at his home in Albuquerque, NM.<sup>1</sup> His significant contribution to early high altitude research and its application under the aspects of flight safety will be long remembered by the aerospace medical community.

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