Ludolph Brauer, German Aeromedical Pioneer

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Ludolph Brauer (1865–1951) played an influential role in the history of aviation medicine in Germany. The Treaty of Versailles had put a stop to the development of German aviation and associated medical activities at the end of World War I. Brauer deserves credit for restarting civilian aviation medicine in Germany in the 1920s, paving the way for it to flourish in the 1930s. As Medical Director of the Hamburg-Eppendorf General Hospital, Brauer established the first German Institute of Aviation Medicine (GIAM) in 1927 in affiliation with the Tuberculosis Research Institute with its two large pneumatic chambers. The GIAM was active in altitude research and the selection of pilots, as well as educating medical students in aviation medicine, training Aviation Medical Examiners, and exploring clinical applications of hypobaric and climatic therapy. Brauer was forced to retire in 1934 for political reasons as the GIAM came under the influence of the military; in 1939 it was made part of the Aeromedical Research Institute of the "Reichsluftfahrt" Ministry. Brauer was a co-editor of the journal *Luftfahrtmedizin* in the 1930s and 1940s. He died in Munich on November 25th, 1951.

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THE EARLIEST aeromedical activities in Germany stopped at the end of World War I (1918) because the Treaty of Versailles (1919) inhibited further developments in German aviation. In 1927, the year of Charles Lindbergh's historic flight, Professor Dr. med. Ludolph Brauer (1865–1951) restarted aeromedical activity in the civilian academic sector (12,13). He went on to implement pioneering programs of research and teaching in aviation medicine.

August Ludolph Brauer was born in Hohenhausen, Western Prussia, on July 1st, 1865. His father was August Wilhelm Brauer. His mother was an American, Onézime Emma Brauer, born Chopard, from New Orleans, LA. Brauer grew up in Bremen and suffered from tuberculosis as a child. He studied medicine in Bonn, Marburg, Munich, and Freiburg, then became an assistant to Friedrich Wilhelm Schultze in Bonn and to Wilhelm Erb in Heidelberg, where he was a lecturer in internal medicine in 1897 (1,2,15,16). In 1905 Brauer was promoted to Director of the medical clinic in Marburg, where he continued his research on the therapy of tuberculosis by the use of an artificial pneumothorax and developed the use of positive pressure breathing to improve patient oxygenation during thoracic surgery. In 1910 Brauer became Medical Director of the 2,000-bed Hamburg-Eppendorf General Hospital. He was interested in establishing independent research institutes modeled on the Rockefeller Institute in the United States, and in 1912 he founded both the Tuberculosis Research Institute and the Cancer Research Institute in Hamburg.

During World War I, Brauer served as a consultant in Internal Medicine in Poland, Palestine, Turkey, and Egypt. He returned to Hamburg in 1919, and his general hospital became affiliated with Hamburg University the same year (1,16). In 1927 Brauer founded the German Institute for Aviation Medicine (GIAM) at the Tuberculosis Research Institute (3,4,6,8), which was equipped with two large pneumatic chambers used primarily for tuberculosis therapy including both hyper- and hypobaric procedures. Research topics for the GIAM included the effects of high altitude on circulation, respiration, performance, metabolism, and the well-being of patients and of healthy volunteers. The cooperation of the GIAM with the University Hospital provided access to diagnostic procedures for the pulmonary and cardiovascular system as well as to various laboratories, such as those used for analyzing blood gases and metabolism (7,11,17,19).

One of the altitude-chambers at the GIAM could be decompressed to a simulated altitude of 14,000 m. However, most studies were carried out at 8,000 m as the huge chamber was leaky. It was used for flight physicals and screening pilot candidates, as well as for physiological training of pilots and of mountaineers. The chamber was used for training by members of the German Himalaya Expedition of Willi Merkl in 1932, and the high-altitude physiologist Hans Hartmann, who was a member of the 1931 expedition to Kangchenjunga (8,598 m), reported on his valuable experiences in 1934 at Brauer's Institute. Altitude research at the GIAM focused mainly on hypoxia tolerance. For example, it was widely believed among airmen at that time that glucose could improve hypoxia tolerance, and the Institute tested that hypothesis using pilots as subjects. Another study examined the effects on hypoxia tolerance of pharmaceuticals including Coramin, Cardiazol, and Sympatol (14)(**Fig. 1**).

The second chamber at the GIAM was used for clinical purposes, as pulmonary conditions such as chronic

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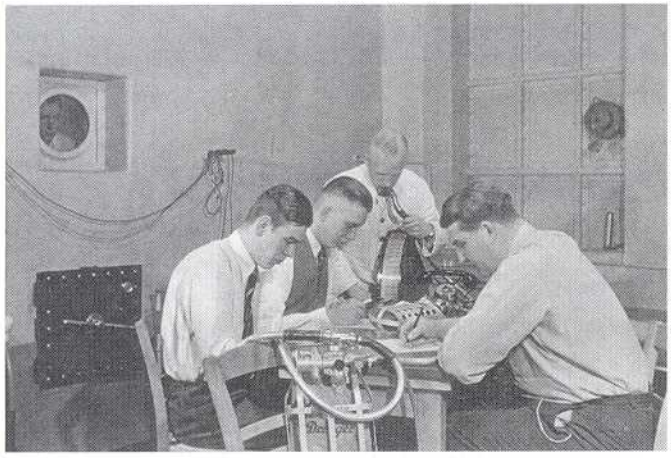

Fig. 1. High altitude research with pilots in the hypobaric chamber in 1937. Picture from "Die Hansische Universität," 1937 (18).

obstructive pulmonary disease were thought to improve with prolonged exposure to altitude in a controlled climate. In this chamber, not only the barometric pressure but also the electric capacity, humidity, ultraviolet light, and temperature could be varied. This so-called "asthmatic chamber" could also be used as a hyperbaric chamber for hyperbaric oxygen therapy of conditions such as carbon monoxide poisoning (4,6,8,13).

Scientists at the GIAM also studied the psychophysical effects of aerobatic flight. Heinz von Diringshofen (1900–1967) specialized in acceleration physiology and in 1933 was the first German physician to train in the field of aviation medicine at the GIAM; in the 1960s, he became the first president of the German Society of Aviation and Space Medicine, now an affiliate of the Aerospace Medical Association. Von Diringshofen began his in-flight acceleration research as a resident at the Würzburg Physiological Institute and continued it as a Resident in Aviation Medicine in Hamburg (13,14).

Aviation medicine became part of medical student training in Germany in 1933, which was a national requirement. In Hamburg, Brauer arranged lectures in Aviation Medicine by Albert Anthony (1933–1938), Heinz von Diringshofen (1933–1934), Wilhelm Knoll (1937–1938), Werner Kyrieleis (1934–1938), Heinrich Lottig (1934–1938), and Wilhelm Schwarz (1938–1944). The syllabus of the academic aeromedical training included: 1) Essence and Need for Aeromedical Work; 2) Aviation Physiology: Effects of Altitude and Acceleration on the Human Body; 3) Medical Aspects of Flight Physicals and their methodology; and 4) Care and Examination of Pilots in private practice and in the German Aero Federation (Deutsche Luftsportverband) (14). The GIAM also provided extended postgraduate training; the first course for Aviation Medical Examiners took place in 1934 with about 50 participants.

Scientists from other German universities and American scientists worked at the GIAM under Brauer's leadership. Brauer explained to H. Lawrence Groves, American Commercial Attaché of the U.S. Embassy in Berlin, that he would welcome young American scientists, who would be received with courtesy and openness at his Hospital and Institute (21,24,25,34)(**Fig. 2**). In 1930 Brauer edited (together with A. M. Bartholdy and A. Meyer) the two-volume "Forschungsinstitute," which covered the history of research facilities worldwide (3,4). At that time Brauer was Rector (head) of the University Hospital, and in 1933 he became Editor of the international *Acta Aerophysiologica*, which was devoted to research on the "effects of life and work carried out in high altitudes, the effects of high speeds, the strain on the organs of sense, the sense of balance, on the respiration and circulation during the flight, the psychic influence on man in these conditions."

Brauer was forced to retire from his university positions in 1934. It seems he did not go along with the political ideas of the times; for example, he was accused by university officials, colleagues, and students of being "national untrustworthy and a supporter of Jews." Brauer left Hamburg but remained head of his German Institution for Tuberculosis Research in Wiesbaden and thereafter in Munich. At that time he showed no interest in the further activities of the work of the GIAM as it fell under increasing military influence. The Institute came to be controlled by the military Research Institute of Aviation Medicine in Berlin, where Hubertus Strughold succeeded von Diringshofen, who went to the Air Force Test and Research Center in Jüterbog as head in 1935 (13,14). Beginning in 1936, Brauer became an editor of the journal *Luftfahrtmedizin* (Aviation Medicine), working with co-editors and physiologists Strughold and Hermann Rein. Many of the articles published in



Fig. 2. Ludolph Brauer (1865–1951) as the Rector of the Hamburg-University in 1930–1931. Picture from Historical Archive of Institute of the History of Medicine, Hamburg-Eppendorf University (14).

the journal came from the Hamburg-Eppendorf institutions and dealt mainly with the physiology and pathologic physiology of altitude (9).

During World War II, Brauer continued to follow scientific advances in aviation medicine as co-editor of the journal *Luftfahrtmedizin*. In 1940 he was honored for his scientific life-work with the Goethe Medal for Art and Science of the German Reich. In 1951 he was named honorary chairman of the German Therapy Congress in Karlsruhe. Only a few months later, on November 25th, 1951, he died in Munich at 86 yr of age (1).

Brauer is an historically important figure for restarting civilian aeromedical activities in Germany in the 1920s and for his pioneering role in research and teaching during the 1930s. He established the concept of "Independent Research Institutes" in Germany and developed abundant interdisciplinary scientific cooperation in research. Many advances in medicine can be traced back to Brauers visionary research, including the use of pneumothorax therapy in the treatment of tuberculosis and positive pressure breathing in thoracic surgery. He is memorialized today by the Northwest-German Society for Internal Medicine with its annual Ludolph Brauer Young Investigator Award and by Eppendorf University, whose Medical Department is housed in the Brauer Villa (14). In the German aeromedical community, Brauer is remembered for initiating systematic research and teaching in aviation medicine and for founding the GIAM, where his scientific vision and organizational skills provided a foundation that enabled his colleagues and succeeding generations of physicians and scientists to continue essential scientific work long after Brauer's retirement.

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