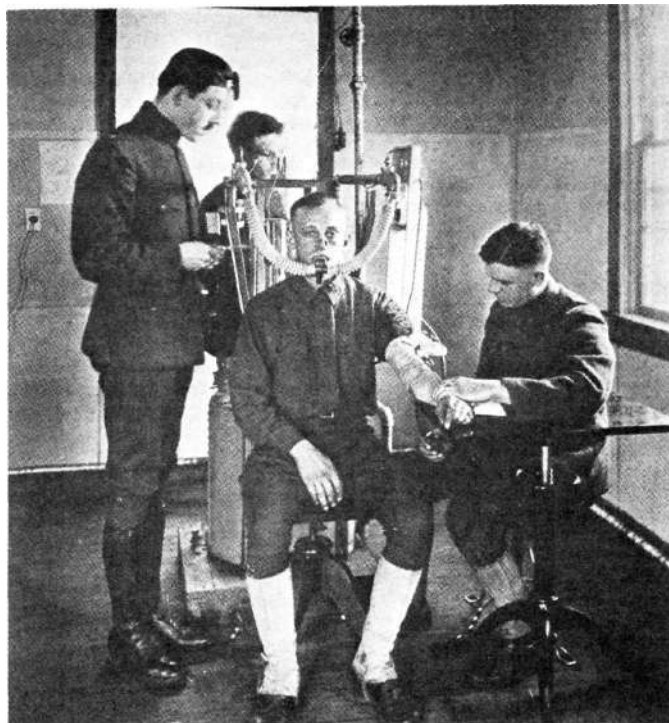


From its first appearance in the American medical literature to the dissolution of the Air Service Medical Research Laboratory in 1920, aviation medicine progressed from a series of low-level and unconnected researches to a recognized specialty, encompassing both research and practice. Along the way were created the institutions which were to serve the United States military through World War II and beyond, as well as the basis for civil practice through the present time.

Aviation medicine is that segment of medicine devoted to the problems of the flier. In practice, it is a branch of preventive medicine, ensuring the safety of flight through the care of the air crew. Research in aviation medicine involves all medical fields; at the time of the First World War, the major areas of physiological research were the responses to the high altitudes and unusual attitudes attainable in the new generation of fighting aircraft. Aviation psychology, then as now, dealt with stress and fatigue.

Another contribution of aviation medicine to aeronautics comes in the humanizing of new technology. Originally interested only in the medical causes of accidents, both flight surgeons in the field and researchers in the laboratory routinely came up with modifications in aircraft design and construction, many of which have had a controlling effect on the evolution of new machines. Two further branches of modern aviation medicine, aerial evacuation and sanitation, contributed little to the development or character of the new medical specialty.

Before World War I, aviation medicine had no special identity. Physiologists of many nations applied themselves at intervals to the problems of altitude. A small number of physicians in France



Rebreathing apparatus was used to rate cadets for tolerance to oxygen lack at altitude.
(Air Service Medical Manual)

The Birth of Aviation Medicine

by Bard C. Cosman

recorded the effects of flight on pilots. In the various military services, surgeons, internists, otologists, ophthalmologists, and psychiatrists, faced with the problem of setting examination standards for the aviation corps, began to think seriously of the medical problems of flying and how best to distinguish the unfit. However, aviation medicine did not exist as a category in the minds of any group except perhaps the French investigators, and these were few and had little institutional support. As for the military surgeons, there was little communication among them, and virtually nothing appeared in writing. Altitude physiologists worked with the support and approbation of major scientific institutions, but mention was rarely if ever made of applications of their research.

The most important work done in the United States in the prewar period was the Anglo-American Pike's Peak Expedition of 1911. In collaboration with two Oxford physiologists, two Americans, Yandell Henderson and Edward C. Schneider, built a laboratory on Pike's Peak in Colorado and spent several months observing their own and others' responses to altitude. Henderson and Schneider, both 37 years of age, of midwestern origin, and holders of Yale Ph.Ds, were to play major roles in the founding, six years later, of the Air Service's Medical Research Board. No mention of aviation was made in the expedition report.¹

The first appearance of aeronautical topics in the mainstream of English medical literature was in 1862, when James Glaisher published "Notes of Effects Experienced during Recent Balloon Ascents" in the journal, *Lancet*.² Ballooning also provided for the genesis of aeronautical medicine in France, with the experiments of Paul Bert and his colleagues in the 1870s. Although Hghter-than-air flight was used in the most advanced altitude research until the 1950s, it never achieved the importance of dynamic flight, and no recognized segment of medicine could have grown up around it.

Aviation medicine had to wait for aviation, which took its time in coming. It is fitting that the first original mention of aviation prob-



Balance functions of the inner ear were tested by whirling the cadet in the Barany chair. This ill-conceived device eliminated many normal candidates as unfit for flying.
(Air Service Medical Manual)

lems in the American medical literature should have been made by an aviator, not a physician. In 1914, Earle L. Ovington, describing himself as a "practical aviator," wrote to the *Journal of the American Medical Association* on "The Psychic Factors in Aviation."³ One can only guess what response was elicited; however, the Great War in Europe was beginning, and aviation was about to be recognized as a crucial factor in the fate of nations.

The prewar European idea of the aviator was of a superman, naturally endowed with the ability to fly. The French pioneers in aviation medicine may have been the first to recognize the statue's clay feet. Although their writings still contained the contemporary rhetoric of hero worship, the French doctors were contributing to a change in the popular perception of the aviator, which had profound repercussions in the later progress of aviation medicine. As more and more men—and even some members of the weaker sex—learned to fly, the image began to crumble; this process was greatly accelerated by the coming of the war.

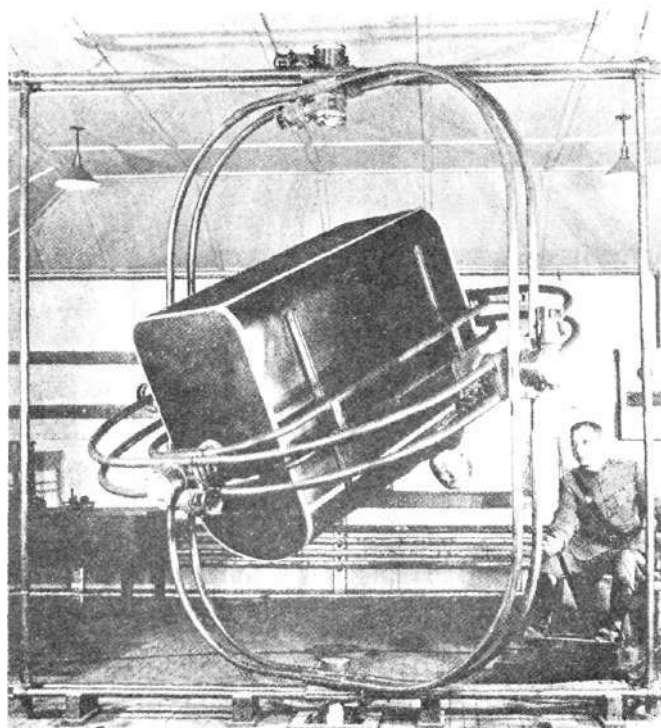
By the time the United States entered the war in April of 1917, Europe had awakened to the need to study the special problems of fliers. Researchers were working in all fields of aviation medicine, and some institutions had been formed to direct investigations. In England, service medical boards were the rule; these supervised examination of cadets and directed research. In France the responsibility for research remained largely with university groups led by civilian physicians or physiologists. Italy boasted a highly organized, military Psycho-Physiologic Institute at Rome in which were gathered civilian academics from all over the country.

It is not surprising that the British model was the one followed by the Americans in 1917. The perils of too little and too great centralization were exemplified by the French and Italian systems: French research was fragmentary, Italian dogmatic. The English system was well adapted to the needs of the military services; in addition, the Americans were further prejudiced by past experience. With Henderson as chairman of the Medical Research Board and Schneider as head of the Physiology Department, it is hardly surprising that, in their first publication, *Manual of Medical Research Laboratory*, reference to the Anglo-American Pike's Peak Expedition should be made throughout. The Americans followed the British lead in appointing a military board to oversee all examination and research.

On October 18, 1917, about four months after the United States entered the war, Lt. Col. Theodore C. Lyster, chief surgeon of the Army Signal Corps' aviation section, ordered the formation of a Medical Research Board, to consist of four Army majors and a civilian chairman. The Board set up six relatively independent departments, with entirely military staff: cardiovascular, ophthalmology, otology, physiology, psychiatry and neurology, and psychology. This organization was to handle the "immediate military problem of classifying new aviators and set up a research laboratory."⁴

The Medical Research Board had the opportunity to accomplish several basic things the Europeans either could or would not. These included applying statistics to the classification procedure, running redundant experiments within the several departments, setting up a working correspondence between the laboratory and the military surgeon on the flying field, and working with entirely untrained applicants (the European applicant was almost always from another branch of the service). Most importantly, it could muster the power and resources of the United States—which were much greater than those of any European nation ravaged by war—behind the idea of the flight surgeon.

The new scale upon which aviation medicine was to be conducted was exemplified by the establishment of physical examining units for aviation across the country. A new protocol for examinations was drawn up by Lyster and other members of the nascent Medical Research Board and, in the summer and fall of 1917, 35 physical examining units were created at universities and hospitals across the country. These were headed by Army medical officers but staffed by local physicians. Thirty-two more units were constituted at Army bases. In the single year between the fall of 1917 and the Armistice, approximately 100,000 applicants were screened.



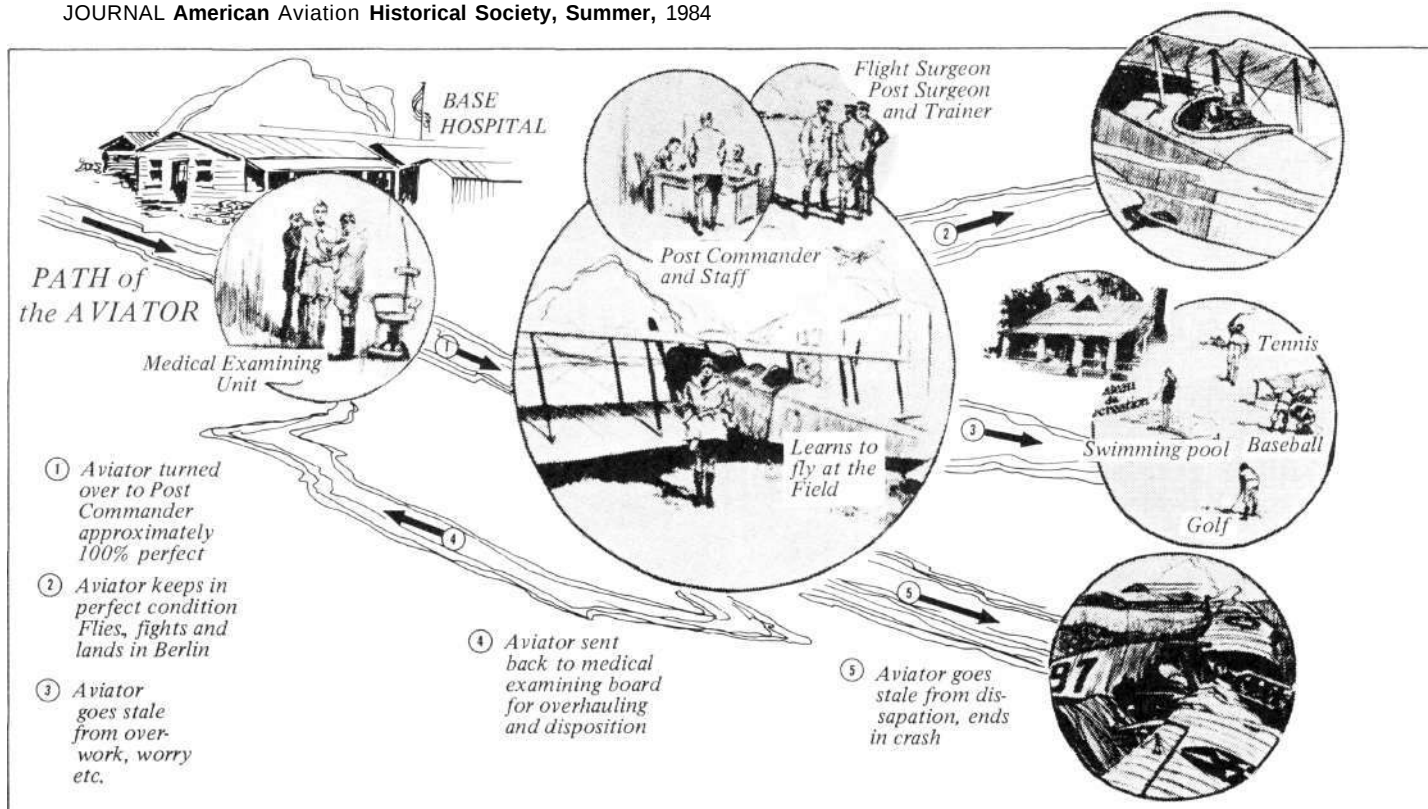
The Ruggles Orientator, a dual-controlled attitude simulator which could spin on three axes.
(Bauer's Aviation Medicine)

A few officers were sent to Europe in October to inspect the English, French and Italian systems. This advance guard paved the way for the Medical Research Board's expedition to France by relaying back technical and organizational information. The Board also established a laboratory at Hazelhurst Field, Mineola, New York. Researchers worked in the laboratory as it was being built in early 1918, and the results were published in the *Manual of Medical Research Laboratory*, which was distributed at home and abroad. The first of its kind in the world, this text suggests that American researchers may already have surpassed their European counterparts. Branch laboratories were planned—and at least some operated—at other flying schools in the U.S.

In August 1918, the 49 laboratory personnel, along with 14 tons of equipment, sailed for France. The main laboratory was reconstituted at the Third Aviation Instructional Center at Issoudun. Under the command of Col. William H. Wilmer, a Washington ophthalmologist, the Medical Research Laboratory set out to make real the goals it had set in Mineola. The foremost of these was a practitioner's goal, exemplifying the cooperation between research and practice which Dr. Wilmer and his staff expected. Flight surgeons, responsible for the preventive care of the flier, were to be placed at several of the fields comprising the Instructional Center, with the hope of materially reducing the accident rate.

Sitting on the Accident Board, working as flight surgeons, making statistical surveys, and setting up branch laboratories, the members of the Medical Research Laboratory were an accepted and potentially influential part of the American Air Service in France. They apparently had the complete support of the generals in Washington, and had the war not ended in November 1918, it is likely that flight surgeons would have spread from Issoudun to every flying field in France. In the context of the support given his programs, Wilmer's often-repeated statement that "a slack control wire is not more dangerous than a weak eye muscle, a poor mixture of gas and air is not more serious than a flier with poor adaptive respiration"⁵ sounds more triumphant than hopeful.

Two major universities had a strong influence on the American effort in aviation medicine. As noted previously, both Yandell Henderson and Edward Schneider held degrees in physiology from Yale, and all the writings of the Board on altitude physiology bear



the stamp of their collaboration. This association was the target for some resentment: one finds Chicago physician Charles M. Robinson objecting in print to the dominance and dogmatism of the "Yale professors."⁶

Johns Hopkins University had a greater influence. Col. Thomas R. Boggs received his M.D. from Hopkins in 1901 and taught there before and after the war; as Chief Medical Officer of the A.E.F. Johns Hopkins Medical Unit (Base Hospital No. 18), he was in Europe early and reported to the Air Service on conditions there. Later, as medical consultant to the Air Service, the chief surgeon's highest ranking representative in the A.E.F., he supported the activities of the laboratory at Issoudun, visiting and giving guidance and encouragement. Major Knight Dunlap, the head of the Psychology Department, also taught at Hopkins before and after the war. Lt. English Bagby, a graduate student of Dunlap's, followed him to France as Psychological Examiner of Aviators, receiving his Ph.D. from Hopkins on his return.

Among the early graduates of the Johns Hopkins Medical School, Boggs and Dunlap were subject to its radical ideals of scientific medicine, research on all fronts, and full-time academic medicine. This is evidenced not only by their personal career choices (both chose academics and returned to Hopkins) but also in their work in aviation medicine. The organization of the Medical Research Laboratory was in large part of Boggs' design, as it was his study of the Allied aero-medical services which were sent directly to the chief surgeon and the chief of the Air Service in 1917. Dunlap's Psychology Department, in the Hopkins research tradition, had little regard for the limits implied by its name; it made investigations on the inner ear which contradicted the findings of the Otolaryngology Department.

Behind this emphasis on medical research is the specter of William Welch and the German research tradition of the late 19th century. Welch was the head of pathology at the Johns Hopkins Medical School when Boggs and Dunlap were students, and his bringing to America German methods of scientific medicine has been linked with the rise of modern medicine. Welch's approval of the Medical Research Laboratory's activities may be seen in that he brought William Wilmer, former director of the laboratory, to Hopkins in 1925 to form the ophthalmology clinic which bears his name.

Publications during and immediately after the war reflect the acceptance of aviation medicine by the medical community. Articles

The path of the aviator through training to success or death became closely associated with the new field of aviation medicine.

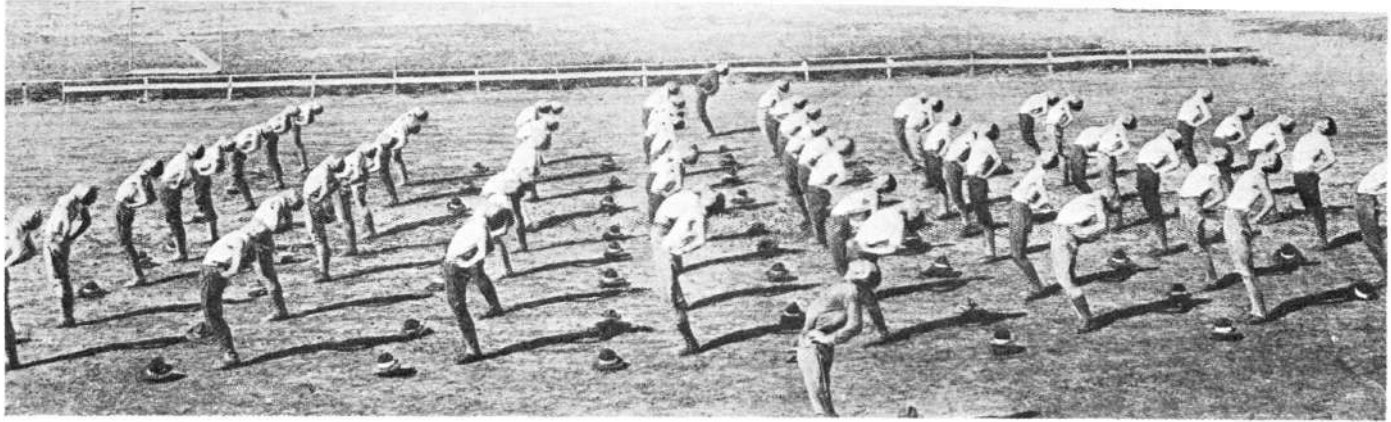
(Air Service Medical Manual)

on aero-medical subjects appeared in the most widely circulated general and specialty journals, and the first textbook, Louis Bauer's *Aviation Medicine*, appeared under the imprint of the premier medical publisher of the day. Very few new diseases or injuries were described during the entire period; the most notable condition one English author could come up with was fracture of the astragalus (ankle bone), which was consequent upon the design of rudder controls. It was not any new discovery that changed aviation medicine into a recognized specialty, but rather the recognition of the importance of aviation and the singularity of the preventive problems it presented.

By the war's end, aviation medicine was clearly fixed within the American institutional framework. Normal practice had been established and a new medical category founded, which through the agency of the journals became rooted in the general consciousness. As early as 1920, one could call the flight surgeon a "new specialist in medicine" in the pages of the *Journal of the American Medical Association*.⁷ A paradigm had been introduced to military medicine, and it proved its flexibility with time, extending substantially unaltered into the military and civilian life of the next several decades.

Emphasizing the validity of the new concept of aviation medicine was the ease with which it was applied to civil aviation. Dr. Wilmer's hopes for a future of research and growth as aggressive as during the war did not, of course, come to fruition, but the idea for the flight surgeon had become sufficiently entrenched that in 1926, when the government set up an agency to regulate civil aviation, the formation of a medical section was a matter of course. The equipment and personnel were available as well: Louis H. Bauer, commandant of the Air Service's School of Aviation Medicine, was simply transferred from one executive post to another.

The crucial difference between the American and the other Allied institutions of aviation medicine was the ultimate bias towards preventive practice. While the most important product of the British effort was undoubtedly oxygen apparatus for high-altitude flight, America's contribution was the flight surgeon. The values of the military establishment can be gauged by what it can afford in peacetime; when the Air Service's Medical Research Laboratory was



dismantled in 1920, its School for Flight Surgeons was allowed to continue. Under the title, School of Aviation Medicine, this originally subordinate division has lasted until the present day.

Postwar stringency caused not only the cessation of organized research but also the end of the athletic aspects of aviation medicine. The idea of the flier as athlete stemmed from prewar conceptions. In the original American conception of the care of aviators, a physical director, responsible for the fliers' recreation and physical training, was to assist each flight surgeon at every flying field. Together, the two members of the coaching staff would work "with might and main to produce the greatest athletes of the air to be found among the Allies to help score the touchdown at the Berlin goal post."⁸ Special aviation calisthenics were invented; these were conceived as flight maneuvers done with the body, and bore such names as "Tail-Spin Exercise" and "Immelmann Turn Exercise."

Changes in the field of medicine are always conditioned by social and economic factors: just as the introduction of an aero-medical paradigm was made possible by the military emergency of World War I, so the demise of the Medical Research Laboratory and the idea of the physical director were consequences of postwar belt tightening. If this were a triumph of practice over research, it was also in essence what the practical-minded researchers of 1918 were aiming towards, namely the institutionalization of aviation medicine in its most basic form. With the flight surgeon firmly in place, research could be revived at any time, as indeed happened in the 1930s.

Among the Allies, the ability to form institutions of aviation medicine seems to have been inversely related to the esteem in which aviation was held before the war. Entering the war late, the United States was in the favorable position of being able to study others' methods and learn from their mistakes. However, the most potent force in the rapid and successful development of the specialty of aviation medicine was the uniquely American partnership of academic physicians with their practicing counterparts. When in 1919, Colonels Boggs and Wilmer were delegated to the Inter-Allied Medical Aviation Conference, they could go with the realization that in less than two years they had created a new American medical specialty, which was already the subject of emulation abroad.

NOTES

1. C.G. Douglas *et al.*, "Anglo-American Pike's Peak Expedition" (*Philosophical Transactions of the Royal Society*, 1913, CHL, B, p. 185ff).
2. James Glaisher, "Notes of Effects Experienced during Recent Balloon Ascents" (*Lancet*, 1862, II, pp. 559-60).
3. Earle L. Ovington, "The Psychic Factors in Aviation" (*Journal of the American Medical Association*, 1914, LXIII, pp. 419-20).
4. U.S. War Dept., Air Service, Division of Military Aeronautics, *Manual of Medical Research Laboratory* (Washington: Government Printing Office, 1918), p. 6.
5. *Ibid.*, p. 5.
6. Charles Moore Robertson, "A Review of the Medical Aspects of Aviation" (*Illinois Medical Journal*, 1921, XL, No. 3), p. 223.
7. W.L. Sheep, "The Flight Surgeon, a New Specialist in Medicine" (*Journal of the American Medical Association*, 1920, LXXV, p. 265ff).
8. U.S. War Dept., Air Service, Division of Military Aeronautics, *Air Service Medical* (Washington: Government Printing Office, 1919), p. 393.

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"Aviation Calisthenics"—here is a flight of young eagles practicing Immelmann turns on the ground.
(*Air Service Medical Manual*)

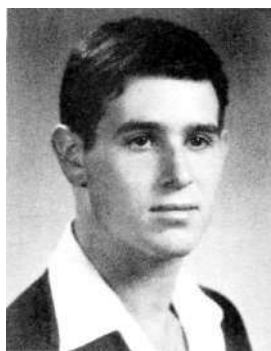
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