SOME RESULTS OF COLCHICINE INJECTIONS

INJECTIONS (Peter Gray method) of 0.02 cc of a 0.0001 per cent. solution of colchicine used on developing 24-hour chick embryos have shown the following results: (1) four of 20 injected eggs hatched, two males and two females; the hatched chicks have now reached the age of 9½ months, except for one hen which has been sacrificed for histological studies. (2) The combs and wattles in both sexes are abnormally large, approximately of twice the size of normal chickens. (3) Two of the tail fathers of the roosters have become greatly elongated. (4) The hen kept in the cage with one of the roosters lays non-hatching eggs at the rate of one every two or three days.

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SCIENTIFIC BOOKS

AVIATION MEDICINE

Principles and Practice of Aviation Medicine. By HARRY G. ARMSTRONG, B.S., M.D., Captain, Medical Corps, U. S. Army, and director, The Aeromedical Research Laboratory. 496 pp. Baltimore: Williams and Wilkins Company. 1939. $6.50.

AVIATION is becoming one of the major factors in history. Gunpowder overthrew the feudal system. Steam created the modern industrial civilization. Electricity and the petroleum motor have profoundly altered the conditions of modern life. But not one of these factors has ever, within so brief a period, exhibited a greater power to influence the course of history than has aviation. Even as these words are written, sea power, long the dominant force in international affairs, is challenged by power in the air.

For efficiency and safety in the use of any great discovery or invention two factors are required: perfection of matériel and selection and training of personnel—the machine and the mechanic—the gun and the man behind it. The railroad and the steamboat in their early days caused numerous fatalities, but these means of travel have gradually been improved until now a railroad train and a steamship are almost havens of safety. Modern industry has involved many new health hazards—chiefly those of industrial poisoning—which medical science is now striving to control. In these illustrations the requirements of safety apply more to improvements in the machines and industrial methods than to the human element. Careful selection of personnel is rarely needed. In aviation, however, the balance is the other way. Even when the machines of flight were in their crude beginnings, the crashes and fatalities due to the human element were many times more frequent than those due to mechanical defects and failures. And, as experience has accumulated, the advances in aerial engineering have greatly diminished the hazards of the matériel of flight, while the hazards involved in the personnel—those inherent in the nature of the aviator—have been relatively far less effectively counteracted. Hence the need for the new science of aviation medicine—the physiology of man in the air.

Man is not naturally an aerial animal. In his construction there are, indeed, finely designed instruments, notably the vestibular apparatus and semicircular canals of the ear, which serve his cousins the monkeys admirably in controlling the muscular coordination of long swings and leaps from the limbs of one tree to another. But in the monkey, as in the tumbler of the gymnasium and the trapeze performer of the circus, the individual himself makes the initial movement, which the organ of equilibrium enables him an instant later to meet with a counteracting movement. Not so the aviator. If a movement of the airplane, in which he is passive, swings him in one direction, the stimulus to the inner ear, instead of inducing a righting reaction, may induce a so-called "forced movement," which, instead of leading to recovery of equilibrium, may hurl the plane and himself to destruction.

In the book here under review the chapters (XIV and XV) dealing with "aerial equilibration and orientation" and with "air sickness" have on this account the greatest general interest. It is clearly shown that the two functions of the ear—equilibrium and hearing—are entirely distinct. "Man on the ground maintains himself and orients himself in relation to his environment by means of sensory impressions from his eyes, vestibular apparatus, deep sensibility (muscle, joint and tendon sense), viscera and skin." In the air even vision, the most important of the senses, becomes inaccurate. As the height above the ground increases, the tilt of the plane becomes increasingly difficult to judge. In "blind flight" and at great altitude the pilot must adjust the level of his plane by an artificial horizon—a gyroscope; and must often act directly against what his sensations dictate. The senses of equilibrium and sight are both misleading, and "the messages sent to the brain are false." More reliable, perhaps, are the somatic senses which enable the pilot to "fly by the seat of his pants."

"Airsickness" is essentially the same disorder as seasickness. Persons susceptible to one are susceptible to

the other, but no ship on the sea ever tossed and pitched and rolled its crew and passengers as does an airplane in "stunting" or in "bumpy" air. But why the vestibular apparatus induces this misery is no clearer in relation to airsickness than to seasickness.

Wholly distinct are the effects of anoxia: the condition induced by the decreased pressure of oxygen at great altitudes. As a name for this condition the author adopts the term "altitude sickness." He shows that it is essentially the same as the "mountain sickness" which has been the object of so much interest to physiologists from the studies of Paul Bert down to the present time. Like the "mountain sickness" of the alpinist the "altitude sickness" of the aviator occurs in two forms; the acute form in which oxygen deficiency for a brief period abolishes muscular coordination and control and even consciousness, and the chronic form resulting from repeated subacute exposures and resembling the "staleness" of the over-trained athlete.

Under the term "aeroembolism" a condition is postulated for aviators in rapid ascents to extreme altitudes essentially like the caisson disease, which is the result of too rapid decompression after work under compressed air in deep diving and subaqueous tunneling. In how far such effects can occur at the altitudes now commonly attainable is still uncertain; but if the stratosphere is to be invaded this hazard, as well as that of "altitude sickness," will have to be met. It will require that the air pressure in the cabin of the plane shall be kept up at least to that of an altitude of 10,000 feet.

Excellent discussions are given of the requirements for the aviator in respect to his eyes, ears, throat, lungs, heart, nervous system and his neuropsychic character. The care that must be taken of his health, physical and mental, equals or exceeds that for the athlete in strict training. Aviation is a profession that makes such demands on both body and mind—particularly the mind—as no other calling has ever made before.

With these considerations before us it needs no argument to establish the enormous importance of aviation medicine. Without this new science there can be no safe commercial aviation and no efficient military aviation; and without an efficient aviation corps no nation can now be immune from attack. This book is the first in its field in America, and is therefore a contribution of great importance. It is encyclopedic in scope, and for the most part accurate in details. Only on two topics, which happen to fall within the reviewer's competence, has it gone astray. They are the so-called "chronic carbon monoxide asphyxia" (pp. 174–75), and the history of the initial investigations in America on pilot fitness (pp. 10 and 34).

As regards carbon monoxide the curve quoted for the blood concentration is that for equilibrium: its values would be attained only after infinite time. The curve that would express the concentrations in the blood after finite periods of exposure would have ordinates only about half as great. Equally misleading are the statements quoted in regard to so-called "chronic carbon monoxide poisoning." They are taken from one of the numerous clinical writers who, knowing next to nothing about carbon monoxide asphyxia, find it convenient to diagnose their neurotic and hypochondriacal, but quite unexposed, patients as suffering from this alleged chronic disorder. Further investigation of this topic is important in connection with aviation; for, as the author recognizes, any appreciable amount of carbon monoxide in the blood adds to the strain of low oxygen and the resulting "altitude sickness."

The author's failure to do justice to the initial American investigations on "pilot fitness" arises from his having entirely overlooked the papers in which they were first reported.[1] Accordingly, he credits to European sources ideas and discoveries that were really American. He makes such statements as that "The Flack [British] bag was the prototype of the first rebreathing apparatus developed in the [American] Medical Research Laboratory." Actually the reviewer had been using such an apparatus for the laboratory instruction of students for several years before the United States entered the war. During those years two men of outstanding scientific ability, Edward C. Schneider and James L. Whitney, had carried on investigations in my laboratory. Accordingly, when I was asked to organize the laboratory and plan the research work on pilot fitness, I centered it on the so-called "rebreather" as the simplest means of imitating altitude, and called Schneider and Whitney into the aviation service. Their work with the "rebreather" marked the beginning of thorough scientific study anywhere on the capacity of pilots to withstand low oxygen. We got little or nothing from foreign sources for the very good reason that at that time there was almost nothing to get. How clear is the case for American priority in this field is demonstrated by the recent investigations of Krogh and Christensen[2] in this field which they recognize to have developed from this pioneer American work.

The format and typography of the book are of the high grade that we have learned to expect from its publishers.

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[1] *Journal* of the American Medical Association, 26: 1382–1400, October 26, 1918.

[2] *Skand. Arch. Physiol.*, 73: 17 and 145, 1936.