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Five Miles High in a Tank

Showing how lack of oxygen produces aviators' brain fog

By Walter Bannard

A CROSS-EYED, one-legged man of sixty may be a good sea-captain; but a twenty-five-year-old dyspeptic will be a failure as an air-pilot. Because a man has flown a few times he is no more fitted to be an air-pilot than a fourteen-year-old girl who has taken a few piano lessons is justified in competing with Hofmann.

Who is fit to guide a flying-machine through the air? The Germans in the early days of the war used to select their flyers from the cavalry. English athletes and polo-players proved to be good airmen. Some of our best flyers were once automobile and motorcycle racers.

But the rigorous test of war proved quickly enough that athletic prowess and a good physique are not enough. Sometimes weedy, pale clerks proved to be better men in the air than trained

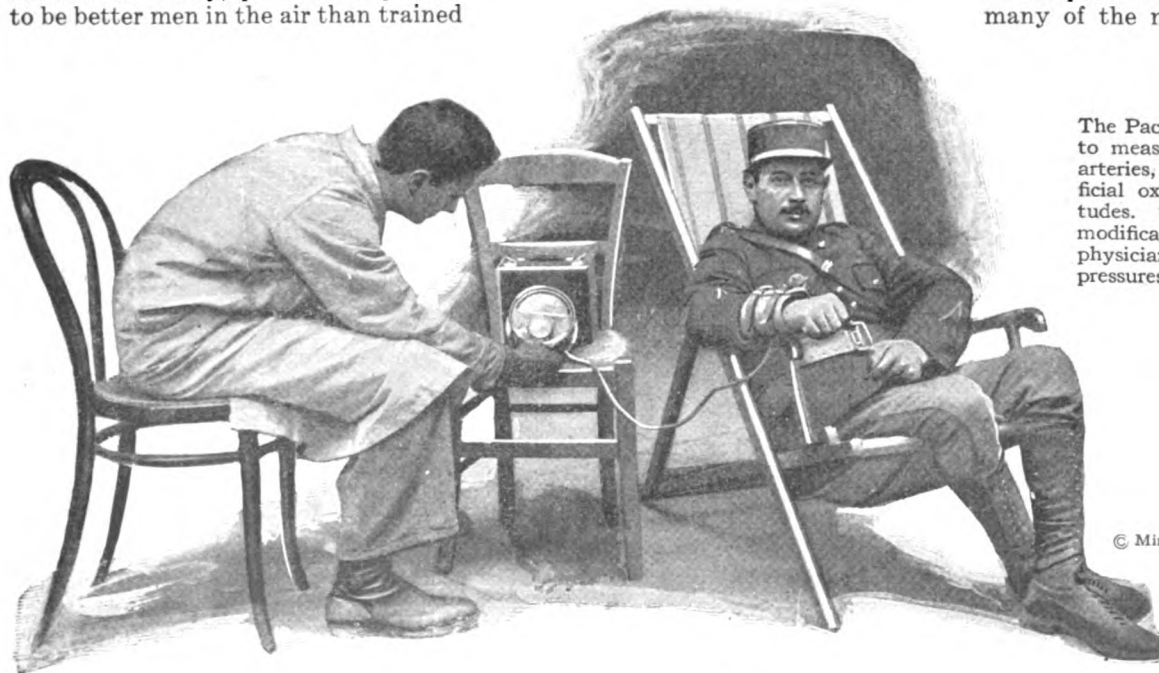
athletes who had learned to handle a flying-machine.

As the war progressed it became apparent that recruits for the flying service must be scientifically selected. The fate of an army depended on the character of the men who fought at great heights, photographed the enemy positions, or watched the fall of shells. Moreover, it was an expensive business to train a flyer and then to find him unfit.

It is said that it cost the American government as much as \$50,000 to fit a man to fly; but the figure must surely include the damage sustained by the training airplane. At all events, it was known long before we entered the war that the British lost 95 per cent of

their airmen, not from bullets, but from physical defects. A taint of epilepsy, the slightest tendency to vertigo, persistent headache, nervousness, and easily induced fatigue were sure to prove the undoing of a brave man in the air.

So it came about that applicants for the air service were systematically studied, both psychologically and physically, to discover latent disabilities. Men were whirled in chairs to test their sense of equilibrium; their eyes were examined; their family history was inquired into; their chest expansion was measured; their height and weight were noted. If all the ideals set up could have been met by any of the applicants, Apollo would have seemed an imperfect weakling in comparison. As a matter of fact, many of the men who were rejected



The Pachon oscillometer is used to measure the tension of the arteries, with and without artificial oxygen, at different altitudes. The instrument is a modification of that used by physicians to measure blood pressures

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by our own army entered the Canadian Royal Flying Corps and gave a good account of themselves.

Not so long ago the conscience of a United States Army medical officer troubled him because he discovered that the best flyer in his camp had flat feet!

Another flyer of unquestionable ability had slightly defective vision in one eye. Two medical examiners have been known to scratch their heads for half an hour because an applicant, acceptable in every other respect, had a chest expansion one quarter of an inch less than the standard.

Now that we have entered the period of commercial flying, it becomes more than ever necessary to determine the fitness of a man to pilot a flying machine.

What is wanted is not that extraordinary product, the ace, but a high average type.

It is doubtful whether much reliance can be placed on the whirling-chair test. Psychological tests, however, are certainly important. It takes a man from nineteen hundredths to twenty hundredths of a second to make up his mind to carry out an act in an emergency—his reaction time.

This reaction time may be delayed by fatigue, drugs, and excesses. On the other hand, it is found to be somewhat lower at times in men who are physically fit than in others.

After a man loses his head there is usually no time for correction in the air. Hence the French may be right in rejecting an applicant who is too slow by even the infinitesimal part of a second.

When a pilot loses his head, he may move the throttle the wrong way; he may keep his engine running full speed when he should throttle down; he may switch off the power entirely when he needs all the speed that he can command.

Brain Fag Breeds Indifference

Fatigue—above all, brain fatigue—may prove as fatal as a poor reaction time.

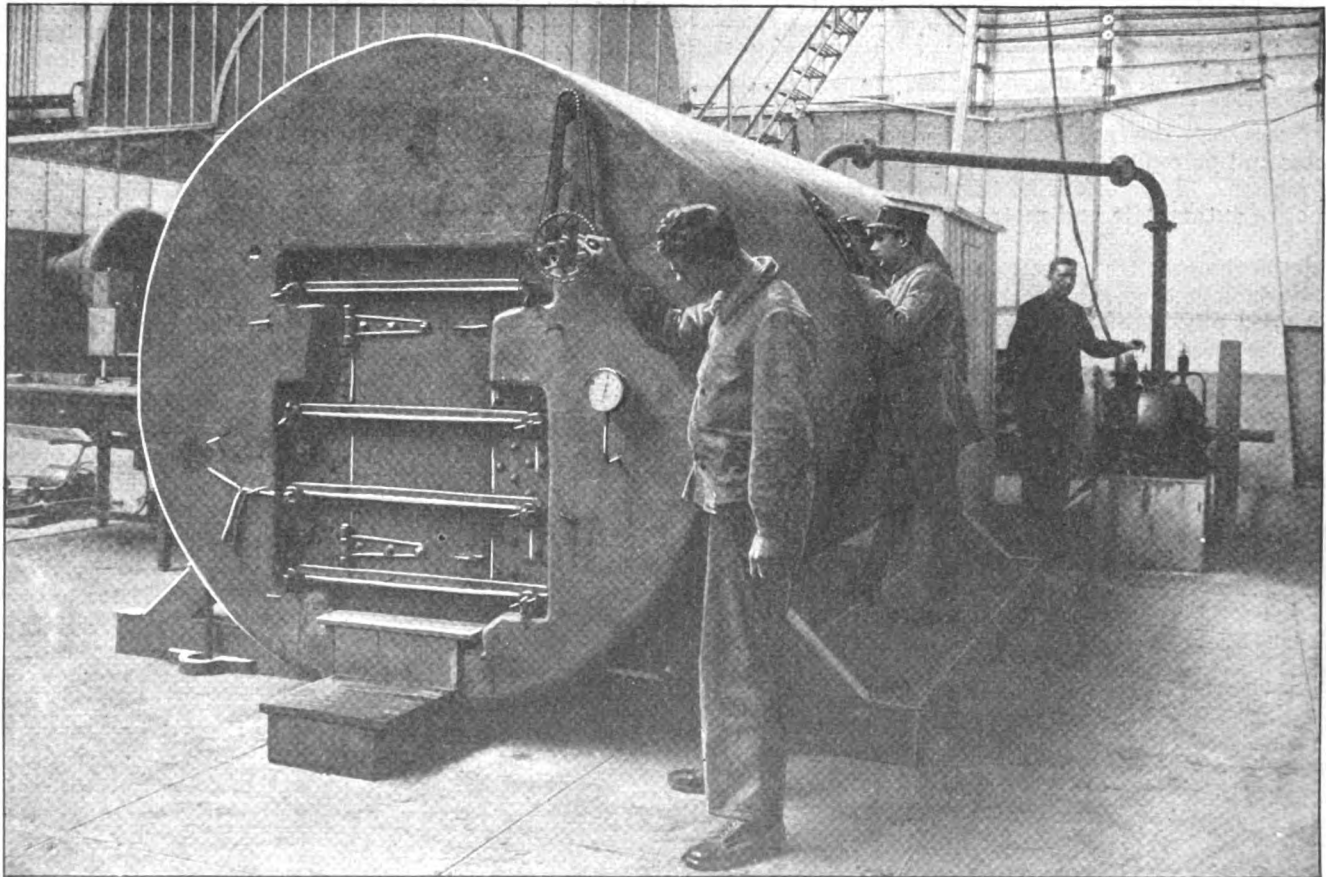
When the brain is fagged out the man has neither the power nor the reason to decide and act. This is probably due to the many impressions received by the brain during flight. He feels alone. He is not afraid. He is simply appalled by the enormity of the enterprise in which he is engaged. Helpless, stupefied, he awaits events

and takes little part in the control of his machine.

It is altogether likely that fast passenger-carrying airplanes of the future will fly at altitudes far above those at which the highest battles were fought in the air. We are told that above an altitude of thirty thousand feet and more the winds are in the nature of planetary swirls into which a machine should be guided in order to gain an advantage in speed and in economy of power.

Now, the human organism was evolved to live on the earth, not above it. As a man goes up, the total quantity of air in a lungful decreases. He must breathe faster. At nineteen thousand feet he inhales only one half the amount of oxygen and nitrogen that he breathes at sea-level. At less than twenty-five thousand feet the lack of oxygen becomes distressing.

The human organism has the ability of adapting itself to changed conditions, but only within limits. How far it can thus compensate itself depends on the man. Before the flyer's limit of compensation is reached, he feels dizzy. Yet he is perfectly happy, although he has lost his faculty of judgment and has passed into a condition of partial or total unconscious-



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This is the tank that is used at the Aerotechnical Institute of Saint-Cyr, France, to test prospective air-pilots. On the next page the interior of the tank is shown. In the

background is a pump by means of which some of the air is removed within the tank so as to produce conditions similar to those at high altitudes



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The man who wants to become an aviator takes his seat within the tank. Air is pumped out to any desired degree. Thus the man is artificially elevated to ten, twenty, or thirty thousand feet

The man in the picture wears an oxygen mask, so that he is quite comfortable, even though he may be in an atmosphere equivalent to that of five miles altitude. Various instruments record his condition

ness. "I'm all right," he says as he flies along at fifteen or twenty thousand feet. But the tests show that every one of us is affected more or less at such heights. It takes longer to judge and to act; it is harder to read an instrument. Positions of objects are misjudged. Pain itself loses some of its poignancy. Excessive fatigue, nausea, and vertigo assert themselves.

For these reasons the oxygen tank has become an indispensable part of the high flyer's equipment. All the recent records of Rohlfs and Schroeder were made with the assistance of oxygen. It is not impossible that in the high-flying passenger-carrying airplane of the future the crew and the passengers will sit in hermetically sealed compartments filled with oxygen supplied from tanks. Otherwise passengers must wear oxygen masks.

Often a pilot crashes at the end of a rapid descent. He has no recollection of what happened; he lost consciousness and was actually asleep. This is highly significant; for this is a state that is induced by an ample supply of oxygen or fresh air at full pressure after a period of degradation. It

is a phenomenon often met with by students of the low-oxygen problem. It occurs in a wide variety of conditions—in miners escaping damp, in city firemen after coming out of smoke, in the older type of submarines on opening the hatches after submergence, in persons who are given oxygen after overexertion on a mountain and after low-oxygen experiments in the laboratory. But in none of these conditions are the consequences so serious as for the aviator.

The Value of the Oxygen Tank

Oxygen plays such an important part in flying that one of the most important tests of physical fitness consists in discovering how a man will behave when he is partially deprived of it. The man is not carried up into the air to be tested, partly because it is unnecessary to do so and partly because the conditions there are against scientific observation. He is placed in a tank from which some of the air is pumped. Thus it is possible to climb, barometrically speaking, to any desired height.

These tanks are now employed by the medical officers of all armies. By their means the truth about a great many airplane accidents has been deduced.

The subjects vary in every conceivable way. The man who has a "weak heart" is usually found at the bottom of the list; he can stand very little oxygen reduction. At the other extreme is the man whose powers of compensation are so good that he can "go up" in the tank to twenty-five thousand feet and show but a slight change in adaptability from the normal.

In these airtight testing chambers, or tanks, from six to ten men can be tested at a time, if need be. Oxygen can be inhaled from a tube, with the result that, although the artificial altitude may be thirty thousand feet, the faculties are normal. The effect of high altitude on the heart, breathing, and nerves without oxygen can be noted. All the effects of a fall are obtained by allowing the air to enter the tank rapidly. Thus the barometric conditions that obtain during an actual flight can be imitated.