

There is no retention. With the knowledge that 30 c.c. of the mixture were required in this injection, a very definite idea of such a cavity is obtained.

An attempt was made to discover whether the pres-

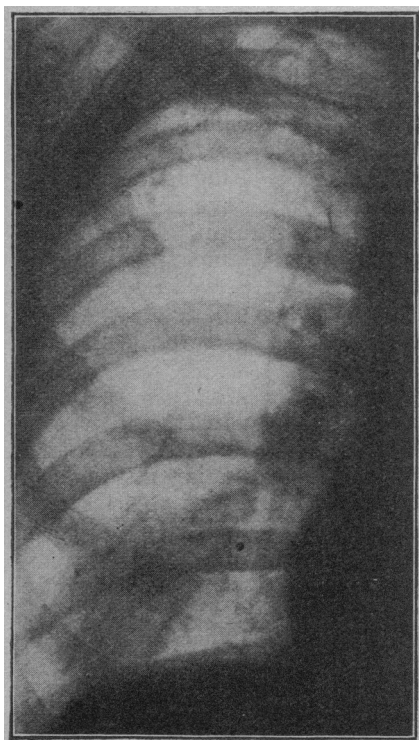


Fig. 5 (Patient M. R. S.).—Cavity sharply outlined after the oil and bismuth have escaped.

ence of this fluid, even under no pressure, caused a distortion. A series of plates was made in the same manner as the three just mentioned. Those made with paste were obviously incorrect. On observing the sinuses filled with oil and bismuth it was noted that although they conformed to the curvature of the chest wall, many were abnormally far from the ribs. This is frequently observed in chests with a very thick parietal pleura. The third pair in each of the series illustrated the collapsed sinus after the oil had escaped. There was sufficient bismuth still adherent to give a definite outline, and the decrease in size was evident, demonstrating the slight distention of the cavity with the injected mass in place. Difficulty was experienced in securing photographs taken in the same position. Since the ventral prone position has been used in the oil injection, it was not always possible to select similar positions from among the previously injected bismuth plates.

**Tax on Child Labor Suggested.**—That an exorbitant tax should be levied on merchandise or any production of child labor as the only logical method of eliminating the evil was the chief point brought out in a rousing address by Owen R. Lovejoy, general secretary of the National Child Labor Commission, at the opening session of the fifty-first annual meeting of the Maryland State Teachers' Association, which convened, November 29, in Baltimore; while a federal, centralized educational system discussed by Dr. William Chandler Bagley, professor of education at the Teachers' College, Columbia University, also struck a responsive note among the hundreds of educators present. In view of the fact that the results of the recent selective draft classification and examinations disclosed that 750,000 persons, all male, were illiterate, Dr. Lovejoy laid stress on the fact that child labor is largely responsible for that deplorable condition. These figures do not include the illiterate females in this country. Although the issue has not yet been adopted by the association, Dr. Rozell Berryman, Baltimore, treasurer, said that it conformed with the unanimous view of the teachers, and that it will ultimately be adopted in the resolutions. This means that a concerted effort will be made to that end in having such tariffs and taxes apply. A national system of education as is in vogue in England and France was strongly advocated by Dr. Bagley, who declared that only in that way could any comprehensive and effective system be evolved.

## THE EAR IN "STUNT" FLYING \*

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Crashes that occur during "stunt" flying are usually the result of something having gone wrong with the pilot. Hence, it is a pertinent matter for medical investigation. Just what this something is, is not always clear. Poor judgment, a sense of bravado, carelessness, "stunting" at low altitudes, and sudden faintness are among the reasons generally offered in explanation of these accidents. Direct testimony of the pilot is not always available, since many of the crashes result fatally. Neither are pilots who have crashed and survived always able to give a clear and concise account or analysis of the causes of the accident.

Underlying them all, however, there runs a story of momentary loss of faculties, resulting in a manipulation of controls without deliberate judgment. Most accounts of crashes read, "The pilot went into a tail spin and failed to come out." The story of Lieut. J. M. M. is quite typical of those collected by this department. While flying, he went into a tail spin. This produced such overpowering dizziness that, not knowing what he was doing or why, he grabbed the "joy stick" and pushed it forcibly over and threw himself into another tail spin in the opposite direction. Before he could come out of this he crashed.

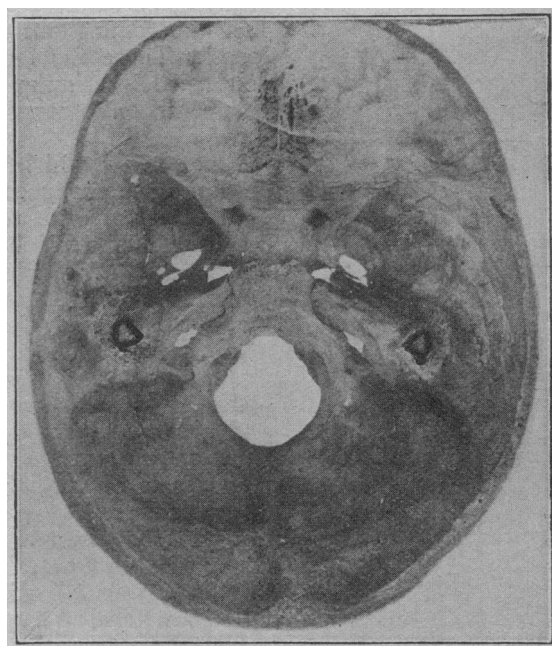


Fig. 1.—Base of skull from above, showing semicircular canals in situ.

So many of the accounts of crashes given by pilots who do survive emphasize dizziness (or vertigo) that the organ responsible for dizziness when an individual is whirled around, namely, the ear, was necessarily made the subject of investigation by the otologic

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department of the Medical Research Laboratory at Mineola. Experiments which involved the whirling of individuals point conclusively to the fact that stunt flying is essentially an ear problem.

By visualizing the position of the pilot as he is whirled in the various stunt evolutions, we found that



Fig. 2.—Three cardinal planes of vertigo: horizontal, frontal and sagittal.

by reproducing a similar whirling in the apparatus it was possible to simulate all the subjective effects of the actual stunt.

Lieut. J. F. D. (150 hours in the air) was placed in a certain position in the apparatus and whirled. He volunteered the information that his sensations were identical with those experienced when coming out of a tail spin. When placed in the apparatus in a certain different position and whirled, he stated that his sensations were those experienced when coming out of a tight spiral. Lieut. W. E. R., an experienced pilot, when placed in the apparatus in the same position as Lieut. D.'s first experiment, made the statement that his sensations were identical with those of his predecessor, saying, "That is exactly like coming out of a

tail spin." When placed in another position and whirled, he said, "Now I feel like coming out of a loop." These facts were confirmed by similar experiments on other aviators.

Since being whirled in an aeroplane produces effects identical with those resulting from being whirled in a laboratory device, such as the turning chair, or other forms of apparatus designed for that purpose, we are furnished with an accurate and convenient means of studying the various vertigo effects of ear stimulation produced by evolutions in the air, and the deductions derived from this experimental stimulation are true and applicable to stunt flying. The facts gleaned were so exactly in accordance with our knowledge of the ear as a "motion-sensing

mechanism" that they were simply corroborative of certain well known otologic principles. Now what are these established facts or principles?

1. In each ear we have three semicircular tubes, or canals, containing fluid, so placed that they are at right

angles with one another (Fig. 1). Because of this arrangement, no change of position of the individual is possible without producing some movement of fluid in one or more of the canals. Movement of the fluid in these canals sends messages to the brain which are there interpreted as body movement. Hence, the ears constitute the motion-sensing organs of the body.

2. When an individual is whirled, be it in the laboratory or in an aeroplane, there is produced a circulation of this fluid in certain definite canals and planes. Now, if the turning is suddenly altered or stopped, or if the aeroplane comes out of a rotating maneuver, the fluid in the canals continues to move in its former plane by sheer force of its momentum. The circulation of the fluid by momentum is interpreted by the brain as body movement; but not being in accordance with fact, the body having ceased to revolve, it constitutes vertigo or dizziness, and is disturbing to the individual.

Labyrinthine vertigo, therefore, is a false sensation of motion similar to the visual illusion of motion observed when one is watching a moving train from the window of a stationary coach, both being unavoidable phenomena of normal special sense mechanisms which, however, the subject easily learns to disregard.

One must not fall into the error, however, of thinking that the lack of a normal ear mechanism would be

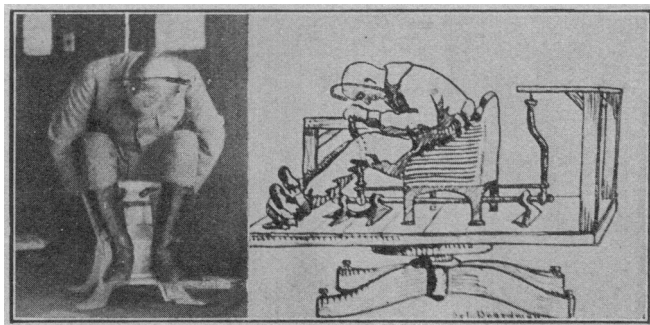


Fig. 4.—Position in turning chair to simulate spinning nose dive.

advantageous to the flier, because of the immunity to vertigo which this condition would confer. The absence of such an essential organ as a motion-perceiving apparatus is too great a handicap to the man traveling in an "air medium" to justify him even in thinking for a moment that he could dispense with it for the sole benefit of a vertigo immunity, especially since the normal individual can acquire such an immunity without much difficulty.

#### VERTIGO EFFECTS OF EAR STIMULATION LEARNED IN THE AIR

1. There are three cardinal planes of vertigo: horizontal, frontal and sagittal (Fig. 2).

2. A sense of being turned in a horizontal plane—horizontal vertigo—is less disturbing than a sense of being whirled in a vertical plane—vertical vertigo. Each semicircular canal, if stimulated, produces a vertigo in its own plane. Therefore, with the individual in an upright position, stimulation of the horizontal canal is much less disturbing than stimulation of the vertical canals.

3. When a disturbing or disabling vertigo is induced in the vertical semicircular canals, the effects can be greatly ameliorated by bringing the vertical canals in a horizontal position or plane, which can readily be done by bringing the head forward.

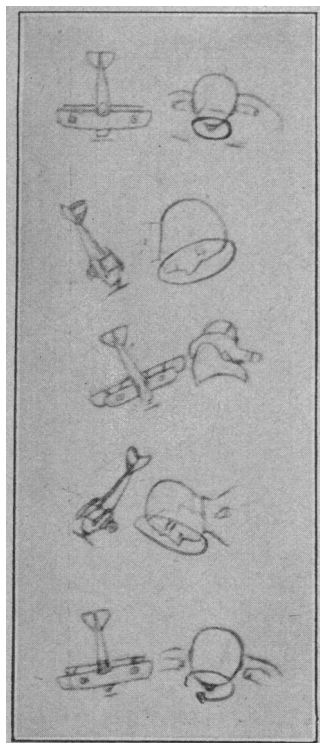


Fig. 3.—Spinning nose dive.

4. All types of vertigo, no matter how induced, are made less and less disturbing by continual repetition.

#### PRACTICAL APPLICATION OF VERTIGO STUDY TO STUNT FLYING

Let us consider how the knowledge of the various effects of vertigo gained in the laboratory can be correlated and applied to various stunts.

*Spinning Nose Dive.*—In this maneuver, the aviator, face downward, is whirled about an axis with his head and body practically parallel to the ground, as shown in Figure 3. In this position there is a stimulation of the vertical semicircular canals in a frontal plane, corresponding to turning in the chair in the position shown in Figure 4. When he "comes out" of the spin, the plane of vertigo which until now has been parallel to the ground becomes vertical in a frontal plane, that is, from side to side, so that instead of feeling that

*Tight Spiral.*—In this maneuver (Fig. 5) the aviator is whirled about an axis with his head and body practically parallel with the ground but facing the horizon. The stimulation occurs in the vertical canals but in a

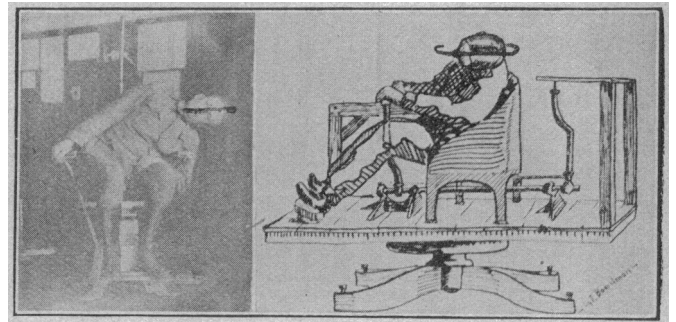


Fig. 6.—Position in turning chair to simulate tight spiral.

plane practically parallel with the ground as long as the spiral lasts. When he comes out, however, the plane of vertigo, horizontal until now, becomes vertical in a sagittal (from before backward) plane, so that he feels himself pitching forward or backward and may again meet disaster in attempting to correct for this illusion.

In the turning chair this maneuver can be simulated by turning the individual with his head sharply inclined over the shoulder (Fig. 6).

The obvious remedy for the aviator in this case is to tilt his head sharply to one side when coming out of the spiral, since by so doing he will prevent the vertigo from assuming an up and down whirl.

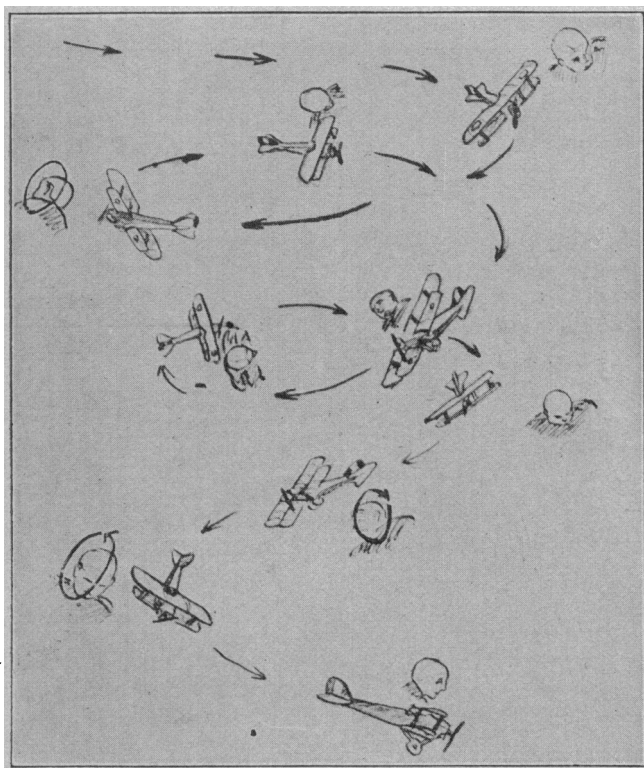


Fig. 5.—Tight spiral.

he is turning horizontally he feels that he is whirling in an up and down plane. This being very disturbing, he is apt to lose himself momentarily and attempt to correct this illusionary movement and so throw himself into another tail spin in the opposite direction. When the same experience is carried out in the chair, that is, when he is turning with his head forward simulating his position during the tail spin, and attempts to sit erect, he similarly changes the horizontal vertigo, with which he started, into a sensation of whirling in an up and down plane. In attempting to correct this false impression, he throws his body to one side or the other with such violence that unless caught by the examiner he would fall to the floor. It is easy to imagine what havoc would be raised with the controls of an aeroplane under similar conditions. The obvious remedy in both cases is to keep the head down as it was in the beginning so that the vertigo remains in the horizontal plane.

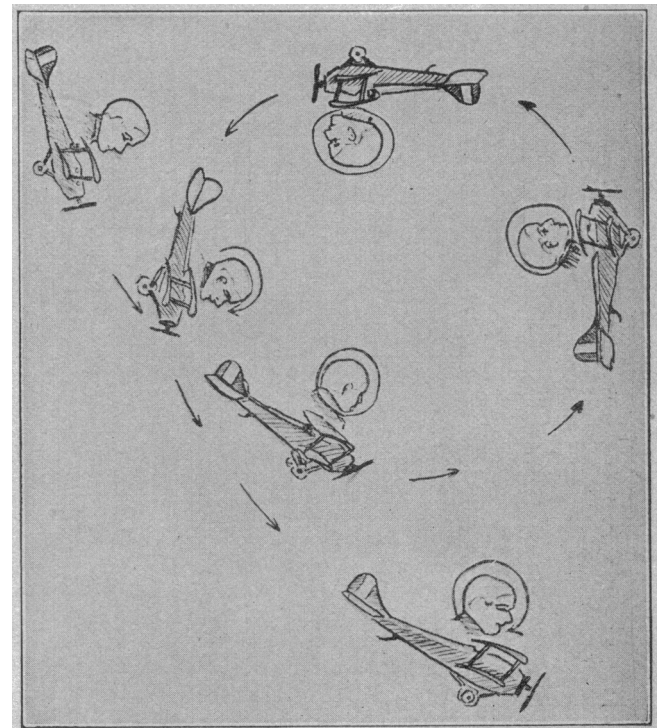


Fig. 7.—Loop.

*Loop.*—In this stunt, as shown in Figure 7, the vertical canals are stimulated in the sagittal plane (as in the spiral) but to a lesser degree. The correction is accomplished by tilting the head sharply over one shoulder (the position shown in Figure 6).

*Immelmann Turn.*—In this evolution, as shown in Figure 8, we have a compound maneuver. During the first or loop portion, the vertical canals are stimulated in the sagittal plane, followed in the second part by a stimulation of the vertical canals in the frontal plane. The effect of the first portion is lost during the remainder of the stunt, so that on emerging the aviator has only to deal with the vertigo induced by the last part, namely, the vertigo on the frontal plane. The obvious correction is to throw the head forward while "coming out." In a similar manner the vertigo induced by the "barrel roll," "falling leaf," "wing over," and other maneuvers can be readily analyzed.

It is, of course, true that the experienced stunt flier is not, as a rule, upset by vertigo induced by these stunts because of the many hours of practice he has had; but no matter how well trained and experienced he may be, he may occasionally find himself, especially in actual combat, doing whirling in a greater amount and at a greater rate of speed than his training has prepared him for, and an understanding of these principles might be the means of saving his life. As a matter of fact, stunt fliers develop instinctively certain maneuvers that neutralize the disabling effects of

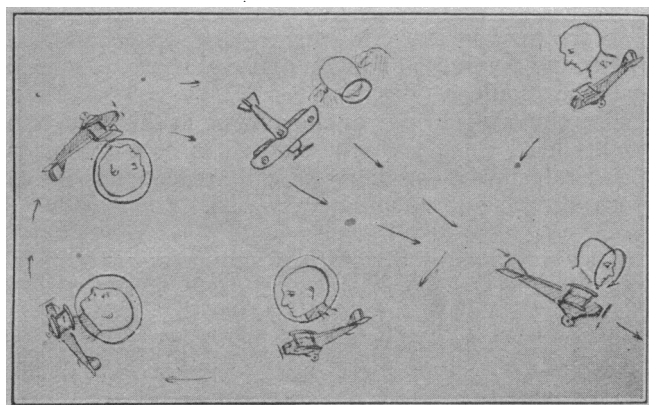


Fig. 8.—Immelmann turn. The circles indicate the plane of vertigo—sagittal first, then frontal.

vertigo; thus one flier found by practical experience that by leaning as far forward as possible, so that his head was practically inverted, a tail spin gave him practically no disabling vertigo. Another found that going into a straight nose dive immediately following a tail spin saved him from any uncomfortable dizziness.

These fliers have instinctively adopted means which at all times kept the vertigo in a horizontal plane—procedures based on sound otologic principles. Experienced aviators, on being put through the various stunts in the laboratory, when shown how easily the effects of vertigo are neutralized by certain changes in the position of the head, are of the unanimous opinion that such knowledge is of the greatest practical value, especially in stunting. It is obvious that to the less experienced this knowledge is of even greater importance.

The greatest usefulness of the knowledge that stunting is an ear problem lies in the fact that the flier may be educated to disregard the vertigo effects of his stunts in the laboratory instead of among the clouds, and without danger acquire a tolerance to evolutions to a degree impossible in the air. This can be accomplished by the use of an otologic apparatus

known as the orientator. In its construction it is like the cockpit of an aeroplane suspended in concentric rings, after the manner of a ship's compass. The movements (or changes of position) which are possible in all directions except actual forward progression are governed by the individual seated in the machine, using a set of controls resembling those of an aeroplane. Strapped in this machine, he is enabled to execute any evolution, such as the loop, spiral, etc., at any desired speed for any number of turns and thus acquire in absolute safety a tolerance for the disturbing effects of vertigo induced by these evolutions, instead of acquiring this tolerance and knowledge by actual flying with its consequent crashes and possible loss of life. In addition, it will enable him to adapt himself to new and most unusual conditions. He will learn to orientate himself in new and rapidly changing positions of the body, and to perform properly the complicated acts necessary to control an aeroplane while flying with his head down, etc., which entails an entirely reversed relation to external objects, a condition in itself most disturbing and pregnant with possibilities of disaster.

## STATIC DEFECTS OF THE FEET

A METHOD OF ACCURATE DIAGNOSIS AND A  
TREATMENT OF PROVED VALUE  
IN THE ARMY

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The underlying principle in all satisfactory treatment of the common static defects of the feet is that of restoring weight-bearing to those parts of the feet to which weight-bearing naturally belongs. All other forms of treatment of the longitudinal and transverse arch defects, all treatments of foot pronations or ankle valgus and the neuralgias of the forefoot that do not rigorously enforce this principle, are merely forms of treatment that support or palliate. Real cures of the static defects depend basically on establishment of the principle, first by artificial, then by natural, means.

There are two modes of approach that can be made use of to reestablish permanently the normal foot functions and the enforced use of the normal weight-bearing areas. First, there are the surgical and mechanical measures which in a valuable way make use of mechanics and force at efforts of reconstruction. These various procedures, valuable and important as they may be in civil practice, have little place in the present discussion. Early in the war, official orders rightly removed the knife from the hand of the orthopedic surgeon in the training camp. Second, there is that mode of approach which, recognizing the abnormality of the foot, determines on shoe alterations intended either to correct the statics of wrong weight-bearing or to render the normal shoe "abnormal" to compensate for the foot abnormality. The latter method is merely the forgotten aims of the old-fashioned horseshoer or the lost arts of the obsolete shoemaker. Further, several of the static foot defects, such as talipes valgus, are congenital affairs that tend to yield toward the normal on the application of the correct shoe mechanics. This paper is an attempt to emphasize the latter therapeutic phase.