AN ATTEMPT AT SIMPLIFICATION OF THE PHYSIOLOGY OF THE VESTIBULAR LABYRINTH.*

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When Father Adam first turned to the right, the endolymph in his semicircular canals lagged behind, relatively to the left. His sight and muscle-sense informed him that he was turning to the right: consequently he came to interpret endolymph movement to the left to signify that he was turning to the right. He always turned *away from* the endolymph, and for this reason he recognized endolymph movement in one direction to mean that he was moving in the opposite direction. Each child born of Adam passes through the same experience—he learns to interpret impulses from the labyrinth, just as he comes to interpret stimuli received from the retina. Images on the retina are upside down, but in course of time the child learns to reverse this image in his consciousness and to realize that the external object is actually right side up. Similarly, through countless repetitions he comes to recognize that endolymph movement in one direction means that he is moving in the opposite direction.

When an individual moves past external objects, his *eyes* attempt to fix upon certain objects as they pass. He does this in the attempt to stabilize the sensorium. When traveling in a railroad train his eyes fix upon telegraph poles and other objects as they pass—consequently his eyes move in the direction of the passing object. Similarly, when he is turning to the right, his eyes, although closed, have been trained to move to the left in the direction of the external objects which are moving to the left.

Experimental stimulation of the ear, by turning in a revolving-chair or by douching with cold or hot water, produces an *artificial* movement of the endolymph. After an individual is turned to the right a sufficient number of times to cause the endolymph to catch up with the movement of the body, he feels that he is standing still if his eyes remain closed, whereas he is actually turning to the right. As there is no movement of the endolymph in relation to the hair-cells within the ear, his interpretation is that he himself is not moving. Now if the chair be stopped, the endolymph by its momentum continues to move to the right; he therefore feels that he is rotating

*Read before the American Otological Society at Atlantic City, May 30, 1917.

to the left, although he is actually sitting still. If the right ear be doused with cold water, the chilled endolymph moves downward to the right and the individual feels that he is falling to the left.

The purpose of this paper is not to deal with physiology for itself alone—the main reason for *simplicity* in this subject is that at the present hour there is practical need for the Barany tests. Probably the most important service that the otologist can give to the government—a service that is peculiarly his own—is in aviation. Perfect equilibration is accomplished through an harmonious co-operation of the eye, the muscle-sense—and most particularly the “balance-sense” of the ear. The ear function is of peculiar importance, in that the vestibular labyrinth has for its sole function the maintenance of balance. After impairment or loss of one of the senses responsible for equilibration, compensation may take place to a certain extent, provided that the individual is on “terra firma”—the tabetic may be taught to avail himself of the visual-sense and of the balance-sense of the ear in co-ordinating his movements. Similarly, the blind man is able to walk by the aid of a cane until deprived of the guidance of either the muscle-sense or the balance-sense of the ear. Deaf mutes, in whom the ear-sense is destroyed, are enabled to maintain their balance by means of sight and the muscle-sense, and develop inco-ordination only in the dark or in the water.

However, when the human being becomes a bird, as it were, he suddenly finds himself in an entirely new environment. In flying through the air, on what does the aviator rely in order to maintain his equilibrium and that of the aeroplane? Can he rely on his sight? Hardly, for when he is sailing through the clouds or in the dark, his eyes positively cannot give him the slightest information as to his position in space, not even whether he is right side up or upside down. As regards the muscle-sense, it is undoubtedly true that it plays a certain part; but when the aviator is seated on an unstable and rapidly moving machine, it is hardly conceivable that the weight of his body could determine and maintain his position in space merely by the sense of gravity. In order, therefore, to preserve that wonderful accuracy necessary in operating such a delicate mechanism as the flying machine, it is obvious that he relies primarily upon his vestibular labyrinth. It is easily conceivable that some of the unexplained accidents in aviating may be due to a concussion of the internal ear, produced by the rush of the air or by the decrease of the usual air pressure when at great heights. Since normal internal ears are such an important asset to the aviator, good prudence would suggest a

most careful examination of the degree of function of one's internal ears, before taking up flying as an occupation. The ear-tests furnish an exact and mathematical analysis not only of the function of the internal ear, but also of the entire vestibular apparatus. When a candidate for the aviation service of the government presents himself, it is for his own personal interest as well as for the good of the service, that every portion of his "balance apparatus" should be declared intact and normally functioning. This can be absolutely determined by the ear-tests,—“Yes” or “No.” If, after the Barany tests, the candidate shows normal responses in nystagmus, past-pointing and falling, he is fit for the service. If he does *not*, he is unfit.

The following standard for entrance in the Aviation Section of the Signal Corps of the United States Army has been approved and is to constitute the requirement for admission into this service.

Equilibrium—vestibular tests.—The nystagmus, past-pointing and falling, after turning, are tested. The turning-chair must have a head-rest which will hold the head 30 degrees forward, a foot-rest and a stop-pedal.

(a) *Nystagmus.* Head forward 30 degrees; turn candidate to the right, eyes closed, 10 times in exactly 20 seconds. The instant the chair is stopped, click the stop-watch; candidate opens his eyes and looks straight ahead at some distant point. There should occur a horizontal nystagmus to the left of 26 seconds' duration. Candidate then closes his eyes and is turned to the left; there should occur a horizontal nystagmus to the right, of 26 seconds' duration. The variation of 10 seconds is allowable.

(b) *Pointing.* 1. Candidate closes eyes, sitting in chair facing examiner, touches examiner's finger, held in front of him, raises his arm to perpendicular position, lowers the arm and attempts to find the examiner's finger. First the right arm, then the left arm. The normal is always able to find the finger.

2. The pointing test is again repeated after turning to the right, 10 turns to 10 seconds. During the last turn, the stop-pedal is released and as the chair comes into position, it becomes locked. The right arm is tested, then the left, then the right, then the left, until candidate ceases to past-point.

3. Repeat pointing test after turning to the left.

(c) *Falling.* Candidate's head is inclined 90 degrees forward. Turn to the right, 5 turns in 10 seconds. On stopping, candidate

raises head and should fall to right. This tests the vertical semi-circular canals. Turn to the left, head forward 90 degrees; on stopping, the candidate raises his head and should fall to the left.

Any candidate for service in any branch of the army or navy must conform to a physical standard. He must be a normal man, such as would satisfy the average insurance company, with the additional requirements of minimum height, weight, chest measurement and auditory and visual acuity. The aviator must have not only these requirements, but must also have a normal balance mechanism. Therefore, the determining test for the aviator is the Barany test.

Therefore the peculiar test, applied only to the aviator, is the Barany test.

Medical Arts Bldg.

PERIODIC ATTACKS OF VASOMOTOR RHINITIS FOLLOWED BY ASTHMA AND SYMPTOMS OF PARANOIA, RE- CURRING OVER A PERIOD OF TEN YEARS.

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This case is interesting in many ways, and the scarcity of the literature on the subject prompts me to report it.

The patient is a female, 51 years of age, unmarried, and passed the menopause about two years ago. There is no history in the family of any mental disease. She is the youngest of six children. There is nothing significant in her previous history, except that as a child she was most bad tempered.

The first attack of vasomotor rhinitis occurred about twenty years ago. While dancing, the patient became overheated, and then took a straw ride without a coat, and the next day had what she thought was a severe cold. This proved to be the first attack of vasomotor rhinitis and lasted about six weeks. At that time there were no asthmatic symptoms or unusual nervous manifestations. The following June she had her next attack, and this lasted until late in September. These attacks recurred annually over a period of nine years. They began in June and lasted the greater part of