1820, and another by Flourens in 1828. Against the usually accepted theory that the semicircular canals are the organs for determining the spatial relations of the head, Cyon contends that the semicircular canals only assist indirectly in this function. He maintains that really our knowledge of the position of the bodies in space depends more upon the nerve impulses coming from the contracted ocular muscles, pointing out that the oculomotor centres are in close relationship with the centres receiving the stimuli from the semicircular canals. Consequently on excitation of the semicircular canals oscillatory spasms of the ocular muscles occur at the rate of from twenty to one hundred and fifty per minute. And this view of Cyon's that the semicircular canals influence the movement of the eyes has been partially supported by Lee (see above). Ewald has divided the labyrinth functionally into two parts, one concerned with hearing and the other with muscle tone. The former is the cochlea, and the latter the semicircular canals of the vestibule. He states that if the labyrinth of an animal be injured and then the animal killed, rigor mortis does not in most cases occur. Sewall carried out a series of experiments on young sharks and skates and claimed that cutting through the canal on one side produced no alteration in equilibrium. But should the utricle be injured and the otoliths be removed the fishes usually dived and swam toward the injured side. Ewald claims that the saccule is more concerned in the equilibrium than any other portion of the internal ear.

Anatomical evidence clearly points to the fact that the function of the semicircular canals and that of the cochlea are different. It is true that the eighth nerve supplies them both; but it is also true that the eighth nerve really consists of two divisions, a vestibular and a cochlear portion, which, although running together in the human subject (in the horse they are separate and distinct nerves), on entering the internal auditory meatus they separate and are distributed as named.

The question may now be asked, In what part of the brain are these impressions from the semicircular canals and other senses received and elaborated into the sense of equilibrium? We have seen above that nearly all the special senses are concerned in maintaining equilibrium and that the semicircular canals are of primary importance.

The cerebellum has long been regarded as the nervous centre for equilibrium and co-ordination of muscles. Certainly pathological evidence points to the fact that the cerebellum is concerned in this function, giddiness being a well-marked symptom of cerebellar disease, although it is not so well marked as in labyrinthine or eighth-nerve lesions.

Should a large portion of the cerebellum be destroyed, we have well-marked inco-ordination phenomena, and here, although sensation may remain good, the inco-ordination must be ascribed to a loss of impulses which regulate body movements without being on their way or in the cerebellum elaborated to conscious sensations.

Experimental work on the cerebellum seems to point to the fact that the organ "functions" as a whole, not in "areas" as the cerebrum, because it is so largely concerned in the innervation of the muscular system of the whole body, and this fact led Flourens and Bouillard, early observers, to express the opinion that the cerebellum was the organ of "equilibrium." The cerebellum, according to Lussana and Carpenter, receives impressions originating in the sense organs of muscles, joints, ligaments, and tendons, and it also is intimately connected with the vestibular nerve, consequently destruction of one side of the cerebellum greatly lowers the muscular tone of that side. Removal of one-half of the cerebellum gives well-marked symptoms of inco-ordination and partial loss of equilibrium. Complete removal of the organ does not give such marked symptoms, but profound lassitude is marked, following execution of movements which should be ordinarily quite unfatiguing. In unilateral ablation the animal usually lies on the side from which the portion of the cerebellum is being removed and with the trunk often curved concavely to the same side. The four limbs are usually extended, the one on the operated side more than the other. There is conjugate deviation of the eyeballs to the opposite side. As a rule, the animal cannot stand and has a great tendency to fall to the injured side. Should it try to move, it will move around in the long axis of its body toward the injured side. In a few days, the majority of these symptoms disappear. However, entire disappearance of the symptoms has not been obtained.

Although an enormous mass of work has been done on the cerebellum, very little definite knowledge has been obtained. It appears that this organ is concerned in a particular class of phenomena, rather than in a particular sense. It is more intimately concerned in receiving impulses from the various senses, more especially of those concerned with equilibrium and muscular sense. Through it habitual posture is supported and it is immediately associated with the movements depending principally on the lower cerebral sense, that is, walking and running, and not with those elaborated with the highest technical movement.

From the foregoing description we can see that the sense of equilibrium is one of the most complex phenomena in the body. As already mentioned, it is made up from impressions derived from nearly all the special senses. Experimental evidence clearly points to the fact that the semicircular canals are of primary importance, that they transmit their impulses to the cerebellum through the vestibular nerve, and the cerebellum in turn, acting through the vermis, may react upon the cerebello-spinal and vestibulo-spinal efferent system and so through these contribute a factor to the normal tonus of the spinal, cranial, and motor cells.

In conclusion it may be mentioned that although we have seen that the semicircular canals and vestibule are primarily concerned in equilibrium, yet pathological cases have been found in which a slowly progressive affection of the internal ear ultimately left these structures transformed into a bony mass in which no trace of the original soft structures remained. And in these cases there was no perceptible disturbance of equilibrium, nystagmus, or giddiness. We must therefore admit that these organs are not indispensable for equilibrium, but that some other organ or combination of organs can vicariously carry on their function.

The question may also be asked, Are the semicircular canals concerned in hearing? Certainly injury to these canals in animals does not appear to cause deafness, but it must be remembered that it is extremely difficult to substantiate any of the special senses in animals. In the human subject it is doubtful if any of these structures are ever affected without causing deafness; but it must here be noted that these structures are seldom affected in the human being without the cochlea becoming involved in the disease, so that deafness may be caused by disease of the semicircular canals, which disease would, in all probability, also involve the cochlea.

Allen M. Cleghorn.

EQUINOX SPRING.—Bennington County, Vermont.

Post-Office.—Manchester. Equinox and other hotels in Manchester.

Access.—Viâ Bennington and Rutland Railroad, a link in the Central Vermont line between Montreal and New York and 50 miles northeast of Saratoga. Manchester-in-the-Mountains, a charming village in the southwestern part of Vermont, is situated on a plateau about 200 feet above the Battenkill River, and 1,000 feet above tide-water, in a valley between the Green and Taconic ranges. For nearly half a century it has been one of the principal resorts of New England, famed alike for its beautiful scenery, fine drives, healthful, invigorating air, pure water, and numerous brooks, alive with trout. The place has been properly termed a model village, the main street being bordered by wide lawns, overarched by century-old elms and maples. Shaded by these trees are marble side-walks, and back of them the cottages in

their setting of emerald, the entire absence of fences on the street giving the effect of a park. The village contains a beautiful new library building, charming drives in all directions, a strictly first-class hotel (the Equinox) and other desirable features too numerous to mention here. In the immediate vicinity is an unending variety of natural attractions. Away off on Mount Equinox, 1,500 feet above the village and 2,500 feet above the level of the sea and far from any habitation, is located the spring which supplies the Equinox mineral water. An analysis of this water in 1892 by Messrs. Chandler and Pellew, of New York, showed the following ingredients:

One United States Gallon Contains: Sodium bicarbonate, gr. 0.55; sodium chloride, gr. .48; potassium sulphate, gr. .08; calcium sulphate, gr. .15; calcium bicarbonate, gr. 1.98; magnesium bicarbonate, gr. .73; iron oxide and alumina, gr. .01; silica, gr. .18; organic and volatile matter, trace. Total solids, gr. 4.16.

This water has become well known for its purity and softness. It is widely used in the hotels, clubs, and private residences of many of our large cities as a drinking-water. It is very lightly mineralized, as shown by the analysis, yet it is recommended by numerous medical men as being useful in the treatment of gout, rheumatism, dyspepsia, and diseased conditions generally which are traceable to the uric-acid diathesis. *James K. Crook.*

END OF VOLUME III.