AURAL VERTIGO.

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AURAL or auditory vertigo, as its name would indicate, is a vertiginous condition due to an irritation of the auditory apparatus. This irritation, usually in the form of pressure, may be situated either in the external, the middle, or the internal ear, or in or upon the auditory nerve, within the cranial cavity. Though originating in the different parts of the organ of hearing, this irritation, in order to produce vertigo, must be exerted ultimately in the form of pressure upon the terminal filaments of the auditory nerve in the semicircular canals, and thence conveyed to the cerebellum, as will be shown hereafter. Some observers hold that all disturbances in equilibration, as manifested in giddiness, are due either to a temporary or a permanent lesion in the labyrinth. In fact, some hold that the semicircular canals are vertiginous centres. While I am not prepared to accept this theory, it is plain to my mind that in the semicircular canals there is found a very sensitive medium of communication of impressions to the cerebellum, and hence that these canals may be considered as in many respects presiding over the equilibrium of the body. Although many instances of vertigo can be shown, in my opinion, to be due to irritation of these canals, by virtue of the vasomotor connection between them and remote parts of the body, it is my object to limit the scope of this paper to a consideration of vertigo arising from irritation in the various parts of the auditory apparatus, and communicated to the semicircular canals, and thence to the cerebellum. The whole matter of aural vertigo will be most easily understood by a consideration, first, of the structure and distribution of the auditory nerve.

Structure of the Auditory Nerve.—Mons. M. Duval has shown* that a portion of the fibres of origin of the auditory nerve are closely connected with a mass of motor cells in the bulb, and that these fibres pass into, and are continued in, the inferior peduncles of the cerebellum. The inferior peduncles of the cerebellum connect it with the medulla oblongata, pass on downwards to the back of the medulla, forming part of the restiform bodies, and are then connected below with the corresponding half of the cord, excepting the posterior median columns.

It is well known that injuries of these peduncles cause disturbances in motion similar to those observed after lesions of the semicircular canals. It seems, therefore, that there is a sort of special function resident in these canals, that exaltation of their function evokes peculiar movements of the head and mediately of the trunk and limbs, and that the anatomical explanation of this is found in their cerebellar connection; and it further appears that there are two kinds of fibres in the auditory nerve, —viz., the motor fibres, distributed to the ampullæ of the semicircular canals and connected with the bulb and the inferior peduncles of the brain, and another set distributed to the utriculus, the sacculus, and the cochlea, which are accepted as purely sensory. It is to the motor set of fibres in the acoustic nerve that our attention must be directed in considering the subject of this paper.

The question naturally arises, are not these inferior peduncles wounded in experiments on the semicircular canals? My reply is that in the pigeon, used for these sacrifices, the semicircular canals stand away from surrounding tissues in the cranium, as the cochlea does in the bulla of the guinea-pig, so that mutilation of any parts but the semicircular canals is avoided. That the phenomena attributed to mutilation of the *semicircular canals* in these experiments are justified seems further confirmed by recent experiments by Gellé, of Paris, upon the *cochlea* alone, by which he shows that in the guinea-pig mutilation and extirpation of the cochlea, easily accomplished in this animal without opening the true cranial cavity, is unattended by the slightest disturbance in equilibration.

It must be further borne in mind that

* Gellé, De l'Oreille, etc., p. 323. Paris, 1881.

the auditory nerve originates from numerous white striæ—the lineæ transversæ—which emerge from the floor of the fourth ventricle, and that it is also connected with the gray matter of the medulla. Now, the fibres of the pneumogastric nerve may be traced deeply through the fasciculi of the medulla, to terminate in a gray nucleus near the floor of the fourth ventricle: so that anatomically the auditory nerve and the pneumogastric are thus shown to be at least contiguous at their origin,—a fact entirely satisfactory in the "overflow" theory, as will be shown.

As has been said already, authors speak of a "vertiginous centre,"* and of vertigo as "undoubtedly a sensation." The latter may be evoked by an overflow of nerve-impulse from some one centre of the encephalon to the so-called vertiginous centre; and, from what we know of the physiology of the semicircular canals, we may assume that the central termination of the ampullar nerves is in a very close connection with a spot in the brain, irritation of which will produce the sensation of giddiness. This, as we now know through the labors of Duval, is in the cerebellum, and owes its great influence most probably to its connection, by means of its inferior peduncles, with the spinal cord.

To this connection we owe the greater or less impulse conveyed over the portion of the auditory nerve supplying the semicircular canals in every turn of the head or movement of the body. When this impulse is slight, or let us say normal, it does not produce vertigo, but informs us, or aids in the information, of our position in space. Thus there is established the so-called "sense of equilibrium." The disturbance of this sense constitutes vertigo.

If such an "overflow" of irritation can take place between the central termination of the ampullar nerves—*i.e.*, the nerves of the semicircular canals—and the vertiginous centre in the cerebellum, it is fair to assume that a similar "overflow" may take place between this ampullar centre and the pneumogastric centre, simply because the two latter are more contiguous to each other than the ampullar centre and the vertiginous centre in the cerebellum. In this contiguity an easy explanation is found of the nausea, vomiting, pallor and faintness, the slow breathing and weak pulse, which occur in aural vertigo; for we are entitled to assume that the irritation in the auditory apparatus and auditory nerve centre overflows to the respiratory, the cardiac, and the vomiting centre.

Anatomical Causes of Tinnitus Aurium.—As tinnitus aurium is almost a constant attendant upon vertigo from any cause, but especially attendant upon auditory vertigo, it is necessary in this paper to consider briefly *its* probable anatomical cause. It should be borne in mind that great error has crept into our diagnoses through considering tinnitus aurium a subjective sensation. Although this originates in the subject, tinnitus aurium, of all qualities, should not be considered a truly subjective sound, any more than we should regard the heart-sounds or aneurismal murmurs as purely subjective. Tinnitus aurium is best understood by being regarded as a truly objective sound; for it will be found upon reflection to be due to the perception by the auditory nerve of the circulation of the blood in the organ of hearing, and not in the nerve itself. The terminal expansion of the auditory nerve—not the nerve-trunk—responds *only* to the stimulus of sound: so that if there is hearing there must be sound; just as the retina, and not the optic-nerve trunk, perceives light, so that if there is a perception of light it must be through a terminal expansion of the nerve of sight impressed by light. Hence, excepting perhaps in some rare cases of cerebral disorder, where statements of the subjects are not highly reliable, there is no such thing as subjective sight or hearing. If there is said to be hearing, there must be sound; so that tinnitus aurium is the hearing on the part of the ear of the sound or sounds which are produced by the movement of the blood in the various parts of the ear. This sound may be due either to an increase in the flow of blood through these vessels, and the consequent vibrations produced thereby, or to a *retention* of sound-waves produced by the ordinary circulation of blood through the organ of hearing.

The normal flow of blood through the vessels in or very near the ear is not heard because the sound-waves caused by the movements of the blood in these vessels flow outward through the drum-cavity, the membrana tympani, and the auditory canal, and are lost to our senses; but stop the external meatus, even for a few seconds,

* P. McBride, of Edinburgh, Medical Times and Gazette, vol. i., 1881; also J. A. Irwin, M.A. Cantab., M.D. Edin., Pathology of Sea-Sickness, Lancet, November 25, 1881. An article of intense interest and great value.

with the finger, and these sound-waves are thrown back into the ear, the resonance of the organ is altered, and a murmur is heard. Thus we can at will produce a tinnitus aurium, and to a great extent comprehend that tinnitus aurium in general is due to the hearing of obstructed, retained, and reflected waves of sound originating in or near the ear. In fact, in tinnitus aurium we have the murmur, of course in varied pitches and intensities, produced by minute vibrations in the walls of arterioles and veinlets in or near the ear, through which blood is flowing and setting up vibrations, just as we hear an aneurismal murmur which is evoked in a similar way.* Hence it is that it can be asserted that tinnitus aurium is really an objective sound, made in and heard by the ear, and is to be explained on purely physical grounds.†

Symptoms.—The symptoms of aural vertigo may be briefly stated as follows. The patient more or less suddenly experiences in one or both ears tinnitus, and more or less hardness of hearing. This is quickly followed by a dizziness passing rapidly into a pronounced vertigo, with reeling and falling, accompanied by nausea, vomiting, and faintness, but rarely with loss of consciousness. When the latter ensues, it is simply complete syncope from the nausea and vomiting. Usually the patient almost instinctively associates his vertigo and attendant malaise with derangement in the ear, which may or may not have been previously diseased. These symptoms, which are here given in the order of their onset and sequence, are subject to modifications according to the part of the ear affected. Thus, when the irritation is in the *external ear*, neither the tinnitus nor the deafness may be excessive; but both are permanent from the onset to the cure, and the tinnitus is acoustically of the uninterrupted quality. When the irritation lies in the *middle ear*, the symptoms are likely to be paroxysmal, as though the physical conditions upon which the altered and morbid pressure or tension depends varied with the state of the atmosphere or with the health of the patient. In cases dependent upon irritation in the external ear or labyrinth, all the symptoms are usually more pronounced, though the attacks of tinnitus and dizziness are paroxysmal, while the deafness is most profound and permanent, whether it comes on suddenly with the first attack of vertigo or not. The latter passes off, but the deafness remains.

Vertigo dependent upon disease like a tumor in or upon the auditory nerve, and which may be denominated a central form of auditory vertigo, is usually not paroxysmal, the patient experiencing a constant and increasing tendency to alterations in gait, with a disposition to fall towards the affected side in walking. Here the permanency of the symptoms should lead us to suspect disease in the cranial cavity.

Differential Diagnosis.—All the forms of aural vertigo are not only confounded in diagnosis with each other,—and in some cases there may be a commingling of two forms in the same subject,—but they are constantly mistaken for stomachic vertigo, so-called biliousness, epilepsy, and even apoplexy. The confusion among the various forms is hardly to be wondered at, but the aural symptoms and the usually retained consciousness should make the differential diagnosis between this disease and others just mentioned very easy. Then, too, the absence of spasm and the marked pallor in the patient should lead away from the diagnosis of either fits or apoplexy. This defective diagnosis has led to a faulty nomenclature, so that the term Ménière's disease, which, if it means anything, means a disease of the semicircular canals only,—*i.e.*, a disease of the internal ear,—has been very erroneously used to designate aural vertigo in general, instead of being limited to the form of aural vertigo dependent upon disease in the aforesaid canals. That this term "Ménière's disease" should be thus restricted will, I think, be plain to you after a closer examination of all the forms of aural vertigo, of which Ménière's disease is clearly only one. Your attention is therefore asked *first* to that form of aural vertigo due to irritation in the *external ear.* This may be considered the simplest form of the disease, so far as concerns its production and cure; but the mode of its action is the same as in other and graver forms; *i.e.*, the pressure and irritation are at last conveyed to the cerebellum, and then the vertigo is evoked.

* The pitch of the note of tinnitus aurium is usually high, such as is to be expected from the rapid vibration of a short wire or string. The note is, in fact, produced by the vibrations of the walls of minute arterioles and veinlets,—vibrations as numerous as sixty thousand per second. The deeper or lower cooing sounds are produced most probably by vibrations in the larger walls of the carotid artery or jugular vein.

† To Dr. Samuel Theobald, of Baltimore, the profession owes the earliest explanation of the real causes of tinnitus aurium, in a paper published in 1875.

Illustration.—Doubtless all are familiar with the celebrated case of external ear-vertigo and other reflex phenomena associated with it, recorded by Fabricius Hildanus. In this instance a young girl 18 years old is said to have exhibited, besides the ear-vertigo, atrophy of one arm, epileptiform symptoms, and even anæsthesia of one-half of the body, all of which were cured by the removal of a glass bead or ball from the external auditory canal, where it had lain for eight years. This case is not only classical but highly instructive, but in this latter feature no more so than numerous cases of tinnitus aurium, vertigo, and nausea due to the presence of foreign bodies as simple as masses of hardened ear-wax in the auditory canal, and occurring in the experience of many of us. Vertigo due to irritation in, or applied to, the external ear and outer surface of the drum-head is also constantly seen in syringing the ear, sometimes when done ever so gently. Here the mode of irritation in most cases is by pressure upon the drum-head, and mediately by means of the ossicles and the labyrinth-water upon the filaments of the auditory nerve in the ampullæ of the semicircular canals, the anatomical reasons for which have already been presented.

The giddiness, however, induced by suddenly injecting cold water into the external auditory canal cannot be altogether explained by the pressure it exerts on the drum-head and mediately upon the ossicles of hearing, the labyrinth-water, and the cerebellar branches of the auditory nerve found in the ampullæ of the semicircular canals. Here an explanation must be sought for in the nervous connection between the external ear, the seat of the irritation, and the vertebral artery which supplies the circulation in the labyrinth. We must bear in mind that the effect of irritation in a vaso-motor nerve-tract is to excite vessel-dilatation in a correlated area through diminished inhibitory nerve power. In this instance the irritation is the sudden presence of cold water in the external auditory canal, the diminished inhibitory nerve power is felt in the vertebral plexus, and the correlated area is the labyrinth and especially the semicircular canals. The morbid impression caused by the cold water is conveyed by the auricular branch of the pneumogastric nerve, found in this part of the ear, to the *inferior cervical ganglion*, to which the vagus sends a branch. From this ganglion the irritation is deflected to the vertebral plexus, into the formation of which, fibres from this lower cervical ganglion enter largely; the inhibitory power of the plexus is overcome, and vessel-dilatation ensues in the vertebral artery. This causes an increase in the blood-supply to the labyrinth, and the latter is in a measure engorged, and the labyrinth-water, having no adequate means of rapid escape, is compressed within its bony cavity. This compression is of course quickly felt by the nerve-filaments in the ampullæ of the semicircular canals, they are compromised, and vertigo ensues, for anatomical reasons already given.

Thus it is shown that external ear-vertigo is produced in two ways,—viz., either mechanically by direct pressure on the drum-head and the chain of ossicles, or reflexively through the nervous system.

Middle Ear-Vertigo.—When we come to consider aural vertigo caused by disease in the middle ear, we approach a much more complicated subject. Here the pressure and consequent mechanical irritation may be conveyed in various ways to the labyrinth-water and the terminal filaments of the auditory nerve in the semicircular canals, and thence by the motor fibres to the cerebellum. The most frequent mode of irritative pressure is exerted by an accumulation of fluid, mucus, pus, or serum in the tympanic cavity. The pressure is conveyed through the foot-plate of the stirrup-bone or through the membrane of the round window, or through both, to the labyrinth-water, and through the latter fluid to the auditory nerve, which, as I have stated, contains motor filaments, and thus to the cerebellum. In fact, this process of conduction of irritation is but an exaggeration of the mode of the mechanism of hearing; and we can very easily understand how a great noise, or any noise at times, may produce dizziness and other cerebral disturbance.

Again, morbid pressure may be exerted from the middle ear to the deeper parts of the auditory apparatus concerned in the production of ear-vertigo by closure of the Eustachian tube in throat and nose disease.

After this closure of the tube, the air shut in the tympanic cavity is soon absorbed, a vacuum is then formed in the drum-cavity, and the external air presses the membrana tympani inward, carrying with it the

malleus and the rest of the chain of bonelets. Thus the labyrinth-water is unduly compressed, and, as in the previous case, the auditory filaments in the semicircular canals are also compressed and the cerebellum irritated. In some rare instances there seems to be reason to suppose that a tonic contraction of the tensor tympani muscle occurs,* and that retraction of the membrana tympani and the chain of ossicles ensues. In this way the foot-plate of the stapes is forced inward through the oval window upon the labyrinth-water, and cerebellar irritation is produced, as heretofore sketched. The attacks of aural vertigo of this latter form are paroxysmal, and are accompanied by so-called "variable hearing,"† the hearing growing worse as the tinnitus, which is in fact the prodrome, increases, and finally ushers in the vertigo. In fact, any undue loading of one or of all of the ossicles, or any abnormal pressure upon them, or even excessive swelling of the mucous membrane covering them, by forcing them inward, or by carrying only the stirrup abnormally inward, would tend to compress unduly the labyrinth-water, especially if at the same time the swelling of the mucous membrane extends to the round window and prevents the compensating yielding of its membrane to the inward pressure of the stirrup. In this way the vertigo so often present in acute otitis media may be explained.

Middle ear-vertigo from *chronic* disease in the tympanum is very common, according to the observation of the writer. This source of vertigo is to be expected when we reflect that there is a direct communication between the circulation of blood in the middle ear and that in the labyrinth. Politzer has shown that the capillary blood-vessels of the tympanum pass directly through the inner or labyrinth wall of the tympanic cavity to the vestibule and other parts of the internal ear. Hence it is easily seen how disturbed circulation, which must ensue in chronic disease in the walls of the tympanic cavity, may be felt in the internal ear; and as disturbances in circulation, by altering the pressure in the labyrinth, especially in the semicircular canals, produce vertigo, it can be shown how chronic middle ear-disease may induce aural vertigo.

In middle ear-vertigo it may also be assumed that the pressure in the labyrinth may at times be brought about by altered circulation due to reflex influences, as was shown in external ear-vertigo. The path of the irritation in this case, however, lies probably between the vertebral artery, the vertebral plexus, and the inferior cervical ganglion on one side, and the otic ganglion on the other.‡

Internal Ear-Vertigo.—In considering ear-vertigo due to disease in the internal ear, we approach at once the most difficult and the most interesting form of the disease under consideration. It may be produced by disease in the auditory nerve or in any part of the labyrinth except the cochlea. From recent experiments of Gellé, of Paris, it is conclusively shown that laceration and destruction of the cochlea in mammals (especially in rodents) has no effect whatever upon equilibration. This throws us all the more forcibly back upon the semicircular canals as the very highly probable seat of the organ of equilibration.

Up to this point we have considered the effect on these canals of irritation originating elsewhere and communicated *to* them. Now we shall consider the phenomena of disturbed equilibration due to disease arising *in* them and the irritation it conveys to the cerebellum; and under this head we shall also consider the phenomena of disturbed equilibration due to irritation in or upon the auditory nerve before it reaches the labyrinth, as we sometimes find in tumors, either in the nerve or lying upon it. The phenomena in the latter case appear to me to be confirmatory of the existence of intimate connection between the auditory nerve-fibres and the cerebellum by means of the inferior peduncles of the latter.

History.—Let me bring to your minds the fact that the experiments of Flourens in 1817 first drew attention to the probability that a lesion of the semicircular canals would produce peculiar disturbances in equilibrium of the head and of the body. Subsequently these experiments were repeated, with more or less correspondence and confirmation, by Harless, Czermak,

* See article on "Variable Hearing," by the writer, in report of Section of Otology, International Medical Congress, Philadelphia, 1876.

† The late Mr. James Hinton, of London, in "Questions of Aural Surgery."

‡ The *tympanic nerve* communicates with the *small petrosal*, a branch from the otic ganglion. The otic ganglion communicates with the superior cervical ganglion, and this with the middle cervical ganglion, if present; if not, with the inferior cervical ganglion. The inferior cervical ganglion supplies largely the vertebral plexus, regulating the supply of blood in the labyrinth.

Brown-Séquard, Vulpian, and Goltz. In 1836 Deleau described very thoroughly a disease of the ear closely resembling that which later was called Ménière's disease. It might just as well have been called Deleau's disease. In 1860 Ménière the elder observed peculiar disturbances in equilibration and motion in a young woman, who also at the same time presented peculiar aural symptoms, prominent among which were tinnitus aurium and deafness. The girl dying suddenly from other causes while manifesting these peculiar aural cerebral symptoms, Ménière examined the internal ear, and thought he found peculiar pathological changes of an apoplectiform nature in the semicircular canals. Although the account of this investigation is extremely meagre and unsatisfactory, it excited so much interest at the time it was made as to lead to the application of the term "Ménière's disease" to every form of aural vertigo,—a most confusing and unjust nomenclature. But these examinations of Ménière served a good purpose in recalling the attention of physiologists to these canals in the labyrinth of the ear, and to lead to further examination into their functions. So that, with the experiments of Boettcher, of Dorpat, in 1872–73, it may be said a new and much more scientific era dawned upon the investigation of the functions of the semicircular canals. But this subject would of itself furnish material for a lengthy paper. It must therefore suffice to say that Boettcher set an example of extremely careful examination and manipulation in his experiments, which was followed by Bloch, Cyon, Mach, Berthold, Breuer, Curschmann, Löwenberg, and Berhardt, and, within a year, by Gellé, of Paris, and to some extent by Baginsky, of Berlin.* These experiments have been in every way brilliant, and from them there is every reason to draw the conclusion that in that part of the ear so long a puzzle to physiologists—viz., the semicircular canals—there resides a "sense of equilibration" which owes its power to its connection by means of the auditory nerve with the cerebellum. The anatomist, working from the brain and its structure, has met the experimental physiologist at the semicircular canals, and to their united labors science owes the important accumulation of facts on this subject now at her command.

Clinical History and Symptoms.—In internal ear-vertigo, the ear having been previously healthy or considered so, the patient is suddenly attacked by tinnitus, vertigo, nausea, reeling, and falling, but his consciousness is retained. After these symptoms abate and the alarm of the patient subsides, the hearing is discovered to be gone in the affected ear. This form of ear-vertigo the writer has seen in adults of various ages, usually in men over thirty, and in all grades and avocations,—in the hard-worked physician as well as in the overworked mechanic. Upon examination, the drum-head will present no great change, or it will look like one belonging to an ear previously the seat of chronic catarrh; and generally, upon close inquiry, it will be elicited that there is history of exposure, in camp or in daily labor, to inclement weather, and that the ear now attacked so severely has already at times felt stuffed and deaf, but that it got better and was a good and serviceable organ. The general health will be found to have recently failed, or to have been greatly taxed by some sudden stress of work, and it will also be found that the ear has "buzzed a little of late," but not constantly, and that this had been forgotten, until the attack of ear-vertigo brought it back to the memory. The hearing will be found to be profoundly impaired and to remain so, while the tinnitus may or may not remain, and the vertigo will be found to have temporarily vanished. Sometimes, with care and proper management, no further attacks of vertigo are felt; but the hearing remains permanently affected. On the other hand, the tinnitus may be always present to some extent, may increase suddenly at times, and form, as it were, a forerunner of subsequent attacks of vertigo.

As I have rarely seen a case of internal ear-vertigo without conclusive evidence of a previous chronic catarrhal disease in the middle ear, with necessarily great changes in nutrition and circulation, and as it is well known as fully established that the circulation between the middle and internal ears is most closely connected, therefore I am forced to conclude that internal ear-

* It seems to the writer that the experiments of Baginsky have been conducted deliberately with great violence, and with a view of producing a rupture of the membrane of the round window and meningitis. Hence they cannot be adduced to prove that a less violent irritation of the semicircular canals will not produce vertigo, nor do they prove anything against the supposition that a sense of equilibrium resides in the semicircular canals. There is more in favor of this view than the experiments of one man can overthrow.

vertigo, or what Hinton, of London, used to call "labyrinthine vertigo," is usually preceded by pathological changes in the circulation of the middle ear, which induce changes in the vessels of the internal ear, culminating in the sudden and grand attack I have sketched. Whether these changes and their results are of an apoplectiform nature cannot be discussed here.

The diagnosis, however, will be aided by the suddenness of the tinnitus, vertigo, and deafness, and especially by the fact that the tinnitus and vertigo are more or less evanescent, while the deafness is profound and permanent from the first. This form of aural vertigo, and no other, may justly be termed "Ménière's disease."

Central Ear-Vertigo.—There is a form of ear-vertigo which is due to a tumor of the auditory nerve.* This nerve, according to Virchow, is more frequently the seat of morbid growths than any other cerebral nerve. When the vertiginous symptoms dependent on the presence of these tumors, usually fibrous or sarcomatous in nature, first show themselves, it is not easy to distinguish between this form of ear-vertigo and that due to chronic changes in the middle and internal ear combined. There are, however, some points of difference so constant in their occurrence as to constitute truly pathognomonic symptoms. To begin with, central ear-vertigo dependent upon morbid growths in the auditory nerve is never sudden, but slow in its onset. The deafness and tinnitus, as well as the vertigo, are comparatively slight at first, but then steadily increase, and are always permanent from the time they first show themselves until the end. The gait is permanently altered, though it may be only slightly changed at first, and the tendency is to fall towards the affected side. Not so, however, in true internal ear-vertigo, in which the initial lesion is in the labyrinth in or very near the semicircular canals. In this the deafness is sudden, profound, and permanent, but the giddiness and falling are paroxysmal. In middle ear-vertigo, in which the deafness and tinnitus are great, the deafness is not sudden or profound, the vertigo comes in attacks, and there is no permanent alteration in gait.

Treatment of Aural Vertigo.—If it has been shown that aural vertigo is due to pressure in some form, either directly or mediately, upon the auditory nerve, and reflexly thence to the cerebellum, the indication in treating such cases is to remove, or at least diminish, this pressure; and this can be done surgically or medicinally. Let me say here that great confusion arises when these cases of aural vertigo are treated as cases of biliousness,—a much too frequent error. If the irritative pressure is due to a foreign substance of any kind in the auditory canal, it is to be relieved by the removal of the foreign substance, best accomplished by syringing with warm water.

If the irritation is due to pressure from matter accumulated and retained in the drum-cavity, it must be allayed by removal of the retained mass. This can be accomplished by paracentesis of the drum-head, by inflation of the tympanic cavity with Politzer's air-bag, or by catheterization. Even when matter is inspissated in the drum-cavity, one or all of these methods combined must effect its removal. The ossicles are thus allowed to swing freely, the stirrup comes back to its normal position, the membrane of the round window is relieved, and the pressure is taken from the labyrinth-water and the ampullar nerves in the semicircular canals.

If the pressure is due to a vacuum in the drum-cavity, and a consequent indrawing of the drum-head and the ossicles from closure of the Eustachian tube at its faucial end, the introduction of air by one or both of the above means will usually restore the drum-head to its proper place and unlock the pressed-in chain of bonelets, thus relieving the compression in the labyrinth and semicircular canals.

In cases of tonic spasm of the tensor tympani muscle, the attacks may be relieved by inflation of the drum-cavity, which forces outward the drum-membrane and the malleus and antagonizes the indrawing effects of the spasm in the tensor muscle. The disease in this form is also to be combated by antispasmodics, preferably bromide of potash in large and frequent doses, as much as ten to fifteen grains every fifteen minutes being given, with most excellent effect, as the attacks are coming on, or when on, as I have had occasion to test.

* By the aid of Dr. Morris Longstreth, I have shown in my "Treatise on the Ear" (p. 581) that tumors of the trunk of the auditory nerve may invade the labyrinth and destroy the auditory nerve-filaments contained therein, as observed by us in a case of tumor of each auditory nerve in a woman 42 years old.

When the vertigo is due to chronic aural catarrh,—*i.e.*, chronic change in the mucous membrane of the middle ear,—the field of treatment becomes indeed a wide one. The catarrh of the mucous membrane of fauces, naso-pharynx, and nares will usually require treatment, as well as the mucous membrane of the cavity of the drum; but in these cases the greatest benefit may accrue from the use of tonics and bromide of potash as above advised.

The morbid circulation which no eye can see, but which surely underlies these cases, may be connected with anæmia or plethora, and the diagnostician must bear this in mind in the treatment of the case. Local treatment in the external auditory canal will usually increase the dizziness by overloading, physically, the membrana tympani. Blisters, leeches, etc., about the external ear and mastoid portion of the temporal bone are useless: they may be so bothersome as to increase the malady.

Rest in bed is absolutely essential when the vertigo is frequent and severe. It is always a relief during an access of dizziness. The vertiginous centre may be said thus to recover itself, and the immediate attack is found to pass off more quickly than if the patient continues to walk about, while the liability to subsequent attacks is diminished. This is not the case, however, if the vertigo is constant and apparently due to a cerebral tumor in or about the auditory nerve or labyrinth.

Respecting the treatment of internal ear-vertigo, it may be said that a typical case of this form of the disease presents deafness which is irremediable. The attacks of tinnitus and dizziness may be lessened in number by attention to the general health, preference among drugs being given to quinia, strychnia, and iron, separate or combined. For immediate relief of the tinnitus nothing has been found by the writer equal to bromide of potash, and, in fact, no remedy is equal to this in relieving tinnitus generally.

Finally, the tinnitus and dizziness may cease, never to be felt again, but the deafness remains, being probably due to an organization of an exudation or extravasation thrown into the labyrinth at the time of the first grand attack. But, unfortunately, the pathological processes in such cases are not well known, as the researches have been meagre. If the case is seen at the beginning of the disease, and there is reason to surmise the existence of an exudation, an extravasation, or a hemorrhage into the labyrinth, the administration of the iodide of potash or of mercury, or both, would certainly be indicated; but, given late in the disease, these are valueless. The greatest care should be taken to build up rather than break down tissue; for there is generally in these cases of supposed exudative disease ample ground for the belief that in overwork a minute vessel in the labyrinth has ruptured or that a passive exudation has occurred from the walls of several vessels.

In conclusion, let me say that I have brought before you the following facts:

1. That there are two sets of fibres in the auditory nerve,—viz., the sensory and the motor.

2. That the motor filaments are connected on one side with the cerebellum by means of the inferior peduncles, and on the other side with the nerve-filaments sent to the ampullæ of the semicircular canals.

3. That irritation of these ampullar nerves may be conveyed from either of the three parts of the auditory apparatus, or from the auditory nerve itself, in the mechanical form of pressure, and that this irritation may be further conveyed to the cerebellum and cause vertigo: so that it logically follows that this reflex cerebellar phenomenon as produced by aural irritation should receive the general denomination of *aural vertigo*, and that Ménière's disease is only a form of aural vertigo. Hence the latter name, unless used after accurate diagnosis of a disease originating in the labyrinth,—*i.e.*, in the semicircular canals,—will create confusion. But it should be said, in justice to Ménière, that, so far as the writer knows, he has never claimed a general application of his name to all forms of aural vertigo. It has been so applied only by well-meaning but inaccurate diagnosticians.