REMARKS

ON

VERTIGO, AND THE GROUP OF SYMPTOMS
SOMETIMES CALLED MENIÈRE'S DISEASE.*

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THE point of view which I propose to submit for consideration in this paper is, that all vertigo is essentially auditory in its seat; that is to say, whenever the symptom of giddiness, disturbance of the equilibrium, defective gait, falling, or whatever modification of these may characterise the symptom of vertigo, its immediate occurrence is due to a modification of tension of that part of the labyrinthine fluid contained in the semicircular canals, and the appreciation by the ampullar nerve-apparatus of this change of tension. It cannot even be admitted that vertigo, associated with lesion of the ampullar nerve in its course through the brain to its root or hypothetical centre, constitutes any exception to this generalisation. If, as will be shown, the semicircular canals are the organs of equilibration, and vertigo the consequence of its disturbance, the organ must be implicated for such disturbance to become manifest. This statement may be predicated of every form of vertigo, however originating. Just as we could not get defect of vision consequent upon disease of the optic centres in a subject who had already lost his eyes, so vertigo, which is defective equilibration, cannot occur if the semicircular canals be absent, however much the central distribution of its nerve may be involved in disease. The converse of this proposition must be true also.

The more clearly this idea is grasped, the more successfully shall we discuss the differentiation of auditory vertigo, because we shall discern what there is to distinguish, viz., the causes which disturb the functions of the organs of equilibration. These may be classed under two heads. The first includes alterations of tension, either *plus* or *minus*, of its contained fluid. There will be found three kinds of change of tension: *a*. That produced by direct pressure due to local ear-disease; *b*. That induced by reflex vaso-motor influences; *c*. That in which a combination of both these exists, which comprises the great bulk of cases.

The second class embraces such intracranial diseases as irritate or disturb the nerve of the organ, and are central in their origin.

To substantiate this position, it is necessary that certain points be understood. These are (1) the anatomical construction of the nerve-supply of the semicircular canals, henceforth called the organs of equilibration; (2) the functions of these organs as indicated by experiment; (3) the anatomical relations of these organs to contiguous and distant regions.

1. With reference to the *anatomical constitution* of the nerve-supply of the organ, it is to be noted that the latest accounts by Gellé and Duval confirm earlier surmises to the effect that a special set of fibres associated with the auditory nerve proper is reserved for distribution to the ampullæ of the membranous semicircular canals only. Traced backwards, these fibres are continued into the inferior peduncles of the cerebellum, the medulla oblongata, and possibly into the spinal cord, though their ultimate destination is still *sub judice*. These ampullar nerves are associated with a mechanism which is also peculiar, their peripheral distribution being connected with certain cells developed from the epithelium of the ampulla, having hair-like prolongations projecting into the lumen of the tube in such a way as to appreciate the slightest vibration of or change of tension in the endolymph.

My reason for recalling these trite anatomical facts, is to emphasise the inference that an organ endowed with a nerve connected with a special mechanism may be fairly accredited with the possession of special functions. In the remaining parts of the internal ear, no such apparatus exists, but, instead, a very special one for each. Thus, while the nerve of the utricle and sacculus is excited

through the medium of crystalline particles known as otoconia or otoliths, the exact function of which organs remains undetermined, that part of the auditory nerve distributed to the cochlea has its special apparatus, the organ of Corti, which, by general consent, is accredited with the function of transmuting the vibrations reaching it into sensations of sound.

With the cochlear nerves we are not now concerned, for it has been demonstrated that the cochlea may be destroyed, but no disturbance of equilibrium ensues.

2. *The functions of the semicircular canals* as demonstrated by experiment. Since the initial investigations of Flourens in 1817, showing that injuries of these organs produced movements of the head, rotation of the body, etc., his experiments have been repeated by a long list of observers, of whom Goltz, Loewenberg, Gellé, and Spamer are among the most recent and reliable. These are in the main all confirmative of Flourens' results. Notwithstanding, Baginsky of Berlin has recently attempted to show that the effects arrived at by his predecessors in this field of research are referable to concomitant injuries inflicted on adjacent tracts of brain-tissue. On this point, the following summary of the latest investigator, Spamer, to my mind effectually disposes of Baginsky's objections, inasmuch as he points out "that the disturbances of equilibrium vary with the canal injured. There is no relation between the amount of disturbance and the amount of cerebro-spinal fluid which escapes when a canal is cut. The disturbances vary with the kind of injury inflicted, being more marked on transverse than longitudinal section. Apart altogether from section of the canals, irritation by different chemical solutions causes marked results; and the effect of touching the canals with a heated point cannot be explained away by any hypothesis of direct injury to the brain such as Baginsky assumes. In his own experiments, the most careful examination failed to detect any lesion of the brain, or, if such lesions were accidentally produced, the cases were considered unsuccessful experiments." (*Brain*, January 1882.)

The weight of experimental evidence, therefore, conclusively justifies the assumption that the function of equilibration resides in the semicircular canals, and that interference with this function produces the phenomena of vertigo. By this term is meant not only the loss of the power by which the upright posture is maintained, but also the loss of the capacity on the part of the vertiginous subject to recognise his relationship to the objects surrounding him. The latter is to be regarded as a lighter phase of the attack. The sequel will indicate that many symptoms not included in this definition are associated in varying degrees of constancy with the more prominent symptom, and are dependent upon the anatomical relations of the organ of equilibration, and that giddiness is only the primary, albeit the most pronounced evidence of its disturbance.

We may now search for the channels by which morbid impressions reach this organ, a proceeding which brings me to the third point, viz., the consideration of the *anatomical relations of the region to contiguous and distant organs*.

Respecting those organs the close vicinity of which to the labyrinth favours the advance of any diseased condition present in them towards the latter, the first in importance are the parts of the auditory apparatus designed for the conduction of sound to the internal ear. The tympanic chamber, including the Eustachian tube and its accessory cavities, the postnasal space and the nasal fossae, are peculiarly obnoxious to morbid states the tendency of which is to implicate the labyrinth. It is unnecessary to insist on the consequences of catarrhal and proliferating processes of the tympanum in producing pressure on the membranes closing the fenestra of the labyrinth, nor on the corresponding result of tubal obstruction, however brought about, these being trite otological facts. We have abundant proof that such increase of intralabyrinthine tension is capable of inducing vertigo, all doubt respecting which may be set at rest by repeating Weber-Liel's experiment of pressing on an exposed stapes. It is not, however, sufficiently recognised, that stenosis of the nasal meatus, is equally potential with direct tubal obstruction in producing middle-ear disturbance, because, if complete, it necessitates buccal respiration, and so abnegates the tubal function. This remark is intended to emphasise the importance of directing attention to the nose when the ear-symptoms are present, as there are a certain number of cases referable to this region alone.

That many of the conditions now glanced at are competent to irritate the tensor tympani muscle, and lead to its spasmodic contraction, seems also clear. The effect of such excessive action is to draw the chain of bones inwards, so pressing on the foramen ovale, with the counterpart effect of Weber-Liel's experiment just referred to. The occurrence of spasm in the muscle in question will some-

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times explain the intermittent and transitory character of the vertigo.

The external auditory canal likewise contributes its quota to the causes which lead to giddiness, as when foreign bodies are located in it. Amongst these are plugs of hardened cerumen, also beads, seeds, pieces of slate pencil, etc., introduced by the curious for the purpose, apparently, of investigating the whither of the orifices of their anatomy; a propensity not entirely confined to the ear, or to the very young. Any of these may cause direct pressure upon the ossicles through the medium of the drumhead, and thus produce tension of the intralabyrinthine fluid. But inasmuch as less tangible irritants, such, *e.g.*, as eczema of the external canal, the presence in it of small insects, penicillium and other fungi, none of which can exert mechanical pressure, are all alike prone to be associated with the symptoms of vertigo—we must seek further for the explanation of their occurrence under these circumstances. This is undoubtedly a reflex phenomenon, the conditions for producing which will be found in the relations of branches of the third division of the fifth nerve. Thus the auriculo-temporal branch of this nerve supplies the external canal with sensory fibres, while another twig of the same nerve passes through the otic ganglion to the tensor tympani muscle. Irritation of the former by any of the above-named causes will readily induce reflex contraction of this muscle, and hence the vertigo.

Passing to the consideration of the relationships of more remote regions to the organ of equilibration, and to the influence which morbid states in them exercise upon the function of the latter, we shall find their import to be very real, and the importance of their recognition of paramount value in regard to the question of diagnosis. It will show the bearing of this division of my subject on the questions at issue, first of all to enumerate the associated symptoms of vertigo, and then endeavour to see how far they can be anatomically connected with the semicircular canals. It is desirable to note here that the following category of attendant symptoms is drawn from actual experience extending to upwards of fifty cases of the disease, observed in hospital and private practice; and, further, that the portrayal of these, when present in a marked degree, leaves little room for over-colouring or exaggeration.

Referring first to the chief symptom—*vertigo*—this is spoken of indifferently as giddiness or swimming of the head, though no single term will suffice to describe it. It appears under many and varied aspects. Trousseau remarks: "Sometimes, when the individual is standing, everything about him seems to be whirling around; he is obliged to shut his eyes and remain absolutely motionless, for he feels his legs tottering and bending under him, as if he were going to fall; and sometimes he does fall. If he be lying down, he thinks he sees his bed revolving on an axis passing through his head and feet; or it may be that the patient sees himself involved in the rotatory movement. Sometimes the earth appears to open at the sufferer's feet, and he feels himself irresistibly drawn into the chasm. At the same time he is oppressed with an overwhelming terror and sense of dread, which, though fully conscious that his sensations are more subjective than real, he is unable to dispel."

Nightmare.—Anyone realising this state of things will, I think, scarcely fail to recognise the great similarity existing between them and what is popularly called nightmare. I believe this latter state has not met with a satisfactory physiological explanation; and, in submitting my conviction that it is really due to an attack of vertigo occurring during sleep, I shall hope to show that the reasons for so doing have a firmer basis than that of mere hypothesis. At present, I can only briefly anticipate, what will be apparent in the sequel, that nearly all vertiginous subjects have more or less impairment of their hearing apparatus. Children are particularly obnoxious to ear-disease; so much so, that it may be predicated of all those who are the subjects of nightmare, that they are either temporarily or permanently thus affected. Later on, it will be shown how an indigestible meal determines an attack of aural vertigo in persons whose auditory nerve is thus rendered morbidly sensitive, thus furnishing all the links in the chain of evidence by which to explain the occurrence of nightmare by an attack of vertigo coming on during sleep.

Returning to the symptom of vertigo, certain conditions will be found to induce it. In some, stooping, in others, lying down, in others, again, rising suddenly from the recumbent posture, will have this effect. In one case, in which, owing to an extensive loss of the drumhead, a granular mass was seen to involve the stapes, lying on the opposite side increased the giddiness, apparently by bringing the weight of the growth exactly on to the fenestra. Constipation aggravates it. In a certain number of cases, turning the

head suddenly to one side determines an attack, probably by checking the even return of blood from the head. Profuse perspiration is a frequent concomitant, especially in the region of the head and face; often also in the hands. In a recent case, the patient fell prostrate whenever a loud sound occurred in his vicinity, such as a railway-whistle.

It is a matter of observation that, even when the patient falls, which is often sudden and always in the same direction in the same case, consciousness is never lost, unless fainting complicate the vertigo. This, however, is very rarely the case; but its physiological possibility will be pointed out shortly. Whenever I have witnessed an attack, the pulse has been rather quickened than otherwise; the face and lips have remained quite natural as to colour, or, if changed at all, it has been in the direction of congestion; though, if fainting occur at the same time, there will be pallor as well as loss of consciousness. Some patients describe the falling as though "the pavement flew up and struck them on the head," thus using the language of the conventional inebriate. This feature is one of absolute and sudden powerlessness—a kind of crumpling up of the body from inability to maintain the equilibrium. As a rule, it passes off as quickly as it happens; and, beyond the mental confusion consequent upon the fall, the patient is able to resume his former occupation in the course of a few minutes.

It will be observed that most of the preceding as well as many of the following conditions point to a hyperæmic state of the head, rather than to one of anæmia.

Deafness.—It is to be observed that vertiginous subjects are nearly always deaf, not more than 2 per cent. of my patients having been free from some degree of hardness of hearing. It is true that this fact is not always admitted by the sufferer, until the hearing is tested, and the defect pointed out to him. From the point of view now insisted upon, it is obviously of importance to ascertain the state of the ears in every case of vertigo. This symptom—deafness—is very uncertainly influenced by an attack; often it is increased before and afterwards, but one patient stated that his hearing "was cleared up" by a fit of giddiness. In either case, the effect is transient. The point of chief importance to be noted in connection with deafness is that, when carefully investigated, it will be found that this symptom preceded the first attack of vertigo by a considerable period. Obviously, these remarks exclude a small class of cases in which no symptom of the kind referred to has ever happened, until the subject is suddenly smitten with vertigo, and, on recovery, finds that he is deaf in one or both ears. These are instances of apoplexy of the labyrinth; they are, fortunately, rare, though not to be lost sight of in estimating the possible factors of the disease.

Tinnitus is, perhaps, the most distressing accompaniment of vertigo. It varies in degree from slight tidal but persistent sounds, to those of a tumultuous storm, in the worst phases of which the patient's life is rendered burdensome. The attempt to explain these, as Burnett has recently done, by attributing them all to vessel-vibrations, is, to my mind, delusive. Depletion often aggravates them, and the bromides more often fail to relieve than prove efficacious. When they are distinctly pulsating, indicating loss of arterial tonus in the circulation of the labyrinth, hydrobromic acid is a specific cure; but it will do little in other cases. A congested state of the venous sinuses of the brain, especially those which receive the blood from the internal ear, is indicated by chattering, chirping, and musical notes. The recumbent posture, tobacco-smoking, and alcoholic excess, induce these; the latter two by impairing the vaso-motor control of the vessels, which indirectly tends to venous engorgement. The lying posture acts in this way by obstructing one or other of the emissory veins. In advanced ear-disease, associated with paresis of the intrinsic muscles, usually local in its source, *i.e.*, impairment of nerve-supply by implication of the latter in the local lesions, it seems more than probable that a tremulous state of the tensor tympani is set up, the vibratile oscillations of which muscle are appreciated as sounds by the ear. Parallel cases are seen in bulbar paralysis, where the muscles of the tongue on the affected side are seen to be in a state of persistent tremor. The numerous factors which contribute to the causation of tinnitus have been fully treated of elsewhere, so that it is unnecessary to discuss them further on this occasion.

Headache is a very constant attendant. It is more often occipital than frontal, and extends to the mastoid region. Associated with it is a very constant sense of rigidity and uneasiness in the nape of the neck, passing down towards the shoulders. The head itself cannot be steadied, and would fall over if not supported; one particular position in each case is usually adopted as the easiest.

Numbness about the side of the head and forehead, corresponding to the affected ear, is occasionally witnessed.

Stomach.—It seldom happens that severe vertigo exists without a concomitant disturbance of the stomach and intestinal tract. This manifests itself in nausea, culminating in vomiting, and forcibly recalls the intimately allied phenomena of sea-sickness.

In chronic cases, *dyspepsia* is a strongly marked symptom. In fact, the association between "swimming in the head" and a "bilious attack" is so frequent, that both professional and lay observers speak of them as effect and cause, but without any recognition of the organ actually implicated to induce the giddiness, or of the anatomical association between it and the region manifesting the dyspepsia. In this class of patients, I have frequently noted the presence of oxaluria; and it should always be looked for in vertiginous dyspeptics, whose pursuits are studious and whose habits are sedentary. It is necessary to allow the urine to stand for twenty-four hours, to precipitate the crystals. Their presence is due, doubtless, to the maldigestion of sugar and the glycogen derivatives; and I need scarcely observe that its recognition affords important indications for successful treatment. Though the evidence on this point is not as yet conclusive, I believe it will be found that an attack of vertigo may be induced reflexly from irritation of the kidneys, set up by the elimination through these organs of excessive quantities of oxalates; just, in fact, as the presence of certain articles of food in the stomach will, in the susceptible, invariably produce this symptom. Solid butcher's meat has this tendency in a marked degree, especially in advanced life, at which era a return to the diet of infancy is imperatively necessary to avert the attacks.

The heart seldom escapes some form of functional disturbance, which greatly enhances the discomfort of the patient. This may take the form of palpitation, præcordial distress, or irregularity of action. These symptoms, though usually ascribed to flatulence or dyspepsia, are distinctly due to implication of certain cardiac factors of the anatomical mechanism, which embrace all the other phenomena of the disease.

The *gait* in vertiginous subjects is liable to be affected, apart from the immediate influence of an attack. These patients are uncertain in their walking powers, often lurching and reeling to one side, without any other sensation of giddiness. These facts should not be left out of consideration by those who may be called upon to decide in a given case, as to whether illness or drunkenness is operating to produce a degree of staggering, which to the lay mind suggests nothing beyond alcoholic excess. This condition is frequent in the later phases of syphilis affecting the labyrinth. One such patient complained of the left foot always feeling as if compressed by a tight bandage. Intense itching of the inside of the foot, and, in another, severe pain in this region, have also been noted.

Mottling of the hands and forearms is met with in nearly every case of severe vertigo. It is a very positive symptom, the blush disappearing on pressure, to reappear when the pressure is withdrawn. It denotes a loss of tonus in the peripheral vessels of the brachial circulation, and possesses this significance, that it visibly portrays what is the state of things in the correlated distant areas of the same circulatory system; i.e., the vessels regulated by the same vaso-motor centre, where these areas are removed from direct observation.

Intimately allied with the anatomical relationships just referred to are the *auræ*, which presage an attack of vertigo. These are frequently, but not invariably, met with. Sometimes the sensation begins in the arm corresponding to the worst ear, passes up the side of the neck; and, when it reaches the ear, the patient becomes giddy. Or the sensation commences in the stomach, and follows the same course. Occasionally it assumes the form of a stifling feeling in the throat; or, of a fancied dysphagia. All the foregoing symptoms are quoted from cases, and preceded the attack in the subjects manifesting them.

The concluding group of symptoms, though seen most markedly and persistently in confirmed cases occurring in advancing life, are yet met with as occasional occurrences in the very young, and in quite curable stages of the disease. I have already alluded to the sense of dread, the apprehension of impending evil, exhibited by the subjects of vertigo, and which is quite uncalled for by the surroundings of the patient, and which no amount of reasoning can allay. To some extent, this painful state may be the effect produced upon the mind of the patient by the uncertainty as regards his relationship to space, and the objects about him engendered by the whirl in which he passes his existence. Closely akin to the foregoing is an equally uncontrollable tendency to sobbing and weeping

without provocation—a symptom which naturally proves very distressing to the friends and on-lookers. This tendency is occasionally witnessed in young persons with advanced ear-disease. In one patient, a great flow of tears was invariably induced by every attempt to read aloud. There is, moreover, in nearly all cases a great and growing impairment of memory; the patient voluntarily complains of forgetfulness in the trivial concerns of every-day life. In the aged subjects of the disease, where it advances unchecked, this expresses itself in inability to talk correctly. This is not aphasia proper, at least, not in the early stage; but, from simple forgetting of the word required, some other quite irrelevant word is substituted, and thus speech becomes incoherent, and at length unintelligible.

Finally, *oscillation of the eyeballs*, called also nystagmus (*νυσταγμός*, nodding, slumber), has been described by some authors as an accompaniment of vertigo. I have never met with it in the entire category of my cases. Its presence would impart a grave aspect to the case, from the fact that the third and fourth nerves (oculo-motor and patheticus) are by general consent connected with the cerebellum. From the point of view of differential diagnosis, one would be inclined to refer a case of vertigo exhibiting this symptom to central lesion, e.g., tumour of the cerebellum, rather than to causes primarily seated in the auditory apparatus.

One other feature met with in the later stages of the disease requires to be noted here; it is the growing habit of picking and fidgeting with the fingers which these patients exhibit. This symptom is curiously similar in every case sufficiently advanced to exhibit it, and takes the form of tapping with the finger-nails, twirling and twisting any small object in their hands, especially feeling the lappels of the coat or other wearing apparel, as well as a disposition to touch with the fingers any object which may be at hand. Although probably a part of the general restlessness of body which advances *pari passu* with the mental vacuity, I cannot but regard the particular localisation of this restlessness in the fingers as a later manifestation of impaired nerve-nutrition in the upper extremities consequent upon the loss of vaso-motor power to which I have referred the mottling of the skin in this region occurring earlier in the disease. In one case, still under observation, this symptom disappeared under treatment of the affected ear, step by step with the cessation of the tinnitus.

In reviewing the symptoms just detailed, the question naturally arises, how are they produced? Obviously that exegesis will be most acceptable which most clearly embraces the entire category of associated phenomena. There are two hypotheses which have been advanced to solve the enigma before us.

One of these, called the "overflow" theory, has quite recently been largely advocated by Dr. Burnett of Philadelphia, and Dr. McBride of Edinburgh. It maintains that an "overflow" of nerve-impulse may take place between centres situated contiguously to each other in the brain; and that, in fact, such an overflow of impressions does take place from a hypothetical vertiginous centre to the oculo-motor, the vomiting, the respiratory, and the cardiac centres; nay, it may even go further, and induce unconsciousness. It is a relief, however, to find that at present no centre of unconsciousness has been suggested, not even a hypothetical one. This theory, then, proposes to establish that the vertiginous centre, being severely stimulated, "tends to involve the others by overflow of nerve energy." (McBride, *Medical Times and Gazette*, 1881.)

It is impossible, in the space at my disposal, to examine even cursorily the arguments used in support of this view. The hypothetical character of all the inferences, even to the existence of most of these centres, indisposes me to accept it. Nearly all the phenomena adduced in its support are capable of quite other and simpler explanations. Again, it suggests a very poor idea of the isolation of these centres if impressions can so readily overflow from one to another; indeed, one may question the utility of such centres if their impressions be really liable to such decentralisation. Perhaps the best substantiated association is that between oculo-motor phenomena and vertigo induced experimentally—i.e., by causing a rabbit to revolve rapidly; a proceeding calculated to excite oscillation of the eyeballs, as well as any amount of "overflow" among whatever brain-centres the animal so rotated may possess. Such an experiment, I submit, can throw very little light on the disease for, as have said, these are exactly the phenomena we are not called upon to explain, because in the large number of cases I have seen, nystagmus, as experimentally induced, or anything approaching thereto, has been invariably absent. At the same time, one is bound to admit, an admirable simplicity in the theory which explains the symptoms grouped around vertigo by assigning centres to each of

these, and then causing the vertiginous impression to overflow, and involve successively the entire series.

The alternative explanation to the preceding, is one which I first promulgated in the year 1878, in a paper read at the Medical Society, on the "Connection between Stomachic and Labyrinthine Vertigo," and which subsequent experience of the disease has tended to confirm. It is based on three considerations, which are practically demonstrable. The first is, that all the symptoms are producible by local ear-disease, and cease with recovery from it; the corollary from which fact is, that in nearly all cases of recurrent vertigo, ear-disease is an established factor. Secondly, in tracing the progress of the symptoms through the life of their subject, unmistakable evidence is afforded of the progressive decay of brain-centres. This latter phenomenon is not the result of an "overflow" of impressions, but of the failure to respond coherently to impressions because of the starved and altered elemental structure of these centres. Thirdly—and this is the chief contention of my thesis—it is to changes in the vessel which is the chief vehicle of blood to the brain—the vertebral artery—that vertigo, and the phenomena associated with it, are due. This, however, is only a partial statement of the case, because the variations of blood-supply acknowledge a vaso-motor source, and are traceable to the inferior cervical ganglia, which are the vaso-motor centres of the vertebral arteries. The widely dispersed symptoms, already enumerated, become intelligible when viewed in the light of the anatomical relationships of these ganglia. Further, the comparison of the anatomical areas implicated, with the physiological occurrences taking place in them, furnishes evidence of the existence of a physiological law previously unrecognised, and which, there is reason to believe, applies with equal force all over the economy. It is to the effect that the afferent fibrillæ of a sympathetic ganglion which are, for the most part, associated with sensori-motor nerves, are in reflex relationship with the efferent vaso-motor nerves furnished to the arteries from the same ganglion. The sympathetic ganglia, therefore, with their afferent and efferent nerves are to be regarded as exercising correlating, or co-ordinating, functions, in regard of such operations as belong to them, between tissue-areas often widely separated. By referring to the anatomy of the region, it will be seen that the following nerves, are connected with the inferior cervical ganglion. They divide into two groups; some, associated with cerebral or spinal nerves are afferent—i.e., they convey impressions from the tissues to the ganglion. There are, first, numerous fasciculi which enter the vagus, and proceed with it to the lungs, stomach, liver, etc.; secondly, a set of fibres which join the brachial plexus of nerves, and are distributed with them to the upper extremity. The other group comprises fibres which go to the vertebral and brachial arteries, and also the inferior cardiac to the heart; they are efferent as regards the ganglion, and vaso-motor in respect of their function. Hence it follows that tissue-impressions reaching the ganglion through the former group, will be reflected in the ganglion through the medium of the latter group to the vertebral and brachial arteries; as vaso-motor impulses, producing either dilatation of the peripheral branches of the artery, equivalent to hyperæmia of the tissues which they supply, or contraction of the arterioles, with corresponding anæmia in these regions.

Now the internal auditory branch of the vertebral artery is the chief source of blood-supply of the labyrinth, and is beyond all others most likely to give rise to marked indications of such changes in its calibre, because it alone is distributed to an organ capable of proclaiming the disturbed condition of the circulation by so pronounced a symptom as giddiness. When it is considered how largely the vertebral artery is concerned in the blood-supply of the brain, and what important centres depend upon it for nutrition, the wisdom of arranging its distribution so that the very earliest departure from its normal condition shall be thus prominently notified, will become evident. In this way, the organ of equilibration serves a sentinel-like function, to warn us of the state of blood-supply of the brain as a whole. The importance of this aspect of vertigo cannot be overrated, because the concomitant symptoms referable to the higher brain-centres, which in some degree at least occur in nearly every case of vertigo, point to disturbance throughout the tract of brain-substance supplied by this vessel. This fact is verified in old-standing cases, where, in consequence of the changes induced in the coats of the vertebral artery by long-continued dilator influences, one faculty after another is lost, and the patient passes prematurely into a state of hebétude, in which the mind becomes a blank.

It is impossible, in the time at my disposal, to trace out all the anatomical relations of the inferior cervical ganglion, so as to show how each symptom is in turn produced through it. Nor is this

necessary, as any one with an elementary anatomical knowledge can do this for himself, now that the clue to the solution of the problem is placed in his hands. Some further observations, however, on the main feature of the problem—the association of vertigo with stomach-symptoms—may be expected.

It has already been intimated that a sensitive state of the nerve-supply of the stomach and *primæ viæ* (so far, that is, as the branches of the vagus reach), induced by local mischief originating in these organs, will cause dilator waves to pass upwards to the vertebral artery, and give rise to vertigo, by adding to the intralabyrinthine tension; and, further, that this sequence is particularly apt to occur in patients who are already the subjects of varying degrees of deafness, and in whom some increase of this tension has been already occasioned by the pre-existing ear-mischief. Now, it is a strong point with the advocates of the "overflow" theory that, in stomachic vertigo, vomiting presents itself *before* giddiness. Speaking from my experience of actual patients, I have no hesitation in affirming the contrary of this statement. Indeed, vomiting very rarely occurs in them, though the slightest indiscretion of diet will induce severe vertigo. Solid butcher's meat, in a large proportion of cases, will do this. In emphasising this fact—the result of observation of many vertiginous patients—I wish to guard myself against any reflection on the conclusions of those gentlemen whose generalisations are drawn from experiments on the lower animals, and especially to reiterate that so crude an experiment as that already quoted has scarcely a remote bearing on the subject under discussion.

In the necropsy of Menière's classical case, where the unique circumstance occurred of quite a young woman dying with marked symptoms of stomachic vertigo, ecchymoses were found in the membranous labyrinth, as well as exudation into the canals. I have elsewhere quoted cases in which patients, previously sound as regards their hearing power, have remained deaf after a sudden attack of vertigo, obviously from apoplexy of the inner ear, and, in at least one such case, I have known death to supervene some time later, with well recognised symptoms of cerebral apoplexy. Obviously, therefore, no room for doubt remains that the coats of the arterioles may be so far reflexly dilated as to allow, first of all, distension of their calibre sufficient to occasion tension of the intralabyrinthine fluid, and consequent vertigo; and, in severer degrees of dilatation, sanguineous exudation may occur; but, whether originating reflexly as above shown, or locally from disease of the ear, it is evident that, in any case, the particular symptom of vertigo is aural in its seat, and arises from changes in the organ of equilibration, the semicircular canals.

Furthermore, it is of great importance to note that a special debility of vaso-motor centres may be induced by any depressing constitutional cause. Perhaps there is no disease so generally attended with mental annoyance as deafness, the extreme irritability and nervousness of these patients being proverbial. Therefore, ear-disease is calculated to establish that very debility of vaso-motor centres to which I am referring; and the direct outcome of this state is a tendency on the part of the vessels they mediate to respond very readily to distantly seated sources of dilatation, reflexly conveyed to them in the manner detailed. Ear-disease is, therefore, at once the predisposing cause of disturbances of the circulation, and supplies, in the anatomical structure of the internal ear, an organ which, when influenced by these vessel-changes, adds a new set of symptoms, of which vertigo is the most prominent, to the pre-existing deafness. Thus we are involved in a pernicious circle, which, commencing it may be in an ordinary catarrh, or an exanthem occurring in early life, tends, after many years of heavily handicapped existence, to dethrone the mental egoism of the individual; landing him prematurely in a state of hebétude, in which little remains to him of life beyond the vegetative functions.

As an illustration, I cannot point you to anyone more striking than the case of Swift, portrayed with graphic force in a recent number of *Brain*. It has been my lot to witness several parallel ones, marked by like mental decadence, which I have traced through their many phases during the past fifteen years.

In this way, the conviction has grown upon me that states of long continued vessel-dilatation, from loss of vaso-motor control, favour the induction of changes in the arterial walls akin to what is often called atheroma. This change, whatever be its nature, implies inability on the part of the affected vessel sufficiently to nourish the organs to which it is distributed; and when, as in the case before us, the vessel-tract is the larger part of the brain and medulla, we shall not need to inquire further, in a given case of vertigo, as to the gravity of the issues involved.