

## REMARKS ON PHYSIOLOGY OF AUDITORY VERTIGO AND SOME OTHER NEUROSES PRODUCED BY EAR DISEASE.\*

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ON reading for the first time the larger works on otology, the practitioner cannot but wonder at the number and variety of symptoms ascribed to ear disease. Careful consideration, combined with a basis of physiological training, will, however, do much to explain what at first sight seems a mystery.

Let us glance for a moment at the afferent nerve-supply of the essential parts of the organ of hearing. From the meatus and outer layer of the tympanic membrane, sensory impressions are conducted to the brain by means of the inferior maxillary division of the fifth nerve. The auricular branch of the vagus also, as we know, ramifies in the external auditory canal. In the tympanum is situated the well-known plexus, composed of fibrils from the glosso-pharyngeal, sympathetic, and fifth nerves.

The chorda tympani, from its exposed position, is very apt to suffer in suppurative middle-ear disease, as pointed out by Urbantschitsch, giving rise to anomalies of taste. It must be well known to all here how pathological conditions of the tympanum, or even of the meatus, may, by influencing the chain of ossicles or the fenestræ, produce stimulation of the auditory nerve. Now, the latter we must, in the present state of our knowledge, consider as equivalent to two independent nerves: the one connected with the auditory centre, which, when stimulated, gives rise to sensations of sound; the other connected with a centre, irritation of which produces vertigo and other allied symptoms. The former has its peripheral end organs situated, for the most part, in the cochlea, while the latter is distributed to the semicircular canals.

From the peculiar anatomical relations between the various parts of the ear, it is quite possible that we may have several afferent nerves stimulated at one and the same time. For instance, in the case of a foreign body in the meatus, the latter may cause irritation alike of the fifth nerve and of the auricular branch of the vagus. Then, again, it may at the same time, by pressing against the drum-membrane, produce increased tension of the labyrinthine fluids, and cause, in this way, giddiness and tinnitus.

As our time is limited, I will not detain you by detailing other possible conditions which are capable of producing stimulation of the various afferent nerves which terminate in the ear. Many will, I am sure, suggest themselves to those present.

Now, although, as far as I know, no actual physiological experiments have hitherto been made in this direction, it still seems fair to conclude that reflex phenomena are more likely to occur when a stimulus is applied to two or more afferent nerves at the same time than if its action be confined to one. It is a well-known fact that, whereas syringing the ear with warm water is not usually followed by any untoward effect further than a slight and transient feeling of giddiness, the results produced by substituting cold water are much more serious, comprising marked vertigo, nausea, and even syncope. The only physiological explanation which seems satisfactory is that, while in both cases we have stimulation of the auditory nerve in the labyrinth by the pressure of the column of water against the drum-membrane, there is, when cold water is used, an unwonted irritation of those branches of the fifth nerve which supply the meatus. It is, I believe, the simultaneous passage of afferent impressions along the auditory, or rather that portion of it which supplies the ampullæ, and the fifth nerves, which accounts for the unpleasant and serious symptoms sometimes produced by injecting cold fluids into the ear.

So far, we have considered the ear as a favourable starting-point for reflex phenomena, on account of its great and varied nerve-supply. There is, however, yet another reason why disease or injury in this part should tend to produce disturbance of the nervous system.

Ridderford and Hallenstein (*Handbuch der Physiologie*, Hermann, *Band II*, 1878) both found that, in stimulating sensory nerves, the reflex

phenomena are more marked the nearer the centre the irritation is applied. In other words, the less the distance an afferent impulse has to travel, the greater will be its effects. All the nerves which supply the ear are, as we have seen, cranial, and the peripheral endings in the organ of hearing are in no case separated by any great length of nerve-tissue from their terminations in the brain. In proportion as this is the case, then, their stimulation by ear-disease will be apt to cause marked reflex phenomena.

We know that various functional nervous affections may have their origin in aural lesions. Thus, epilepsy has been traced to the presence of a foreign body in the meatus, and to pathological changes in the middle ear, as, for instance, chronic suppuration. Cases have been recorded by Schwartze, Köppe, and (more recently) by Browne, in which mental disorders were distinctly traced to pathological conditions of the organ of hearing; and, what is more important, cured by local treatment of the part. Less marked phenomena, such as loss of memory and morbid irritability, are described by Von Tröltzsch as of comparatively common occurrence in chronic middle-ear catarrh. Quite recently, I had occasion to treat a patient who, besides being very deaf and suffering from constant tinnitus, had become childish and forgetful. Suitable treatment, directed to the ear, materially relieved all the symptoms.

The group of symptoms which are now almost universally admitted to be due to lesions of the semicircular canals, must be familiar to you all. The morbid condition may be an actual pathological change in the labyrinth, or simply an alteration in the relative tension of endo- and perilymph, such as may be caused by disease of the middle ear, or even by the pressure of a foreign body on the drumhead. In a typical case of ear-giddiness, the most striking phenomena are—(1) vertigo, (2) nausea or actual vomiting, and (3) faintness, going on even to actual syncope.

The questions I now propose to discuss are—

(a) How can we explain the occurrence of these symptoms from irritation of that portion of the auditory nerve which supplies the semicircular canals?

(b) What is the relation between auditory and stomach vertigo?

The elementary facts of nerve-physiology teach us that, in a centre—be it the brain or spinal cord—impressions conducted thither tend to radiate. In the common experiment of tickling the sole of the foot, the impression conveyed by the sensory nerve is radiated first to the motor nerves of the leg, and then, if the stimulus be still applied, to all the motor nerves of the body. It is urged by some that, while radiation from a sensory nerve to a motor often occurs, yet radiation from one afferent nerve to another does not take place. In reply, we may cite the pain referred to the knee, which is a frequent accompaniment of hip-joint disease. Another example, and one with which all here must be familiar, is the reflex ear-ache produced by a diseased tooth. In this country, if a patient complain of severe ear-ache, without deafness, and without inflammatory changes in the meatus or drum-membrane, the cause may generally be sought in some dental inflammation.

With this statement, I think, most of you will agree. The explanation of the pain being referred to the ear is, that the impression originating in the decayed tooth has, in the Gasserian ganglia, been transferred to those centripetal fibres which correspond to the auricular branches of the fifth nerve, and has thus been conveyed to the sensory centre as a message from the ear instead of from the tooth—if I may be allowed a simile. It is sometimes asserted that, in these cases, the pain is due to secondary vaso-motor changes in the ear; in fact, to inflammation. All that I can say is, that I have seen many cases of aural pain due to diseased teeth in which there was no trace of inflammatory reaction revealed by inspection of the meatus and drum membrane. Indeed, it is the absence of all signs of inflammation that enables us to diagnose the cause of the suffering.

Now, so far we have studied the phenomenon as a transferred impression—the radiation taking place in the Gasserian ganglion; but these cases sometimes go a step further if the tooth be not removed. The nerve-impulse is then radiated to centres corresponding to nerves which supply the arm and mammary region, causing pain in the shoulder and mastodynia.

I believe that the explanation here adopted is simpler, and in the present state of our physiological knowledge more scientific, than theories based upon hypothetical reasoning.

The phenomena of auditory vertigo are to be explained on the same principle.

It will, I think, hardly be denied that stimuli conveyed along the ampullar portion of the auditory nerve are conducted to a brain-area, which, when active, produces the phenomena of vertigo. This we are taught alike by experiments upon animals and by clinical observation.

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If the stimulus be severe, however, it radiates beyond the vertiginous centre, and next involves the vomiting centre, producing nausea, if not actual vomiting. A still more severe stimulus will travel further and involve the cardiac inhibitory centre, causing faintness, chilliness, and even syncope—the vital phenomena of auditory vertigo. The loss of consciousness, which sometimes occurs in so-called Menière's disease, is probably oftener due to syncope than to any other cause.

We have seen that a nerve-impulse reaching the centre of the ampullar nerves tends to spread first to the vomiting and then to the cardiac inhibitory centre. The oculo-motor centre seems to be less frequently involved in man, although the experiments of Cyon show that nystagmus is a common result of section of the semicircular canals in some of the lower animals. Cases are on record where the latter symptom was found to depend upon ear-disease in the human subject. It is difficult to see how any other explanation than the above can be found to account for the phenomena of Menière's symptoms—not the vertigo alone, but its accompaniments, sickness and syncope. Here it will at least be difficult to find a vaso-motor connection between the labyrinth and the various centres involved.

I shall now consider the relation between auditory and stomach vertigo. For the production of giddiness, it is essential that the brain-area which corresponds to the ultimate origin of the ampullar nerves be stimulated. We have already seen that this vertiginous centre is in intimate physiological relation with the vomiting centre. The latter is directly connected with the vagus. The physiological process in the production of stomach-vertigo is, I believe, as follows. By irritation of the afferent fibres of the pneumogastric, an impression is conveyed to the brain, producing either nausea or actual vomiting, and it then radiates to the physiologically adjacent vertiginous centre, causing giddiness.

In auditory vertigo, then, we should expect the first symptom to be giddiness, because the wave of nerve-impulse is conducted directly to the vertiginous centre. In stomach vertigo, on the other hand, we should expect, first, nausea or vomiting, because the wave of nerve-force has to pass through the vomiting centre first. So far as I have seen, this is borne out by clinical experience.

In the case of ear-cough, an analogous explanation of the phenomenon suggests itself. The auricular branch of the vagus conducts an impression to the respiratory centre, producing the combination of expiratory movements known as cough. In his work on *Deafness, Giddiness, and Noises in the Head*, Dr. Woakes says, in speaking of ear-cough, "Thus, it cannot be said that the conducting of morbid impression along the sensitive fibres, from one region to another, will produce the symptoms; because, if reflex action be excited through a sensitive nerve, this is manifested as muscular contraction in the correlated area."

Now, I think that in the preceding part of this paper it has been shown that impressions may be transferred from one sensory nerve to another, or, rather, to its centre, without inducing muscular spasm. Thus it is in the case of the pain in the knee occurring in hip-joint disease, and again in earache, brachial neuralgia, and mastodynia, which may owe their origin to a decayed tooth.

Again, Dr. Woakes, in support of his theory, has laid much stress on the trophic changes in the larynx which occur in ear-cough. I am strongly inclined to agree with Dr. Orme Green, who ascribes them to the commotion of the larynx. In answer to this objection, Dr. Woakes says that this explanation "failed to commend itself for acceptance, chiefly because such laryngeal complications are so frequently—one might say usually—absent in chronic bronchitis, whooping-cough, and other diseases, in which the larynx is even more violently commoted by cough than in the cases referred to in the context."

In reply, and in conclusion, I simply ask whether inflammatory changes in the larynx have indeed been proved to be, relatively, more frequent in cases of ear-cough than in the diseases named?

**CORONERS' INQUESTS.**—The following were the disbursements of the different coroners presented to the Committee for Accounts and General Purposes of the Middlesex magistrates: Sir John Humphreys, eastern district, 216 inquisitions from October 2nd to November 10th, £388 10s. 6d.; Dr. Danford Thomas, central district, 150 inquisitions, October 3rd to November 10th, £285 3s. 6d.; Dr. Diplock, western district, 75 inquisitions, October 2nd to November 10th, £147 6s. 6d.; Mr. St. Clare Bedford, City and Liberty of Westminster, 30 inquisitions, October 1st to October 31st, £63 17s. 6d.

**MIDDLESEX LUNATIC ASYLUM.**—On the motion of Mr. A. W. Gadesden, the plans and estimates for the extension of the County Lunatic Asylum at Banstead, by which 120 additional female patients may be received, were submitted to the court and approved. It was also resolved that the sum of £18,000 be granted by the court towards the cost of erecting and furnishing the new buildings, the sum to be raised by mortgage of the county rates in the usual manner.

## DISLOCATION OF THE LENS, WITH REMARKS ON THE OLD OPERATION OF COUCHING.\*

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MOST writers on injuries to the eye, producing dislocation of the lens into the vitreous body, are inclined to take a grave view of the condition; but, from a number of observations made, my opinion is much more favourable; in fact, I have been surprised, under such circumstances, to notice the great power of recovery the eye possesses, and the excellent vision obtained by the aid of glasses, with little or no treatment besides rest. In the majority of such favourable cases, it must be allowed that the lens has been dislocated with its capsule entire, and the external coats of the eyeball left intact. When, from greater violence, other lesions are added, such as rupture of the lens capsule, or rupture of the external coats, with admission of air containing the dreaded germs of the present day, the prognosis becomes more and more unfavourable in proportion to the addition of these evils; recovery becomes much more slow, as the iris is generally implicated; the vision obtained is less perfect; much more active treatment is required; and, when these evils are conjoined with admission of air, often general inflammation is set up, requiring immediate extirpation of the whole eyeball.

It seems, then, to me, that simple dislocation into the vitreous body of the lens encased in its capsule causes little or no irritation, and most commonly has a favourable termination. Without referring to the spontaneous dislocation of the lens, and usually the very slight disturbance therefrom, the two following cases are recorded, out of several others, in support of the above views.

**CASE I.**—G. J., aged 70, a labourer, whilst breaking stones, received a severe blow on the right eye from one of the fragments; the pain produced was only temporary, but vision was so impaired that he was unable to continue his work, the left eye being previously affected with incipient cataract; after five weeks' rest, therefore, he presented himself at the Eye Hospital.

On examination, the right pupil was found round and contractile; the iris was flat and vibratile; tension normal or *minus*; the cornea was clear; there was little or no conjunctival injection; the disc was clearly seen; there were no moving bodies, and the lens was distinctly visible, resting on the lower surface of the eyeball. With +2½ and 4, he could read for near sight No. 4 of Jäger, and for far sight ⅔ of Snellen.

As there was no sign of any irritation, merely a placebo was given. Six months later the right eye was perfectly quiescent; the media were clear, and vision same as before. In the left the cataract had advanced. He was told to report himself, should he feel the slightest uneasiness in his eyes, but he has not done so for the last eighteen months.

**CASE II.**—J. P., aged 73, came in March last for injury to his right eye, also from stone-breaking, six months previously. There was detachment of the inner half of the iris, forming a double pupil, not contractile. The iris was slightly inclined backwards, and very vibratile; tension was normal, or slightly increased; the cornea was clear; there was no injection. The lens was partially dislocated outwards and backwards; the inner margin was very visible, from having a fringe of pigment adhering to it. It was slightly hazy, but the disc could be seen through it indistinctly. With +10 letters of 16 could be made out with the greatest difficulty, but for distance ⅔. He said he had lost the sight of his left eye for twelve years from a slight injury. On examining this left eye, there was a small central contractile pupil with a vibratile iris. Tension was normal, the media clear, and disc distinct; there were no moving bodies; and the lens was found dislocated to the lower fundus, movable, and apparently anchored in this position by the lower part of the suspensory ligament. The edge was readily seen by a black circular margin; the capsule seemed shrivelled with a white centre (nucleus?). With cataract glasses, to his astonishment, he could make out No. 1 Jäger and ⅔ Snellen. Seeing the happy result of accident in his left eye, I determined to imitate the proceeding in his right eye. He was placed under ether; a small opening was made near the corneal margin with a narrow bent flat needle, and an instrument made of a piece of stiff wire, having a rounded point, and a line to half a line of its extremity bent at a right angle, was introduced, and the suspensory ligament torn through except at its lower part. The instrument was now placed sideways in front of the lens near its upper margin, and pressed back so as to push the lens downwards and backwards in its capsule to the lower fundus of the eye. On recovery from the ether, the patient

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