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THE EUSTACHIAN TUBE.

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IT was difficult to decide on a subject for this address which should be at once commensurate with the occasion and the audience.

Out of a mere "side issue" of the head, in more senses than one, we have elaborated an auditory and vestibular apparatus, flinging, as the last word on the former, Part I. of the Report of the Hearing Tests Committee to our Section to read—or rend—with determined threats of yet further parts, whilst the latter function has been separated into kinetic and static senses with their separate peripheral and central connections, and even more daring adventurers have explored the subtleties of the statocyst or sought solace in swim-bladders. Nothing, surely, has escaped attention.

With all these various considerations I felt some relief, on asking myself the question, "What, after all, is the greatest common factor in aural pathology?" to find the seemingly simple answer—"Sepsis" and the corollaries of its introduction. Ninety per cent. of our work, at a conservative estimate, is an effort to control the effects of this enemy, whose only portal of entry is the Eustachian tube.

I therefore thought that a few moments might not be misspent in some study of this phylogenetic legacy of our fishy forefathers. The selection of this subject, too, I realised, would give me an opportunity of reminding you of comparatively recent work, to which I wish to draw attention later, and stress in this connection.

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With this end in view, I obtained a copy of the passage describing this tube by Bartolommeo Eustachio, the Italian anatomist, from a reprint dated 1707 of the original edition of his work published in 1564.

If any apology be needed for such references to the investigations of the past, I would quote no less an authority than that of Adam Politzer, who, in the preface to his comprehensive history of aural therapy, says: "He who would claim complete knowledge in this respect, must learn the work of earlier times." *

After a general description of the tube and its anatomical relations, the account by Eustachius proceeds as follows:—

"The portion attached to the apex of the petrous bone is cartilaginous and extremely thick, but the part opposed to this is not cartilage throughout, but has (although I am not quite clear on this point) something of a membraneous character and ends more thinly. Further, at the internal extremity of this passage—which faces the middle of the cavity of the nose—it consists of a strong and more prominent cartilage and is covered by the mucous membrane of the nose and seems to be set as a janitor at the end of the canal. The shape is not round, but somewhat depressed and forms two angles. The breadth of the canal is almost equal to the pen with which we are writing, but at the end is twice as broad as at the beginning and this in like fashion is covered with a thin mucous lining.

"This wonderful provision of nature—which has been discovered by me—in my opinion ought not to be passed over lightly since it can be of no small advantage to both philosophers and doctors, for the more ancient philosophers, amongst whom (as Aristotle reports in *De Natura Animalium*, bk. 1, chap. xi.) was Alcmæon, perchance thought that goats do not breathe only by the nose and mouth but also by the ears, because they were not ignorant of the canal which I have described, and therefore would rather often find that the breath, if held, is drawn back by a certain force into the cavity of the ears and as a wave strikes the organs of hearing.

"The knowledge of this canal will also be of extreme value to doctors in their right use of medicines, because in future they will know that even the most dense material can be discharged from the ears, not by narrow ducts, but by a broad passage either by an effort on the part of nature, or by the help of medicines which are called masticatoria." [1]

* "Wer Anspruch darauf erheben will, sein Gebiet nach jeder Richtung hin zu beherrschen, muss die Leistungen früherer Epochen kennen," *Geschichte der Ohrenheilkunde*, Bd. I. Vorwort.

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I am sure you will agree that this description suggests much food for thought and commentary. I had never expected such anatomical and physiological detail, or such suggestion of the great pathological importance of the tube, and it was not a little humiliating to me to find that, even 400 years ago, so many points were recognised which I had intended to emphasise myself.

I would like to direct attention to:—

(1) The accurate description generally. (2) The fact that the tube was described as lined with mucous membrane throughout. (3) That the mucous membrane was continuous with that of the nose. (4) That the pharyngeal end of the tube and its mucous membrane were regarded as a janitor and a wonderful provision of nature, thus protecting the various parts of the middle-ear cleft beyond. (5) The stress laid on the point that the knowledge should be of such importance to doctors. (6) The value of mucus and how it can be increased. (7) The inclusion of the phenomenon connected with the so-called experiment usually attributed to Valsalva (though not described by that anatomist till over 100 years later). (8) And finally, the modesty with which, although he claims to have discovered this tube, he acknowledges that Alcmæon and others some 2000 years previously must have known of it, and his reason for thinking this.

It is interesting in this latter connection to note that (in 1770) a French commentator on this work was also struck by this character of Eustachius and emphasised the same in the following words: "Although the author was able to claim this discovery as his own, since none of the ancient anatomists had explicitly spoken of this canal, he was not ashamed to quote Alcmæon, who had pointed out that goats breathed through the ears. One is only greater when one renders to each writer what belongs to him. By this act of justice Eustachius has acquired for himself an immortal reputation and no one will deny him the discovery of this canal." [2]

The Alcmæon quoted, by the way, was not the disreputable poet of that name who murdered his mother, but the philosopher, who lived about 550 B.C., was a disciple of Pythagoras, and is said to have been the first man to have dissected animals as an aid to the study of human anatomy. He also produced a work on the labyrinth of the ear —possibly the first—and influenced the followers of Hippocrates.

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Unfortunately, though often quoted, his works are lost, and I have been unable to discover why it was thought that goats breathed also through the ears.

Masticatoria were substances chewed to excite the secretion of saliva (which presumably was not then distinguished from mucus) and derived their name from the gum "mastic" used for this purpose.

Now, how far have we progressed? How much use have we made of this knowledge and these stimulating suggestions by Eustachius during the last 400 years?

Naturally, the name of Valsalva will at once be mentioned, and his method of aiding hearing by inflation of the middle ear via the tube; but this, as I have pointed out, seems to be wrongly ascribed to him, and further, on reference to his classic work ("*De Aure Humana Tractatus*," 1707) it is a little difficult to imagine how he has become accredited with this "experiment." It is true that he describes the use of self-inflation, but only as a means of clearing the purulent lesions of the ear, which he stresses at some length, stating that he adopted it as treatment for his "very best patients." It is true also that he realised at least some of the functions of mucus and how tubal obstruction prejudices hearing, but I have sought in vain in this book for any definite description by him of improvement in hearing as the result of self-inflation. I was interested also to find that Politzer had come to the same conclusion in his publication, which I have already quoted. Valsalva was a great anatomist and demands all our respect and honour, but I cannot help reflecting on the difficulties which surround at times, even now, the differential diagnosis between a furuncle, with an intact tympanic membrane, and suppurative otitis media; and visualising his exhortations to one of his "very best patients," suffering with the former very painful malady, urging him "to blow harder" when no bubbling discharge from the meatus resulted. I must confess to an unholy speculation as to whether a sudden cerebral hæmorrhage resulting thereby in the patient, perhaps gave Valsalva the opportunity of investigating the anatomical causes of apoplexy which he was also the first to describe!

After Valsalva apparently a long gap of 150 years occurred, till Mayer, of Copenhagen (1868), urged the removal of adenoids, as a means, amongst other results, towards relief or cure of otitis media.

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Some thirty years later still, Adam Politzer, of Vienna, introduced the use of the air-douche—a method, of course, of very considerable importance. This suggestion, however, was considerably abused, and my own first recollections of the practice seemed to me more with a view to reminding the audience of the advantages of a classical education, as it included an instruction to the victim to commence to decline the demonstrative pronoun, "hic, haec, hoc," when synchronously with the sexless "hoc," compression of the bag was made, and the effect appeared to the onlooker—and must have seemed to the patient—something more like a knock-out blow in the ring than a skilled, deliberate, controlled therapeutic measure of precision.

Fortunately, at the present time, this useful method, with a proper respect, is restricted largely to the cautious, quiet use of the catheter under cocaine controlled by the auscultation tube, and that only after preliminary detailed examination of the nose, post-nasal space and ears, and associated with a previous and subsequent test of the hearing.

As to any additional effect by bougies, and the introduction or attempted introduction of medicated oils and vapours, I must confess that I am a heretic, although I know that skilled aurists of repute still use the same.

Later yet, prompted by Killian, we have developed intranasal surgery and have discovered that a structurally normal and healthy nose is of as great importance to the maintenance of hearing, and the relief of some forms of otitis media, as is the removal of adenoids and the provision of a healthy nasopharynx.

But what else has been done? How much further have we advanced in our knowledge of this anatomical structure? How far have we justified the prophecy of Eustachius 400 years ago, that such knowledge should be of great assistance to doctors?

I am afraid we must admit that, with certain exceptions, to which I will shortly refer, our claims are small, though the detailed suggestions of the discoverer certainly merited more attention, and, much more especially, when we reflect that in addition to his then limited methods of investigation, we have had all the advantages which the developments in connection with microscopical histology and physiology offer.

I submit the following as a summary of our present views

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on the physiology and pathology of the Eustachian tube: (1) It acts as a normal exit for the normal tympanic secretion. (2) It provides a means of maintaining an equality of air pressure on each side of the tympanic membrane, thus permitting an unhindered transmission of aerial vibrations to the inner tympanic wall. (3) It shares in the general congestion associated with acute or chronic nasopharyngitis, and thus (4) acts as guard against the introduction of septic organisms. (5) As such guard becomes incompetent it constitutes a comparatively easy route for infection of the middle ear, and thus (6) is a large factor in the occurrence of the major portion of aural pathology. All of which points, on consideration, are merely a transcript of the original description given 400 years ago.

If such summary be admitted, surely we should give more attention to a tract, the efficient control of which should, *ex hypothesi*, also control not only impairment of function, but also the fatal sequelæ of septic infection of the blood-stream and intracranial contents.

From this rather gloomy destructive criticism of the lack of use we have made of the discoveries and teachings of Eustachius and Valsalva, it is a satisfactory relief to be able to refer to some comparatively recent British work in connection with the functions of the Eustachian tube and which, I believe, points the way to possible progress.

Six years ago, Mr. Lowndes Yates read a paper at the Summer Meeting of the Sections of Laryngology and Otology[3] which impressed me most strongly, and in which he showed the general action of the cilia and the method by which they controlled the continual flow of mucus, demonstrated that this action was not impaired by the presence of such agents as liquid paraffin, and concluded with a most instructive suggestion as to the mode of infection of both the tonsils and Eustachian tubes from the nose; phenomena that can be easily confirmed by observing the flow of the blood in, *e.g.*, any slight case of epistaxis.

Then in February, 1928, we had a notable paper from Dr. Alexander Fleming, who showed that the tears and nasal mucus are "much more potent than are the common chemical antiseptics in the strengths in which they are employed."[4]

I would submit that these investigations are of paramount importance to us, and should form a very definite milestone in

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our aim towards protection of the body generally against infection, and the ear in particular. They represent, in my opinion, the first great step forwards since the first description of the Eustachian tube, and are the first real development of the suggestion made by Eustachius that the valve-like pharyngeal orifice of the Eustachian tube, with its lining similar to that of the nose, acts like a janitor for the entry of the middle-ear cleft, the knowledge of which fact (as he said) "should be of great benefit to doctors."

But, although we have thus been taught that the provision of mucus and its constant control by the cilial action are physiological phenomena to which attention should be directed, our knowledge of these phenomena is incomplete. We need to know, for instance, how, when, and why the cilial action fails, and what is the particular constituent of the mucus which acts as such a drastic deterrent to septic activity.

That mere provision of mucus and cilial action are not sufficient is, I think, illustrated by contemplation of two common ailments, namely, otosclerosis and atrophic rhinitis. In otosclerosis, most will agree that the mucous membrane of the nose is abnormally dry and the tube abnormally patent, yet septic otitis media in such cases must be very rare. In atrophic rhinitis, again, the mucus is scanty, whilst in addition the cilial action apparently may be almost absent, yet in this disease also suppurative aural lesions are uncommon.

Obviously there must be other factors, and the mention of atrophic rhinitis recalls the work of Benians and Hayton,[5] on the treatment of this ailment—treatment which I have found most helpful—and which was based on an examination of the nasal mucus, and the experimental results of rendering acid its normal alkalinity.

This article has prompted me also to attempt some investigations on the reaction of the nasal mucus, but I have been unable yet to form any definite conclusions as to the correlation of such reaction with health and disease. Further research in this direction may be of value.

I would strongly recommend all these three papers for consideration since they teach us, on the one hand, the function of mucous membrane generally, and on the other, how much we owe to this structure for help in our own specialty.

As a result of the work and writings of these three observers, I have restricted my applications for the nose, throat,

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and ears, almost entirely to ointments composed of vaseline and lanoline, or sprays of liquid paraffin.

I have come to the conclusion that these applications combine the best solvent for pus and viscid mucus and the best artificial deterrent to septic activity, with the least disturbance to the local effort of recovery, assisting both in cleansing purulent deposits of the tympanum, when introduced into the external auditory meatus, and in restoring the functions of the Eustachian tube, when introduced into the nose. They are also almost the only applications I use in the subsequent treatment of mastoid operations after the initial dressing is removed.

The health of the post-nasal space and nose is, of course, of paramount importance. An efficient rhinologist should certainly rob the aural surgeon of much of his work. Indeed, from one point of view, otology consists in dealing with the faults of omission and commission by the rhinologist.

If it be true that 90 per cent. of otology is dependent on the action of sepsis—if it be admitted, as of course it must, that with negligible exceptions, the sole portal of such infection is the Eustachian tube—if we assume that it is only the functional integrity of the lining of this tube which prevents such infection (always potentially present), then we must certainly concentrate on assistance towards the maintenance of this function of the mucous membrane and its restoration when threatened. It certainly seems to me that our progress in the treatment of aural sepsis must be by preventive measures on these lines.

The necessity for the adequate treatment of the ultimate sequelæ of aural sepsis I wish in no way to minimise. It will, of course, always be important to learn better how to deal with those dire conditions, suppurative otitis media, labyrinthitis, cerebral abscess, septicæmia, and meningitis, and to recognise the symptoms and signs connected therewith—but I suggest that just as this mucous membrane is a surface structure, so we should not overlook the obvious in seeking the obscure.

Stimulated by these three recent communications, it seems to me we should be at length in a position to take real advantage of the discoveries of Eustachius and Valsalva, whose teachings can perhaps be summarised as emphasising the importance of continually recognising the presence and functions of the Eustachian tube.

I would urge in conclusion that we require further research

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on these lines, and that our aim should be to provide the individual with a constant efficient mucous secretion.

We must, in accordance with our old well-known dictum, "treat the patient and not the disease," and, if by this means we may be able to avert disease, we shall be able to appreciate more fully the significance of the happy French paraphrase of this sentiment: "*Il n'y a pas de maladies—il n'y a que de malades.*"

In dieser Schrift verweist der Verfasser auf den original artikel von Eustachius, in welchem die nach ihm genannter Röhre beschrieben ist, und stellt in Kürze die allgemeine Ausichten ihrer wichtigkeit zusammen. Er zeigt an, dass heutzutage, wenn auch vier hundert jahr später, unsere Ansichten über ihre Physiologie und Pathologie nur wenig Fortschritt gemacht haben. Jedoch skizziert er neues Englisches werk in Verbindung mit den von Wichtigkeit anscheinenden Verrichtungen der Röhre, hauptsächlich unter bezug auf den Schleim Strom und seine chemische Rückwirkungen. Er betont die notwendigkeit weiterer untersuchung auf diese Weise.

L'auteur se rapporte à l'article par Eustachius d'où la trompe d'Eustache tire son nom, et il décrit sommairement les idées courantes sur son importance. Il constate q'aujourd'hui (quatre cent ans après) nos appréciations à l'égard de la physiologie et de la pathologie de la trompe d'Eustache n'ont pas fait beaucoup de progrès. Il attire l'attention, cependant, sur les études récentes en Grande Bretagne qui seraient importantes. Plus particulièrement a l'égard de la coulée du mucus et ses réactions chimiques. Il insiste sur la nécessité des recherches plus approfondies dans cette voie.

References.

[1] (Eustachius, B., *Opuscula Anatomica*, Lugd. Bat., 1707, pp. 138-140.) Substantia sane ejus, qua extrema fissuræ ossi Temporum et Cuneo simili communis tangit, cartilaginea est, ac admodum crassa; huic vero oppositae partis substantia exacta cartilago non est, sed membranosum nescio quid habet, et tenuior evadit: at hujus Meatus interna extremitas, Narium cavitatis medium respiciens, robusta est cartilago, quae plurimum extuberat, mucosa Narium tunica obducitur, ac fini ejusden Meatus quasi Janitor praefecta esse videtur: figura teres non est, sed aliquantum depressa duos efficit angulos: latitudo cavitatis calamum, quo scribimus, fere adaequat, sed in fine duplo latior est, quam in principio, quae similiter

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mucosa, sed tenui induitor tunica. Hoc callidissimum Naturae artificium a me inventum contemni (ut opinor) non debet ; siquidem tum Philosophis tum Medicis non parum utilitatis afferre potest ; nam antiquiores Philosophi, quorum numero (ut Aristoteles refert primo de Natura Animalium undecimo) fuit Alcmaeon, capras non modo Ore ac Naribus, verum etiam Auribus quoque spirare, forte ob eam causam arbitrati sunt, quod Meatum, quem descripsi non ignorarent, atque adeo saepius experti fuissent, spiritum, ubi ipsum quis cohibet, ad Aurium cavitatem vi quadam impulsum recurrere et instar fluctus Auditus Organa percutere.

Erit etiam Medicis hujus Meatus cognitio ad rectum Medicamentorum usum maxime utilis, quod scient posthac ab Auribus, non angustis foraminibus, sed amplissima via posse materias etiam crassas, vel a Natura expelli, vel Medicamentorum ope, quae masticatoria appellantur, commode expurgari.

[2] (Portal, *Histoire de l'Anatomie et de la Chirurgie*, Paris, 1770, vol. i., p. 617.) "Quoique l'Auteur eût pu s'attribuer cette découverte, puisqu'aucun des anciens anatomistes n'avoit directement parlé de ce canal, il n'a point rougi de citer Alcmeon qui avoit remarqué que les chèvres respiroient par les oreilles. On n'en est que plus grand lorsqu'on rend à chaque Ecrivain ce qui lui appartient. Par cet acte de justice, Eustache s'est acquis une réputation immortelle, et personne ne lui a refusé la découverte de ce canal."

[3] *Journ. Laryng. and Otol.*, 1924, xxxix., 554.

[4] *Proceedings R. S. M.*, 1928, xxi., 859 ; *Journ. Laryng. and Otol.*, 1928, xliii., 385.

[5] *Journ. Laryng., Rhin. and Otol.*, 1919, xxxiv., 325.

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