ON

The Cephaloscope,

AND ITS USES

IN

THE DISCRIMINATION OF THE NORMAL AND ABNORMAL SOUNDS

IN

THE ORGAN OF HEARING:

WITH

Remarks on the Diseases in which it is applicable.

By JOHN HARRISON CURTIS, Esq.

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TO

C. KLUGE, M.D.

Physician to his Majesty the King of Prussia;

DIRECTOR OF THE CHARITE HEILANSTALT, BERLIN; AND MEMBER OF SEVERAL LEARNED AND SCIENTIFIC SOCIETIES,
&c. &c. &c.

This Work is dedicated,

AS A SLIGHT MARK OF GRATITUDE

FOR THE MANY KINDNESSES RECEIVED FROM HIM DURING

THE AUTHOR'S RECENT VISIT TO THAT CITY.

JOHN HARRISON CURTIS.

SOHO SQUARE,
December 29th, 1841.

PREFACE.

Since the days of the illustrious Harvey, the discoverer of the circulation of the blood,—a portrait of whom I have selected as a frontispiece for this work, as a proper tribute of respect,—the improvements that have been made in medicine are of such a nature as to cause almost a reconstruction of the science. The last quarter of a century has been witness to numerous alterations and discoveries in every department of medicine and surgery, the result of the unwearied labours of talented physiologists; while the equally important pursuits of the chemist have furnished us with new and most valuable agents for the cure of disease. In this great race of discovery and improvement, acoustic surgery has not been left entirely in the background. Although its progress has been delayed by popular prejudice and other concurrent circumstances, still there has been sufficient evidence of a more thorough and general acquaintance with the anatomy and physiology of the organ, as well as with the diseases to which it is subject, and the remedies which should be used for their removal, to convince the most critical inquirer that acoustic surgery is really on the advance. Of this truth the pages of the present work afford full proof. In the summary at the close will be found a succinct account of many of these improvements, more especially in reference to acoustic therapeutics; while, at the same time, the attention is drawn to the manifold advantages derived by the aurist from the improved modes of diagnosticating disease by means of the newly invented instruments, which I have more fully described elsewhere.*

The importance of the organ is now better understood; and the necessity for early attention to its diseases, or loss of function, is as freely allowed; and I am happy to be enabled to add that, as a consequence of the anatomical and physiological condition being better known, the opinion that many of its diseases, previously placed in the list of the *opprobria medicinæ acousticæ,* admit of relief, if not of absolute cure, has been for some time gaining ground, not only among the profession, but also among the public at large.

This improvement will, I believe, be materially

* Vide "The Present State of Aural Surgery," second edit.

advanced by the invention of the Cephaloscope; by the due application of which the aurist will be enabled to diagnosticate between many diseases hitherto confounded together, or little understood, by the pathologist and practitioner. I allude especially to the affections of the middle, or intermediate ear, where the sonorous undulations are most likely to produce such an effect as can be appreciated through the medium of such an instrument. I feel confident that it will be of great service in affording information in cases of those unfortunates who are deaf and dumb, and in enabling the practitioner to discriminate between those whose maladies are incurable, and those which admit of relief or ultimate cure.

In order that its uses may be the better understood, I have prefixed a chapter on the anatomy and physiology of the parts concerned in audition, and have added a detailed notice of certain interesting facts connected with the philosophy of sound and the science of acoustics, bearing more or less directly on the immediate subject of the work. The chapter on the anatomy and physiology of the vocal organs may at first view be regarded as rather out of place; but when it is considered how intimately the voice is connected with the function of audition, and that the absence of the latter precludes the acquirement of the former in those who are deprived of hearing from birth or from within a short period afterwards, the candid reader will at once admit that it was requisite to make him acquainted with the contents of that chapter, in order that he might rightly understand all the bearings of the question.

J. HARRISON CURTIS.

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CHAPTER I.

THE ANATOMY OF THE ORGAN OF HEARING.

In a work written expressly to demonstrate the uses and advantages of a new instrument, in the investigation of the diseases of the organ of hearing, it is absolutely necessary, in order that the proper application of the instrument, and the principles on which it is constructed, may be understood, to give an account of the anatomical disposition and physiological relations of the parts concerned, together with a description of the mode, as far as the present amount of our information will permit, in which sound impinges on the auricle, or external ear, and is conveyed thence to the sensorium through the internal part of the organ, contained in the temporal bone.

It is a matter of surprise that, notwithstanding the great and universally acknowledged importance of the organ of hearing to man as a source of gratification, and the medium of instruction in his social intercourse with his fellow-creatures, yet there is not any part of the human frame to which so little attention has been paid. This may be ascribed partly to its position in the interior of the temporal bone, by which it is concealed and withdrawn, as it were, from the investigations of the ordinary observer; partly to its exceedingly minute, intricate, and complicated mechanism; and partly to the fact that, until of late years, notwithstanding the honoured names of Casserius, Vesalius, Eustachius (whose name is given to the tubes which he discovered), Duverney, Cassebohm, Cotugno, Meckel, Scarpa, Camper, Comparetti, Hunter, Monro, Bichât, Cuvier, Cooper, Carlisle, Bell, and Swan, are all connected with acoustic anatomy, yet the treatment of the diseased organ was principally confided by the public to illiterate persons. From such men but little could be expected in aid of science; their ignorance on most points connected with general principles of anatomy and surgery being a sufficient guarantee that they could not extend the boundaries of the medical art. Accordingly, we find that monographs embracing the pathology of the organ of audition very rarely made their appearance, and only from members of the profession. Of these, the best proceeded from the pen of Leschevin, the senior surgeon of the Hôtel-Dieu at Rouen, who in 1765 gained by it the prize offered by the French Academy of Surgery about two years before. This memoir is still of great value, few modern treatises being more complete.

This state of things has been changed, however, very much for the better, of late years. In 1817, the first edition of my Treatise on the Ear was published, containing its anatomy, physiology, and pathology; it has since gone through six editions, and, together with several of my other works, has been translated into the German language. In addition to this, my Map of the Anatomy of the Ear, shewing the structure of the external, intermediate, and internal portions of the organ of audition, and my Chart of the Diseases physiologically arranged, with the requisite treatment, which were published several years since, have contributed much in effecting this beneficial change.

This, coupled with the fact that other works on the ear have also been published, shews that the apathy of the profession has ceased, and that aural pathology has taken its proper place in the studies of the medical man, who has thus wrested it from the hands of the empiric. Having successfully devoted a long series of years to the investigation and prosecution of my favourite studies, I feel myself encouraged to persevere and renew my efforts in advancing a science so remarkably beneficial, and which is now, for the first time, correctly appreciated.

Of the organs of sense, none is equal to the ear in importance to man; it warns him of the approach of danger, by which he is led to evade insidious attacks, and to escape from situations of peril; it is a principal channel of knowledge, and essential to the enjoyment of the inestimable blessing of social intercourse.

A modern writer observes,—"When we turn our attention to man, we find the importance of hearing most remarkably augmented, from its intimate connexion with speech. The human being who has been blind from infancy, would doubtless shrink from the idea of exchanging his acute hearing for perfect sight; yet are there few enjoying the benefit of both senses, who do not feel that a greater amount of happiness is the product of vision than of audition; and, with a full consciousness of the all-delightful and rapid—and delightful because rapid—interchange of thought, by the means of conversation—of the all-pleasing, all-exhilarating, all-soothing influences of musical concord,—still must we feel that the deaf man has to be thankful that it is not his sight of which he is deprived.

"But when we recollect the melancholy state of insulation of the deaf and dumb, and remember that deafness from birth inflicts upon the individual deprivation of the splendid faculty of speech,—and when we recall to our minds many blind from their birth who are proficients in music; who have acquired vast information; who have made considerable progress in the mechanical arts, even sometimes in the more difficult sciences, as exampled in a celebrated professor of mathematics; and who thus perform their parts of usefulness in the great machinery of society, we are undecided whether to be deprived of sight, or of the conjoined faculties of hearing and speech, be the greater evil."

Every thing respecting the ear must be acknowledged to be highly interesting, when we consider it in connexion with our personal safety, our external relations, and social happiness.

"What, indeed, would have been our lot, if nature had been less liberal, and not endued us with the sense of hearing? As Leschevin has observed, we should then have been ill qualified for the receipt of instruction; a principal inlet of divine and human knowledge would have been closed; and there being no reciprocal communication of ideas, our feeble reason could never have approached perfection. Even our life itself, being as it were dependent on all such bodies as surround us, would have been incessantly exposed to dangers. The eyesight serves to render us conscious of objects which present themselves before us; and when we judge them to be hurtful, we endeavour to avoid them. But, to say nothing of our inability of looking on all sides at once, our eyes become of no service to us whenever we happen to be enveloped in darkness. The hearing is then the only sense that watches over our safety. It warns us not only of every thing which is moving about us, but likewise of noises which are more or less distant. Such are the inestimable advantages which we derive from this organ."*

An interesting illustration of the truth of the remark, that the absence of the inestimable function of hearing shuts up the unfortunate who is its subject from the

* Cooper.

avenues of instruction, both religious and moral, is contained in the French memoirs quoted by the Count de Buffon, and mentioned in my Treatise on the Ear.

A young man, 24 years of age, born deaf and dumb, after having experienced a discharge from the left ear, found himself in possession of the function of hearing, and gradually obtained, by his own efforts, that of speech. Interrogated afterwards by able divines respecting his opinions of the existence of the Deity, and of moral good and evil, he was found to be in a lamentable state of ignorance on these points, although, while labouring under his affliction, he had apparently complied with all the dictates of the religion of his country.

Here, then, we have a striking example of the immeasurable importance of the function of hearing, and of the fearful consequences resulting from its deprivation. A young man, evidently possessing ability, from the want of that instruction by which alone the human being can be fitted for his proper station in society, and which can be obtained only by intellectual and social intercourse with his fellow-creatures, but from which he was precluded by his unhappy infirmity, was buried in the grossest ignorance of all things affecting his spiritual and worldly welfare, save such slight ideas as he might receive from the exercise of vision. When we bear in mind that persons born blind, or becoming so soon after birth, have acquired a high degree of information on even very abstruse points,—have had the intellect so cultivated as to become excellent mathematicians, while the sense of hearing has improved to such an extent as to serve in lieu of vision, enabling its possessor, on entering a room, to judge accurately of the length, depth, and breadth thereof, while they could judge of colour by the sense of touch, and of the disposition of those presented to them by the sound of the voice,—can we hesitate for a moment in thus answering the question (for such it almost amounts to) as before noticed—the congenital deprivation of the conjoined faculties of hearing and speech is a greater evil than the loss of sight; for the latter is a mere corporeal blindness, while the former involves mental and spiritual cecity, and reduces its victims to a position in the animal scale below even that of the beasts that perish.

THE EXTERNAL EAR.

The ear is an organ destined to receive sound, and to convey the impression produced thereby to the sensorium. It may be divided into three principal parts: for the collection, the transmission, and the reverberation of noise from sonorous bodies, or such as are calculated to make impressions on its mechanism and ultimate nervous arrangement. The first part, for the collection of sound, is termed the *external ear;* the second part, for its transmission, is called the *middle,* or *intermediate ear;* the third part, for the reverberation of sound, and its impression on the expansion of the nerve of audition, is the *internal ear.*

The EXTERNAL EAR is attached to the side of the head by its root to the meatus in the temporal bone. It is also called the *auricle;* and sometimes its upper cartilaginous portion, with its hollows and sinuosities, is named the *pinna;* and the inferior fleshy prominence, or appendage, the *lobe.* In shape it somewhat resembles a shell; and presents, on its anterior surface, certain elevations and depressions, so arranged as to give it a concavo-convex appearance; the use of which is to arrest the pulses of the circumambient air, to collect them in the concha, and direct them into the meatus, so that they may reach the sentient extremities of the auditory nerve.

The auricle is attached to the temporal bone only at its root, by far the larger portion standing out from the head, and capable, in some few instances, of being moved in several directions by corresponding muscles. The margin of that side which is turned from the head is considerably elevated; and the general concavity within is, by elevations of the surface, subdivided into certain curvilineal grooves, all of which are directed towards a canal formed in the root of the auricle — the meatus externus. The concha, the deepest and largest depression of the auricle, and to which the rest of the external ear is subservient, is situated at the entrance of the meatus externus. The boundaries of the concha are formed by four eminences: viz. the tragus, helix, anti-helix, and anti-tragus. The tragus and helix bound it anteriorly; the helix and anti-helix posteriorly; and the anti-tragus posteriorly and inferiorly. The tragus is placed immediately behind the condyle of the lower jaw: it forms a small prominence, and lies over the fore-part of the meatus auditorius externus, which it partially conceals. It is fancifully named the tragus, because there are generally a few hairs on it, to protect the aperture to the meatus, and thus it affords a far-fetched resemblance to the hide of a goat. The helix arises from the concha, which it partially divides into a superior and inferior depression: it advances from its origin a little posterior to the tragus; is soon reflected in the form of a curve, forming the outer circumference of the pinna; and in its descent gradually becoming less distinct, is lost in a soft, pendulous substance, called the lobe. The anti-helix is situated within and opposite to the helix, and is formed with a similar curve; above, it consists of two ridges, which unite; and the eminence formed by their union is continuous below with a little projection called the anti-tragus, (from its position being directly opposite to the tragus,) which is occasionally furnished with a few hairs. Between the helix and the anti-helix is a considerable groove, which increases in depth and narrowness as it approaches the concha, in which it terminates. It is called the cavitas innominata. Another groove, the scapha, situated between the two ridges of the anti-helix, joins the former just before its termination. These are the most remarkable appearances on this side of the auricle.

The posterior surface of the external ear presents little requiring particular attention: it may be said to be convex; but in the general convexity, the projections of the concha, helix, and anti-helix, are very apparent.

The pinna consists of an elastic fibro-cartilage, and of the common integuments. It owes its figure chiefly to the cartilage, in which are formed the eminences and depressions already mentioned, except the lower part of the helix and the lobe; these are merely duplicatures of the skin, containing a portion of fat. The root of the auricle is disposed in the form of a tube; but the cartilage itself does not complete the circle. This is effected by the union of the tragus to the helix, by means of a ligamentous fascia and the common integuments. This tubular, or rather infundibuliform part of the auricle, is adapted to a tubular part of the os temporis; and thus united, they form the meatus auditorius externus, a canal leading to the intermediate ear. This canal is observed to vary in length in different subjects, from an inch to an inch and a quarter, and even an inch and a half. In the fœtus it is very long, wide within, contracted in its centre, and large without. There is a space between the fibro-cartilages, and the osseous part of the canal does not exist; but its place is supplied by membrane. The shape of the meatus is rather elliptical than cylindrical; its direction inwards, with a slight declination. It is not straight, but winding; at first turning forwards and upwards, then downwards, and rather backwards, and again slightly bent near its termination. Its lower part is longer than the upper; for it terminates, as it were, by an oblique section, which is closed by the membrana tympani, in such a manner that this membrane makes an obtuse angle with the canal above, an acute angle with it below. The common integuments having covered the cartilage of the auricle, enter the meatus externus; and having reached the bony portion of this canal, they become much attenuated. They form a lining to the meatus, and terminate in a pouch, which constitutes the external layer of the membrana tympani. This cul de sac may be separated by the putrefactive process.

The fibro-cartilages forming the meatus, and giving it shape, are a prolongation of the tragus and inferior and anterior parts of the concha. They do not form a perfect tube, nor do they coalesce; but are connected together by cellular tissue. Between these fissures, in the interstices of a reticular membrane, are placed the ceruminous glands. These are about the size of a millet-seed, approach to a spherical or oviform figure, and are of a slight yellow hue; which colour they receive from their cerumen. From each little gland proceeds a small excretory duct, that opens into the meatus externus, and discharges the cerumen by which the membrana tympani and the lining membrane of the meatus are lubricated. The ceruminous secretion is thick, viscid, and inflammable; it is also bitter, and is supposed to be poisonous to insects which may pass within the meatus. It consists of an oily fat, albumen, colouring matter, and a peculiar animal matter. Its use is to keep the lining membrane moistened, and thus prevent too great a degree of reflection of the sonorous rays: when diseased, it is a frequent cause of deafness.

The auricle is retained in its situation by the ligamentous connexion of the cartilage with the bone of the meatus externus, and by three ligaments—the superior, the anterior, and the posterior. There are three muscles attached to the ear, which in a state of nature should move the ear backwards or forwards; and when all three act together, should enlarge the opening of the meatus auditorius; but from the habit of wearing hats and bonnets, binding the ears close to the head, all command over these muscles is lost, as also over the five others which are attached to different parts of the ear.

The description just given is that of the adult ear. The parts in the fœtal ear are less perfect; in it the meatus externus is almost entirely cartilaginous and membranous. Instead of a process of the os temporis forming a considerable part of the meatus externus, nothing more is observable than a slender piece of bone of an elliptical figure, but not making a complete ring; it contains the membrana tympani, and adheres to the rest of the os temporis by its extremities only. The space between the tragus and this ring of bone is occupied by a very dense membrane, that seems placed there as a kind of bed, in which bone is afterwards deposited. As ossification extends, the different parts of the os temporis are consolidated; indeed, soon after birth the fœtal ring is united to the rest of the bone, and is gradually elongated during the progress of growth, until it occupies the place of the membranous substance just mentioned. It has already been said that the meatus externus terminates obliquely, and that its lower part is longer than the upper. A little groove, making three-fourths of an ellipse, is formed in its extremity; it contains the membrana tympani, or drum of the ear; which is the partition between the external and middle, or intermediate part of the ear, and is so called from its closing the orifice of a cavity named the tympanum.

THE MIDDLE OR INTERMEDIATE EAR.

The intermediate ear is that part comprised between the external ear just described, and the internal minute mechanism on which the acoustic nerve is spread. In it sound is received from the cavities of the external ear, forwarded by the action of the atmospheric air into the cavity, in order to be impressed on the sensorium through the medium of the nervous expansion: it may be considered as the reservoir for concentrating sound, and detaining it for its different uses. It consists of the tympanum and its appendages, namely, the membrana tympani, the four small bones of the ear, with their ligaments and muscles, the Eustachian tubes, and the mastoid cells.

The principal part in this division is the tympanum, which is the cavity placed immediately at the bottom of the meatus externus. It is situate in the outer and rather posterior part of the petrous portion of the os temporis. Its figure, although irregular, approximates somewhat to the spherical. The regularity of the bony parietes of the tympanum is interrupted by numerous little pits, spiculæ, and foramina. The depth of the tympanum is not equal in all directions. Its greater depth is opposite to the aperture of the vestibule, the less to the apex of the cochlea: the former scarcely exceeds three lines, the latter is hardly two. The diameter from before backwards is rather the longer, about half an inch in extent, the transverse, crossed by the small bones, being the shorter. It is bounded externally by the membrana tympani, posteriorly by an osseous plate separating it from the mastoid cells, internally by an imperfect osseous plate between it and the labyrinth, and anteriorly by the Eustachian tubes, by which it communicates with the pharynx. It is lined with mucous membrane continuous with that of the fauces.

The mastoid cells are placed behind the tympanum. They are large and numerous, freely communicate with each other, and open by a large aperture in its posterior and superior part. They may be considered as a part of the tympanum; for the communication is perfectly free, and they are both lined with a delicate and vascular membrane, which secretes a fluid to moisten the internal surface, at the same time that it answers the purpose of a periosteum to the bony parietes.

In the anterior and lower part of the tympanum is placed the aperture of the Eustachian tube. The tube proceeds from the tympanum, passing obliquely forwards, downwards, and inwards, by the side of the internal ala of the pterygoid process of the os sphenoides, and opens in the superior and lateral part of the pharynx above the velum pendulum palati, about a quarter of an inch behind the posterior opening of the nostril, and at the same distance above its floor. The Eustachian tubes reach their termination with such a degree of convergency, that if they were continued, they would meet each other at the back of the vomer. The tube is composed of bone and fibro-cartilage, and is lined by a prolongation of mucous membrane from the throat. The bony portion, the shorter of the two, is an elongation of the tympanum, together with part of the ala of the sphenoid, and ends in a scabrous extremity, that receives the cartilage. The pharyngeal and larger portion of the tube is fibrous and fibro-cartilaginous, the fibro-cartilage forming the superior and internal walls, and the fibrous tissue the lower and external surfaces. The two portions united constitute a tube from about an inch and a quarter to an inch and a half in length, of an elliptical figure, the major axis of which is vertical. The magnitude of this tube varies much in different places. Its orifice in the tympanum is about two lines in its major axis: thence it gradually lessens, until it does not exceed one. This size it preserves for a short space, but at the junction of the bony portion to the cartilaginous, it suddenly enlarges, and continues to increase until it terminates in the pharynx, where it opens by an orifice large enough to admit a goose-quill.

Besides the apertures already mentioned, viz. the aperture of the mastoid cells and that of the Eustachian tube, two others are found in the inner wall of the tympanum. These are the aperture of the vestibule, and the aperture of the cochlea,—the former called the fenestra ovata or ovalis; the latter the fenestra rotunda. The fenestra ovata is placed in the superior part of the internal superficies of the tympanum, in an oblique direction, but parallel with the plane of the membrana tympani; it is situated in front of and above the promontory. It is not perfectly elliptical; its upper part is the segment of an ellipse; the lower a straight line, connecting the extremities of the segment. Its long diameter is almost transverse. It exactly resembles the base of the stapes, a bone hereafter to be described, which fits the aperture. In the recent state, therefore, it is not apparent until the bone has been displaced, and then it is found to be closed by a very delicate membrane. The fenestra rotunda is situate lower than the fenestra ovata, nearer the mastoid process, and behind the promontory, by which it is partly concealed. It is rather triangular than round, and in its recent state is closed by a membrane similar to the membrana tympani, and, like that, convex internally. The membrane is placed some way within the fenestra rotunda, and is not discoverable without dissection even in the fœtal ear, in which the bone is less formed. The promontory is a projection of bone, forming nearly a third of the whole surface of the inner wall—it is a mere shell, being the internal parietes of the enlarged commencement of the scala tympani. Grooves are observed on its surface, for the nervous filaments of the tympanic plexus.

The eminentia pyramidalis, an irregular cone of bone, containing the origin of a muscle attached to the stapes, is situate on the posterior wall, and is on a level with the lower edge of the fenestra ovata. Behind and below it is a small aperture for the passage of the chorda tympani.

The tympanum is separated from the meatus externus by the intervention of the membrana tympani, a pellucid membrane, of an elliptical figure, situated obliquely, and forming an acute angle with the tympanic parietes. Its obliquity is from above downwards and inwards. It is fixed in the elliptical groove, at the termination of the meatus auditorius externus, except in the posterior and superior part, where the groove is deficient;—there it is attached to a rough surface of the bone. The membrana tympani is a thin pellicle of membrane, strengthened externally by a reflection of the cuticle lining the meatus externus, and internally by the lining membrane of the tympanum. The intermediate layer is supposed to be muscular. Sir E. Home, in the Croonian lectures, positively asserts its muscularity. He says, "If the membrana tympani of the human ear is completely exposed on both sides, by removing the contiguous parts, and the cuticular covering is carefully washed off from its external surface, then, by placing it in a clear light, the radiated direction of its fibres may be easily detected. If a common magnifying glass is used, they are rendered nearly as distinct as those of the elephant appear to the naked eye; their course is exactly the same, and they differ in nothing but in being formed on a smaller scale. The muscular fibres appear only to form the *internal* layer of the membrane, and are most distinctly seen when viewed on that side."* Anatomists in general, however, notwithstanding this high opinion, believe that the membrana tympani is only fibrous, not muscular. It presents a bright silvery appearance, more or less distinctly fibrous, especially on the inner surface. Although always in a certain state of tension, yet it is not a plane; on the contrary, its external surface is concave, having a conical depression usually situated a little below the centre, although it has occasionally been found above it: it is very convex towards the tympanum, and the convexity is of a conical figure, the apex of which is corresponding to the depression in the outer surface. To this the manubrium of the malleus is attached. Some writers speak of an aperture in this membrane, which I believe is always the result of

* Sir E. Home, Croon. Lect., Phil. Trans. Part I. 1800.

accident or disease. In the healthy state it constitutes a complete septum. Marchetti in 1652, and Rivurus still later, described this opening; and the latter stated it was furnished with a sphincter and valve, but it has since been sought for in vain. Walther, wishing to decide if the membrana tympani was impervious, injected, by the Eustachian tube, air, tobacco-smoke, mercury, and infusion of saffron; and after the most attentive examination, could not perceive that any of these had passed the membrana tympani. Ruysch has shewn that the opening is always accidental.* The membrana tympani is exceedingly vascular. Numerous small vessels descend along the manubrium of the malleus, from which diverging twigs proceed. These form beautiful and intricate inosculations, with a plexus of vessels ranged in the margin of the membrane.

The tympanum contains four little bones, articulated with each other, and forming a chain of communication between the membrana tympani and the membrane of the internal part of the ear, in which the sense of hearing is seated. They are the malleus, incus, os orbiculare, and stapes. Some writers only mention three, considering the os orbiculare merely as a process of the incus, which it certainly becomes in the adult, but which is as certainly distinct in the young subject. The first of these is the malleus, or hammer, which may be divided, for the purpose of description, into four portions, namely, the manubrium, head, processus brevis, and the processus gracilis. The manubrium, which forms the bulk of the bone, descends from the cervix, and adheres to the membrana tympani; it is incurvated, particularly at its extremity, which reaches the centre of the membrane, and draws it into its convex state. From its upper and outer part, a short process, called the processus brevis, or obtusus, passes to the outer wall of the tympanum, and forms a fulcrum for the motions of the malleus.

* Thesaurus Anatomicus, vol. iii. 1703.

The head is joined to the manubrium by a slender portion of bone, which some have called the neck: it makes a considerable angle with the manubrium, and its direction is obliquely upwards and backwards. It projects into a cavity called the tympanic sinus. It is of a globular form, smooth upon its upper and outer surface, but irregular on its inner and rather posterior part, where are two articulating surfaces, separated by a ridge, by which it is connected with the incus. The processus gracilis passes off just between the head and the manubrium, from which it proceeds in a curved direction forwards and a little downwards, terminating in a fine point, which is attached to a particular groove in the os temporis, the fissura Glasseri, to which it is fixed by a ligamentous substance, which some anatomists have considered a muscle. It turns in this groove, and is in fact a pivot, on which the motions of the malleus are performed. It is nearly as long as the rest of the bone. The second bone is called the incus, or anvil, an instrument to which it bears a crude resemblance. It may be divided into the body and two crura of unequal length. On the body of the bone, which is nearly square, is the irregular articular surface, by which it is so firmly connected with the malleus as to be almost immovable. The shorter crus is thicker than the other, and is placed almost horizontally. It projects nearly directed backwards, to be articulated in a little depression near the aperture of the mastoid cells. The ligaments which retain it in this articulation allow a considerable degree of motion. The longer crus descends from the body of the bone, is more slender than the other, and bent inwards at its extremity towards the stapes, with which it articulates by the intervention of the os orbiculare. Its direction in the tympanum is parallel with the manubrium of the malleus, and consequently with the membrana tympani. The third bone, the os orbiculare, is about the size of a small millet-seed. Although named the os orbiculare, its figure is oval. It may be considered as an inter-articular bone between the incus and stapes—connected with both, but more firmly with the former, to which it generally adheres when the bones are separated. The fourth bone is the stapes, or stirrup. It consists of a base and two crura, which unite to form the head. The latter is of an oval figure, with a depression on its upper surface to receive the os orbiculare. The two crura are curved, and that which is nearer the mastoid process more so than the other; and it is consequently the longer, so that the stapes of one ear may be readily distinguished from that of the other. They are grooved on the inside, and a membrane, occupying the area of the stapes, is fixed in the groove. The base of the stapes corresponds in shape to the fenestra ovata, which it closes, but it is rather smaller, so that its motions more completely influence the membrane. It is a horizontal oval, convex superiorly and slightly concave on its under surface. It is kept *in situ* by the membranous lining of the tympanum and the membrane of the vestibule, but enjoys a certain degree of motion. The stapes stretches across from the extremity of the incus to the fenestra ovalis in an oblique direction, so that the base is a little higher than its head, and the sides are between the vertical and horizontal line. These bones are articulated with each other by capsular ligaments, of a degree of delicacy adapted to their minuteness. They are covered with a fine vascular membrane, which may be considered as their periosteum, from which numerous little vessels proceed, that penetrate their substance, and are their nutritious vessels.

The mechanism of the bones of the tympanum is regulated by the action of two muscles, the tensor membranæ tympani and the musculus stapedeus. Cruveilhier says, the former only can be clearly demonstrated; while some authors describe others, allotting three to the incus alone. The tensor membranæ tympani is contained in a small bony canal, parallel with the Eustachian tube, from the upper part of the cartilaginous and bony portions of which its fibres are derived. These fibres are eolleeted into a long round muscle, that passes through this canal, and enters the tympanum by a slender round tendon. The tendon, passing through a small aperture at an obtuse angle to the line of the muscles, is gently defleeted towards the manubrium of the malleus, and is inserted into its upper part, just below the proeessus graeilis. The aetion of this muscle retracts the tendon into the aperture of the bony eanal, so that the manubrium of the malleus is drawn inwards; and the membrana tympani, whieh is attaehed to it, put on the stretch, increasing the internal convexity and the external eoncavity. The stapedeus, which arises from one of the mastoid eells and from the pyramid, becomes tendinous on leaving the osseous eanal in whieh it is eontained, and is inserted on the posterior part of the neck of the stapes. It produees a similar effect on the membrane of the vestibule by drawing the stapes backwards; and is also supposed to assist the tensor tympani by its aetion on the ehain of small bones. Two other muselcs are described as influencing the ossicula in the tympanum, the existenee of whieh is not generally admitted. They are the laxator tympani and levator tympani. The laxator takes its origin from the spinous proeess of the sphenoid bone; passes inwards and backwards through the fissura Glasseri, and is inserted tendinous into the root of the long process of the malleus. Its aetion will be to relax the membrane by drawing the malleus outwards and a little forwards. The levator tympani is a very small muscle, and rarely to be found—it is inserted into the short process of the malleus, and assists the laxator tympani in its aetion.

What remains to be described of the intermediate part of the ear, is the little nerve of the tympanum, well known by the name of the ehorda tympani. As the portio dura of the auditory nerve passes through the stylo-mastoid canal, between the tympanum and mastoid process, it sends a small branch through a particular canal, which opens in the back of the tympanum, near the groove that contains the membrana tympani. The chorda tympani traverses the tympanum, lying between the manubrium of the malleus and longer crus of the incus, and enters another little canal nearly opposite to the former. It then continues its course forwards and downwards, between the pterygoid muscles, and joins the lingual branch of the inferior maxillary nerve. This extremity of the chorda tympani is larger than that which is joined to the portio dura, whence some have considered it as a branch of the lingual nerve. It is, in a word, a nerve of communication, which belongs equally to both, and is connected with the trunk of each at an acute angle. The tympanic plexus of nerves is situated near the promontory, and is formed by branches from the great sympathetic nerve, the otic ganglion, and the chorda tympani. It supplies the membrane and muscles of the tympanum.

THE INTERNAL EAR.

The internal ear may be considered the actual seat of the organ of hearing—in it is contained the expansion of the acoustic nerve. In consequence of the intricacy of its structure, it has received the name of the labyrinth: it consists of a congeries of canals or tubes, curiously curved, all communicating with the vestibule, and each having its particular use and nice adjustment for the grand design. It comprehends the vestibule, semi-circular canals, and the cochlea, which are incased in the petrous portion of the os temporis. It is situated between the meatus auditorius internus and the tympanum.

The vestibule is the central cavity, and communicates both with the semi-circular canals and the cochlea; the latter lying in the extreme point of the petrous portion of the os temporis; the former towards the mastoid cells. It is bounded internally by a plate of bone at the bottom of the internal auditory passage, which is pierced through with a number of small holes, for the passage of the acoustic nerve. The shape of the vestibule is irregularly spheroid or oval. On examination, when it is properly laid open, two distinct depressions are apparent; one semi-elliptical and situated above, which communicates with the cochlea; the other, and the larger of the two, oval in shape, and placed below. In it are found the five openings of the semi-circular canals. Both are opposite to the meatus internus. The vestibule in the prepared bone is open towards the tympanum; but, as has been already stated, the fenestra ovata is closed, in the recent state, by a membrane and the base of the stapes.

The semi-circular canals, the posterior and most extensive part of the labyrinth, although universally so called, are all more than semi-circles. They constitute at least three-fourths of a circle: their calibre is small, about the size of a common pin, and of an elliptical figure. The smallest part of each canal is about the middle of its curve; they enlarge as they enter the vestibule, but one extremity of each canal is particularly dilated, and is called the ampulla. The semi-circular canals are three in number, and are distinguished from each other by names given to them from their position or direction. They have been called the vertical, the oblique, and the horizontal. The vertical, superior, or anterior canal, is the most extensive; it describes its curve in the summit of the petrous portion of the os temporis, and crosses it with its convexity upwards, forming an eminence on the superior surface of the bone. Its anterior crus forms the ampulla, its posterior uniting with the superior one of the oblique canal, to form one common opening in the vestibule. The oblique, posterior, or inferior, on the contrary, describes its curve in the occipital side of the os temporis, and its convexity is placed outwards; the inferior part of the arch is enlarged into the ampulla, and opens into the lower and back part of the vestibule. The horizontal canal, the shortest and largest of the three, is bent with its convexity towards the mastoid process, and is directly above a portion of the stylo-mastoid canal. The anterior crus forms a slight ampulla, and communicates with the vestibule, immediately below and external to the opening of the vertical.

The cochlea derives its name from its resemblance to the shell of a snail. The similitude is merely external, and is only discernible in the cochlea of the fœtus during the first months; for as ossification advances, the bony substance of the cochlea is blended with the rest of the petrous portion of the os temporis. However, the proper substance may be discovered even in the adult, by its greater brittleness and yellow colour. When its walls are exposed without opening into its interior, by cautiously filing away the petrous bone, it is seen as a well-marked pyramid, with the base opposed to the meatus auditorius internus, and formed by a plate of bone, beautifully perforated for the admission of vessels and nerves. The cochlea is constructed with a modiolus, or central pillar, on which a spiral tube is wound, divided by a spiral lamina into two; its figure is conical and position oblique; it is placed in the anterior part of the petrous portion of the temporal bone, contiguous to the canal, through which the internal carotid artery passes, the base being directed towards the meatus internus, and the apex, which is lower than the base, towards the tympanum.

To facilitate the description of the cochlea, it will be advisable separately to consider the three parts of which it is formed; that is to say, the modiolus, the spiral tube, and spiral lamina. The modiolus commences at the bottom of the meatus internus, by a concave plate, perforated with numerous foraminula, the extremities of small bony tubes that freely communicate with one another, and are continued from the base towards the apex. The modiolus itself consists of these little bony tubes, blended into a mass, of a conical figure. The exterior fasciculi of tubes are the shortest; and they lengthen towards the centre, in which the longest and largest, which reaches the apex of the cochlea, is placed. They terminate on the sides of the modiolus, at different distances. At their terminations they bend at right angles towards the spiral tube, and their orifices describe about the modiolus a spiral tract, corresponding with the tube in direction. In proportion as they terminate, the modiolus diminishes, and its apex is exceedingly slender. The apex forms a second, and a smaller hollow cone, called the infundibulum, the base of which is directed forwards, its apex uniting with that of the modiolus. The spiral tube commences at the inferior and posterior part of the base of the modiolus by a large opening from the vestibule, and winds round the modiolus to its apex, where it terminates under the cupola. As it passes to the apex, the curve which it makes is constantly diminishing. It makes two turns and a half from the base to the apex, and gradually decreases in capacity. It is divided into two scalæ by a septum called the lamina spiralis, which arises from the vestibule; it is complete at the commencement, but not so at the apex, not extending so far as the canal; it there terminates in an hamuliform process, beneath the cupola. Its greatest breadth is at its origin, whence it gradually becomes narrower, as it approaches the apex of the cochlea. Two thin plates of bone compose it, and appear to unite at their margin, from which a membranous substance proceeds, and is reflected on each side. The spiral lamina, with the aid of this membrane, makes a complete septum, and divides the spiral tube into two canals, one of which is called the scala tympani, from its having its aspect toward the tympanum; the other, the scala vestibuli, from its arising in the vestibule. The scala tympani is nearer the base of the cochlea, and begins from the fenestra rotunda, but is prevented from communicating with the tympanum by the membrane which closes this aperture. The scala vestibuli begins by an oval orifice between the fenestra ovalis and the ampulla of the vertical canal. The two scalæ run parallel with each other; but have no communication, except at the apex of the cochlea, where they unite into one. The scala tympani is the inferior, and throughout its extent the more capacious canal.

When the cochlea is cut obliquely from the base to the apex, at a proper distance from the modiolus, the section exhibits the appearance of three successive compartments, each containing a portion of the septum of the scalæ. The half-turn of the septum occupies the last compartment, and as it joins the extremity of the spiral tube, a little hole is left: this is the hole by which the scalæ communicate.

To obtain a view of this aperture of communication, it is necessary to preserve the membranous part of the septum, for the spiral lamina itself does not reach the extremity of the tube. This may be ascertained by examination of the macerated cochlea, in which, when a similar section is made, the extreme point of the spiral lamina may be perceived just rising into the last compartment, and perfectly detached; but in the recent state, the membrane, which goes off from the spiral lamina to complete the septum, passes also from its point to the extremity of the tube, where it is so attached as to leave the little hole already mentioned.

The aqueducts of Cotunnus are two in number; they were supposed by physiologists to play an important part in the function of hearing; but the researches of Ribes have proved that they are merely osseous canals, serving for the passage of blood-vessels and absorbents: they are respectively named the aqueduct of the cochlea, and of the vestibule. The aqueduct of Fallopius, commencing by an opening in the upper and inner part of the osseous plate, at the bottom of the meatus internus, transmits and protects the portio dura, a nerve which issues from the motor track, and accompanies the portio mollis, or acoustic nerve, in its course to the ear.

On the posterior and upper surface of the petrous portion of the temporal bone, contiguous to the vestibule and cochlea, is the canal through which the auditory nerve passes; it is named the meatus auditorius internus, is oval in form, passes outwards and forwards, and is about half an inch in length. The extremity towards the labyrinth is closed, except at the upper part, where a small foramen, which is the beginning of the stylo-mastoid canal, appears. Immediately below the foramen, two cribriform plates are placed, the upper opposite to a portion of the semi-elliptical cavity of the vestibule; the lower, to the oval. A little lower, and separated by a slight ridge, a cribriform sulcus is continued to a round concave cribriform plate, the base of the modiolus of the cochlea. The vestibule, semi-circular canals, and the cochlea, are lined with a delicate periosteum: they contain also a membranous texture, formed into sacs and tubes, and filled with a transparent fluid similar to the aqueous humour of the eye. The membranous sacs and tubes are smaller than the osseous cavities which contain them, but otherwise exactly correspond in shape: they adhere very slightly to the periosteum of the osseous cavities by an exceedingly fine cellular membrane.

The vestibule contains two membranous sacs, one seated in the oval depression, the other in the semi-elliptical; I shall call them by the names of the depressions in which they are lodged. The semi-elliptical sac is larger than the oval, and is that in which the membranous semi-circular canals and scalæ vestibuli centre.

Although the cavities of these sacs are distinct, the sacs themselves cannot be separated, because their sides are in contact with each other and adhere, and they are too delicate to admit of division by dissection. The membranous semi-circular canals exactly resemble the osseous tubes in which they are placed, but are rather smaller, and project a little into the vestibule ere they unite. The membranous tubes of the cochlea correspond with the scalæ. One arises from the semi-elliptical sac of the vestibule; the other from the membrane of the fenestra rotunda, to which it adheres; they communicate in a manner similar to the two scalæ in the apex of the cochlea. The cavities of these membranes, by their interior surface, secrete the fluid they contain, in the same manner as the pericardium secretes the liquor pericardii. A considerable degree of vascularity seems necessary for their secretory functions. The vessels which supply them pass from the periosteum in a serpentine direction, and so far are easily discovered; but when dispersed on the peculiar structures of the membranes, they are too minute to admit the red globules of the blood.

The membranous texture just described is destined to receive the ultimate distribution of the auditory nerve, or portio mollis, which arises from the tuberculum annulare in the ventricle of the cerebellum, and the crus cerebelli. As it turns round the medulla oblongata, it is joined by the portio dura, which it partially receives in a species of groove, and both enter the meatus internus, being connected by a fine cellular membrane. The portio dura quits the portio mollis at the bottom of the meatus internus, and continue sits course through the stylo-mastoid canal, and is no otherwise connected with the organ of hearing than by receiving the chorda tympani. The portio mollis consists of two fasciculi, nearly equal in size, one of which supplies the vestibule and semi-circular canals, the other the cochlea. The nerve of the vestibule and semi-circular canals subdivides into three branches, after forming a gangliform enlargement. The largest branch sends its fibrils through the cribriform plate opposite to the semi-elliptical sac of the vestibule. They pass in a distinct plexus upon the sac, and are lost in a pulpy substance, which vanishes in the ampulla of the vertical and horizontal membranous canals. The second branch, passing through the inferior cribriform plate, is dispersed in a similar way on the oval sac. The last branch also passes through a small cribriform plate, and is lost on the ampulla of the oblique membranous canal. The fasciculus of the cochlea is twisted; an appearance which arises from the mode in which its fibres enter the modiolus. As they pass through its substance, they form plexus through the communicating holes of the bony tubes. Some of the fibres issue from the modiolus through the foraminula of the spiral lamina; but the greater number and the largest pass through the foramina, between the spiral lamina and the junction of the spiral tube to the modiolus. As the nerve detaches its fibres along the spiral tract of the foraminula, it becomes smaller towards the apex, as does the modiolus; but its central filament passes straight through the central foramen of the modiolus, and ramifies on the half turn of the spiral lamina. As the fibrillæ of the nerve pass into the scalæ of the cochlea, they may be very readily observed making a distinct plexus on the spiral lamina, in the edge of which a perfect network is formed. This network appears to be continued in a semi-pellucid pulpy substance, which goes from the edge of the lamina spiralis on to the membranes of the scalæ.

The arteries of the external ear come anteriorly from the arteria temporalis, and posteriorly from the occipital. The veins are branches of the external jugulars. The portio dura, after having passed out of the cranium, through the foramen stylo-mastoideum, gives off a branch, which runs up behind the ear, whence it sends off several filaments to the meatus and fore-side of the ear. The second vertebral pair send also a branch to the ear, the ramifications of which communicate with those of the other branch from the portio dura.*

* For a description of the comparative anatomy of the organ of hearing in mammalia, birds, beasts, fishes, insects, and vermes, see the author's Lecture on the Ear delivered in the theatre of the Royal Institution of Great Britain, before the president and members of the Society, May 30, 1828. Longman and Co.

PLATE 1.

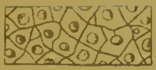


Fig. 4.

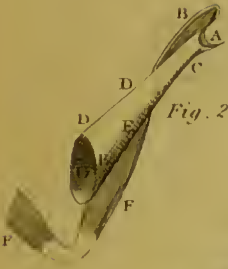


Fig. 2.

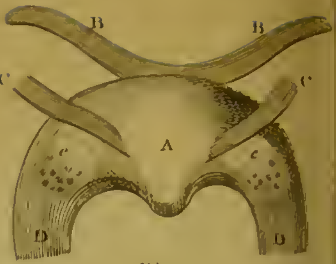


Fig 3.

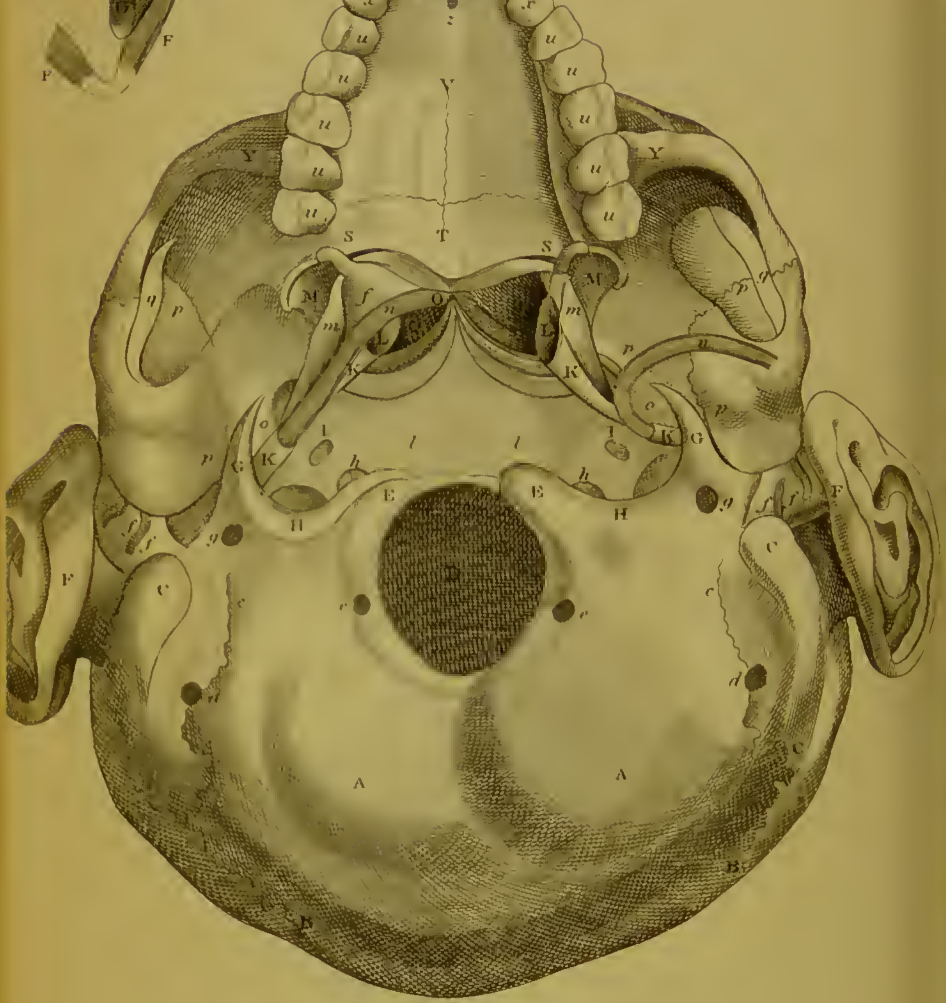


Fig. 1.

A View of the base of the Cranium.
Exhibiting the Eustachian Tubes &c.

Description of the Plates.

Plate I. Fig. 1.

A A The occipital bone.

B B The lambdoidal sutures.

C C Mammillary processes.

c c Sutures of the temporal bones.

D The foramen of the occiput, through which the spinal marrow and vertebral arteries pass.

d d The openings for the occipital veins within the cranium.

E E The two processes of the occipital bone, by which its articulation with the first vertebra of the neck takes place.

e e The opening for the vertebral veins.

F F The external ears.

f f The cartilages of the auditory passages laid open.

G G The styliform processes.

g g The openings forming the extremity of Fallopius' aqueduct, through which the portio dura passes on each side.

H H The openings for the jugular veins.

h h The openings for the passage of the ninth pair of nerves.

I I The openings for the entrance of the carotid arteries.

i i The internal membrane of the nose.

K K The Eustachian tubes.

L L The extremity of the tubes.

M M The external part of the pterygoid processes.

m m The muscles of the Eustachian tube.

n n The palato-pharyngeus muscle—anterior view.

O Posterior view.

o o The openings for the arteries of the dura mater.

P P The openings for the large branches of the fifth pair of nerves.

p p The sutures of the temporal bone with the sphenoid.

Q Q Internal, or posterior openings of the nose.

q q The sutures of the processes of the temporal bones, with part of the upper jaw.

r r The posterior part.

s s The openings for the course of the blood-vessels to the palate.

T The superior portion of the upper jaw.

V The fornix of the palate.

u u The dentes molares.

x x The dentes canini.

y y The dentes incisores.

Z The opening of the naso-palatine canal.

FIG. 2.

The Eustachian tube viewed from its posterior part, with the osseous canal.

A The commencement of the tube.
B The osseous canal.
C The bony part of the tube.
D The cartilaginous part.
E The membranous part.
F The muscle of the tube.
G The extremity of the tube.

FIG. 3.

A The uvula.
BB The palato-pharyngeus muscle.
CC The stylo-glossus muscle.
DD The stylo-pharyngeus muscle.
ee The tonsils.

FIG. 4.

Ceruminous glands of the meatus, exhibited purposely on a larger scale than natural, that they may appear more distinct.

PLATE II. FIG. 1.

B Lobulus.
C Concha.
c Anti-helix, and its crura.
z Eustachian tube.
a Helix.
e Tragus.
i Fossa innominata.
m Meatus auditorius.
m Mastoid process.
n Fossa navicularis.
o Anti-tragus.
p Cartilaginous portion of auditory tube.
q Styloid process.
r Membrana tympani.

FIG. 2.

a Tympanic cavity and auditory ring of temporal bone.
r Membrana tympani.
u Base of stapes.
1 Head of malleus.
3 Long slender process of malleus.
5 Handle of malleus.
6 Body of incus.
7 Short crus of incus.
8 Long crus of incus.
9 Short anterior crus of stapes.
10 Long anterior crus of stapes.
17 Apex of stapes.

PLATE 2.

Fig. 4.

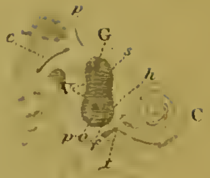


Fig. 7.

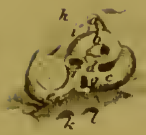


Fig. 6.

Fig. 1.

Fig. 5.

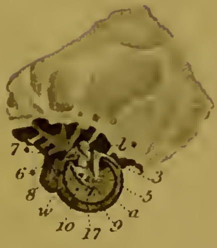


Fig. 2.

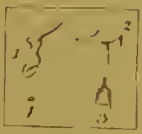


Fig. 3.

Fig. 8.

A View of the External, Intermediate, and Internal parts of the Ear, in a Young Subject.

FIG. 3.

1 Malleus.
2 Incus.
3 Stapes.
4 Os orbiculare.

FIG. 4.

C Cochlea.
a Petrous portion, covered with dura mater.
l Levator tympani minor muscle.
m Mastoid cells.
p Superior, or vertical semi-circular canal.
r Membrana tympani.
v Vidian nerve.
1 Twig of vidian nerve, assisting to form the great intercostal nerve.
p Cuneiform process of sphenoid bone.
9 Tensor tympani muscle.
9 Tendon of tensor tympani muscle.
c External or horizontal semi-circular canal.
m Meatus auditorius externus.
l Head of malleus.
*l** Semi-osseous canal of tensor tympani muscle.
3 Long slender process of malleus.
6 Body of incus.
7 Short crus of incus.
8 Long crus of incus.
44 Facial nerve.

FIG. 5.

a The sac in which the semi-circular canals and scala vestibuli terminate.
b The vertical canal.
c The oblique canal.
d The common termination of the vertical and oblique canals.
e e The terminations of the horizontal canal.
f The portio mollis.
gg The portio dura.
h The branch of the portio mollis, supplying the sac of the semi-circular canals.
i The branch of the oval sac.
k The twig supplying the ampulla of the oblique canals.
l The fasciculus of the cochlea.

FIG. 6.

a g The labyrinth.
a b c The three semi-circular canals: *a*, the superior, or vertical; *b*, the exterior, or horizontal; *c*, the posterior, or oblique.
d The vestibule.
e The cochlea.
f Fenestra ovalis.
g The fenestra rotunda.
h The margin to which the squamous portion of the temporal bone was connected.
i Part of the tympanum.
k The jugular fossa.
l The canalis caroticus.
m Part of the Eustachian tube.

Fig. 7.

C Cochlea.
G pyramid of vestibule.
h Cavitas hemispherica.
V Vestibule.
c External or horizontal semi-circular canal.
f Aqueduct of vestibule.
p Vertical, or superior semi-circular canal.
p o Tubulus osseus communis.
s Cavitas sulciformis.
t Aqueduct of cochlea.

Fig. 8.

a Aqueduct of Fallopius.
C Cochlea.
V Vestibule.
r Foramen rotundum.
c External, or horizontal semi-circular canal.
l Lamina spiralis.
O Oblique, or posterior semi-circular canal.
p Vertical, or superior semi-circular canal.
p o Tubulus osseus communis.
w Aperture leading from the vestibule to the cochlea.

CHAPTER II.

ANATOMY AND PHYSIOLOGY OF THE ORGANS OF VOICE.

The organs concerned in the performance of the function of speech comprise the tongue and adjacent parts, which are secondarily concerned, and the larynx. The tongue is a large fleshy mass, of an oval shape, composed almost entirely of muscles, and situated in the lower part of the mouth. It is movable in every direction. It is divided by anatomists into three parts—the base, the body, and the apex. The base is the thickest and most posterior part, placed at the back of the mouth just anterior to the opening of the larynx; the tip is the part termed the apex, the intervening portion being the body. The tongue is composed of several muscles, by all of which, with the exception of the lingualis, it is connected with other structures, and which serve, by their several actions, to thrust it forwards, to contract it, to move it from side to side, and to raise the apex to the roof of the mouth. It is abundantly furnished with blood-vessels and nerves, the latter being supplied by the ninth pair, which influences the muscular action, and by the gustatory nerve, a branch of the ganglionic portion of the third division of the fifth pair, which is dispersed not merely amongst the muscles of the tongue, but also supplies the mucous surface, and two of the salivary glands, by the glosso-pharyngeal nerve, which sends branches to the surface of the base of the tongue. This nerve is the cause of the exquisite sensibility of this organ, the ninth of that of motion, as the following experiments clearly shew.—If in dogs or rabbits the ninth pair be divided on both sides, the tongue will lose the power of motion, so that when it is drawn a little way out of the mouth, it will remain protruded, and it will not retract when acrid substances are applied to it, although sensation is evidently excited by their application. If the gustatory nerve of animals be divided immediately after death, no motion will afterwards be perceived in the fibres of the tongue; but if the ninth pair be compressed suddenly, its muscles will be thrown into action, and this will take place several times, if the experiment be repeated. If in animals, immediately after death, the glosso-pharyngeal nerve be pinched, no spasmodic action of the lingual muscles follows. The other parts connected with the function of speech are the lips, teeth, roof of the mouth, uvula, and palatine arches.

The larynx is composed of a mouth-piece, the aperture of which admits of expansion or dilatation, and of a tube, which is capable of being lengthened or shortened. The tube is situated upon the superior part of the trachea, forming, in fact, a continuation thereof, so that as the air passes out during expiration, it causes the edges of the aperture, at the entrance of the larynx to the mouth, to vibrate. If the upper part of the trachea be removed, on looking into the larynx from below, the tube, from being cylindrical, is seen to assume abruptly a triangular prismatic form, the two long sides of the triangle extending horizontally inwards and forwards, to meet at the front of the larynx. The base of the triangular opening is short, and is placed transversely.

The mouth, or orifice of the larynx, is called the rima glottidis; the two long edges that meet at its fore-part are termed the chordæ vocales. On the upper part of the larynx we find the epiglottis; it consists of a thin flap of fibrous cartilage, held vertically, by its elastic connexions, against the root of the tongue, but capable of being thrown down to cover the opening of the glottis, the lips of the glottis, or the reflection of the mucous membrane, from the edges of the epiglottis to the posterior margin of the larynx, and the ventriculus laryngis (as the fossa placed immediately above and to the outside of the chordæ vocales is called), which permits these parts to vibrate freely.

The principal piece in the structure of the larynx is the cricoid cartilage, a thick ring rising behind to the height of an inch; it is received between the two plates of which the thyroid cartilage consists, and upon its raised posterior margin two little pyramids of fibrous cartilage, called the arytenoid cartilages, are loosely articulated, so as to move freely. The edge of the chordæ vocales appears to be formed of a peculiar elastic substance, extending from the front of each arytenoid cartilage to the thyroid, so that any movement given to the former immediately affects the dimensions of the rima glottidis. Small muscles, extending between these cartilages, contract or enlarge the orifice of the larynx by their action, and thus materially modify the voice. These are supplied with nervous influence by the recurrent branch of the nervus vagus, the division of which causes aphonia, or loss of speech, by depriving the muscles to which it is sent of their due stimulus. The superior laryngeal nerves supply certain small muscles, the action of which is to close the orifice of the larynx during deglutition, so as to prevent the passage of food into the windpipe.

Voice is produced by the act of respiration, as connected with the larynx, according to certain states of which it is grave or acute. The glottis is more especially the seat of the voice, as shewn by making an opening in the trachea, when the voice immediately ceases, and returns when the opening is closed. The other parts are subsidiary to the larynx with respect to this function. The different sounds of the voice in man and mammalia are generated in the larynx, and are somewhat modified in quality by the parts above and anterior to the larynx through which the air passes. In whistling, we give rise to an entirely different series of sounds, which have their source in the lips and cavity of the mouth. The voice of birds, again, has another seat; it is produced not in the superior, but in the inferior larynx, which occupies the lower extremity of the trachea at its point of division into the bronchi. In the few other vertebrata below birds which have voice, as the frogs and toads, the sound is generated in the proper larynx, as in man and the mammalia.

If in a living dog an incision is made immediately below the cornua of the os hyoides, so that the cavity of the larynx is exposed, the following phænomena disclose themselves: at each expiration the rima glottidis is narrowed, and the chordæ vocales are brought nearer to each other, so that in part of their extent they are in contact. When the animal cries, the chordæ vocales appear to vibrate; when the tone uttered is grave, the rima glottidis is closed posteriorly, and the chordæ vocales appear to vibrate in their whole length; when the animal utters a shrill cry, the rima glottidis is observed to become much narrower anteriorly, and the chordæ vocales being then in contact at their anterior part, their posterior portion only appears to vibrate. The rima glottidis is the mouth-piece of the larynx, and corresponds in some measure with the reed of the clarionet, or with the lips of a person while playing the flute. In pursuing this comparison, we observe a contrivance similar to the stops in these instruments, by which the tube may be shortened or lengthened, in the alternate rising and falling of the larynx. When the larynx is raised, the vocal tube is shortened; when it is depressed, the tube is lengthened. Accordingly, when an acute note is uttered, the larynx is felt to rise, and to sink when the voice falls to a grave tone. The ventricles of Galen, cavities which are situate within the larynx, serve to increase the resonance of the voice, an office to which the frontal and sphenoidal sinuses are also considered to be subservient.

The following results, from experiments on the isolated larynx, are recorded by M. Müller in his work on Physiology—the larynx experimented on had been previously deprived of the epiglottis, superior ligaments of the glottis, the ventricles of Galen, &c. :—

"By blowing from the trachea through the aperture of the glottis, narrowed by the approximation of the vocal chords, clear and full tones, which come very near to those of the human voice, are produced. These tones, emitted by the lower ligaments of the glottis alone, differ from those heard when the upper ligaments and the epiglottis are not removed, merely in the latter being louder; the parts of the larynx last mentioned being, when present, as well as the posterior wall of the trachea, thrown into strong vibrations, whenever the vocal chords vibrate. The sonorous vibrations of the vocal chords are produced most readily and certainly when the posterior part of the glottis—that part between the arytenoid cartilages—is closed; this disposition is, however, not absolutely necessary; for, although Magendie and Malgaigne have asserted the contrary, sounds may frequently be produced when the glottis is open in its whole length; still these sounds are feeble, and produced with difficulty. If the arytenoid cartilages be approximated in such a manner that their anterior processes touch each other, but yet leave an opening behind them as well as in front, no second vocal tone is produced by the passage of the air through the posterior opening, but merely a rustling, or bubbling sound."

The use of the epiglottis, according to Magendie, is to perfect the larynx as a musical instrument. It is said that in the clarionet a note swelled beyond a certain degree of loudness is liable to break into a higher note.

Now M. Grenie discovered that by placing a tongue of elastic substance to break the current of air, this imperfection may be remedied. The epiglottis is just such a contrivance in the organ; its use was unknown until it was thus accidentally discovered.

The tongue, lips, teeth, and roof of the mouth, are concerned in the production of speech; the two latter as offering the necessary resistance to the tongue, the lips and tongue for the formation and articulation of letters.

A little attention will shew that the tongue expresses some letters with the apex, and some by means of its root. Those letters which may be considered proper to the apex are only the five following, viz. D L N R T. In the letters C G S X Z, it only assists; these letters can be performed by the teeth alone. The lip-letters are B F M P V; and those pronounced by the base of the tongue are K Q. The aspiration H, and the vowels, are chiefly expressed by means of the lips modifying expiration.*

* The speech of animals, although articulate, differs from that of man, inasmuch as it is not regulated by reason, but simply by imitation and memory, by which they accommodate words, which by their docility they have gained, to particular things, as they have been accustomed to them, and according to their often-repeated appellations. Vide G. Sibscota on the Speech of Animals, and the Author's work on the Deaf and Dumb.

The authors who have written respecting the human voice, are, Dodart, Mém. de l'Acad. de Paris, 1700, 1706, 1707; Ferrein, 1741; Magendie, Physiologie; Biôt, Elem. de Physique, 1824; Savart, Leipsic, 1814; Mayer, 1826; Bennati, Paris, 1832; Mayo, Outlines of Physiology; Sir C. Bell, Philos. Trans. 1832; Willis, 1832; Malgaigne; Lehfeldt, 1835; Cuvier, Anat. Comparée; Müller, Physiologie.

PLATE 3.

Fig 1.

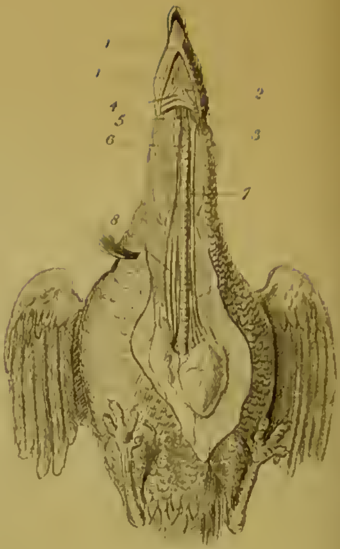


Fig 2

Fig 5

Fig. 3

Fig 4

THE ORGANS OF VOICE.

Fig. 1. Man   Fig. 2 The Turkey.
3. The Dog   4. The Cat.
Fig 5. The Glottis in Man.

Plate III. Fig. 1.

1 The genio-hyoideus muscle } Muscles of the tongue.
2 The hyo-glossus muscle }
3 The stylo-glossus muscle }
4 The os hyoides.
5 The inter-membranous space.
6 The thyroid cartilage.
7 The trachea.

Fig. 2.

1 The lower mandible.
2 The hyo-glossus muscle.
3 The stylo-hyoideus muscle.
4 The os hyoides.
5 The styloid process of the os hyoides.
6 The trachea.
7, 8 Muscles of the larynx.

Fig. 3.

1 The thyroid cartilage.
2 The cricoid cartilage.
3 The crico-thyroid muscles.
4 The trachea.
5, 6, 7 The superior and inferior laryngeal muscles.

Fig. 4.

1 The lower jaw.
2 The temporal muscle.
3 The masseter muscle.
4 The genio-hyoideus muscle.
5 The thyro-hyoideus muscle.
6 The sterno-thyroideus muscle.
7 The crico-thyroideus muscle.
8 The trachea.

Fig. 5.

1 The epiglottis.
2 The ala of the thyroid cartilage.
3 The rima glottidis.
4 The chordæ vocales.
5 The ventricle of Galen.

CHAPTER III.

PHYSIOLOGY AND PHILOSOPHY OF SOUND.

Hearing may be described as the function intended to acquaint us through the medium of the sensorium with the vibratory motions of bodies, by which sound is produced. It is the exercise of that faculty or sense by which we appreciate and estimate all vibrations from sonorous bodies. Its true seat is in that part of the organ where the portio mollis of the seventh pair is distributed, and to which the undulations or waves of sound are conducted through the medium of the external and intermediate portions of the organ of hearing.

The external ear receives and collects the vibrations of the air caused by any sonorous body by means of its eminences and depressions, and conducts them through the concha to the meatus auditorius externus, through which they pass, concentrated and reflected by the parietes of the meatus to the membrana tympani, on which they excite a vibration. This is communicated, through the chain of the small bones, to the labyrinth, the malleus receiving the impression from the membrane with which it is in intimate contact, and transmitting it, through the incus and os orbiculare, to the stapes. The basis of this last bone is extended within the vestibule, in that part where, placed as a centre, it faces the common channel of the membranous semicircular canals, as well as the orifice of the scala vestibuli. In consequence of this situation, and which may be rendered more available by its muscles drawing the bone more deeply into the foramen, the vibrations on the stapes are extended to the water of the labyrinth; and the waves directed from this part, as from a centre to the circumference, pass through the liquor labyrinthi surrounding the membranous semicircular canals, agitating, by its undulations, their whole surface, and consequently affecting the nervous expansion spreading over all these parts. One scala of the cochlea opens into the vestibulum, and the other begins from the fenestra rotunda, or cochleæ; and both being filled with water of the labyrinth, and communicating with each other at the apex of the cochlea, the sonorous vibrations are in this manner conveyed also to the scalæ of the cochlea. Besides this, between the scalæ of the cochlea, in the middle point, as it were, is placed the zonæ mollis, where the nerve is also extended, and the sonorous undulations take place. The nerve spread on the cochlea is also affected by the vibration of the membrana tympani, in consequence of the undulations being communicated to the air contained in the interior of the drum (which is admitted by the Eustachian tube), and thus producing an impulse on the membrane stretched across the fenestra cochleæ, whence it is transmitted through the aqua cochleæ to the expansion of the auditory nerve. "It would be, however, very incorrect to imagine that the oscillatory motion or vibration must be imparted to the auditory nerve itself for the sensation of sound to be produced. On the contrary, it appears that the immediate cause of the sensation of sound, even when this is excited by the vibrations of sonorous bodies, is really the regular succession of impulses which the auditory nerve receives. This is proved by the investigation of those sounds which are produced, not by the vibrations of an elastic body, but by a series of mere impulses, quickly succeeding each other. If a piece of wood be held against the teeth of a rapidly revolving wheel, every stroke of the teeth of the wheel will be communicated as an impulse to the ear, and produce the sensation of sound. If, however, the wheel be now made to revolve more rapidly, so that the separate strokes on the wheel cannot be distinguished, in place of a succession of shocks, a continuous sound will be perceived, the pitch of which will be higher, as the rapidity of the wheel's motion is increased. Still greater interest, in reference to the theory of the essential cause of sound being a quick succession of impulses, attaches to the tones which may be produced by a current of a gas, or liquid, such as water, or quicksilver, interrupted at regular and very short intervals, particularly since liquids are not elastic, and therefore not capable of producing sound by vibration. Thus, in the siren, an instrument invented by M. Cagniard la Tour, a rapidly revolving wheel interrupts momentarily, and at successive intervals of very short duration, the escape of a fluid from the opening in the body of the instrument. Even when the revolving wheel interrupts at regular and frequent intervals the current of water supplied by pressure from below, the impulses produced by the periodic escape of the fluid, if they follow each other in sufficiently rapid succession, give rise to a clear sound, of which the pitch is higher in proportion to the rapidity of the succession of the impulses, or moments of interruption of the current."*

In this way, then, the waves of sound are collected by the external ear, pass through the meatus auditorius, and produce an impulse on the membrane of the tympanum, which is communicated to the water contained in the sacs, on which the extreme branches of the acoustic nerve are distributed, through the medium of the chain of small bones which convey it to the membrane of the fenestra ovalis, and also through the air contained in the tympanum itself, by which the waves of sound are transmitted to the membrane of the fenestra cochleæ. The

* Müller's Physiology. When I was at Berlin last year, I waited on Professor Müller, to whom I had a letter of introduction from Professor Otto ; but like most of the principal German physicians at the close of the season, he had left for a tour of recreation to the Spas, by which I was prevented seeing him.

bones of the head can serve to convey the vibrations of sonorous bodies to the auditory fluid, provided the acoustic nerve and the sensorium are healthy. From this cause, persons hard of hearing can distinguish the ticking of a watch placed between the teeth, and those who are almost quite deaf can hear the sounds of a musical instrument when they hold one end of a rod between their teeth, and strike the instrument with the other.

It is by these varied actions of the different parts on the auditory nerve, that the latter is enabled to convey the vibrations to the sensorium, by which the mind is informed of the existence of sound, and is enabled to calculate its import, and to judge of its difference in degree; for gravity or acuteness of sound depends on the rapidity of the vibratory motion, and consequently on the number of vibrations in a given time. For the deepest tone ordinarily employed in music, the C of the open organ-pipe 32 feet in length, 32 vibrations of the air in the pipe take place in a second; for the octave higher than this, there are 64 vibrations; for the next octave, 128; and for the next, there are 256 vibrations in a second. It being a matter of indifference whether impulses are produced by the teeth of a revolving wheel, or by the vibrations of a sonorous body, we have now in an instrument invented by M. Savart, in which the sounds are produced by the successive strokes of the teeth of a wheel, an easy means of ascertaining with precision the number of vibrations necessary for the production of each tone.

The situation of the ear, it may be observed, is more internal, and its powers are more concentrated, than those of the eye. Its nervous expansion is more limited; and the bodies which act upon it are denser, and more solid, than those which influence the organ of vision; hence the sensations conveyed by it are limited, in point of distance, from its object, though they are more numerous and durable than those of the eye.

The degree of fineness and subtilty of hearing depends chiefly on the greater or less state of perfection of the different parts of the organ. It is nevertheless in our power, by an effort of the will or the attention, by certain changes in the position and degree of tension of the parts, or by certain excitants, to render the function more subtle, or the reverse. It is even possible not to hear a very loud noise, by fixing the attention very strongly on another object.

Sound is, in the sonorous body that produces it, the same it is in the air itself that conveys it to the ear; viz. the vibration of a body put in motion by the impulse of some other—such as a bell struck by its clapper; a violin shaken by its strings, which the bow sets a trembling; a flute influenced by the impulse of the air against its orifice. A familiar and easy experiment shews the vibratory motion that produces sound. Take a drinking-glass nearly filled with water: on rubbing the finger with a gentle equable motion along the rim, the surface of the water is fretted, and thrown into the finest waves by the undulations of the air; yet such is the nature of these undulations, that the flame of a candle is not visibly agitated, when placed near a sonorous body of the largest magnitude. The vibration of a body producing sound is shewn in that beautiful instrument, the Æolian harp. It consists of a long narrow deal-box with a thin belly, its length suited to the breadth of the window when the sash is up, and eight or ten catgut-strings lightly stretched over two bridges placed near the ends, and tuned in unison. The action of the wind upon this instrument, when placed under the window-sash, will produce melodious sounds and harmony. The notes successively rise from silence, swell to exalted tones, and then gradually die away. They do not accord in any musical proportion of sound, though all are most exquisitely pleasing and ravishing to the ear. By the vibrations of sonorous bodies similar vibratory motions are extended to the surrounding air; which, thus set in motion, conveys the impression to the external ear. The atmosphere is therefore a conductor of sound; but its power of conducting varies much at different times, having reference to its dryness or humidity, density or rariness, or its electric condition—to the prevalence of winds, &c. Wood, and certain metals, such as gold, silver, copper, and iron, are good conductors; but tin and lead, which are inelastic, are the reverse. Bodies, to be sonorous, must possess the principle of elasticity. It is singular that tin, which is a bad conductor, should improve the tone of copper: bell-metal is composed of ten parts of copper and one of tin. Glass and flannel are also good conductors of sound. Among sonorous bodies, we have bells of various figures and magnitude; pipes of wood and metal; and strings formed either of metal or an animal substance. The sounds produced by the latter are more or less grave according to their thickness, length, and degree of tension.

All these bodies, when struck, produce sound by the trembling, or intestine movement of the atoms of which they are composed; and of which the result is the vibratory motion of the whole, by which the external air is impressed. The waves of sound spread themselves in all directions, visiting a thousand with the same facility as one; freely influencing all who bestow their attention on them. They cross each other also constantly, without an appreciable effect being produced; the result of which is, that a great variety of sounds may be heard and distinguished at once; and also, that the loudness of sound diminishes according to the square of the distance. Euler is of opinion that no sound, making fewer vibrations than thirty in a second, or more than 7520, can be distinguished by the human ear; thus limiting the hearing, as to acute and grave sounds, to an interval of eight octaves.

The speed with which sound is propagated through the air has been differently stated. Robertval calculates it at the rate of 560 feet in the second; Gassendus, at 1473; Mersenne, at 1474; Duhamel, at 1338; Newton, at 968; and Derham, whose opinion was supported by Flamstead and Halley, and is now generally considered to be correct, at 1142 feet in the second, or above thirteen miles in a minute. The reason of this variation is supposed to have been the use of strings and plummets instead of pendulums, the too great nearness of the sonorous body to the place of observation, and the direction of the winds not having been allowed for. The utmost limits within which the loudest sounds, produced by artificial means, can be heard, is 180 or 200 miles; although the noise from a volcano has been heard still further off. A wind blowing against the direction of sound does not arrest its progress entirely, but diminishes its rapidity and strength. In a dense atmosphere it is propagated with more force, but at the same time more slowly, while the reverse holds good in rarefied air; it then passes more swiftly and more feebly.

Notwithstanding the rapidity with which the vibrations of the atmosphere, caused by the body which produces sound, are conveyed, a certain time is still requisite to transmit the impression to the air at a distance from the exciting body. The reason of this delay is because the air being elastic, that which surrounds the sonorous body gives way to its pressure as it vibrates, transmitting the impression in a regular undulatory manner to the air beyond; which in its turn dilates a little, causing a similar action on the atmosphere beyond it, agreeably to the disposition of all elastic bodies; and thus, by a series of undulations, or waves, the impression is conveyed to a distance. The process, of course, requires time. This fact is readily ascertained; for the flash of a gun discharged at a distance is seen some time before the report is heard; and the distance may be calculated by the time that elapses between the seeing the flash and hearing the report. For instance, as sound travels thirteen miles in a minute, should there be ten seconds pass between the two, it will be evident that the discharge took place rather more than two miles off.

The following are the conclusions, drawn from experiments instituted by the Academy of Sciences. It will be seen that the rate of propagation of sound differs from that generally admitted.

First, that the report of a cannon is propagated 1107 feet (English) a second; and, of course, 66,420 feet in a minute. A league being 14,604 feet, sound is conveyed every minute nearly five leagues; consequently, it travels in an hour about 283 leagues.

Secondly, that sound is transmitted with the same velocity when it traverses a great space as when it runs over a smaller, without any diminution.

Thirdly, that sound is transmitted with the same velocity in the daytime as in the night.

Fourthly, that there is likewise the same velocity in rainy weather as when the sky is serene.

Fifthly, that the swiftness of sound is equal, both when the noise that produces it is great and when it is small. When the mouth of a cannon, for example, is directed towards the place whence the report is made, and when it is pointed in a contrary direction.

Sixthly, that the velocity of sound increases when the wind sets fair for it, and diminishes when it is contrary, in proportion to the force of the wind.

When the vibrations of the air that produce sound strike a body of a certain extent, they are reflected from that body to a particular point; preserving their modulation in such a manner, that the vibrations are there repeated, though in a less degree. This repetition, or reflexion of sound, is called an echo. The principles on which echoes are founded are these: every point against which the pulses strike becomes a centre of a new series of pulses, sound moving through equal spaces in equal times; consequently, when any sound is propagated from a centre, and its pulses strike against a variety of obstacles, if the sum of the right lines drawn from that point to each of the obstacles, and from each obstacle to a second point, be equal, then will the latter be a point in which an echo can be heard.

Several echoes will result from a place where there are several bodies at different distances, that reflect the sound toward the same spot. The reflexion of sound is governed by almost the same laws as the reflexion of light. There is no necessity for the reflecting body being concave; but still its powers of reflection are aided very considerably by its possessing that shape. Convex bodies have yielded echoes. The wall of a house may return the sound which is impelled against it. On these principles whispering-galleries, speaking-trumpets, and other acoustic instruments are constructed.

The augmentation of sound by acoustic instruments depends on its reflexion from their vibrating elastic internal surface; which reflexions, by propagating the pulses in the same direction, every impulse against the sides becoming a new centre; whence the waves of sound form renewed undulations, increasing alike the intensity and the number of sounds transmitted to the ear. From this it is evident that the substance of which acoustic instruments are constructed should be of an elastic nature, or else they will not be capable of transmitting sound, all non-elastic bodies being non-conductors; instruments, therefore, made of wood, gold, silver, iron, or bell-metal, or, better still, a tinned one, are those most likely to be serviceable. At the same time, the longer an instrument is, the more useful it will be; inasmuch as it will offer a greater extent of surface for the reflexion of the sound transmitted, and consequently the greater will be the impression on the external ear. The small voice-conductors, which have been invented with the view of their being worn in the external auditory passage, and which I introduced many years ago, to comply with the wish of some fanciful patients, can be of but comparatively little use; while many of those which are now sold, made in imitation of my instrument, but of copper-gilt, instead of pure metal, are liable to cause much mischief in the ear, especially if they should be used while there is any discharge or otorrhœa present, or the parts be in an ulcerated condition. Indeed, when otorrhœa exists, instruments should never be had recourse to, nor in cases of incipient deafness, or tinnitus aurium; as I have stated in my other works, they should be employed only when the hardness of hearing is confirmed, and beyond the reach of medicine. It is utterly impossible that a short trumpet, however well it may be constructed, can render a service at all to be compared to that derived from one of a proper length.* Instruments should be used as little as possible; for the more rest given to the ear at a time the better, and the longer will the trumpet answer its purpose. The length of the tube should be in accordance with the intensity of the hardness of hearing; and the more sonorous material should be chosen for its fabrication.

Some years since I invented an acoustic chair, by means of which, with its connecting pipes, a communication could be sent from Downing Street or the Horse Guards to the Mansion House in a minute and a half, and to every police or fire-brigade station in the metropolis in the course of a short time; so that the necessary intelligence, in case of fire or other calamity, could be con-

* My last new hearing-trumpet, as well as the Keraphonites, or improved ear-cornets, voice-conductors, and other instruments, may be had of Mr. Gifford, chemist to the late king, 104 Strand; of whom may be obtained every description of acoustic instruments for the use of deaf persons, made in the best manner, and many of them of a novel construction.

veyed with surprising rapidity. The advantage of such a medium of communication cannot be too highly estimated.

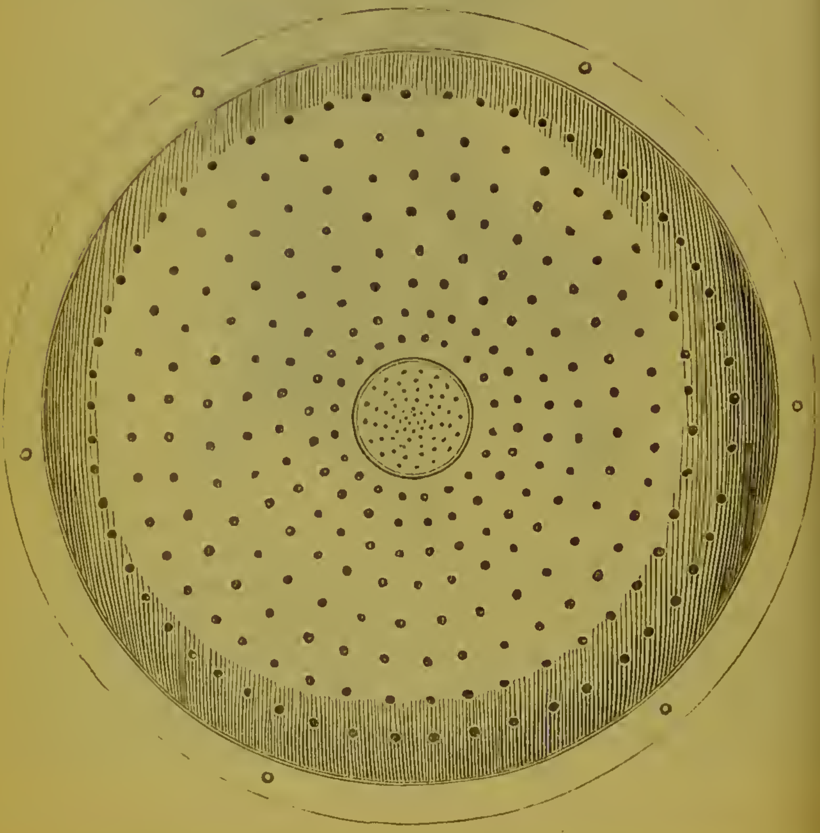
The principle on which it is constructed is that of conveying sound to great distances by means of contrivances termed acoustic tunnels. It is intended for the benefit and use of the incurably deaf. A somewhat similar chair was constructed in 1706, by M. Duguet, who likewise invented some acoustic tubes. But one of the great advantages possessed by my chair over his consists in this—that the person sitting in it hears at the opposite side from that at which he is addressed; thus avoiding the unpleasant and injurious practice of the speaker coming so close as to render his breath offensive, and at the same time detrimental to the organ of hearing, by causing a relaxation of the membrane of the tympanum. This is an effect commonly produced by the use of short flexible tubes, no less than by hearing-trumpets; which latter are as often, perhaps, employed for speaking through, as for the purpose for which they were designed; and it is a certain fact that many persons, after having used a trumpet for half an hour, are quite deaf from the action of the breath impelled against the membrana tympani.

My acoustic chair is so constructed, that, by means of additional tubes, &c., the person seated in it may hear distinctly, while sitting perfectly at ease, whatever transpires in any apartment from which the pipes are carried to the chair; being an improved application of the principles of the speaking-pipes now in general use. This invention is further valuable, and superior to all other similar contrivances, as it requires no trouble or skill in the use of it, and is so perfectly simple in its application, that a child may employ it with as much facility, and as effectually, as an adult. It is, moreover, a very comfortable and elegant piece of furniture.

The chair is of the size of a large library one, and has a high back, to which are affixed two barrels for sound, so constructed as not to appear unsightly; and at the extremity of each barrel is a perforated plate, which collects sound into a paraboloid vase from any part of the room. The instrument thus contrived gathers sound, and impresses it more sensibly, by giving to it a small quantity of air. The convex end of the vase serves to reflect the voice, and renders it more distinct. Further, the air enclosed in the tube being also excited by the voice, communicates its action to the ear, which thus receives a stronger impression from the articulated voice, or indeed from any other sound.

In the engraving, on the near side of the chair, is seen the barrel for sound, with the conductor attached; and beneath the chair is the tunnel for the conveyance of the sound. Within the chair is seen the tube to be applied to the ear. This chair is only adapted for hearing; to complete the design, and convey sound to it from a distance, requires another conductor and a mouth-piece.

By means of tubes of sufficient length, this chair might be made to convey intelligence from St. James's to the Houses of Lords and Commons, and even from London to the Queen at Windsor. In the apartment from which the intelligence is sent, a large convex plate, perforated with holes, and connected with the tubing, is requisite, affixed or let into the wainscoting of the room. The following engraving represents the plate attached to the vase in my dining-room, which communicates with the chair in my library by tubing conveyed across the passage and under the flooring of the rooms and stairs. By it conversation in the one room may be heard in the other; and so accurately is the sound rendered, that even the tick of a watch may be clearly distinguished.



Upon the subject of Acoustic Tunnels, we find some illustrative information in Dr. Dick's *Christian Philosopher*, which will be read with peculiar interest. "In the progress of human knowledge and improvement," observes Dr. Dick, "it would obviously be of considerable importance, *could we extend the range of the human voice*, and communicate intelligence to the distance of a thousand miles, in the course of two or three hours; or could we hold an occasional conversation with a friend at the distance of twenty or thirty miles. From experiments which have lately been made, in reference to the conveyance of sound, we have some reason to believe that such objects may not be altogether unattainable. * * * In Nicholson's *Philosophical Journal* for February, 1803, Mr. E. Walker describes a simple apparatus, connected with a speaking-trumpet, by means of which, at the distance of 17½ feet, he held a conversation with another in whispers too low to be heard through the air at that distance. When the ear was placed in a certain position, the words were heard as if they had been spoken by an invisible being within the trumpet. And what rendered the deception still more pleasing, the words were more distinct, softer, and more musical, than if they had been spoken through the air."

But what bears more closely on the object hinted at above, are the experiments made by M. Biot, "on the transmission of sound through solid bodies, and through air in very long tubes," which Dr. Dick proceeds to quote :—

"These experiments were made by means of long cylindrical pipes, which were constructed for conduits and aqueducts, to embellish the city of Paris. With regard to the *velocity* of sound, it was ascertained that its transmission through cast-iron is 10½ times as quick as through air. The pipes by which he wished to ascertain at what distance sounds are audible, were 1039 yards, or nearly five furlongs, in length. M. Biot was stationed at the one end of this series of pipes, and Mr. Martin, a gentleman who assisted in the experiments, at the other. They heard the lowest voice, so as perfectly to distinguish the words, and to keep up a conversation on all the subjects of the experiments. 'I wished,' says M. Biot, 'to determine the point at which the human voice ceases to be audible, but could not accomplish it: words spoken as low as when we whisper a secret in another's ear, were heard and understood; so that not to be heard, there was but one resource, that of not speaking at all. This mode of conversing with an invisible neighbour is so singular, that we cannot help being surprised, even though acquainted with the cause. Between a question and answer, the interval was not greater than was necessary for the transmission of sound. For Mr. Martin and me, at the distance of 1039 yards, this time, was about 5½ seconds.' Reports of a pistol fired at one end occasioned a considerable explosion at the other. The air was driven out of the pipe with sufficient force to give the hand a smart blow, to drive light substances out of it to the distance of half a yard, and to extinguish a candle, though it was 1039 yards' distance from the place where the pistol was fired. A detailed account of these experiments may be seen in Nicholson's *Phil. Jour.* for October 1811. Don Gautier, the inventor of the telegraph, also suggested the method of conveying articulate sounds to a great distance. He proposed to build horizontal tunnels, widening at the remoter extremity, and found that at the distance of 400 fathoms, or nearly half a mile, the ticking of a watch could be heard far better than close to the ear. He calculated that a series of such tunnels would convey a message 900 miles in an hour.

"From the experiments now stated, it appears highly probable that sounds may be conveyed to an indefinite distance. If one man can converse with another at the distance of nearly three quarters of a mile, *by means of the* *softest whisper*, there is every reason to believe that they could hold a conversation at the distance of thirty or forty miles, provided the requisite tunnels were constructed for this purpose. The latter case does not appear more wonderful than the former. Were this point fully determined by experiments conducted on a more extensive scale, a variety of interesting effects would follow from a practical application of the results."

Marvellous as this may seem, the idea is not a novelty; it is but another confirmation of the saying of Solomon, that there is nothing new under the sun. M. Itard, in his excellent work on the Ear, tells us that Aristotle (who was physician to Alexander the Great) invented a trumpet for his master, which was capable of conveying orders to his generals at the distance of 100 stadia—equal to rather more than twelve miles. And I may remark—bearing in mind, too, that both Alcmeon and Hippocrates are said to have invented ear-trumpets—that the ancients do not seem to have been so ignorant of acoustics as some in our day have represented them to be.

That the ancients had arrived at considerable proficiency in this branch of natural philosophy is attested by records of their ingenuity, and relics of their inventions. The history of Egypt, the cradle of arts and sciences, presents many examples.

Of the application of this early skill several interesting proofs are recorded. Thus, we read of "acoustic vessels" in the ancient theatres: these were a kind of vessels made of brass, shaped in the bell fashion; which, being of all tones within the pitch of the voice, or even of instruments, rendered the sound more audible; so that the actors could be heard through all parts of theatres, which were even 400 feet in diameter. With the knowledge of this fact, it is somewhat strange that our public buildings are generally ill constructed for hearing; and that the only attempted remedy is in costly and uncertain experiments, such as have been made, but with indifferent success, in the present House of Commons.

This chair has been seen and examined by several noblemen and scientific gentlemen, as well as by many of the foreign ambassadors, who have expressed themselves in terms of unqualified approbation of the principle of its construction, and its applicability for a variety of useful purposes.

In concluding my remarks upon sound, I would wish to draw the attention of my readers to a highly interesting fact connected indirectly with acoustics, recorded by Lieut. Newbold in a communication read at a recent meeting of the Royal Asiatic Society with respect to the Gibel Nakus, or Mountain of the Bell, in Sinai. "This curious hill has been long celebrated for the extraordinary tones elicited from it, which have generally been compared to the deep looming of a church bell. Of the cause of the phenomenon many opinions have been broached. The Arabs in the neighbourhood, with their ordinary propensity to a belief in the marvellous, attribute it to the real bells of a subterraneous convent, swallowed up by some convulsion of nature; and the Christian monks of Mount Sinai countenance the belief by the idle story that the sound was first heard after the destruction of one of their convents in its vicinity. The ideas of European travellers on the matter, have been sometimes scarcely more reasonable. Some have supposed the sounds to be caused by the dropping of sand into the cavities of the rocks; others, by its motion over hollow rocks; others, again, have attributed them to subterraneous volcanoes; and a few have supposed that the action of the wind upon the elastic plates of mica, which is a component part of granite, may be the origin of the sound. Lieut. Newbold seems to have proved that the opinion of Captain Wellsted is correct, that the sound is produced by the rolling down of the sand, put in motion by the wind, or by persons walking on its surface. Lieut. Newbold left Wadi For, on his visit to the Mountain of the Bell, on the 10th of June last. After two hours' riding, and a short walk of half an hour, he reached the place, which he describes as a bell-shaped hill, from 350 to 400 feet in height. On its western side, which faces the Red Sea, is a slope of about 80 feet, covered with a very fine quartzose sand, varying in depth from five or six inches to as many feet, according to the form of the sandstone rock which it covers. This is the spot whence the mysterious sounds issue. Not the slightest noise was heard; but their Arab guide, desiring them to wait still at the bottom of the slope, began to ascend the slope, sinking to his knees at every step. The travellers soon heard a faint sound, resembling the lower string of a violoncello slightly touched; and being disappointed at the result, determined to ascend themselves, in spite of the intense heat of the sun, and extreme fineness of the sand. On reaching the summit, they sat down to observe the effect. The particles of sand set in motion agitated not only those below them, but, though in a less degree, all around them, like the surface of water disturbed by a stone. In about two minutes they heard a rustling sound; and then the musical tone above alluded to, which gradually increased to that of a deep mellow church-bell, so loud that it rivalled the rumbling of distant thunder. This occurred when the whole surface was in motion; and the effect upon themselves the travellers compared to what they supposed might be felt by persons seated upon some enormous stringed instrument, while a bow was being slowly drawn over the chords. They descended while the sound was at its height; and soon after, it began to lessen with the motion of the sand, until at the end of a quarter of an hour, all was perfectly still. Lieut. Newbold remarked that the surface of the land was in every part traversed by waves, or furrows, from one to two inches in height; and, from the triangular form of the face of the slope, increasing in length as they got nearer the earth. He also noticed that the sand in motion, when near the top, produced shriller notes than when lower down; and consequently that the lowest notes were heard at the bottom. He appears from this to draw some analogy between the increasing length of the waves and that of the chords of a stringed instrument. While the experiment was making there was a steady breeze from the west, blowing against the surface of the sand; and this he considers essential to the production of the sound, it having been found that the sounds are much fainter in still weather, or even quite inaudible. When the weather is wet, no sound is produced, because the sand is then agglomerated, and will not slide at all. The paper concluded with a remark by Lieut. Newbold, on the singularity of the phenomenon, observing that he had seen in Spain, Arabia, and Egypt, many localities where loose sand had accumulated under circumstances apparently similar to those of Gibel Nakus, but where nothing has been heard of a similar nature: at the same time he regretted that leisure and opportunity had not admitted of an examination of the localities sufficiently minute to put the matter beyond doubt."

CHAPTER IV.

THE STETHOSCOPE.

The principles of acoustics, which have been explained and illustrated in the preceding chapter, served as a foundation for the discovery by which the illustrious Laennec so greatly enlarged the boundaries of medical science, and brought many of those diseases within the reach and ken of the medical practitioner, with which he previously did not possess the means of grappling. Among the long list of complaints with which the *stethoscope* makes us more thoroughly and intimately acquainted than heretofore, the diseases of the lungs and heart, numerous and complicated as they are, stand pre-eminent. Previous to his time, notwithstanding the continued and unremitting labours of his unwearied and talented predecessors, comparatively little was known respecting them. With the exception, perhaps, of inflammatory attacks, diseases of the lungs were ranked under the general name of phthisis pulmonalis; but few attempts having been made to classify them according to the portion of the parenchyma that was affected, or to the amount of disease existing. A similar remark may be made respecting disease of the central organ of the circulation. Structural alteration of the heart must have been nearly as frequent among our ancestry (allowing for the excitement produced by increased civilisation, and the greater exercise of the mental faculties) as at present; but, notwithstanding, little information was ever obtained from the symptoms during life; and the knowledge of the cause of death was not always gained by a *post-mortem* examination, owing to the prejudices which existed, and still exist, among the friends of the deceased. The examples of death occurring almost instantaneously were in all probability as frequent then; but until the labours of Laennec, Bayle, and Corvisart supplied the requisite information, cardiac disease was so rarely recognised, that the cause thereof was considered to be apoplexy, as it is far too often now. We owe the invention of the stethoscope to a case of diseased heart coming under the notice of Laennec; in which, from the extreme fatness of the subject, percussion, and the application of the hand, proved unavailing.

"In 1816," he says, "I was consulted by a young woman labouring under general symptoms of diseased heart, in whose case percussion, and the application of the hand, were of little avail, on account of the great degree of fatness. The other method just mentioned* being rendered inadmissible by the age and sex of the patient, I happened to recollect a simple and well-known fact in acoustics, and fancied at the same time that it might be turned to some use on the present occasion. The fact I allude to is the augmented impression of sound when conveyed through certain solid bodies; as when we hear the scratch of a pin at one end of a piece of wood, on applying the ear to the other. Immediately on this suggestion, I rolled a quire of paper into a kind of cylinder, and applied one end of it to the region of the heart, and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear. From this moment, I imagined that the circumstance might furnish means for enabling us to ascertain the character, not only of the action of the heart, but of every species of sound produced by the motion of all the thoracic viscera, and consequently for the exploration of the respiration, the voice, the rattle, and perhaps even

* That of immediate auscultation.

the fluctuation of fluid extravasated in the pleura or pericardium. With this conviction, I forthwith commenced at the Hospital Necker a series of observations, which have been continued to the present time. The consequence is, that I have been enabled to discover a set of new signs of diseases of the chest, for the most part certain, simple, and prominent, and calculated, perhaps, to render the diagnosis of the diseases of the lungs, heart, and pleura as decided and circumstantial as the indications furnished to the surgeon by the introduction of the finger, or sound, in the complaints wherein these are used.

" The first instrument which I used was a cylinder of paper, formed of three quires compactly rolled together, and kept in shape by paste. The longitudinal aperture, which is always left in the centre of paper thus rolled, led accidentally, in my hands, to an important discovery. This aperture is essential to the exploration of the voice. A cylinder without any aperture is best for the exploration of the heart. The same kind of instrument will indeed suffice for the respiration and rattle; but both these are more distinctly perceived by means of a cylinder which is perforated throughout, and excavated into somewhat of a funnel-shape at one of its extremities, to the depth of an inch and a half. The most dense bodies do not, as might have been expected from analogy, furnish the best materials for these instruments. Glass and metals, exclusively of their weight, and the sensation of cold occasioned by their application in winter, convey the sounds less distinctly than bodies of inferior density. Upon making this observation, which at first surprised me, I wished to give a trial to materials of the least possible density; and accordingly caused to be constructed a cylinder of goldbeater's skin inflated with air, and having the central aperture formed of pasteboard. This instrument I found to be inferior to all the others; as well from its communicating the sounds of the thoracic organs more imperfectly, as from its giving rise to foreign sounds, from the contact of the hand, &c.

"Bodies of a moderate density, such as paper, the lighter kinds of wood, or Indian cane, are those which I always found preferable to others. This result is perhaps in opposition to an axiom in physics; it has, nevertheless, appeared to me one which is invariable. In consequence of these various experiments, I now employ a cylinder of wood an inch and a half in diameter, and a foot long, perforated longitudinally by a bore three lines wide, and hollowed out into a funnel-shape to the depth of an inch and a half at one of its extremities. It is divided into two portions; partly for the convenience of carriage, and partly to permit its being used of half the usual length. The instrument in this form—that is, with the funnel-shaped extremity—is used in exploring the respiration and rattle; when applied to the exploration of the heart and the voice, it is converted into a simple tube, with thick sides, by inserting into its excavated extremity a stopper, or plug, traversed by a small aperture, and accurately adjusted to the excavation. This instrument I have denominated the stethoscope. The dimensions mentioned are not a matter of indifference. A greater diameter renders its exact application to certain parts of the chest impracticable; greater length renders its retention in exact apposition more difficult; and when shorter, it is not so easy to apply it to the axilla, while it exposes the physician too closely to the patient's breath, and besides frequently obliges him to assume an inconvenient posture—a thing above all others to be avoided, if we wish to observe accurately. The only case in which a shorter instrument is useful, is where the patient is sitting in a chair or in bed, with his back close to the chair-back or head-board."*

* Forbes' Translation of Laennec on Diseases of the Chest.

The opinion advanced by Laennec, that the central canal in the stethoscope is essential for the transmission of the pulmonic sounds, has been controverted by Dr. G. Budd, in the *Medical Gazette* for 1837; in which he has advanced an opinion that the solid material of the stethoscope is the sole conductor of sound, and that the advantage of the hollow is merely to give the solid a thinness and lightness which make it more susceptible of vibration. His opinion is supported by Dr. Cowan, who states that if one or both ends of a stethoscope are accurately closed with cork, the respiratory murmur is only very slightly weakened. Dr. Williams, and others, have repeated this experiment; and they affirm that, on the contrary, sound is impaired very considerably. "The experiment," Dr. Williams says, "may be more fairly tested on the flexible ear-tube, used as a stethoscope, which, according to my views, conveys sound almost entirely by its enclosed column of air; but, according to Drs. Budd and Cowan, it conducts only through its solid walls. *The cork here will be found almost wholly to intercept the sound.* With this instrument, too, I have often heard the sounds of the heart and of the voice, when the ear-piece is only approached to the ear, without contact. So, in like manner, with a common stethoscope, very loud cardial murmurs may sometimes be heard by placing the ear close to the ear-piece, without contact. In both these cases the transmission is *wholly prevented* by a plug in the tube. All these facts shew the important share which the column of air has in the conducting properties of the stethoscope."*

The original form of the stethoscope invented by Laennec, and described page 55, was not long adhered to; indeed, it would be difficult to find one now made exactly in accordance with his directions. As in the operation recently brought forward for the cure of squinting,

* Williams on the Chest.

almost every operator has had recourse to instruments and modifications of instruments (not always improvements) to assist him in its performance, so did almost every stethoscopist speedily leave the track beaten for him by his predecessor, and publish to an admiring world an instrument far superior in utility to the simple, rude stethoscope of Laennec. The shop of the surgical-instrument maker, accordingly, will exhibit a show of some twenty different kinds: long and short; made of one piece, or composed of several; jointed, or single; trumpet-shaped, or straight; with a flat ear-piece, or one shaped to fit into the external auditory passage, &c.; but all agreeing in this, that the material of which they are made is a light elastic wood—generally of cedar,—and that they are all possessed of a central canal, and a concave excavation at the end, destined to receive the sounds. Of the value of these improvements some idea may be formed from the fact that Dr. Williams, in a work on the Chest published only last year, gives an engraving of Laennec's stethoscope, only somewhat shorter, as one of the two best instruments for mediate auscultation now in use. He describes it as composed of a cylinder of a light, rigid wood, having in it a central canal, terminating at one end by a conical excavation, into which fits a plug by a flute-joint. The other end is slightly hollowed, and enlarged by a rim to fit comfortably to the ear. The length, he considers, should be about eight inches. The other he recommends is the trumpet-shaped one, which is generally preferable, on account of its lightness. The ear-piece slips on and off, for the sake of portability.

The stethoscope, when invented by Laennec, was applied by him to discover certain symptoms in pectoral and cardiac disease, which could previously be discovered but imperfectly by percussion, or by the naked ear. A marked improvement in diagnosis, and the classification of these diseases, speedily followed. As the instrument got into more general use, the more obscure râles and sounds of the heart were distinguished and traced to their respective sources. One grand step was thus taken in therapeutics; for to be able clearly to diagnosticate and classify a complaint, and ascertain its causes in the alteration of structure, is half the battle. The treatment of many of the diseases affecting the lungs has made equal progress. We are now enabled to separate many cases which were formerly set down as inveterate phthisis, and to bring them within the list of those that admit of cure; and although, as yet, but little has been done for the cure of genuine consumption, yet we may hope, as the result of a well-digested series of observations made by skilful practitioners, noting every circumstance bearing directly or indirectly on the complaint, that much may be done hereafter to modify, if not altogether to eradicate, this fearful scourge; that is, if more attention be paid to the general health, to which I have endeavoured to direct attention in several of my works. As yet but little has been done for the relief of disease of the heart, and it is much to be feared that but little can be effected; but what has been done is still a step in advance; and if nothing more had been the result of the use of the stethoscope, than the determining that many cases of sudden death, previously attributed to apoplexy, were really due to disease of the heart, by shewing the condition of that organ previously, and thus drawing attention to it when the autopsy was made,—still would its invention have proved a most important one.

The stethoscope was not long confined to rendering assistance in forming the diagnosis of diseased lungs and heart. Laennec himself was of opinion that it might be applied in cases of doubtful fracture, and of urinary calculi; and his judgment was admirably borne out by the experience of Lisfranc, whose experiments leave no doubt on this subject; so that, even in the most doubtful cases, precision may be obtained.

The peculiar noise produced by moving the two portions of a broken bone on each other, which is not at all times perceptible, and which is frequently masked by the large mass of muscles surrounding the broken part, or by the great swelling which so generally follows, can be readily distinguished by the aid of the stethoscope; and indeed, in many cases even the pressure of the instrument will elicit crepitus. In other cases, the sound will be heard more readily and more audibly than by the naked ear. The crepitus is loudest over the site of the fracture, and gradually diminishes in a due ratio to the distance from it; but it may be heard at a great distance from the fracture, when it is a long bone that is injured. When fluids are effused around the broken bone, a gurgling is also perceived, which is compared by M. Lisfranc to the sound produced by a shoe full of water. In cases of dislocation, the sound is dull and obscure.

When it is doubtful whether there exists a stone in the bladder, the catheter when passed producing a sound resembling it, the application of the stethoscope to the pubes, or sacrum, when the instrument is in the bladder, will enable the surgeon to form a correct judgment, and thus preclude all chance of needless operation, which, to the suffering patient, is a matter of high importance.* In abscesses and hydatids of the liver, and in diagnosticating the presence of biliary concretions, it is said to be also of service. Dropsy will be indicated by a distinct sense of fluctuation; while in tympanites, by tapping the abdominal parietes with the fingers, a sound like that of a drum at a distance is transmitted through the stethoscope. In cases where there are foreign bodies in the joints, it may be of use; as also in instances of water on the brain, when the fontanelles are in existence, or the sutures are

* Instances are on record where persons have been operated on, and no stone found in the bladder.

opened. Mr. Alcock has used it with advantage in cases of doubtful hydrocele.

One of the most important uses to which the stethoscope has been applied, is that of ascertaining the presence of a fœtus in the uterus, in cases of suspected or doubtful pregnancy. Instances of this kind are constantly occurring in practice, and occasion a great deal of trouble and annoyance to the practitioner, as it is at all times difficult to form an opinion in such cases, unaided by this valuable invention. As a matter of medical jurisprudence, again, it is not unfrequently requisite to pronounce a decided opinion when a woman pleads pregnancy in stay of execution. Here, again, the stethoscope steps in to aid the doubting accoucheur. Kergaradec was the first to publish the results of his experiments on this important subject; although it is said that Mayor, of Geneva, had previously had recourse to immediate auscultation with the same view, with advantage. By using the stethoscope, the ear assures us of the existence of pregnancy by detecting the following signs, which result from the presence of a child in the uterus: namely, the beating of the heart of the fœtus, the movements of the limbs, and the pulsations of the umbilical cord; in addition to which, there is a peculiar pulsation, resulting from the circulation of the blood in the uterus, and which is synchronous with the mother's pulse at the wrist.

The presence of twins may also be detected; but the discovery is not made with equal facility. The only certain sign results from the pulsations of the two hearts being distinguished in respective parts of the uterus. Naegele and Dubois state that the pulses in these cases are synchronous. The latter says, "Tous nos soins furent employés à rechercher quel était le rhythme des deux circulations; il nous a semblé qu'il existait un isochronisme parfait entre les pulsations des deux cœurs." Hohl, who auscultcd in a case of triplets, was unable to form a decided opinion as to the number of fœtuses present.

As the stethoscope has been found to be useful in so many instances, it would appear to be exceedingly extraordinary should it not be of service in aural surgery, the diseases of that organ being so intimately connected with sound and the atmospheric air. Accordingly, we find recommendations respecting its use in several authors; but unfortunately the stethoscope, as at present constructed, is very unfit for such a purpose. To remedy its defects, I have caused an instrument to be made, combining all its advantages, while at the same time the lower extremity, which is placed over the ear, is sufficiently large to cover it entirely, and applies so closely to the adjoining parts, as to exclude the external air. When I was at Paris, Deleau introduced to my notice several of his deaf and dumb patients, some of whom had recovered both hearing and speech under his care, while others were still under treatment. He examined the latter very carefully, applying his ear at the side of the head, in order that he might listen to and distinguish the sounds heard within the organ. I did the same at his request, and thus obtained the idea from which I was led to construct this instrument. This proceeding I was again requested to adopt latterly by Dr. Böehm, of Berlin, with whom I attended in consultation on an interesting case in that city, in which the information thus obtained proved of service in forming an opinion as to the nature of the disease.

Of this instrument, which I have called the Cephaloscope, I subjoin an engraving; from which it will be seen that it differs from the stethoscope chiefly in the greater size of the bowl.

Fig. 1 represents the instrument in its complete state. Fig. 2 is a plan of the bowl; and fig. 3 of the ear-piece. It is made entirely of wood, except the bowl and ear,

Fig. 1.

Fig. 2.

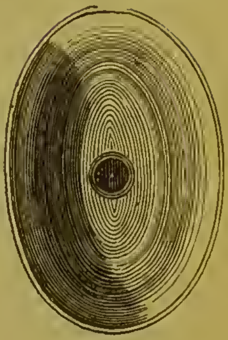


Fig. 3.

which are made of ivory, and are moveable. I have had this instrument registered, and not patented, as I am anxious that a good, well-made article should be supplied to the profession, instead of a fictitious implement of little value.*

In using it, it is requisite to apply the large oval bowl over the ear, on the part to be auscultcd, placing it on a complete level, so that the sounds heard through the central canal may not be confounded with those produced by the circumambient air. It should not be pressed too powerfully, lest it give pain, but held firmly, and the hand applied near the lower end of the instrument. Some persons are of opinion that it is necessary to possess a more than ordinarily fine sense of hearing to practise auscultation advantageously; but this is an error, for, by constant practice, the organ will be rendered so expert, as to catch the slightest variations of sound. As the space occupied by the organ of hearing is so exceedingly small, and its anatomical structure is so fine and so complicated, it will be evident that practice alone can enable the auscultator to distinguish correctly the normal and abnormal sounds heard in the organ. This should not prove a discouragement; while the same observation may be made on acoustic auscultation as was remarked by Laennec of that process in pregnancy,—" L'étude de ces phénomènes demande incomparablement plus d'attention que celle de tous ceux que présentent les maladies de la poitrine."

* The Cephaloscope may be obtained of Mr. Einsle, 46 St. Martin's Lane, London, surgical-instrument maker to the Royal Dispensary for Diseases of the Ear.

CHAPTER V.

THE CEPHALOSCOPE.

The diseases of the organ of hearing in which assistance can be derived from the use of the cephaloscope, are chiefly those of the intermediate ear, in which the resonance of sound takes place, comprising affections of the cavity of the tympanum, of the Eustachian tube, and of the mastoid cells.

Affections of the organ of hearing implicating audition are much more frequent than is generally anticipated; persons suffering from incipient deafness being willing and anxious to attribute their inability to hear correctly to a want of attention, or to pre-occupation, rather than to its real cause; at the same time the complaint, being less prominent than an affection of vision, is more disregarded by those who are not labouring under it. Their attention is less attracted to it, than it would be were the malady to shew itself by signs that could not be mistaken. Nevertheless, there can scarcely be conceived an individual more unhappy, as far as the physical senses are concerned, than one isolated by this calamity from the social intercourse of his friends and relatives. Incapacitated by the deprivation of this important sense from joining in the delights of conversation, from hearing the voice of affection or of friendship, the sufferer is cast back entirely upon his own resources, and becomes a hermit in the midst of society. Many affections of this organ, which terminate in irremediable deafness, admit of cure, or palliation, if placed under treatment at an early epoch.

It will be borne in mind that the function of hearing depends on the conveyance of sounds impinging against the external ear through the meatus auditorius to the membrane of the tympanum, where their action is exerted, causing vibrations to extend through the cavernous structure by the medium of the chain of small bones, and of the air contained in it, which enters through the Eustachian tube, to the expansion of the auditory nerve on the internal ear. It will be evident, therefore, that the influence of the external air must produce sounds which will be more or less audible through the medium of the cephaloscope, and the nature of which will serve to indicate the state of health or disease of the parts concerned.

An operation, originally introduced by M. Guyot, a postmaster at Versailles, an account of which will be found in my Treatise on the Ear, published in 1817, has been reproduced of late years under circumstances of a peculiar nature, for examining the condition of the Eustachian tube, the closure or narrowing of which is an occasional, though rare, cause of deafness. Averse as I am to operations involving risk of life,* when they can be avoided, I have not often had recourse to this proceeding, although I have now and then had occasion to employ catheterism. Occlusion of the Eustachian tube is the result, in most instances, of an inflammatory affection of the throat, and may be caused by scarlet or typhus fever, cynanche maligna, syphilis, &c.

* A case is recorded in the *Lancet* for December 25, 1841, in which this operation was performed on a schoolmaster at Barnstaple, in North Devon, in the previous August. Considerable excitement followed the operation; and on the third day, profuse hæmorrhage from the nose and diarrhœa supervened. Continuing to get worse, on the seventh day further advice was sought and obtained. The physician who was called in gave no hopes of recovery. On the tenth day the delirium increased, and the patient constantly exclaimed, "Pump the gas out of my head, which you have pumped into it! It is the gas which has done it!" He died the next morning. An inquest having been held, the physician who was called in, stated in evidence that the patient had died of inflammation of the brain—the operation shocked the nervous system; but, he added, decomposition was so far advanced, that the existence of recent inflammation could not be detected. He stated further that the operation was dangerous, and had caused death previously. It was like

The closure of the tube may be induced either by inflammatory action, or by the ulcerative process; but in either case the result is the same. The non-permeability of the tube produces deafness, inasmuch as the external air cannot enter the tympanic cavity through it, and the necessary vibrations of the membrane do not take place. This state will be readily discovered on the application of the cephaloscope. If the nostril on the opposite side is closed by a finger covered with the handkerchief, whilst the patient inspires forcibly through the other, the rushing of the air into the cavity of the tympanum will be very evident, if the tube is perfect. The contrary result, or a diminished sound, will indicate the occlusion, or a stricture of the canal. If any mucus should exist in the Eustachian tube, a gurgling like the mucous rattle will be perceived.

Diemerbroeck proposes the following means to find out an obstruction or obliteration of the tube. "When, after closing the ears, a violin-bow is taken between the teeth, and the strings of that instrument are touched with it, without the sound being heard, it is a sign," says he, "that the tubes are obstructed." This was also the opinion of Haller: "Another road," says this illustrious physiologist, "by which the air charged with sonorous oscillations may penetrate to the organ of hearing, is the Eustachian tube: in cold-blooded animals it is the principal road for sound." Lentin proposes the following plan to ascertain whether the tube is stopped:—To lay the head on a table with the affected ear uppermost, which he fills with tepid water, and stays some moments to see

firing an air-gun into the ear. The verdict was in accordance with the evidence.

Although I associated last year very freely with the principal medical men on the Continent, I met with very few, comparatively speaking, who practised this proceeding, or thought of it as a surgical operation worthy of commendation.

When catheterism has succeeded, it has been in cases of slight obstruction only.

if the tympanum is pierced or not: in the first case, the liquid will pass through the hole to the throat,—the patient is to close the mouth and nose, and press the inspired air; if the membrane of the tympanum is perforated, air-bubbles will arise on the surface of the water; but if it is perfect, the air introduced into the tube will cause the membrane to project towards the external passage, when as much water will come out of the ear as the convexity of this membrane has displaced: this circumstance supposes the tube to be free in its whole extent; if obstructed, the water will not flow over, nor will there be any air-bubbles. Lentin's reasoning does not appear to me so conclusive as he seems to believe; for, supposing the membrane to be entire and the tube free, and the water is thus forced out of the ear, how can we be assured whether it is from the impulsion of air against the membrane, or an involuntary movement of the head occasioned by the forced expiration?

Dr. Robbi, of Leipsic, who translated my treatise on the Ear into the German language, says, patients who labour under obstruction of the Eustachian tubes have by no means that disagreeeble feeling of the impression which is usually derived from the air forced by the tubes upon the membranæ tympani, when they fetch breath forcibly, the mouth and nose being shut up; they have a perpetual tingling in the ears, and it appears to them that there has been a sound without the ear, which they think they have heard; but the cause of this is, the air still shut up in the tympanum; and the best idea one can form of it is, by passing two fingers into the external passage, and thus preventing the possibility of this air escaping. Such persons hear better when there is much noise, than in quiet places.

The application of the cephaloscope over the mastoid cells will in like manner evidence their permeability and freedom from disease. The absence of sound in the tympanum after a blow on the side of the head, may be taken as an indication of the cavity being filled with blood, &c. The varied sounds resulting from morbid conditions of these parts cannot as yet be laid down with sufficient certainty, as numerous and repeated examples are required to admit of the due classification and arrangement of the symptoms and sounds which are heard. The cephaloscope will be found useful in cases of foreign bodies in the meatus auditorius, aiding the probe and the speculum in their discovery. It will shew, by the modification and deadness of the resonance of the sound in the meatus, the existence of the obstruction. Instances occur occasionally, where severe symptoms have arisen after the impaction of a foreign body in the meatus, which are supposed to result from its presence in the passage, and the cases have terminated fatally, when, on examination after death, no extraneous substance has been found. A case has been placed on record which bears out this assertion; it occurred some few years back in one of our London hospitals, and is doubtless in the recollection of many of my readers. A poor little boy, who had, by some accident, forced a nail into the meatus, was admitted as an in-patient, labouring under very severe symptoms, which had arisen after the accident. The surgeons proceeded to examine with the probe, &c., and finding a hard substance, deemed they had lighted on the head of the nail, and commenced efforts at extraction with the forceps, in which, however, they failed. The boy made great resistance. The nail could not be removed. The result was, the symptoms increased in severity; evident indications of inflammatory action in the brain followed, and the little unfortunate speedily sunk. After death, the ear was examined; there was not any nail, or portion of a nail, present; but considerable injury to the parts contained in the cavity of the tympanum had been effected. Had the operating surgeons possessed Grüber's speculum, and his illuminated auriscope, this fearful result would not have happened, and the poor boy's life might perhaps have been saved. With the former, the passage might have been gradually dilated and enlarged; whilst by the aid of the reflecting lens of the auriscope, so strong a light would have been thrown into the canal, as to give a clear and full view of the entire passage, and all parts connected with it. The absence of the extraneous substance would thus have been most readily ascertained, and the consequent sufferings of the little patient during the operation would have been spared. The treatment then indicated to check and remove the inflammatory action, which had already been set up, in consequence of the accident, would have been adopted, and would, in all human probability, have been successful in saving his life.

I first saw the illuminated auriscope during my visit to Vienna. In consequence of my being in professional attendance on the Princess L——, with Dr. Verity, the physician to the embassy at Paris, who accompanied a distinguished patient to Vienna, I was sent for to Mad. S——, who was then under the care of Dr. Grüber, a talented physician at Vienna. Dr. Charles de Schriebers, physician to the Emperor of Austria, met Dr. Grüber and myself in consultation on this case. She was labouring under otorrhœa. After a careful examination, I agreed with Dr. de Schriebers that there was not any ulcer, when, to convince me that I was in error, Dr. Grüber the same day produced his illuminated auriscope, threw a strong light into the auditory passage, and then dilating it with his speculum, shewed me a small ulcer, situated deeply on the side of the membrane, which could not be detected by any other means.* I have since had occasion to use this

* This instrument and the speculum, as well as other instruments, are fully described in my last work on Aural Surgery. The auriscope

auriscope in daily practice, and have derived much advantage from it. I am indebted to Dr. Grüber for many other kindnesses and attentions; he gave me much information, introduced me to the principal physicians, and kindly accompanied me, when I went over and examined the hospitals, with the arrangements of which I was exceedingly pleased. I had the satisfaction, when at Vienna, of seeing Professor Dieffenbach perform several surgical operations, which he did in a masterly manner.

The invention of the auriscope reflects great credit on Dr. Grüber; but the idea is by no means novel, as will appear on reference to an interesting paper, written many years since, by Mr. Cleland, surgeon to General Wade's regiment of horse, and which I have quoted in my Essay on the Deaf and Dumb. He employed a convex glass, three inches in diameter, fixed in a handle, in which is lodged a piece of wax candle, which comes out of a hole near the glass, and reaches to the centre; when illumined, the collected rays of light are thrown to the bottom of the meatus, and its condition is then disclosed to the careful examiner.

Cases are sometimes met with in which, from the improper use of acoustic instruments, or from a sudden and very loud noise, the membrana tympani is rendered concavo-convex in an improper sense. To remedy this, I have constructed a bag of caoutchouc, with a large ivory bowl, or concavity, attached to it, and pierced in its centre with an aperture communicating with the interior of the caoutchouc bag, to which I have given the name of the Musoton. By emptying the bag of the air contained in it, and then applying the concavity over the ear, such a force will be exerted in filling it again with air, that the membrane will be drawn out, and restored to its natural condition.

consists of a lamp, the rays of light from which are thrown into the meatus by means of two powerful lenses.

The above engraving represents the instrument, which I have had constructed to remedy the abnormal position of the membrana tympani. The bowl resembles that of the cephaloscope, as will be easily seen by a reference to the engraving of that instrument, and it is connected to the caoutchouc bag by a long ivory nipple on its upper surface, on which the caoutchouc is securely fastened. When applied over the ear, it is perfectly air-tight, the ivory bowl being cut expressly to fit the shape of the parts circumjacent to the auricle. I have used it occasionally also for dry cupping, and it has proved very efficient for that purpose.

The principal use of the cephaloscope will be, as I conceive, in its applicability in ascertaining the state of the parts concerned in hearing in those born deaf and dumb. I have for years past contended that many cases of the deaf and dumb, consigned to an asylum for education, and not for medical relief, admit of palliation, if not of cure. In the year 1817, I addressed a letter to the governors of the Deaf and Dumb Asylum in London, urging the necessity of appointing some aurist to examine the state of the organ in all cases previous to admission; as it is far preferable to effect a cure, than to make the unfortunate an object of charity. In this I failed; but the subject has latterly excited great attention on the Continent, where it will be the means of doing much good.* The cephaloscope, in shewing whether there is a free circulation of air in the tympanum, and a consequent opportunity for the necessary vibrations, will aid materially in forming a diagnosis.†

The causes of congenital deafness are so numerous, and many of them so obscure, that it is difficult, and perhaps impossible, to give an exact and complete account of them.

In the first place, the acoustic nerve itself may be absent *ab origine:* this has been proved to be the case in some instances, but is not a very frequent occurrence. It is evident, that deafness must be the consequence of the want of so essential a part of the auditory apparatus. This nerve may be under such pressure in the interior of

* Vide my work, entitled "The Present State of Aural Surgery," second edition.

† Mr. Swan thinks that the reason why those who are born deaf, and who are consequently dumb, are not more frequently able to acquire a degree of perfection in hearing is, because their whole attention is taken up with signs; and no methods are generally used to increase the power of the provision usually made by nature for supplying the defects occasioned by imperfections of the tympanum.

the skull, either at its origin or in its course, as to prevent the nervous influence, and so intercept all communication between the organ and the brain. The diagnosis in these cases is so much the more difficult, as the source of the malady is profound and concealed.

Although the auricular portion of the external ear is a very useful part, and tends to perfect the organ, yet it is not of such great importance as to produce total deafness by any disease to which it is liable; provided all the other parts are in a proper state, absolute deafness would not be the consequence of the absence of this portion: affections of the meatus externus are more serious in their results, and frequently prevent hearing; and if they occur before birth, or in the early months after birth, and are not cured, dumbness will be inevitable. The most frequent causes of deafness and dumbness in young children are, obstructions of the Eustachian tube, viscid mucus impacted in the meatus, herpetic eruptions, which so often afflict children at birth or at the time of teething; also fever, measles, small-pox, syphilis, &c.: besides these sources, there are various affections of the membrane of the tympanum. This membrane in new-born infants, says M. Leschevin, is covered, on the side next the external passage, with a very thick, spongy membrane, which falls off after suppuration,—if it remain fastened to that part of the tympanum, it is certain that it will occasion deafness. M. Portal raises doubts as to the existence of this membrane—it is not possible, he says, to be assured of this fact in infancy. The suppuration, it is said, is almost imperceptible; besides, when it takes place, the pus must be so mixed with the cerumen of the ears, that it would be difficult to distinguish it. In order to remove all doubts upon this subject, the infant should be constantly under the eye of a surgeon, who might examine the nature of the cerumen, which, during the suppuration, is altered from its natural colour, and has an unpleasant odour. But, adds the author, all these observations are difficult to make—it may be said impossible, because so many circumstances oppose it. It is necessary to wait a short time, when the child will shew whether it hears or not.

The whole outer wall of the cavity of the tympanum has been found wanting in a monstrous fœtus. Hyrtl, who mentions the case, says that the cavity of the tympanum itself was represented only by a very shallow depression in the petrous bone, in which the lining of the auditory passage formed a cul-de-sac. The Eustachian tube was present. The membrana tympani has been sometimes found congenitally too large, sometimes too small, sometimes elongated, and sometimes triangular.

Mons. Saissy observes, the membrane of the tympanum may be covered, on the side of the auditory passage, with a spongy pellicle, in consequence of some inflammation, connected with a polypus which implants itself on its external part. It may be relaxed, and project into the tympanic cavity; sometimes it is too tight, inflamed, ossified, cartilaginous, wanting in part, or entirely absent.

It is not long since, says Rusenthal, "that I had an opportunity of examining the body of a deaf and dumb subject, who had become so in consequence of the small-pox. I found this membrane relaxed, and thicker than usual; the auditory nerve appeared also a little harder:—but on the whole, the parts of the internal ear were well formed."

There are various affections of the membrane of the tympanum, involving diseases of its cavity, its bones and muscles, likewise affections of the labyrinth, mastoid cells, tumours, polypi, morbid septa of the passage, &c.

From the formation of the ear, it is obvious that, in order to the proper exercise of the sense of hearing, all parts of the organ must duly perform their functions, in the reception, the concentration, and the percussion or action of sound on the auditory nerve; when there is an imperfection in any one part, hearing must be either defective, or entirely suspended, according as the part of the organ is more or less of primary importance to the influence of sound. In cases of deaf and dumb, if the error lie in the external ear, it will be obvious on inspection; if in the intermediate ear, it will be nearly the same: it is only, therefore, in its connexion with the Eustachian tube, and in the internal ear, that the imperfection is liable to be overlooked. We find that in many children and grown persons deafness has taken place from previous affections of the throat influencing the state of the Eustachian tube, and that this deafness has continued till some means of restoring the healthy state of the throat and ear have been employed.

It may be safely affirmed, that in a considerable proportion of the deaf and dumb, this tube is either impervious from original malformation, or has been rendered so by viscid secretions plugging up the orifice. This tube forms a slender pipe, merely sufficient for the passage of air leading from the cavity of the tympanum, exactly the same in use as the hole in a drum; the membrane of the tympanum being the drum-head, and liable, like it, to tension and relaxation. Though every other part of the ear be perfect, as generally appears in deaf and dumb persons on dissection, yet if this perforation of the Eustachian tube be wanting, the organ either cannot act, or but imperfectly, and that only by strong excitement from loud sounds, as the report of a gun, &c. It has been already noticed, that deafness has followed an affection of the throat both in syphilis and simple inflammatory cases, producing cohesion of the sides of the Eustachian tube during the febrile process; and did not this happen when speech is perfect, dumbness would be the natural result. This might be inferred from what we know of the important use of the passage, but it is fully confirmed by experience,—a fact not less important than obvious.

The following interesting case of original deafness was communicated some years ago by the late Dr. Haighton, of Guy's Hospital, to the Medical Society of London, and afterwards published. This case, from the known character of the author, and the important and satisfactory reasoning contained therein, deserves our attention.

The doctor commences by observing, that the vital parts and the organs of sense are more perfectly formed, and exist in a higher degree of perfection at the time of birth than the other parts of the body. The necessity of this is very obvious; for if the former were not at this period formed in some degree of perfection, they would be unfit for performing those offices which are absolutely necessary for the preservation of life. The different organs of sense are also very perfectly constructed, that they may be the more able to receive those various impressions which every surrounding object is ready to make on the new-born infant, and which, being conveyed to the mind, produce what is called perception. As soon as the mind becomes furnished with a variety of perceptions, it begins to employ itself in comparing them with each other, by which it discovers their agreement or disagreement: this is called judgment. But before the mind can exert itself in acts of judgment, it must be well stored with a variety of perceptions: to this end it is expedient that the different organs of sense convey faithfully to it such impressions as may be made on them; but when, either from disease, accident, or original malconformation, they are unable to discharge that office, the mind is deprived of a part of its materials, its operations become proportionally circumscribed, and its attainments impeded. Original blindness has always been considered as a misfortune, because it keeps us in total ignorance of every thing relative to colour, confines our knowledge of the situation of places, and unfits us for most of the common employments of life. But original deafness places a person in a still more pitiable situation,—he is unavoidably dumb; for in order to speak, it is necessary to learn a language, and to learn a language it is necessary to hear. But to form a just idea of his calamity, we need only reflect on the very great loss he sustains from being deprived of the lights of education, and of the knowledge of many important truths inseparably connected with his happiness. It would be a god-like act to relieve a fellow-creature from such a state of wretchedness; it would be, in effect, elevating his mind from a low, grovelling state, to the condition of a rational being. But this is an arduous work!—I wish the circumstances of the present case had been such as admitted even of palliation; this paper would then not only have had the merit of explaining one of the causes of deafness, but afterwards of suggesting the most probable means of affording relief. But even this has been denied. I must therefore content myself with laying before you, in as clear a manner as I am able, the appearances which presented themselves on dissection, and subjoining such remarks as the circumstances furnished me with.

Mr. B. died when he was about thirty years of age. Having been deaf from his birth, he was consequently dumb. He possessed but little originality of genius, and his intellectual powers were very limited; but he was not destitute of talents for imitation. He frequently employed himself in drawing patterns for needle-work, and generally executed them with great exactness. He has shewn me several of his productions. I have occasionally conversed with him in his own way upon ordinary occurrences; and though he often made inquiries, they were always trifling, and such as indicated a very confined understanding. His disposition was naturally irascible, but his conduct was neither vicious nor immoral. While he was lamenting his situation, during the illness of which he died, his friends attempted to console him on religious grounds; they endeavoured to impress his mind with the necessity of patience, and an entire resignation to the will of the Deity, whom they represented as the author of his sufferings: but so little light had his mind received concerning natural or revealed religion, and the relation subsisting between the Creator and creature, that he put himself into a violent fit of anger, which was with difficulty appeased. After death, Dr. Walshman, who had attended him during his illness, very obligingly gave Mr. Cline and myself an opportunity of examining the parts concerned.

Appearances on dissection.—The brain, which was carefully examined, exhibited nothing peculiar, nor did any thing worthy of notice occur, until, in the order of examination, we arrived at the seventh pair of nerves, which, from its function, is called auditory. This nerve consists of two portions, one of which is called portio dura from its firmness, but its connexion with the sense of hearing is somewhat remote: the other is called portio mollis, and is very properly considered the true auditory nerve. This last portion was remarkably small; it did not appear to be half its usual size; but the portio dura seemed in every respect natural. Having taken out the temporal bones, in order to examine the parts more at leisure, we found nothing preternatural in the meatus auditorius, membrana tympani, the cavity of the tympanum, or the two apertures leading from it, viz. the Eustachian tube, and the communication with the mastoid cells. The figure of the four bones of the tympanum was natural, and their relative situation very proper. The first of them, called malleus, was attached, as usual, by its manubrium to the membrana tympani; and the last, called stapes, had its basis resting on the entrance of the vestibulum, called the fenestra ovalis. Every appearance hitherto was natural. The sole cause of deafness was found in the labyrinth. This part of the organ, consisting of the vestibulum, cochlea, and semi-circular canals, was perfectly formed; but instead of containing water, was filled with a solid, caseous substance. This was the only preternatural appearance, and I believe will be very sufficient to explain the case, when we consider the economy of this organ. With this view, permit me to subjoin a few remarks.

Remarks.—The organ of hearing, instead of being divided into external and internal, may, perhaps, with more propriety, be distinguished into parts preparatory to the impression of sound, and parts more immediately subservient. Under the first class may be ranked every part except the labyrinth, as the meatus auditorius, membrana tympani, the cavity of the tympanum, with its apertures and contents. Under the last class may be considered the labyrinth and its contents. In the present case, the first of these classes appeared very perfect; the meatus auditorius conveyed the tremulous motions of the air to the membrana tympani, which again, by the communication of the malleus, incus, os orbiculare, and the stapes, conveyed those movements to the labyrinth. The Eustachian tube, being pervious throughout its length, performed its office, viz. that of preserving the balance between the air on the outside of the membrana tympani, and that in the cavity of the tympanum, by which means that membrane is allowed to vibrate in a more perfect manner. It is not altogether certain, that an obstructed Eustachian tube will produce total deafness, though it may diminish that sense in a very high degree, in proportion as the freedom of vibration of the membrana tympani is impeded. But if it could be clearly proved, that a total deafness arose from this cause, and if it were also possible to ascertain this in a living subject, there is a probability of obtaining relief from an operation. The most natural idea in such a case would be to restore the natural opening by the introduction of instruments up the nose. But the distant situation of the orifice of this tube from the entrance of the nostril, together with its being out of sight, create a difficulty; and it is probable that our attempts in this way might be in vain. There remains, however, another expedient. It is well known, that the mastoid process of the temporal bone is internally composed of large cells, which have an opening of communication with the cavity of the tympanum, in a manner similar to that of the Eustachian tube: in such a case, a perforation might be made into that process, and the communication between the external and internal air be again restored. But in the present case even this was a lost hope! The evil here was deeper seated,—the labyrinth was the part which alone was concerned in the complaint. Not that it failed in the performance of its office from any imperfection in its form, but merely from the nature of its contents.

Before the time of Cotunnus, this part of the ear was supposed to contain air. It was that fluid which was thought to be put into motion by sonorous bodies, and which, by pressing against the auditory nerve lining that cavity, produced the sense of hearing. The investigations of this anatomist have placed that matter in a clear light, and have shewn that, instead of air, it contains water. In the year 1761, he published a treatise at Naples, under the following title, *De Aquæductibus Auris humanæ internæ*, in which he proved that there is no air contained in the labyrinth, and that its natural content is water; but he does not seem to have had the clearest idea of the source of this fluid. He imagined that the two canals which pass from the labyrinth to the inside of the cranium, called aquæductus vestibuli and aquæductus cochleæ, conveyed this fluid from the inside of the cranium into the labyrinth. But Dr. Meckel, the present professor of anatomy at Halle, has shewn, with more probability, that these canals serve as outlets, and that their true office is to prevent a surcharge. The labyrinth, besides being lined by an expansion of the auditory nerve, is likewise furnished with a very vascular membrane, probably for the purpose of secreting this water. But, whatever opinions may be formed on this point, it is demonstrable that water is the proper fluid of this part, and that by its means the vibrations of sonorous bodies are conveyed with greater force to the auditory nerve than can possibly be done by the lighter fluid, air. For although both air and water are, from their fluidity, capable of having a very perfect intestinal motion excited in them, yet the force with which these fluids strike against the nerve will be in proportion to their respective densities. But in the present case there was no fluid of any kind; its place was supplied by a solid substance, which, being incapable of receiving so perfect a vibratory motion, was unable to produce its proper effect on the immediate organ.

In recording the appearances on dissection, the diminished size of the auditory nerve was noticed. Is this to be considered as a cause of deafness, or as an effect? I should imagine the latter. For if it were the cause, we should naturally expect the effect to be in proportion, and, instead of a total deafness, there should have been only a partial one. It is most probable that its connexion, in this case, is only an effect; for it is a law in the animal economy, that parts increase in bulk from moderate use, and become diminished from the want of it. This is very evident in the muscles, where, from a diseased joint, which prevents motion, the whole limb is observed to shrink. I have known the same thing take place in the optic nerve, where there had been an accidental blindness. I should therefore consider this as the effect, and not the cause.*

* Transactions of the Medical Society of London, vol. iii.

The dumbness which is in every instance the attendant on congenital deafness, and not unfrequently on deafness occurring from acquired causes in early infancy, does not result from any defect of structure in the vocal apparatus, but because sound not producing its natural and proper effect on the auditory nerve, the little patient is unable to bring his voice into use, the faculty of imitation not being called into operation.* If the child could hear, it would soon learn to speak; as has been clearly evidenced in those instances of the deaf and dumb where the hearing has been restored: being able to distinguish articulate sounds, it would soon obtain the power of giving them utterance. A reference to the anatomical description of the parts concerned in the production of the voice will shew that they are less minute and intricate in their structure than is the organ of hearing, and consequently are far less liable to structural deficiency.

In a word, then, I have reason to believe, from the

* The art of speaking well has in most civilised countries been a cherished mark of distinction between the elevated and the humble conditions of life, and has been immediately connected with some of the greater labours of ambition and taste.

"The Greek and Roman rhetoricians, and writers on music, have recorded their knowledge of the functions of the voice. They distinguished its different qualities by such terms as hard, smooth, sharp, clear, hoarse, full, slender, flowing, flexible, shrill, and austere. They knew the time of the voice, and had a view to its quantities in pronunciation. They gave to loud and soft appropriate places in speech. They perceived the existence of pitch, or variation of high and low; and noted further, that the rise and fall in speaking are made by a *concrete* or continuous slide of the voice. This *concrete* sound was by them contradistinguished from the change of pitch produced on musical instruments, which consists in a rise or fall to other places of pitch, without the continuous junction of the slide. This was called *discrete* sound. * * * The cultivation of the art of speaking was conducted altogether by imitation; and the means of improvement were not reduced to any precise or available directions of art."—*Rush on the Human Voice—Philadelphia.*

results of my experiments, that, when time and experience have given sanction to the results, and confidence to the auscultator, the cephaloscope will be found as useful in discovering the state of the diseased organ of hearing, as the stethoscope has been in diseases of the chest; but from the greater degree of minuteness, and the complicated structure of the organ of audition, more care, more time, and more experience, will be required in attaining precision.

It is also possible that in cases of hydrocephalus, in mania, aneurism within the head, and other cerebral diseases, it would be of service; and I am of opinion that there are many cases of disease in other parts of the body, in which, from the great size of the bowl, it would prove more applicable than the ordinary stethoscope. I have presented the instrument to the Royal and several other learned societies, which have accorded it their approbation, and returned me their thanks.

CASES.

Mrs. G——, the widow of an officer in the army, had been deaf four or five years. She suffered from tinnitus aurium, which presented symptoms indicative of a nervous affection; the weaker noises being produced, such as the blowing of wind and the rustling of leaves, accompanied by lowness and great depression of spirits. She had been under the care of a surgeon, who had treated her for an obstruction of the Eustachian tube of the left side, which she was supposed to labour under. She had been recommended to have the passage catheterised, and the air-pump used for the inflation of the canal; but she could not be induced to submit to the operation. In consequence of the professional opinion she had thus obtained, I was the more anxious to ascertain the state of the canal by means of the cephaloscope; and which I accordingly carried into execution at once. On applying the instrument over the ear, I directed her to close the nostrils and mouth, when the lungs were full of air, and then endeavour forcibly to expire. After two or three attempts, she succeeded in inflating the tympanic cavity, and I could distinctly hear the rush of air. There was not any obstruction, consequently, in the tube. I accordingly employed successfully the usual means for the removal of the deafness, which I looked upon as resulting from a diminished state of nervous energy; and by the use of the arnica montana and imperatoria ostruthium, I also cured her of the tinnitus.

Capt. W—— had been afflicted with deafness, of a greater or less degree, for the last seven years, following a severe attack of fever and cold. The complaint was attended occasionally with a profuse discharge from both ears, which had a disagreeable smell or fœtor, and occasioned him great annoyance. The otorrhœa came in part from the cavity of the tympanum, as I afterwards ascertained; and from his experiencing a most unpleasant taste in the mouth at times, I was led to believe that it passed into the pharynx through the Eustachian tube, and might in part have lodged there, narrowing the canal. The discharge from the meatus was cured by a solution of the lapis divinus; but the deafness continuing, I examined the ear with the aid of the speculum and illuminated auriscope, and ascertained that there was a small central perforation in each membrana tympani, and the membrane itself had been drawn inwards, and was adherent to the internal lining of the cavity. I then had recourse to the Musoton; by exhausting the instrument, and causing it to be re-inflated when over the ear, and repeating the process, I was enabled to break the adhesion, and restore the membrane to its proper situation. He could then inflate the cavity and distend the membrane, which before he could not do. I afterwards discovered, by the cephaloscope, that there was neither stricture nor occlusion of the Eustachian tube. The hearing was ameliorated considerably by these operations; but again and again was worse afterwards, when the membrane of the tympanum adhered to the internal lining. By closing the mouth and nose, and making a gentle expiration, the cavity became inflated, the membrane detached, and the hearing again restored; and by repeating that process, advantage was always the result. He can now perform it at will, which previously was beyond his power.

Miss D——, aged 16, a young lady from the country, the daughter of a medical man, had been deaf for four years, following an attack of cynanche tonsillaris, attended with fever. She was otherwise in good health. The tonsils on each side, and the uvula, were relaxed and enlarged; for which I prescribed a gargle of decoction of oak-bark and alum, by which they were restored to their pristine condition. By means of the cephaloscope, I ascertained the existence of obstruction in the left Eustachian tube, the right being free; but by continuing the process adopted to test the state of the tube, it was cleared, and the cavity of the tympanum inflated. The hearing was afterwards restored by the usual remedies. In fact, it is not an unusual thing for persons to hear immediately after the tube has been cleared; for the fact has been mentioned by Dr. James Sims, in the Transactions of the Medical Society of London, as I have stated in my work on the Ear.

Eliza Richards, aged 21, a single woman, by employment a dress-maker, of a delicate constitution, applied at the Dispensary Nov. 9, 1841, labouring under deafness, the result of typhus fever, which had existed about three years before. The cephaloscope was applied over the ear, and she was directed to close her mouth and nose, when the lungs were distended with air, and then endeavour to expel the breath. The sounds indicated a slight obstruction of the Eustachian tubes, which was gradually overcome by the repetition of the process just mentioned, and the hearing consequently improved.

Several interesting cases of obstruction of these tubes are detailed by Dr. Sims, in the Transactions of the Medical Society of London, in which great relief was obtained by practising these attempts to dilate the tubes. He says: "In the summer of 1773, I was desired to visit a young gentleman in Fenchurch Street, who, from having taken cold, had been seized with deafness about three weeks before. The disorder was at first attended with feverishness, and some degree of inflammation about the tonsils, for which he had been bled. The other symptoms of the case, such as an eruption upon his face of a leprous appearance, which afterwards yielded to the Æthiopic pill, are not necessary to be related here; let it suffice to say, that on the morning before my first visit he had been perfectly restored to hearing by a violent fit of sneezing, his ears giving a loud crack at the same time. That a stoppage of the Eustachian tube might occasion a deafness, I did not doubt, from having frequently observed, both in myself and others, the hearing injured for a short time during colds, together with a noise in the ears, which usually went off on their giving a smart crack; but that this might be so permanent as in the following case, and yet still be remediable, I must own did not fall within my conception; I shall therefore relate it circumstantially, as given to me by the gentleman himself, the application of it seeming very important in medicine:— Mr. Robert Stephens, a student of medicine, of a strong make, and about twenty-one years of age, on his return, in the month of April 1770, from Edinburgh to Ireland, embarked at Greenock in a small vessel; and as there were a great number of passengers, he suffered many inconveniencies during the voyage, which proved very tedious. When at sea, they were becalmed in such a situation as rendered it equally inconvenient to turn back or proceed; making choice, however, of the latter, they endeavoured to hasten their arrival at Belfast, by towing the vessel with the long-boat. This employed them, by turns, for three days and as many nights, during which time Mr. Stephens was often violently heated, and afterwards much exposed to cold. Being an unexperienced sailor, he neglected applying to spirits, their nostrum in such circumstances, of which imprudence he began to find the effects before his departure from the vessel, being seized with a very severe fit of the rheumatism, which lasted many months. Eight or ten days after his arrival in Ireland, he was seized with an inflammation of the tonsils that almost threatened strangulation; nothing could be swallowed but thin diluting liquors, even thick water-gruel not finding a passage downwards without the most exquisite pain, and the least motion of the glottis in swallowing the saliva being attended with such torture, that the remotest member of the body felt its effect. For three days it had the appearance of suppurating, but on the fourth it subsided so much that he had recourse to his usual manner of life. Immediately after its abating, he perceived his hearing begin to decrease, with a prodigious noise in his ears, which continued for three weeks, until it brought him to such a situation that he could not hear common conversation; or even when spoken to in a louder voice, he lost the half of what was said, from the impression of the first sound remaining so long upon his ear as to render the following ones indistinct. Under these disagreeable circumstances he continued a whole year, during which he tried blisters, syringing, and every thing that could be thought of, both by himself and some very eminent physicians whom he consulted, without receiving the least advantage. His patience was at length quite exhausted, and he resolved to resign himself to his fate, and lay aside the use of all applications, thinking that they clogged his ears, and rendered sounds more confused. In this state of inactivity and despondence he continued two months, without perceiving the least alteration, until at last fortune, who often bestows upon us those good gifts that reason and forecast have in vain sought for, cast a person in his way whose daughter had suffered under the like calamity for a space of time he does not at present recollect, and whose hearing had been luckily restored in a very simple and unexpected manner. Her nose happening to be stopped by a cold that hindered the intercourse of air through that organ, to rid herself of this inconvenience, and make a passage for it by that way, she closed her mouth, and applying her fingers to her nose, made a violent effort to emit her breath, when, instead of procuring a passage through her nose, she found one into her ears, which occasioned each to crack like a pistol. The experiment was attended with so little trouble, that he made the trial in the same manner; but, after many attempts, it proved unsuccessful. Loath, however, to remain in that melancholy state, which is so remarkably the lot of deafness, he at last made some little alteration in his method, and, to his inexpressible joy, it had the desired effect: instead of filling his mouth with air, he kept his lips closely pressed to his gums and teeth; this made the air exert itself in full force about the entrance into the larynx, and the first trial with these alterations succeeded with one ear. In twenty-four hours, during which time his many anxious efforts to recover so valuable a blessing may be more easily conceived than expressed, the like success attended him with the other ear. For the space of three days afterwards, he was obliged to avoid all company, on account of the disagreeable impression each sound made upon his ears. He could hear distinctly a whisper from a distant part of a room, frequent trials of that kind having been made to prove the reality of the cure; he has ever since enjoyed as usual that inestimable faculty.

"From the circumstances of this case, the situation of the disorder in the Eustachian tube was evident; and the extraordinary and unexpected cure roused my attention in the highest degree. I must own that the almost magical manner in which it was performed caught my fancy so much, that I obliged all my deaf patients to make efforts similar to those described in this case; the natural consequence of which was, that I failed in vast numbers of instances where the disease was not situated in the Eustachian tube. One good, however, resulted from these indiscriminate trials; which was, that I became able, in a considerable degree, to point out the characteristic differences between it and the other kinds of deafness. . . . A beautiful young lady, sister to an ingenious surgeon of this town, had been deaf to a considerable degree for above two years. From a thorough conviction of the seat of the disorder, I strongly recommended the foregoing method, and got her brother to second my persuasions. The consequence was, that she appeared at first perfectly cured; but I find that the complaint has since repeatedly returned. She is, however, always considerably relieved by the same method as the first . . .

"Perseverance in repeating the efforts is very requisite in this way; in the same manner as we see in reducing hernia, or in child-bearing, a number of efforts succeed, any one of which singly appears of no service whatever. Considerable force is likewise requisite; indeed, I always order the force to be increased until the air is found to rush against the membrana tympani, and to give pain. In cases where only one ear is originally affected, I think it best to stop the other one with wax externally, or some other soft adhesive substance, whilst using the efforts to expel the breath, lest their violence might rupture the membrane of the tympanum of that ear in which the tube is free, or at least give it considerable and unnecessary pain. Where the deafness has been of long standing, if the efforts made in this way do not succeed at first, I think it best to have recourse to blisters, or some of the methods which are ordinarily employed for emptying the vessels of the tube; after which, the efforts are renewed at times with superior efficacy."

Mr. W——, who had been under treatment for obstruction of both Eustachian tubes, had the cephaloscope applied to test their condition. A degree of obstruction was discovered, which was removed by the repeated renewals of attempts to inflate the tympanic cavity. His hearing was perfectly restored, after he had been deaf three years.

Many patients, indeed, both of those in attendance at the Dispensary, and others whom I have seen in private practice, in whom an incomplete obstruction of these tubes has been demonstrated by the cephaloscope, have recovered their hearing without there existing a necessity for any other measures than the repeated practice of the attempts at inflation.

Henry Bull, a Dispensary patient, three years and a half old, was born deaf, and was consequently dumb. On examination of the external meatus and of the throat, the parts were found to be normal; and the cephaloscope demonstrated, on its application, that the Eustachian tubes were clear, the noise resulting from the rushing of air into the tympanic cavity being readily perceptible. He has been under treatment about three months: he can now hear when spoken to, attempts to talk, and can say a few words. The tartarised antimony ointment was applied behind the ears in this case with advantage.

William Mallet, aged 12, a Dispensary patient. When he was two years old, he was attacked with brain fever, which resulted in deprivation of hearing, and the loss of that speech he had previously acquired.

He has been a patient at the Dispensary for some time; and at his first attendance the ears were well syringed, and afterwards stimulant and rubefacient applications were directed. By the use of these remedies he has derived considerable advantage; and this day, Nov. 10th, 1841, his mother expressed to me her gratitude for the benefit he had received. I then examined the tubes with the aid of the cephaloscope; at first he did not succeed in impelling the air against the membranes, but he was ultimately successful.

Edward Jackson, a lad about thirteen years of age, was born deaf and dumb, so far that at the age of three he was able to pronounce his father's Christian name, Benjamin, and that only. He has been a patient at the Dispensary some time, at different periods. I saw him this day, Nov. 9th: he has recovered his hearing and speech; but it must be acknowledged that, from the length of time that he has been deaf, there are some words he has great difficulty in pronouncing. On examining the intermediate ear with the cephaloscope, the tubes were ascertained to be clear, and the cavity of the tympanum resonant.

Emily Smith, aged 5, an interesting little child, was born deaf and dumb. On Nov. 9 the cephaloscope was tried, and the permeability of the Eustachian tubes clearly demonstrated. The child has been subjected to the usual treatment, and with advantage. She can now hear a little, and tries to speak. She is improving daily.

For information on the particular treatment of these diseases, I must refer my readers to my "Essay on the Deaf and Dumb," my "Treatise on the Physiology and Pathology of the Ear," and my late work on the "Present State of Aural Surgery."

CONCLUSION.

Half the battle is gained by the professor of the medical art when he has detected the causes of the disease he is called upon to combat; as by so doing he will be placed in the only track by which the due and requisite treatment can be ascertained, and the cure consequently rendered a matter of greater probability. The truth of this statement must be so evident, as to place it at once far beyond the possibility of a controversy. With this view, in so far as regards the department of aural surgery, the instruments which I have described in this work have been invented. With their aid we are rendered cognisant of the causes of several maladies of the organ of hearing with which we were previously unacquainted; and are, by their assistance, consequently enabled to form a more correct and decided diagnosis and prognosis. By means of the speculum and illuminated auriscope of Grüber, we are enabled to examine the external auditory passage; and, with the aid of the cephaloscope, the state of the intermediate ear is laid open before us; so that the only portion still left in darkness consists of that in which the expansion of the acoustic nerve is contained. In other words, the diseases of the ear at present involved in obscurity are those of a nervous character; the treatment of which has been much improved of late years, owing equally, perhaps, to the results of the investigations into the nature of the nervous influence, and into the proper physiology of the organ; so that we may venture to express a hope that ere long these complaints will be withdrawn from the list of the *opprobria medicinæ acousticæ*.

Nervous diseases of this organ are in many instances, if not in all, connected with derangement of the ganglionic, or tri-splanchnic nervous system, as I have already demonstrated in my other works; and by proper attention to these and the general health, on the part of the medical attendant, they admit of cure or relief.* Otorrhœa is curable, as I have already shewn, by means of a weak injection of the lapis divinus in solution, gradually increased in strength, when the complaint is in the first stage; while the fungus, or polypous growth, which indicates the transition to the second stage, can be removed by the application of a ligature by Schiller's forceps, without there existing any necessity to have recourse to the knife. Herpes, and other cutaneous affections of the auricle, are removable by the anthrokakali; while the most annoying, the most distressing of all the complaints, the tinnitus aurium, yields to the internal administration of the arnica montana, combined with the imperatoria ostruthium.

The most important subject remaining for consideration is the treatment of the deaf and dumb; not as regards their education, but with the view of curing or alleviating the disease by which they are reduced to a level, in one sense, with the beasts that perish. Many of these cases are produced by functional disorder, and not by structural disease; and these admit of relief, many of ulti-

* In an earlier part of this work, page 47, I have stated that acoustic instruments should be used as little as possible, and only employed when the deafness is confirmed, and beyond the reach of medicine. The following extract from Mr. Buchanan's excellent work, entitled "Physiological Illustrations of the Organ of Hearing," will furnish an explanation of the injurious results. "Although an auricle were twenty-three or twenty-five lines in length, yet, from its angle of attachment it would scarcely occupy one-third of that space in breadth; consequently the recipient orifice of an ear-trumpet, if six inches in diameter, would be capable of retaining and conveying to the membrana tympani upwards of ten times the quantum of pulsations of sound that a moderately-sized auricle could possibly retain; and which in its condensed state must ultimately injure and destroy the percipient qualities of the sentient parts of the organ."—Page 74.

mate cure, as I have shewn in my former works on the ear. I am determined henceforward to devote a large portion of my time and attention to this branch of aural surgery, and to prosecute a series of inquiries relating thereto; and I have no doubt that ere long I shall be able to bring some very favourable results before the profession. In the asyla in Vienna, Berlin, Leipzic, and Hamburgh, I observed numerous instances in which the affection was not congenital; that is, not dependent on structural deficiency, but superinduced by fever and neglect of premonitory symptoms, and other causes, exerting their influence after birth.

When I was at Berlin last year, I accompanied Dr. Böehm, the physician to the General Hospital, and the Deaf and Dumb Asylum, to the latter institution, where I was received very kindly by M. Saëgert, the superintendent, who gave me every assistance in prosecuting my inquiries. On examining the children, I found that many of the most healthy could hear a little. I have since then received letters from M. Böehm and M. Saëgert, approving of my plan of treatment, and expressing their intention to make trial of it in their institution. M. Reich, of Leipzic, director of the asylum in that city, informed me that "there are 56 pupils in the institution, 37 boys and 19 girls; of these, 3 boys and 2 girls can hear *words* a little; 7 boys and 4 girls hear something of *sounds*. Of the male pupils, 15 were not born deaf, and of the female 7." I examined the most healthy of these children very carefully. Reich considers scarlet fever to be the most frequent cause of deafness. M. Saëgert told me that there are 60 pupils at present in the asylum at Berlin, of which there are 6, (3 boys and 3 girls) who can hear the voice; 15, (8 boys and 7 girls) who are capable of hearing sounds, and 39 who are quite deaf. He is convinced that much may be done to improve the hearing in many of these cases, by proper medical and surgical assistance. Several of the pupils have experienced a beneficial change on attaining puberty. Seventeen, who possess a slight degree of audition, have progressed so far in the pronunciation of language, that any one can instantly understand them, and more than 30 articulate clearly enough to be understood after a few hours' acquaintance with them. The rest speak tolerably well, but the natural sound of the voice is wanting. There are only 2 who cannot be taught to utter sounds. In my work "On the Present State of Aural Surgery," recently published, will be found statistical tables of the relative proportion of the deaf and dumb to the population in the different countries of Europe and the United States.

Were children, as soon as they are suspected of deafness, submitted to inspection by competent medical persons, instead of being allowed to remain deaf until they are eight or ten years old, by which time the disease becomes inveterate, and then admitted into asyla and treated as incurably deaf, the result would be very different, and many would be rendered useful members of society, who under the present system remain helpless objects of commiseration as long as they live.

That I may be enabled to devote my time and opportunities more exclusively to that interesting subject—the state of the organ of audition in the deaf and dumb, and the practicability of a cure in many instances, I have resolved to abandon the study and treatment of the diseases of the eye, and restrict myself entirely to aural pathology; for it is only by a close and undivided attention to any one branch of the medical sciences that we can hope to attain eminence, and to be possessed of that skill by which we may benefit our suffering fellow-creatures, and add to the store, at present far too scanty, of medical knowledge.*

* Medical men have long been divided in opinion on the importance of the division of medical labour; but the belief in its necessity

Daily practice, conjoined with a correct knowledge of the anatomical structure and physiological arrangement of any organ, together with an acquaintance with its healthy and morbid sympathies with other parts of the system, and a habit of observation, are needed, to enable their possessor to extend the boundaries of medicine; and these are very requisite in the study of aural pathology, on account of the intricacy and minuteness of the structure, and the obscurity in which its diseases have been hitherto involved.

While visiting the various hospitals on the Continent, both in France and Germany, I found many remedies in use, the efficacy of which I have since had an opportunity of testing at the Royal Dispensary, and in my private practice, and which will ultimately, as I think, find a place in our pharmacopœia. I have derived so much advantage from my professional visits to the foreign medical institutions, that I should advise every one, before settling in practice, to pass a few months on the Continent, visiting the hospitals. By so doing, many of the prejudices inseparable from an education conducted at one school will be got rid of; while he will have an opportunity of comparing the Foreign and English modes of practice, and be enabled to form a more correct judgment on diseases and their treatment.

Twenty-five years have elapsed since I commenced this line of practice; and I have every reason to be satisfied with what I have accomplished in that period. I leave it to the profession to say what was the state of aural surgery before I commenced practice, and what had been done to increase our knowledge of the diseases which affect that organ, and the treatment which should be adopted. I have been followed by many persons of talent not only in this country, but on the Continent,

and value is rapidly gaining ground. Vide Dr. Leonard Stewart's work on this subject.

both by regular and irregular members of the profession, and I have had the gratification to know that I have rendered much service to many of my fellow-creatures from the highest to the lowest, and have mitigated much human suffering. From the intercourse I have had with the heads of the profession in this country and on the Continent, I have obtained that information which does not fall to the lot of many; and if I look back with satisfaction to what I have accomplished in the last twenty-five years, I look forward with pleasure to what I may accomplish in the next twenty-five years, should God spare my life. Notwithstanding many obstacles which have been thrown in my way, and which I have had some difficulty in overcoming, I have met with such patronage and success as has proved a stimulus to exertion, and will enable me to continue labouring in my vocation, and to carry out the views with which I originally commenced, every day's experience presenting new matter, and adding to the information which I possess. I may here take occasion to remark that at the last annual general meeting of the governors of the Royal Dispensary for the Diseases of the Ear, held May 13th, 1841, the Right Hon. the late Earl of Harewood, vice-president, in the chair, it was proposed by the Most Noble the Marquess of Downshire, and seconded by the Right Hon. Lord Sondes, that a subscription be entered into for a building-fund, to erect an institution to receive poor people from the country afflicted with diseases of the ear, and the infant deaf and dumb, and for which a handsome contribution was immediately made.

The attacks to which I have been subjected by my less fortunate brethren, for my exclusive attention to one line of practice, have had one good effect,—they have spurred me on to increased exertion, and to make improvements and discoveries which have been exceedingly beneficial, when otherwise I might have rested contented with my own acquirements. Still, as a general rule, the petty jealousies and rivalries of some of the members of the medical profession, prove a great drawback to the advancement of science, by deterring those who could afford information from coming forward, they being unwilling to expose themselves to personal attacks, when their only aim has been to benefit their fellow-creatures. I am glad to find that this spirit is dying away.

It has been for a long while the practice to follow in the footsteps of our predecessors, without deviating therefrom, like the disciples of Galen of old, abiding by the routine advocated by their master; but, if I mistake not, the practice of medicine altogether, in a very few years, will undergo an extraordinary change. Even now, indeed, since the introduction of the new French and German remedies, many of our former favourite medicines have been laid aside; pathology is better understood; and the public see the necessity for attending to sanatory measures, by which means they ward off disease. It would be as well that the pharmacopœia now in use should be remodelled; many of the medicines, which are still admitted, and have been for the last hundred years, are not in reality of much service, and might be expunged with decided advantage, other medicines, far more valuable, being substituted in their place.

Lithographic L
AND CURE;
BY CHARLES BEW,