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A NEW AND FAMILIAR

TREATISE

ON THE

STRUCTURE OF THE EAR,

AND ON

DEAFNESS.

By A. W. WEBSTER,

INVENTOR OF THE OTAPHONE, &c.

Price 5s.

Mr Edward Edwards,
with the Author's affectionate Regar

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CONTENTS.

INTRODUCTION.

THOUGH the sense of Hearing has ever been deemed next to that of Sight the most important, and the structure of the eye has not only been clearly demonstrated in books, but represented in all its parts most accurately by models; yet there exists at the present moment, scarcely any work written expressly on the ear, calculated to convey that useful and correct information which is required by the deaf. To supply this deficiency, the following treatise was undertaken; and as the names of the different parts are generally derived from the dead

languages, and have been compared to objects to which they now bear but a slight resemblance, the author has added such explanations of their meaning, as may seem useless to the medical student, but which, by giving the reason for their adoption, he hopes may be deemed of interest to the general reader.

The difficulties which have been supposed to surround this subject, though considerable, are by no means insurmountable; and have been in some degree occasioned by the want of a proper distribution of the different parts, into the distinct functions they severally execute. No two writers with whom the author is acquainted, have adopted exactly the same arrangement, and his differs from all preceding ones. By this original classification, he hopes he has

rendered the mutual dependence of the parts more clear, while, by avoiding minutiæ, he has directed the attention exclusively to those more actively engaged in the collection, transmission, and perception of sound. This arrangement has enabled him to rescue from undeserved neglect, one of the principal organs, namely, the auricle or outward ear, by which sound is received; while his ideas respecting it have received confirmation, by the success which has attended an instrument he has adapted to its assistance.

The numerous cases of deafness which have been cured by this invention, contribute greatly to prove the correctness of the author's general inductions; and he hopes that other parts, to which he has for the first time attributed considerable importance, will be equally

benefited by successful applications, to accomplish which object, he has entirely devoted his attention to the treatment of the diseases of the Ear.

102, New Bond Street, London,
31st October, 1836.

ON THE

STRUCTURE OF THE EAR,

&c. &c.

CHAPTER I.

INTRODUCTION.

"In every work regard the Writer's end,
Since none can compass more than they intend."

POPE.

THE purport of the following treatise is to give a faithful, concise, and familiar description of the structure of the ear. The want of such a work at the present day may be traced to several causes; first, the intricacy of the subject; secondly, the contradictory opinions held by some of the first authorities respecting it; and, thirdly, the absence of any well-defined and successful mode of treatment, resulting from the two preceding causes.

Dr. Paley remarks—"It is probable the ear is no less artificially and mechanically

adapted to its office than the eye; but we know less about it; we do not so well understand the action, the use, or the mutual dependency of its internal parts;"* and Sir Charles Bell admits, that as "we find late physiological writers acknowledging their ignorance of the functions of the particular structures in this organ, we cannot therefore conceal that there is a difficulty in assigning the uses of the parts."†

When to these authorities is added that of Dr. Arnott, who concludes a very short notice of the ear with this remark,‡ "The exact uses of these various parts are not yet perfectly known," it may be supposed that some weight attaches to the first reason; the second one will be exemplified as this work proceeds; but notwithstanding the difficulties here admitted, I feel some expectation that even the present little treatise will

* Paley's Natural Theology, p. 52.

† Notes and Illustrations to ditto, vol. ii. p. 358.

‡ Elements of Physics, p. 500.

place our knowledge of this organ one step in advance of its present position, particularly as regards its successful treatment—a result to which all other information should be made subservient.

Besides the difficulties which seem inherent in the subject, a number of incidental ones have contributed to confine the knowledge of the ear within very narrow limits. Amongst these may be reckoned the names employed to designate the different parts. Some of them having been applied at the very dawn of science, the lapse of time has altogether removed their similarity; others again, where the likeness continues, are so disproportionate in size, and different in purpose, as to give the most incongruous idea of the parts they would represent; while the assemblage, in which is comprised a hammer, an anvil, a stirrup; canals, a shell, and a labyrinth; as well as round and oval windows, and a promontory, presents such a combination of unassimilated images, that the mind is utterly

unable to conceive any perfect organ which can be composed of such materials, or parts in any way resembling them.

Certain erroneous terms seem to have been used from the earliest times, indicating points of resemblance. Thus every one has heard of a drum to the ear; but the general use and application of a drum is to create sound; while the drum of the ear, or tympanum, has no such quality, though the popular interpretation has been deemed, even by respectable writers, the correct one. Sturm in his Reflections, states "The auditory canal is terminated obliquely by a membrane, generally known by the name of the drum. In contact with this membrane on the inner side, is a small bone (malleus) *against which it strikes* when agitated by the vibrations of sound." Now this is not the fact; there is no striking, nor can I imagine that so excellent a naturalist could have fallen into this mistake, but through a desire to reconcile his description to the popular belief.

The confusion attendant on the names, has been heightened by the necessity authors have found themselves under of representing the different parts of greatly enlarged proportions; and not preserving one uniform scale throughout, and rarely stating that which they have adopted, both the mind and the eye are misled, and we turn away with fatigue, if not with disgust, from a study presenting such preliminary difficulties.

These causes have nearly confined all knowledge of the ear to professed anatomists; and those popular writers who have rendered almost all other abstruse researches familiar, have been deterred from attempting this, the nature of the subject requiring personal investigation of difficult procurement, and the deductions of those who have thus investigated it, affording a very impefrect guide. One great channel for the extension of knowledge has thus been cut off; the most valuable discoveries having frequently been brought to light by those who, having a

particular affliction, and a general knowledge of the structure affected, treasure up the lessons of experience, and thus greatly enlarge the field of usefulness to others. But their observations having been founded on no known principle, were deemed merely applicable to their particular cases, and were consequently forgotten; while a more extended knowledge would have proved, that their efficacy was based on the principles of nature, and would bear an application as wide as the spread of the calamity.

Being aware of these disadvantages to the understanding of the subject, the author has presumed to treat it altogether in a novel, but, he trusts, in no less a correct and scientific manner. He has avoided as much as possible all technical phraseology and minuteness of detail, feeling convinced that they indispose the mind from taking an enlarged view of the subject. He hopes by familiarity of language to improve the science, by enlisting in its support and elucidation all

those, whom the preceding modes of description have hitherto excluded.

Before, however, proceeding to that division of parts which will facilitate the understanding of the organ of hearing, it is desirable to make a few remarks on the great importance of this sense. Its advantages are generally classed under two heads; namely, as the channel of ideas, and consequently the parent of social intercourse, mutual instruction, and the perception of harmony; as well as being essential to public worship, senatorial influence, and martial command; and, secondly, as contributing to our safety. During nearly one half of the period into which time is divided, namely, between day and night, the eye affords us no assistance, and the ear then becomes our most effective protector; but at all times this sense, by informing us of impending danger, whether it be the roaring of beasts of prey before their approach, the peculiar rustling of leaves preceding a storm, the crackling of an adjoining fire, or the foot-

steps of a robber; the ear, ever watchful, gives notice of the coming danger, and thus furnishes the most probable means of escape.

To these a third may be added, less generally insisted on, but as intimately interwoven with the sense as the other two, namely, the Cheerfulness its perfect possession creates. It has been a subject of frequent comparison, whether the loss of sight or of hearing was the greater calamity; and though the former has been generally judged to preponderate, yet in our present consideration, it will be found to be infinitely the least. Blind persons are generally inquisitive and cheerful; the loss of that important sense seems to quicken all the others, and their proficiency in music, and many of the manipulative arts, proves that it stimulates them to greater mental and bodily activity, and consequently to an increase of happiness, which consists in action, but more particularly in action well applied.

But the loss of hearing generally involves a loss of energy; the desire to excel is chilled by the incapacity to receive "the voice of praise," and a despondency, partly arising from the disease, and partly producing it, renders the deaf less social; while the greater effort required on the part of others to amuse them, closes many avenues to entertainment and instruction which are open to the blind. This unfavourable comparison is not introduced to render the deaf less contented with their lot, but to stimulate them by the employment of natural means, and their inborn energies, to endeavour to repair their loss; with the assurance, that an effort on their part to dissipate the gloom which surrounds them, or before it is too late to prevent its approach, will be the best assistance that art can receive to effect their recovery.

Before entering into a description of the parts constituting the organ of hearing, it will

be necessary to make a few remarks on the nature of Sound.

This property, like all those which are common and impalpable, has at different periods been the subject of conflicting opinions; and though the greater diffusion of experimental knowledge has given these latter times an advantage over preceding ones, still the subject cannot be considered as fully investigated at the present day.

It is now well ascertained that the atmosphere we breathe is a dense and elastic fluid, the weight of its pressure on the surface of the globe being nearly equal to 15 lbs. on the square inch, and that it is capable of great compression and expansion. Its compressibility is proved by the contraction it undergoes, when forced by art into the chamber of an air-gun; and its power of expansion may be best exhibited by the following experiment. If a closed bladder, containing a

small quantity of air, be placed within the receiver of an air-pump; on exhausting the receiver, the bladder will begin to swell, and expand sufficiently to raise a weight placed upon it.

Having ascertained these two facts, of its contractile and expansive power, in other words of its elasticity, it seems a more ready induction than natural objects generally present, to imagine that it may be endowed with another quality, namely, of becoming sonorous under a certain degree of agitation or percussion. The value of this quality, as respects its benefit to mankind, cannot be estimated, nor can any approach to it be made, except by those individuals, who have, in some degree, lost its enjoyment. The animal creation generally appears endowed with faculties to excite in the air this sonorous property; the brutes, sufficiently to express the few ideas necessary to their wants; and man, to convey not only all animal desires, but to give utterance to those emotions which prove the

existence of the mind; and thus, through the deductions of natural philosophy, lead to the presumption of its immortality.

The well-known experiment of a bell not being heard if rung in an exhausted receiver, proves that air is essential to the transmission, if not for the creation, of sound; while the loudest noise of which we are conscious, namely, Thunder, is effected by the air alone. The combustion of certain aerial particles causing a vacuum, the surrounding atoms, acted on by the general law of pressure, and further impelled by their inherent elasticity, cause a simultaneous rush in all directions, and the concussion thus created is heard for miles. The inference hence to be drawn is, that sound is not a substance transmitted through the air, but *the air itself with a new property super-added;* and it may consequently be expected to pervade all bodies as air does, though its sonorous properties are detected by the ear alone. Sound would thus exist if the hearing was not created, and it may be

expected to impregnate air in proportion to the force of the percussion to which it owes its existence. The striking of two stones thus agitate a less number of particles than the explosion of a gun; and as each communicates the emotion to those in immediate contact with it, the number must increase with the extension of the circle the vibration fills, the sound becoming weakened by division and distance, till at last it is lost to our senses.

Sound is thus expanded in air with an equal pressure and divergence in all directions, precisely as motion is perceived to diffuse itself in water. A stone thrown into a pond is observed to make undulating circles, which become weakened by distance; and if in any part of the circumference thus formed, an opposing body intervenes, the motion is continued in another direction, or reflected back, to the extent it would have reached but for this interruption. Air impressed with sound, in like manner, if interrupted by a cave, or angle formed by the junction of the ends of

two buildings, is heard reverberated in echo; and passing with the quickness of 1142 feet in a second of time, monosyllables, uttered at the distance of a quarter of a mile, are returned, little impaired in strength, in less than two seconds from their utterance.

Sounds no longer distinguishable in their original and distinctive character, yet make up in their multiplied and undefined proportions a perpetual buz during the day; while at night, when the traffic of man ceases, the birds retire to their nests, and the winged insects to their holes, the air regains its tranquillity, and the sound of a watch seems increased to double the strength with which it beat during the day.

It was this delightful cessation of the din of earth which gave to the ancient fabulists the notion, that at night the motions of the heavenly bodies could be heard, which they poetically called the Music of the Spheres.

CHAPTER II.

ON THE STRUCTURE OF THE EAR.

"I see the rivers in their infant beds!
Deep, deep, I hear them labouring to get free.
I see the leaning strata, artful rang'd;
The gaping fissures to receive the rains,
The gutter'd rocks, and mazy-running clefts.
Beneath th' incessant weeping of these drains,
I see the rocky syphons, stretch'd immense,
The mighty reservoirs, capacious formed."

THOMSON.

THE author of the Seasons, in the above condensed extract, describes the operations of Nature in the formation of the globe, by allusion to mechanical aids in use amongst ourselves; and it will be my endeavour, by the use of similar illustrations, to define that more delicate construction of parts which form the Structure of the Ear. Though we thus at-

tempt to exemplify the works of the Almighty by reference to those of man, it will be found that the whole were pre-existent in nature, as all our inventions are but the application of some part of that wonderful organization which has existed from the beginning, and which the imperfection of our faculties has hitherto prevented us from perceiving. The most extensive discoveries that mechanism or chemistry have produced, have but combined two or three of these original properties into one conjoint operation; while all "we know in part," is constantly employed by the great Author of our existence, with such admirable art, and imperceptible union, that, though daily before our eyes, we are at a loss to know where one principle ends or another begins.

The Structure of the Ear consists of a succession of the most singular contrivances, some of which have been applied to the wants of man; but the combination they present is

such as no one could conceive, nor unless we possessed the certainty of their efficiency as constituting the organ of hearing, would it be possible to imagine them conducive to that end. To facilitate their description, anatomists have reduced them into certain divisions, the limits of which they presume have been affixed by nature; but such an arrangement is purely imaginary, no two exactly following the same classification, and all dividing them where the functions of the preceding parts still continue. Mr. Saunders, who has arranged them into an outward, middle, and inner ear, candidly admits, that "the terms employed to denote the three divisions of the ear express nothing more than their position. They have been adopted, imperfect as they are, since language does not afford terms more comprehensive."

But the advantage thus solely insisted on, of following their natural arrangement or

position, does not preclude a classification which shall embrace their functions also; and as I attribute the little advantage derived to the ear from art, to an undiscriminating adhesion to the views of preceding writers, I shall venture on such an arrangement as appears equally natural and more scientific; namely, a description of the parts in the order of their succession; and a division of them into classes, dependent upon the different offices which they perform.

The ear then, in relation to its separate functions, and the parts essential to their exercise, may be divided thus:

DIVISION

I. The auricle, or visible ear — *to collect sound.*

II. The external auditory passage, the membrane of the tympanum, and the small bones within it — *to concentrate its force, and impress it on*

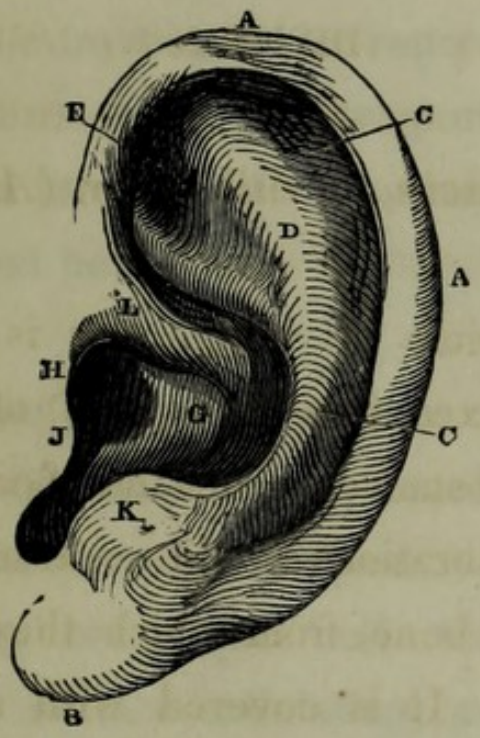
III. The internal ear, consisting of the vestibule, semi-circular canals, and cochlea, comprehended under the name of the Labyrinth—*where sound is rendered cognizable to the mind.*

Several other parts, which, like episodes, contribute indirectly to the main action, will be described as they successively present themselves.

DIVISION I.

The Auricle, or visible ear. (*Auricula*).

The auricle or visible ear is composed (with the exception of the lobe) of cartilage; a gristly substance, harder than flesh, by which sonorous vibrations would be absorbed; and softer than bone, from which they would reverberate. It is covered with a very thin skin, which is lubricated by small glands placed beneath it; and in health, has all the smoothness of polished ivory. It is attached to the temporal bone by a number of ligaments, and has on its surface several muscles, seven of which have received names, but which the design of this work renders it unnecessary to enumerate; it is also plentifully supplied with nerves, blood-vessels, and lymphatics. It is divided into the several parts particularized in the description following the plate.



The outer rim takes the name of the *helix* A. A. as far as its curved margin extends, the remaining outer portion being the *lobe,* B. The small cavity caused by the turning over of the helix, is called the *cavitas innominata* C. C., and separates the helix from the *anti-helix,* D. A small depression next adjoining towards the top of the ear, is called the *scapha,* E. These parts surround the upper part of the *concha,* G. in which all the other channels for collecting sound

terminate. About the middle of the concha, on the facial side, is the entrance to the head, H, called the *meatus auditorius externus*, or external auditory passage, which is nearly imperceptible on looking direct at the ear. The part which obscures it from view is the *tragus*, J, opposite to which is the *anti-tragus*, K. The concha is unequally divided into an upper and lower part by a strong ligament, L, which may be called the root or origin of the helix.

It will be necessary to compare this description with the drawing, which represents an ear of the natural size, well-proportioned, and taken from the head of a gentleman possessing excellent hearing.

It will be perceived that the outward ear, or auricle, is formed in a manner most conducive to its intended purpose. Its shape is concave, as being the best recipient for sound; its surface undulating, as presenting a larger superficies than any other form; and it is supplied with nerves to direct its motions, and muscles to execute them. The social state of man has rendered this moveable power of the ear less necessary than in the earlier ages of the world, when his existence depended principally upon the chase; but the organization is still observable, and in many parts of the earth in full exercise. This is particularly perceptible in the natives on the coasts of the Asiatic Islands, and is said to exist among the Arabs; but the greater facility which man possesses in the motion

of the head, is a further reason for the general suspension of this power. But in several instances it is still exercised, particularly when derangement of other parts renders additional assistance from this more desirable.

Sir Charles Bell, in the following extract from his work on the "Anatomy and Physiology of the Human Body," thus speaks of it: "In most men the motion of the ear is lost, but some still retain it; and this is very remarkable,—that when the more internal mechanism of the ear is injured, and ceases to strengthen the sound before it conveys it inwards to the labyrinth, the external ear resumes the office *to which it was originally adapted,* and by a degree of motion and erection, assists the hearing."

Sir Astley Cooper favoured the author with references to two individuals having this power; but though his attention had been so long and so successfully directed to the sub-

ject of the ear, it was only in April and May, 1835, that these cases occurred, which proves they are infrequent in this country. In the author's comparatively short experience, one has already presented itself, and is a strong illustration of Sir Charles Bell's remark. The gentleman possessing this power, is proprietor of a provincial newspaper, and has lost the membrana tympani of both ears, attended with puriform discharge. In one he is totally deaf, but with the other he is enabled to hear sufficiently well to report the proceedings of public meetings for his journal. On speaking to him, you observe the ear begin to redden, then to move, and by change of position and contraction adjust itself for the purpose of collecting sound. His avocation, it will be observed, is perhaps the most likely to call for the exercise of this power; and the desire, added possibly to a more than ordinary facility of execution, has enabled him to bring it thus beneficially into exercise. Sir Everard Home also gives in-

stances to the same effect. But notwithstanding the just remark of the eminent anatomist before quoted, and the reasonable deduction that so exquisite and large a portion of this important organ would not be made in vain, a succession of writers have represented it of inferior importance, and grave arguments have arisen whether it was essential or only adventitious to hearing.

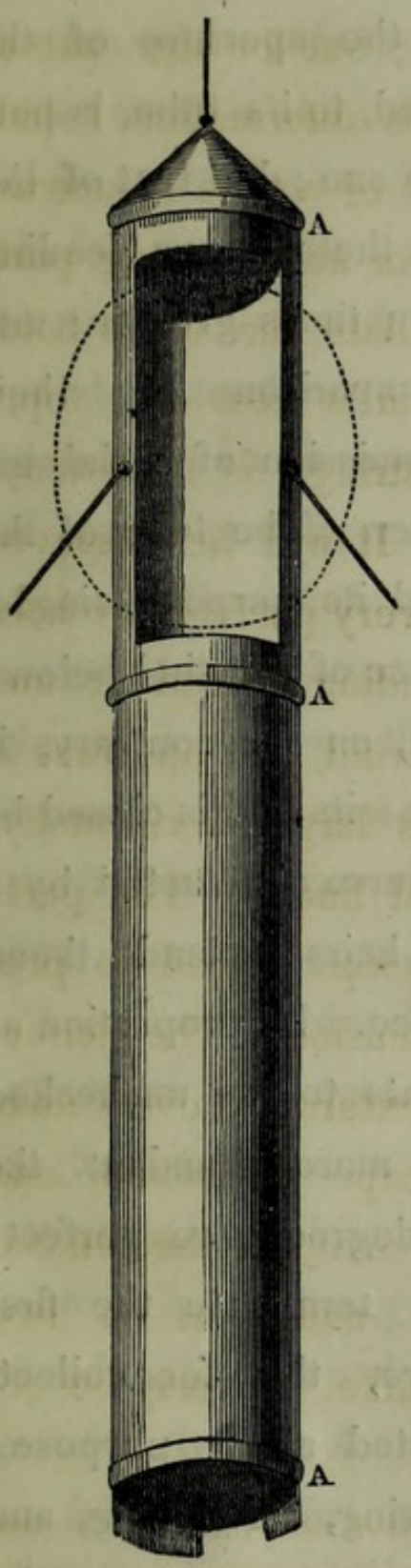
This discussion owes its origin and support to some recorded cases, where the loss of the external ear was said not to be attended with deafness, but that the patient heard as well a few days after his loss as he did before. The deprivation of the whole of this part rarely takes place, and nothing but its ***total removal*** could enable us to judge of the correctness of these observations. However, even this may be granted, and yet we are not obliged to adopt the conclusion, that a part which may be dispensed with is, when perfect, of little value. Nature accommo-

dates herself wonderfully to the casualties to which man is subject; but we must not take her extraordinary efforts as the rule, but only the exception. Where this part of the organ exists entire, the comparison with a state in which it is lost, is inapplicable. The warmest advocate of the comparative inutility of the auricle, would not recommend its excision with the hope of improvement, and consequently it becomes a fit object for restoration of shape, if any deviation from its original and most useful structure can be observed.

Almost every other part of the ear has been compared to some familiar object; and one cause which has greatly contributed to lessen the relative importance of the auricle, is the want of any well-known invention that would illustrate its power. This deficiency I will endeavour to supply. The machine to which it bears the strongest resemblance, is called a wind-sail; known to all nautical men, and even to those accustomed to take trips

on rivers in steam-boats; but for the sake of those not possessing this information, I shall describe it. It consists of a tube of canvas, supported by a rope from an adjoining part, and is intended to ventilate the ship's hold. The tube has a hole in it near the top,* and by means of a string, is hauled opposite to the wind. It will be observed in the drawing, that every part of the hole has a small edge extending beyond it; and when expanded by the wind, the aperture is drawn up, and becomes larger horizontally, as shown by the dotted lines. The parts marked A. A. A., are hoops placed to preserve one uniform distension. The perfect ear also presents an external curved margin, preventing the escape of sound, and concentrating it in the cavity of the concha, or general receptacle; and thus no two objects can be more alike. It may be re-

* The tube is made of three breadths of canvas, each about fourteen inches wide, and the aperture is formed by the omission of one breadth, or one-third of the circumference.



marked that the wind-sail is hung perpendicularly, to catch the direct wind from the skies and transmit it below; while the ear has its head or collecting edges placed horizontally, the sounds it is most destined to receive being projected nearly in a straight line, or level with it. It only remains to be shown the vast quantity of wind this machine will collect, which, in five minutes, will disperse the foul air in a large cabin, or ship's hold.

The proportion of the aperture of the wind-sail, when distended, to its tube, is perhaps as three or four to one; but that of the surface of the ear to the passage leading from it, is at least three times greater; and consequently the comparison of their adaptation for the transmission of aerial impressions goes no further. The tube of the wind-sail is straight, and its purpose single, to transmit the whole force of the wind below; the passage of the ear, on the contrary, is tortuous in the extreme; its end is closed by a membrane, and its course obstructed by a thick secretion, while hairs extend themselves across the entrance. In proportion as these natural impediments to the unchecked progress of sound are more abundant, the hearing is in the same degree more perfect; which induces me to terminate the first division of parts here, that for collecting sound having effected all its purpose; while those for condensing, restraining, and transmitting its power, commence at the

junction of the tube with the auricle or collecting surface.

Before I close the present division, it may be expected I should define what constitutes a good external ear. Size for this purpose is of much less consequence, than concave shape and proper prominence. The ears of females are generally one-third smaller than those of men; but the internal parts being proportionable, they are equally efficient; and being frequently more smooth, are in that respect better. A fleshy ear is disadvantageous, and a large one is more readily depressed, and by its own weight deprived of those undulations which are beneficial. The parts should rise from the surface of the cheek to the outer extremity, like the rows of an amphitheatre, each being elevated above the preceding one; and if to this be added a curvature in the shape of the lobe towards the face, the most desirable form, which is

that of a longitudinal section of an egg, is obtained. This is further improved if the position of the ear is slightly angular, rather than parallel with the face.

Ladies in England have generally some bandage connected with their head-dress, which ties down a large portion of the ear, and restricts the recipient for sound to the concha merely; but the bonnets they wear, which are almost peculiar to this country, and one or two others in Europe, partly redeem this disadvantage, as they act in some degree like the mouth of a large trumpet, within which the ears are placed. The accession of sound from this cause, is particularly perceptible by those who occasionally sit down to an instrument with the bonnet on.

When attention shall be more fully directed to this part, it may tend to correct those opinions so long prevalent, which have pre-

vented mankind from deriving that practical benefit from a knowledge of the construction of the ear, which closer observation would have pointed out. As every department of art depends for its perfection on some particular faculty, those who have devoted themselves to the musical profession might have had some guide to their fitness for it, in the formation of that organ on which their proficiency must greatly depend. The widow of the celebrated Mozart, afterwards the wife and widow of Count Nissen, has rescued one of these physiological facts from oblivion, in preserving a correct drawing of the ear of their youngest son, Wolfgang Amadeus, whose ear resembled that of his father. Mozart might be said to have embodied musical sensibility; at six years of age "he could distinguish and point out the slightest differences of sound, and every false or rough note, not softened by some chord, was a torture to him." At ten years of age, "the most numerous orchestra did not prevent him

from observing the slightest false note; and he immediately pointed out, with surprising precision, by what instrument the fault had been committed, and the note which should have been made." He died at the early age of thirty-six. The resemblance to his ear which is given at page 37, exhibits a most unusual appearance; it has no lobe, but the cavitas innominata extends throughout the circumference. Other peculiarities present themselves in the shape of the concha and the anti-helix; but to avoid any false conclusions, I need only point to its figure, compared with that in page 21, to perceive as great a difference in its development, as there was between the sensibility of his mind to musical impressions, and that of persons in general.

Dr. Arnott, in the following extract, complains of the misapplication of talents, which a knowledge of the best configuration of the visible parts of the organs of hearing would

frequently prevent. "It is the prejudice with respect to musical ear and musical taste, which condemns many young women, possessed of every species of loveliness and talent, except that of note-distinguishing, to waste years of precious time in an attempt to acquire this talent, *in spite of nature;* and yet, when they have succeeded as far as they can, they have only the merit of being machines, their performance being as little pleasing to true judges as would be the attempt of a foreigner, who knew only the alphabet of a language, to recite expressive poetry in that language."

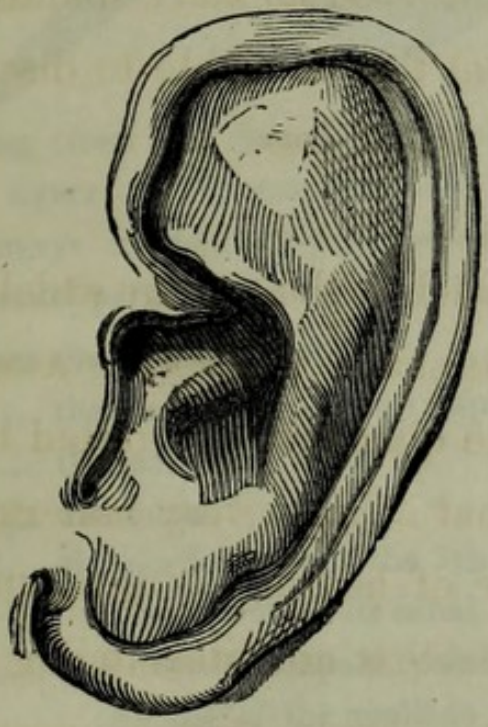
Many writers describe parts of the ear as strengthening, increasing, and improving the sound; but the utmost that the most perfect construction can perform, is to transmit it faithfully. Sound can receive no addition after its creation, which must precede its perception; and as our organs are more or less perfect, we receive the whole or only part of the impression. It is thus with the

other senses. Persons will differ respecting the flavour of wine from the same cask, and form a different judgment before or after dinner, in good or ill health; and in respect to colours, some will detect differences of shade not perceptible by others. But in these cases the difference is in the organs of sense, and not in the objects submitted to them. Mozart, who could distinguish the performance of each individual in a large orchestra, observed *no more sounds than were created;* but those, unable to discriminate so accurately, *heard less.*

As the auricle is the part by which sounds are received, its shape must have a considerable effect on the quantity transmitted to the inner ear; and that it has a very material influence on the state of hearing, is apparent from this observation: that notwithstanding all persons must alike be liable to the internal injuries and casualties by which deafness is produced; yet, in nine instances out of ten, those who

possess well-shaped ears, hear well; and though hearing may exist, sufficiently for the ordinary purposes of life, with very defective organs, the finer impressions can only be conveyed by a combination of parts in every respect perfect.

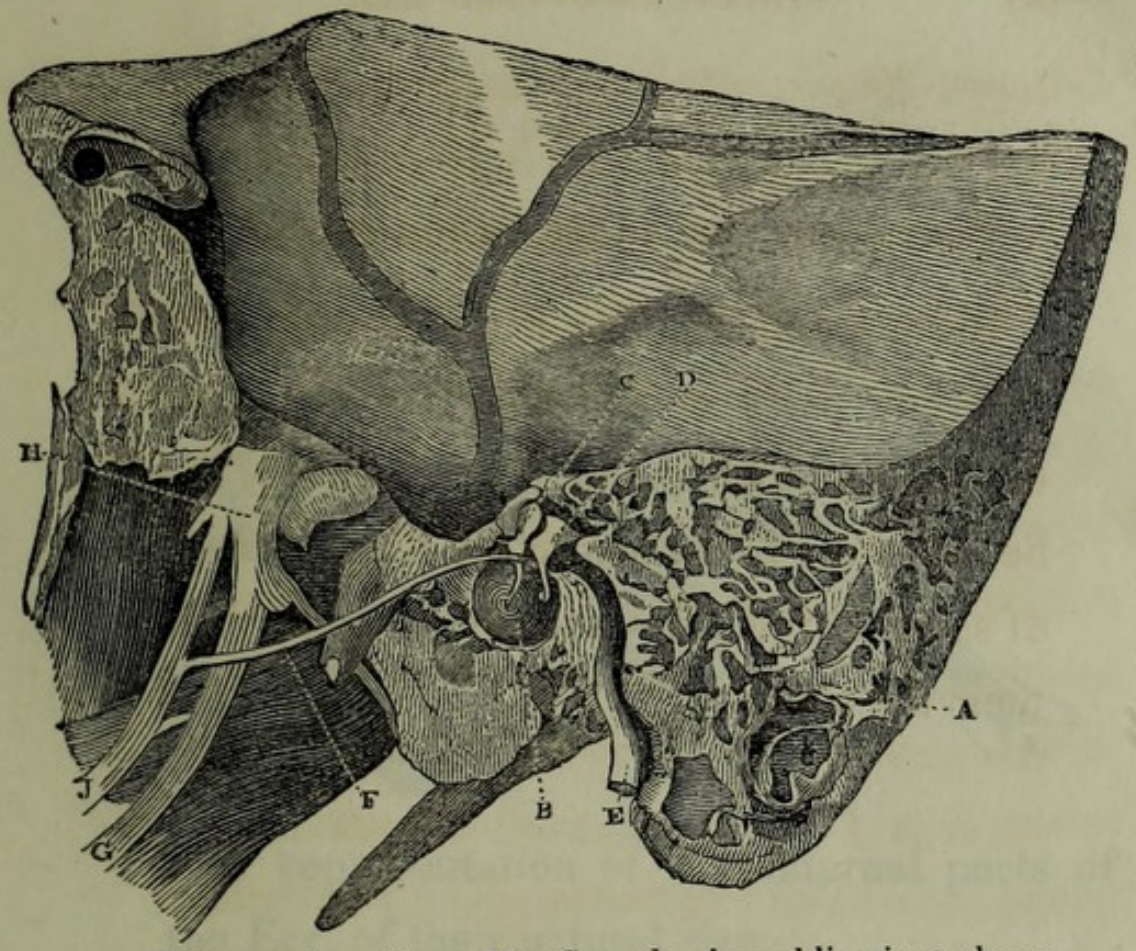
MOZART'S EAR.



DIVISION II

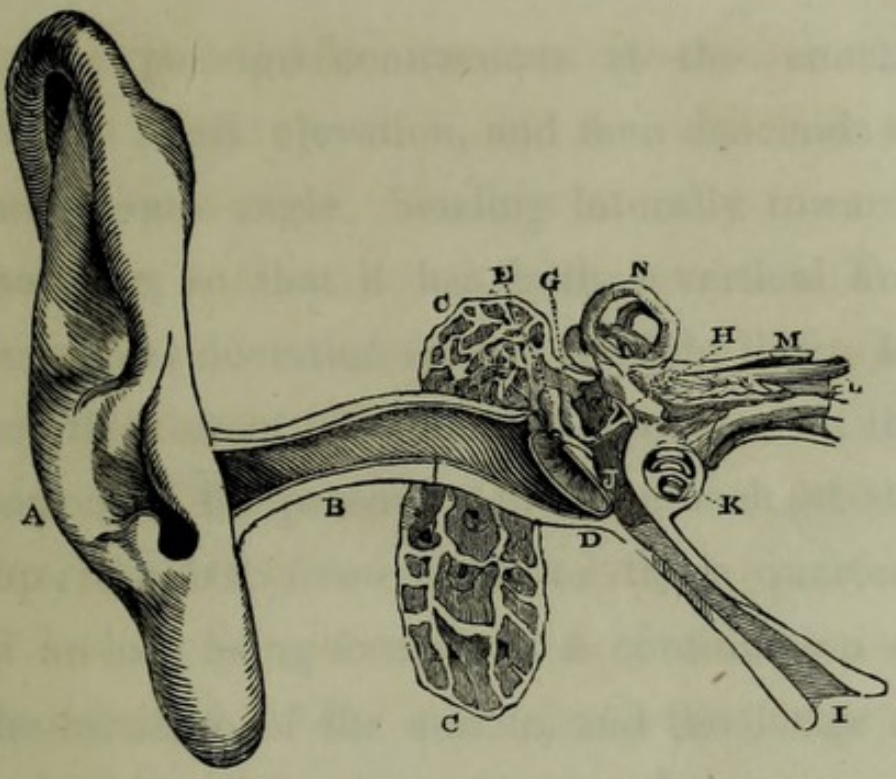
Parts for the transmission of Sound.

Before entering into a description of the different parts constituting that portion of the ear by which sound is transmitted, it will be necessary to lay before the reader drawings, of some of the parts about to be described, of their natural size.



This drawing (from Mr. Saunders's publication) shows the size and figure of the mastoid cells when perfect, and also conveys a clear view of some of the most important internal parts of the ear.

A. represents the mastoidal cells.
B. ..... the membrane of the tympanum.
C. ..... the malleus.
D. ..... the incus.
E. ..... the portio dura of the 7th pair of nerves, turned out of its canal.
F. ..... the chorda tympani, passing between the handle of the malleus and the longer leg of the incus, and joining the sub-lingual branch of the inferior maxillary nerve.
G. ..... the dental branch.
H. ..... the inferior maxillary nerve.
J. ..... the sub-lingual branch.



A representation of the internal parts of the Ear, of their natural size.

A. The Auricle.
B. External Auditory Passage.
C. Mastoid Cells.
D. Membrane of the Tympanum.
E. Malleus
G. Incus
H. Stapes
} The small bones within the Cavity of the Tympanum.
I. Eustachian Tube.
J. The Cavity of the Tympanum.
K. Cochlea, (section of, to show its internal structure.)
L. The two portions of the Auditory Nerve.
M. Internal Auditory Canal.
N. Semi-circular Canals, which are embedded in the solid bone, but which are here represented of the size of their cavities.

External Auditory Passage. (*Meatus auditorius externus*).

On taking such a view of the head as presents a profile of the face, and a full view of the ear, the entrance into the auditory passage is nearly hidden by the projection of the tragus; and to inspect it, it is requisite to press the tragus towards the face, and pull the auricle back and upwards towards the crown of the head.

The passage commences at the concha with a small elevation, and then descends at an oblique angle, bending laterally towards the face, so that it has both a vertical and horizontal deviation from a straight line. Its length is about one inch and a quarter at the bottom of the passage, and one inch at the top; the first five-eighths or three quarters of an inch being formed of a continuation of the cartilage of the auricle, and the latter of a cavity in the temporal bone. Its narrowest diameter is where the bony and cartilaginous structures meet, or a little nearer the outward ear. In proportion as it deviates from regularity of figure, the hearing is generally more acute; the sound appearing to receive increase of concentration from the greater irregularity of the tube. The lining membrane throughout is peculiarly delicate. It is interlaced with hairs at the entrance, which protect it from the inroads of insects, and tend to check the velocity of sound. In advanced life the hairs frequently fall off, but are reproduced in

abundance on the tragi, where they did not exist before.

The meatus is lubricated with a secretion called

CERUMEN, or WAX,

which, in a good state of health is abundant, and produced daily, by which the sound is further restrained; but which, by neglect, frequently becomes very compact, and is then the cause of partial deafness, and an unpleasant singing in the ears. When it flows inward, it is retained by the contraction before mentioned, and will become as hard as resin, which, in some cases, I have seen it resemble in colour and consistence, and in that state requires great care in its extraction. It is said, by some writers, to be formed for the purpose of lubricating the membrane at the end of this passage; but I have ever found that part most perfect when free from all incrustation, and presenting the appearance

of a large opal bead. The evaporation of the volatile particles of the cerumen may have a stimulating effect upon it; but it is only with that view it can be considered as calculated to produce any benefit to the membrane, though it has a considerable effect on the perfection of hearing, by contracting the width of the auditory passage. Many attempts have been made to promote the secretion, or provide a substitute for it; and Buchannan, having analysed it, recommends a salve made of its component parts, (which he describes,) to be introduced by a camel's-hair brush along the passage; but those artificial substances only tend to close the mouths of the ducts, and consequently rather impede than promote the secretion. Buchannan's practice having fallen into disuse, is the best proof of its unsuccessful application.

When the cerumen ceases to be produced, the hearing is generally imperfect, and sometimes lost; but its cessation is as frequently the

effect as the cause of this state of things, indicating a general indisposition of the adjoining parts to form that healthy fluid which is essential to their free and perfect exercise. From the same cause the roots of the hair, being deprived of nourishment, cease to be reproduced, while the fleshy nature of the lobe, adjoining to which the tragus and anti-tragus are placed, favours their growth on those parts. Wax will often continue to be formed after the hearing has been for many years lost, such deafness being occasioned by injury to the more internal parts, not yet described, and not affecting the cerumenous glands.

The Membrane of the Tympanum. (*Membrana Tympani*).

The auditory passage is closed by the membrane of the tympanum, the structure and importance of which have given rise to more difference of opinion than almost any other part within the ear. It forms an

impervious septum or boundary between the outward air and the inward cavity ; and being that part by which the pulses of sound are first intercepted, it is singular that an injury to, or total obliteration of, this membrane, is attended with less ill consequences than the abstraction or destruction of almost any other part. It has been frequently punctured by design, and this operation is the more perfect in proportion as the aperture is sufficiently large, and incapable of re-uniting. Cheselden observes, " This membrane does not entirely close the passage, but has on one side a small aperture covered with a valve ;"* and numerous instances exist where persons whose hearing is perfect, can pass smoke through the ear from within, and consequently can only produce it through some natural opening ; but those instances must be considered as deviations from the general construction, which is only considered perfect when the adhesion is entire.

* Cheselden's Anatomy, page 305.

As I have restored the hearing where deafness had continued for twenty years after the destruction of this membrane,* the importance attached to it by preceding writers is over-rated; still, for the finer perceptions of sound, it may be most essential; consequently, as a component part of the perfect auricular machinery, it must be deemed of great, but not of paramount importance.

It is formed on the external surface by a continuation of the delicate lining of the meatus, and within of the lining peculiar to the cavity of the tympanum (the next part to be described); and between these two, is placed a very fine membrane, on which are disposed radiated fasciculi of fibres, which have obtained from some anatomists the denomination of muscles, a character which has been denied by others. Sir Everard Home was the first to insist on, if not to discover this muscular construction, which is

* The instance to which allusion is made, is Case V. in the last Chapter.

fully developed in the ear of the elephant; but Sir Charles Bell, in his work before quoted, without giving Sir Everard's deductions a positive contradiction, inferentially leads to that conclusion in these words:* "But what is the supposed use of this muscular membrane? Sir E. Home says, it is principally by means of this muscle that accurate perceptions of sound are communicated to the internal organ; that it is by means of this muscle that the membrana tympani is enabled to vary its degree of tension, so as to receive the vibrations in the quick succession in which they are conveyed to it. But we have seen that the tension and relaxation of the membrana tympani is already sufficiently provided for: 'The malleus has three muscles by which it is moved; one of them is called the tensor from its pulling the malleus inward, and tightening the membrane of the tympanum; the other two act in an opposite direction, and

* Bell's Anatomy and Physiology of the Human Body, vol. iii. p. 162.

relax the membrane.'* We should naturally suppose this to be sufficient," &c.

In volume I., p. 59, of Paley's Natural Theology, with illustrative Notes by Lord Brougham and Sir C. Bell, it is remarked in the notes, "The description of Sir Everard Home is altogether fanciful. There is no proof that these fibres are muscular," &c.; but the difference, as to the application of this membrane given by these learned men, is rather in words than in things, as the radiated fibres, admitted on both sides, possess a power nearly analagous to that of muscles.

The membrane does not cover the extremity of the auricular passage in a straight line, as a glass does the end of a telescope, but forms an acute angle; a contrivance adapted to restrain the force of the sonorous impressions, which it does not receive in a direct line,

* Sir E. Home's Lecture.

but partly reflected from the floor of the passage. The meatus is consequently rather less than a quarter of an inch longer on the lower part than on the upper. From the correctness with which I have been able, on inspection, to decide which was the best ear in the great number submitted to my notice, where the auricle presented no particular formation, I do not doubt, but further observation will lead to such an accurate discernment, as to define on what construction of parts the musical ear principally depends, which, I believe, are nearly all external of the tympanum. By the musical ear I mean that peculiar sensibility possessed by some, of perceiving the slightest differences of sound, which I consider arises from the perfection of their organs of hearing not permitting any vibration to escape. The power of definition, which they also possess, is a faculty of the mind; but I have presumed it to be dependant, at least to a certain extent, on physical causes, which must precede the mental discrimination.

This exquisite taste, therefore, is well defined by Akenside as nothing but

> "The internal powers,
> Active, and strong, and feelingly alive
> To each fine impulse;"

which impulse, I conceive, depends on the perfect construction, and extreme susceptibility, of those parts by which it is conveyed.

The Cavity of the Tympanum. (*Cavitas Tympani.*)

The tympanum is not a part actively engaged in the transmission of sound, the impression being conveyed through it by a succession of small bones, the first of which is attached to the centre of the membrane, and the last terminating over an aperture which forms the entrance to the next division, or the inner ear. But though the cavity of the tympanum is not an active agent in the furtherance of the vibration, it is more frequently the cause of its interruption than any other part. Its purpose

is to preserve an equal temperature on both sides of the membrane, for which purpose it is connected with the outward air. As very erroneous notions have prevailed relative to this part, I shall enter more fully into its construction than I should otherwise have deemed necessary.

It derives its name from *tympanum*, a drum; and it will not be necessary to enter into a long description of that musical instrument with which most are so familiar. It generally consists of two pieces of parchment, closing the ends of a wooden cylinder; and though kettle-drums are made with but one covering or membrane, on which the impression is received, it is to be observed that this instrument is only occasionally employed, not being so perfect as the one having two flexible ends. But drums of whatever form have this structure in common, that air is admitted by a hole below the covering, without which the vibrations

would not be perfect. Now the tympanum or drum of the ear is constructed on this principle; and I will treat of the two as far as they assimilate, and then describe those additions to the human ear which give it altogether a different character. The tympanum is bounded by two principal membranes (there is a third, but it is not desirable to interrupt the description with any notice of it at present) namely; the membrana tympani before described, at the end of the auditory passage, on which the vibrations of sound are impressed through the agency of the air; and a second, which forms the entrance into the inner ear, but which, unlike that of the musical drum, is of much smaller dimensions than the first, not being above one-fourth of its size, and is placed nearly opposite to the larger one, at a distance of less than half an inch. The economy of nature not permitting a greater depth, the tympanum is provided with space horizontally, though the difference

each way is not great. But the necessity of admitting air, being common to both, it is introduced into the latter by a tube, called the Eustachian, which having a large opening in the fauces, admits air into the cavity at every inspiration. By this means, the membrane is always preserved in the same medium, and when the frequency of its oscillations are described, the necessity that it should experience no diminution of its elasticity by a difference in the density of the air will become apparent.

One more point of resemblance exists, namely, the power of tightening the two membranes. In the drum, this is effected by strings, which being attached to the hoop on which the parchment is stretched, can by means of a piece of leather add to or decrease its tension at the pleasure of the musician. With the ear, the same effect is produced by the three muscles attached to the malleus, which act with a power beyond our controul in

accommodating the surface of the membrane to the different degrees of pressure to which it is subject; and to this is superadded the power I have before presumed it possesses, of some self-adjustment. Mr. Tod remarks, "that its own muscular fibres are more powerful than the combined strength of all those belonging to the cavitas tympani*."

It sometimes happens when these muscles are rigid by the effect of inflammation, proceeding from cold, that sudden and forcible impressions, like the report of a cannon, break the membrane, the muscle or elastic spring being unable to accommodate itself to the unusual pressure. On this account, young artillerymen are instructed to fire the great guns with the mouth open, that the impression being received at once on each side of the membrane, all mischief may be avoided; but though this practice

* Tod, On the Organ of Hearing, page 20.

may make the chances of rupture less, it does not always prevent it.

These, I believe, are all the points of similarity; which I have detailed with the intention of showing in what manner a drum does resemble the tympanum, and in what it does not. The only likeness, excepting in the name, consists in the possession of two membranes, and the necessity of communication with the external air. In all other particulars they differ; the drum by the motion of the stick occasioning sound, whereas the membrane of the tympanum is but part of a mechanical contrivance, to receive certain vibrations and transmit their pressure further onwards. It is not sonorous in itself. Attached to it, on the inner side, is the first of a succession of small bones which will now be described.

SMALL BONES WITHIN THE TYMPANUM. (*Ossicula auditûs.*)

The first is called the *malleus,* from some resemblance to a mallet or ancient hammer. Its long limb or handle is joined to the inner side

of the membrana tympani, reaching nearly to its centre; and is attached near its neck, by a small projection called the *processus gracilis,* to the bony ring (*os annulare*) on which the membrane is stretched; while its round head is articulated into a dent formed in the next bone, called the incus, from its supposed resemblance to an anvil. The *incus*

has a broad top or crown to receive the head of the malleus, and two limbs, one of which, the shortest and thickest, is unattached, or suspended in space, as a counter-balance to the longer one, by which the communication of the chain is carried on; having a very small bone, the *os orbiculare,* joined to its longer extremity, which is represented both attached and separate. This is the smallest bone of the body, being no larger

than a poppy seed, but is supposed to be of considerable use, from its orbicular shape enabling it to accommodate itself to variety of motion, and impress the next and most important bone, the stapes, with a direct and central pressure. Some anatomists deny a separate character to the os orbiculare, and call it the *lenticular process of the incus*.*

The *stapes* derives its name from its resemblance to a stirrup, the lower part, by which the foot is supported, being fixed exactly over the fenestra ovalis, which is the membrane connected by this chain of bones with the membrana tympani †. If more importance is due to one part than to another, it is to this bone, the stapes, and the membrane it covers, they being as it were the key to the auricular machinery. Where all the preceding parts have been deranged, the preservation of the stapes has preserved

* Tod, p. 16. Shrapnel's Anatomy of the Human Bones; Explanation to plate vii.

† The size of its base is given under the drawing of the stapes.

the functions of the labyrinth entire, and by artificial aid the hearing has been restored; but if it is removed, however perfect all the other parts may be, the destruction of the small membrane it covers, which generally ensues, by permitting the fluid to escape from the labyrinth, renders deafness completely incurable. This subject will be again adverted to in describing the Division of the Internal Ear, where the sonorous vibrations first become perceptible to the mind; but there remain two important parts within the tympanum, still demanding distinct description.

THE EUSTACHIAN TUBE. (*Canalis Eustachianus*).

This tube is about one inch and a half in length, and supplies to the cavity of the tympanum atmospheric air, and is of the same use in relation to it, that the hole in the cylinder is to the common drum. It is wide at its entrance from the fauces, becomes nar-

rowest at about two-thirds of its length, and though it increases in width before it enters the tympanum, it is not there larger in diameter than one-eighth, or at most three-sixteenths of an inch. At the wider or trumpet-like extremity, it is large enough to receive a goose-quill. Towards the tympanum it is formed, for the space of half an inch, of bone, and enters nearly at the top of the membrane. It cannot, therefore, act as a drain to the tympanum till that cavity is almost filled up. It is frequently closed by inflammatory action, causing adhesion of its lining membrane; and is sometimes obstructed by enlargement of the tonsils, polypi of the nose, and inflammation of the throat. But in whatever way this obstruction may arise, while it lasts and prevents the passage of the common air, the action of the membrane becomes paralyzed, and imperfection of hearing ensues. Sir Astley Cooper endeavoured to remedy deafness thus occasioned, by making a small hole in the membrane; not so large as to destroy

its vibratory power, and yet sufficiently extensive to permit the air through the meatus to pass to the other side. In some instances this succeeded, but more generally failed, from the closing up of the aperture; and though numerous instruments have been constructed to obviate this difficulty, they have not been successful. Where the attempt has been frequently made, a deafness more obtuse than the original one has ensued, from the thickening of the membrane after every successive cicatrization of these punctures.

This practice, which is now but rarely resorted to, was first recommended by Cheselden, who observes,* "If any disease of the membrane should obstruct the passage of sounds to the internal parts of the ear, which are the seat of the sense, an artificial passage through the membrane might recover hearing. Some years since, a malefactor was pardoned on

* Cheselden's Anatomy, p. 306.

condition that he suffered this experiment; but he falling ill of a fever, the operation was deferred, during which time there was so great a public clamour raised against it, that it was afterwards thought fit to be forbid." *

Mastoid Cells. (*Cellulæ Mastoideæ.*)

Lying on the opposite side of the tympanum to the Eustachian tube, are placed the Mastoid cells, in the lower projecting angle of the temporal bone; but they envelope almost every part of the internal ear. They have been compared by some writers to the cells of a honeycomb, a description from which I

* The following further elucidation of this affair, is from a note to Walpole's Reminiscences. "Lady Suffolk" (Mistress of George II.) "was early affected with deafness. Cheselden, the surgeon, then in favour at Court, persuaded her that he had hopes of being able to cure deafness by some operation on the drum of the ear, and offered to try the experiment on a condemned convict, then in Newgate, who was deaf. 'If the man could be pardoned, he would try it; and if he succeeded, would practise the same cure on her ladyship.' She obtained the man's pardon, who was cousin to Cheselden, who had feigned that pretended discovery to save his relation, and no more was heard of the experiment. The man saved his ear too, but Cheselden was disgraced at Court."

beg to differ, the latter being sexagonal, while the mastoid cells are of no defined shape. They are not perfectly formed till about the tenth year, and frequently become obliterated, or filled with osseous substance before death. The changes they undergo may have occasioned a difference in their description, depending on the age and state of the parts from which it may have been made; in some cases they may be said to resemble petrified sponge, and in others pumice stone, the lava of Mount Vesuvius. The cavities are supposed to communicate, and are lined throughout with a very delicate membrane. As they are not described by anatomists as possessing any specific functions, I will endeavour to show, in the general remarks in the next chapter, the important effects to which they frequently contribute.

Within the tympanum, or rather opening into it, is the foramen rotundum, an aperture somewhat resembling that covered by

the stapes, from which it is separated by a small projection in the cavity of the tympanum, called *the promontory*. This hole has obtained the name of rotundum, from its being more circular than the other (covered by the stapes), which being semi-lunar, is called indifferently the

foramen ovale, or oval hole, and
fenestra ovalis, or oval window.

The purposes of the *foramen rotundum*, or round hole, will be more fully explained on treating of the next, or sentient division of the ear, to which I consider it properly belongs.

DIVISION III.

The Internal Ear.

We have now arrived at that division of the ear, where the parts to collect the sound, and those to transmit it, are united with that portion in which the sense of hearing is completed. The various characters of sound, from that occasioned by the concussion of two stones, the bleating of cattle, the harmony produced by musical instruments, or the more difficult and delicate perception of speech, are equally communicated to the mind, and discriminated by it, through that part of the structure called the internal ear, which has obtained the name of

The Labyrinth,

from its different parts having communication with each other. Throughout the three divisions of which it is composed, is disposed a fluid, discovered by Cottugna, before whose time it was supposed to contain air alone. The knowledge that fluid conveys aerial impressions, with four times greater force than air, has added much to the importance of this discovery.

The three parts into which the labyrinth is divided, are first

The Vestibule,

or central space, where the foramen ovale is placed on the side next to the tympanum, and is kept closed by the pressure of the stapes. Nearly opposite is the *internal auditory canal,* which is about three-eighths of an inch in length, and introduces the sentient nerve of hearing. The vestibule is irregular in its shape, but does not consist of more than a

quarter of an inch in breadth, and rather less in depth.

On the side adjoining the mastoid cells, are placed the

Three Semi-circular Canals,

so called from their semi-elliptic shape, though they differ from each other in extent, and are not exactly of any defined geometrical figure. As it will only needlessly embarrass the description to describe their position in relation to each other, suffice it to say, that two of them (the vertical and the oblique) form a junction of their cavities before they re-enter the vestibule, from which, consequently, but five apertures are observable. These canals, though they will readily admit a hog's bristle to pass, are not so large as to permit the entrance of a substance equal to a small pin's-head; but three of their terminations in the vestibule are more enlarged than the circumference of their respective

canals, and have thence obtained the name of *ampullæ,* or bottles with long necks.

Opposite to the canals above described, and placed at a greater distance from the outward ear, is situated

The Cochlea,

so called from its supposed likeness to a shell. It is divided into two passages called *scalæ*, running throughout from the *base* to the *apex,* in which space they perform two turns and a half. In the centre, round which these scalæ wind, is a *newel,* or central pillar, called the *modiolus.* At the apex the two passages communicate, but at their base one division connects the cochlea with the vestibule, while the other is terminated by the foramen rotundum, and thus cuts off all communication with the tympanum, into which it would otherwise lead.

The central pillar, or *modiolus*, has a small funnel-shaped opening at the top, or *cupola*, called the *infundibulum*, and the two scalæ there, and there alone, communicate ; so that the impressions made by the action of the stapes, though confined to a small space, are by these various turnings greatly prolonged ; while the angular direction given to their progress, enables the foramen rotundum to accommodate itself with ease to the great range of external impressions, and consequently of internal pressure, to which this wonderful structure is exposed ; varying in intensity, from the report of artillery or of thunder, to the chirping of a grasshopper, or the murmuring of a stream.

This arrangement is strictly analagous to the construction of a steam-engine, the boiler of which, being exposed to a varied pressure from the action of heat, is provided with a valve, which at a certain degree of force relieves the machine ; and the ear, in like manner, being also subject to unequal impres-

sions, might be expected to be furnished with a similar contrivance; but as a valve would admit of the escape of the liquor Cotunni, which circulates in the labyrinth; either a new provision must have been created to supply its loss, or the arrangement take place the Creator has adopted, of an elastic membrane, like the foramen rotundum, which yielding to internal impressions, and not permitting the escape of the fluid, meets the difficulty and purpose with the most economical means.

This being a new illustration, as applied to the purpose of this membrane, I have turned to Sir Charles Bell's description of the ear, where I find his opinion coincident with my own; but as he arrives at this conclusion by a different course of reasoning, I give his deductions in his own words.

*"In the cavity of the tympanum we observed two foramina, the foramen ovale and the

* Anatomy and Physiology of the Human Body, vol. III., p. 181, et seq.

foramen rotundum, both of which lead into the labyrinth ; but one of them (the foramen ovale) into the vestibule, the other (the foramen rotundum) into a scala of the cochlea : now it becomes a question, whether the oscillations of sound pass by one or by both of these foramina?

"It is contended that the sound passes in both ways, that is, along the solid bones, and through the air of the tympanum. Did it pass through the air, why is there all this expense of apparatus? why a membrane of the tympanum? for unless the impressions of sound were to be conveyed as powerfully through the air, as by the bones, why are they there at all? If the air were the medium, then the chamber containing it should be direct and regular. * * *

" An absolute confusion of ideas has led to the opinion, that the foramen rotundum receives the undulation of the air. It is not enough to state to those physiologists, that the

foramen ovale is directly opposite the membrane of the tympanum, and the foramen rotundum turned away from it. No, they say, that is the very reason, because it does not receive the impulse directly, but by reverberation and obliquely. * * *

"In the labyrinth there is no air, but only an aqueous fluid: now this we have seen conveys a stronger impulse than the atmosphere; stronger in proportion to its greater specific gravity and want of elasticity; for an elastic fluid like air may be compressed by concussion, but an inelastic fluid must transmit fairly, every degree of motion it receives. But if the fluid of the labyrinth be surrounded on all sides; if, as is really the case, there can be no free space in the labyrinth, it can partake of no motion, and is ill suited to receive the oscillations of sound. Against this perfect inertia of the fluids of the labyrinth I conceive the foramen rotundum to be a provision. It has a membrane spread over it, similar to that

which closes the foramen ovale. As the foramen ovale receives the vibrations from the bones of the tympanum, they circulate through the intricate windings of the labyrinth, and are again transmitted to the air in the tympanum, by the foramen rotundum. Without such an opening there could be no circulation of the vibration in the labyrinth; no motion of the fluids communicated through the contiguous sacculi, nor through the scalæ of the cochleæ; because there would be an absolute and uniform resistance to the motion of the fluids. But as it is, the provision is beautiful. The membrane of the foramen rotundum alone gives way, of all the surfaces within the labyrinth, and this leads the course of the undulations of the fluid in the labyrinth in a certain unchangeable direction.

"To me it appears, that to give a double direction to the motion of the fluids, or to the vibration in the labyrinth, far from increasing

the effect, would tend to annihilate the vibrations of both foramina by antagonising them.

"The common idea is, that there is a motion communicated through the membrane of the foramen rotundum along the scala tympani, and another through the foramen ovale into the vestibule, and through the vestibule into the scala vestibuli; and that the concussion of these meet in the infundibulum of the cochlea. But as there is no space for motion in the fluids, in either the one or other of these tracts, the vibration must have been received in the infundibulum at the same time that the motion was communicated to the membranes of the foramen ovale and rotundum; for if a tube full of water, a mile in length, loses one drop from the extremity, there must be an instantaneous motion through the whole to supply its place. The evident consequence of this double impulse would be (if they were of the same strength) to suppress

all motion in the fluids of the labyrinth. But we have shown that the strength of the vibration communicated to the foramen ovale and foramen rotundum are not the same: for the mechanism of the bones in the tympanum is such as to accumulate a greater force or extent of motion on the membrana ovalis than is received upon the membrana tympani; therefore the lesser vibration, which is communicated through the medium of the air in the tympanum, cannot be supposed capable of opposing the stronger vibration which is conveyed from the foramen ovale through the labyrinth. Besides, the air in the tympanum has a free egress, and cannot therefore strike the membrane on the foramen rotundum forcibly.

"For these several reasons, I conceive that the following account of the manner in which the sound is conveyed is erroneous: "Et quo ad zonam cochleæ spiralem quoniam altera cochleæ scala in vestibulo patet, altera a FENESTRA ROTUNDA initium sumit, atque earum

utraque aqua labyrinthi repleta est, et scalæ in apice cochleæ simul communicant, zona spiralis inter duas veluti undas sonoras media, a tremoribus per vasim stapedis, simulque ab iis per membranam *fenestræ rotundæ* advectis utraque in facie percellitur et una cum pencillis acoustici nervi per eam distributis contremiscit: quibus porro omnibus, in ampullis videlicit canaliculorum semicircularium alveo eorum communi, sacculo vestibuli spherico et lamina cochleæ spirali acoustici nervi affectionibus auditum contineri nemo non intelligit."*

I have extracted these opinions at some length, though by no means to their full extent, partly to show the slow process by which this conclusion is obtained; and also as I shall have occasion to refer to them again, to elucidate my peculiar views respecting the occasional application of the foramen rotundum. For the purpose of terminating the

* Scarpa, p. 61.

direct impression received by the outward ear, I may perhaps venture to hope that my opinions are not at variance with those I have transcribed; but I feel convinced that a secondary channel for receiving sound exists, and imagine that this membrane, which is undeviating in its action under the stronger and most usual impression, assumes a retrograde movement when obstructions cause the first power to be no longer felt, by which the secondary or inferior one becomes the strongest. This part of the subject will be renewed in the next chapter, which embraces general observations, it being necessary here to describe the nerve of hearing, by which the sonorous impressions are rendered sensible to the mind.

The Nerves.

The physiology of the nervous system is not only an unsettled one amongst the most enlightened anatomists, but even those to whom science owes the greatest obligations, after

tracing them to a certain extent, are obliged to admit "that the absolute proofs stop here, and the rest is hypothesis." Within the last few weeks, a physician of eminence* has laid claim to a further discovery respecting them, having described certain nerves which he designates as excito-motory, or inducing others to action.

The intricacy of the subject, and differences both of opinion and of arrangement prevailing, would have induced me to pass the subject over in silence, did I not rely on the candour of the reader in this attempt to convey a more general knowledge of the different offices of the nerves, than has hitherto been given in any work restricted to the ear, and which is rendered necessary by the vague notions prevalent respecting them; as they have not only prevented many curable persons from obtaining relief, but have induced practitioners to acquiesce in an erroneous

* Dr. Marshall Hall.

description, while the impediment to hearing was frequently not nervous; or, if so, was remediable by art.

The nerves have been defined by Sir Charles Bell, as consisting, "besides the nerves of vision, smell, and hearing, of four systems combined into a whole, namely; those of sensation, for voluntary motion, and for respiratory motion; and others, which being deficient in the precise qualities which distinguish the three preceding classes, seem to unite the body into a whole in the performance of the functions of nutrition, growth, and decay." But for our present purpose I shall consider them as consisting but of four separate classes, including the nerves of all the senses; as those which are described for sensation, are merely those of feeling in the most extended sense. The peculiar one of touch at the finger's ends has been deemed distinct from that which pervades every other part of the body, and has induced

some French philosophers to consider it equal to a sixth sense; but as that supposition has never been adopted, I consider all nervous action may be comprised under the following heads or classes:

I. Nerves of the five senses; by which we *see* the sunshine, *hear* the singing of the birds, *feel* the freshness of the air, *smell* the odour of the flowers, and *taste* the different fruits.

II. Nerves of voluntary motion; by which we elevate an arm, move a leg, or change any part of our position; actions which require one nerve to convey the intention, and others to execute it.

III. Nerves of involuntary motion; by which we respire, the heart beats, &c.; actions which are performed during the unconsciousness of sleep.

IV. The sympathetic nerves; by which the whole of the nervous system is associated, and a bond of union established between all parts of the body.

This division of nerves is partly necessary to enable us to comprehend the peculiar nerve of hearing. As each side of the body is supplied alike, the nerves are formed in pairs; and the auditory ones, or the seventh pair, consist, at their origin in the brain, of two different parts possessing dissimilar functions. One portion called the *portio dura*, or harder portion, is a nerve of motion, contributing to the expression of the face, and ramifying on the lips, cheeks, nostrils, and eyelids, "and is no otherwise connected with the organ of hearing, than as it receives the chorda tympani, which unites it with the lingual branch of the inferior maxillary nerve, whence some have considered it as a branch of the lingual nerve. It is, in a word, a nerve of communication, equally belonging to both." To this imperfect description of Mr. Saunders, I must add, that the portio dura supplies the nerves of motion to the auricle, and consequently is of importance to the ear, while the chorda tympani is affected by the action of the small

bones within the tympanum, between which it passes. (See its direction on Plate I, p. 39).

But this extract is given to show how very distinct it is from the *portio mollis*, or softer portion, which is the sentient nerve of hearing, and terminates in the inner ear. Both portions of the seventh pair enter the internal auditory canal together, enclosed in the same sheath; but the portio dura immediately passes off to its functions before described, while the other portion spreads its fine but scarcely perceptible organization throughout the inner ear, "in which fibres, stretched across like harp-strings, constitute the lyra."*

It will be requisite to explain, for the purpose of understanding any other work on this subject, that Willis and others have considered these two portions as two separate classes of nerves, calling the portio mollis the seventh pair, or auditory nerve; and styling

* Arnott.

the portio dura the eighth pair, or facial nerve. Sir Charles Bell, and many others, treat them as one nerve, the seventh pair, consisting of the two portions already described, which arrangement I have followed. Thus some writers adopting one classification, and others another, call the auditory nerve the seventh or eighth pair, according to the system they prefer.* I am sorry this peculiarity in nature, and difference in definition, obliges me to enter into this detail; but without it, those who carry their researches further would be involved in difficulty.

It therefore remains to describe the portio mollis of the seventh pair, which, like all nerves not exposed to external injury by passing near the skin, is more delicate, and probably more susceptible. On entering the

* Dr. Hall, pursuing the classification of Arnold, styles the seventh pair, the facial, and the eighth, the auditory; while Mr. Cock, whose work on the "Practical Anatomy of the Nerves," &c., is in the hands of most students of anatomy, reverses this arrangement, calling the seventh the auditory, and the eighth the facial.

labyrinth, it divides itself into two nearly equal parts; one of which ramefies on the membrane which lines the semi-circular canals and vestibule, the other half supplying the cochlea. Here it follows all the sinuosities of the different parts, passing along and through its winding and open structure, and terminating at the two membranes alluded to before, the fenestra ovalis, and foramen rotundum, which commence and close the inner ear.

But though the two portions of the seventh pair of nerves have these distinct properties, the one being for motion, and the other a nerve of sense, they not only have sympathy, but receive injuries in common; and where this is the case, the nervous deafness is the more confirmed. When the nerve of hearing alone is affected, and the varied expression of the countenance remains, it proves that the injury is not deep seated, and arises after the separation of the two parts; but where the loss of muscular power in the face is apparent,

causing a blank expression of countenance, the cause of the auricular and facial affection must be sought in the state of the nerve, previous to its passage into the interior auditory canal, and can only arise from injuries within the brain. Many physiological writers, who observe the essential difference in origin, shape, and function, of the two portions before described, admit no possibility of any reciprocal influence; but observation has led me to the conclusion of a more intimate union than is generally admitted. No direct communication exists with the portio mollis by any other nerve except the portio dura; but I consider the following extract from Monro, as sufficiently accounting for the sympathy I attribute to them. "Where the nerves come out distinct and separate, and afterwards conjoin under the same covering; though the nervous fibrils probably do not communicate, yet because the coats at the conjoined part are common, these strong coats may have great effects on the soft pulpy nerves,

and it is evident all such will have a common sympathy with one another." * This is peculiarly the case with the seventh pair, the portio mollis being essentially a pulpy nerve; and the two portions are compressed into one sheath in the internal auditory canal, where a filament of communication is perceptible. Their sympathy consequently arises from their connection at this part, and I have frequently remarked, as in Case I. in the succeeding chapter, that when the hearing has become improved through a greater sensibility of the portio mollis, the auricle, which is influenced by the other portion, has shortly after experienced a visible change; its surface, if shrivelled, has become more smooth and pliable; its form more capacious and erect; and the countenance has lost that depressing appearance almost always attendant on injuries affecting both divisions.

It is essential to the health of a nerve, that it should be fully supplied with blood; conse-

* Monro in Cheselden, page 226, 7.

quently any pressure upon the brain, by compressing the nerve lying within it, impairs its vital principle. It may also be injured by want of constitutional vigour, which will deprive it, in common with every other part of the body, of its due nourishment. The treatment of such cases must consist in raising or depressing the constitutional action, to obtain a mean and proper standard; but as it was well observed by the late Mr. Abernethy, that every substance we take, with the exception of water, ought to be considered as medicine; the regulation of the quantity and quality of diet, and the time of taking it, will frequently remove these causes of deafness, without the application of medicine (properly so called), or any other restraint than that which we ought always to place upon our corporeal faculties, to preserve the ascendancy of our intellectual ones.

Another consideration arises out of the importance attached to our food. It is well ascertained that the body itself undergoes a

change by the absorption of food into our system, and in ten years, or sooner, it is calculated that no part (with the exception of the enamel of the teeth) remains unchanged; consequently the nerves are re-formed, and depend on the health of the secretions during that period for their proper sensibilities. This accounts for persons passing through affliction with very little shock to their nerves; but in a year or two afterwards, when the cause of their suffering may be forgotten, or no longer lamented; or the loss, if pecuniary, may be recovered; yet the nerves become shaken, and what did not greatly alarm at the acmé of its pressure, is experienced in its effects when the original cause has passed away.

It is for this reason that persons are frequently unable to trace the source of their nervous disorder; but it will generally be found to have been fostered under an unhealthy state of the digestive organs, which will require a long time for their perfect restoration. However,

every approach to a better condition is perceptible; and I have witnessed deafnesses of twenty years duration, so modified by four months' strict attention to diet, as to encourage every one to attempt to remove this most intractable cause of deafness, by the most pleasant of means, an improvement of the general health.

The auricular nerves are also affected by the sympathetic, or IVth division, which, having their ramifications in the stomach, and principal viscera, convey the sensations of those important parts throughout the body. In what proportion, as compared with others, the nerves of hearing are affected from this source, is a matter of great doubt; my own observation has occasioned me to remark, that temporary derangement of stomach affects the hearing less than the other senses; but if long continued, they partly recover and accommodate themselves to the existing state of the health, while the auditory affection

increases. The recollection of most persons will supply them with instances, where occasional irregularities have caused black spots to float before the eyes, the taste to become deranged, and the senses of touch and smell imperfect, while the ear has preserved its functions unimpaired; on the other hand, a long-continued illness has spared those several faculties, and wholly affected the sense of hearing, which has afterwards undergone no alteration, unless for the worse.

Many persons are affected by sympathy with others; I am acquainted with two sisters, one of whom is hard of hearing, but she becomes impenetrably deaf when she perceives any indisposition affecting her sister; a calamity this lady observed that was not without its consolation; for as on such occasions talking was fatiguing, she found she could convey her meaning as well by the motion of the lips, as by the effort of the voice. Many also hear well in their own families, but immediately

become deaf when addressed by strangers. This affection, which is by no means uncommon, can scarcely be classed under any of the preceding heads, though certainly proceeding from the IIIrd Class, and shows our inability to confine, within any prescribed limit or definition, the perpetually changing affections of the nerves.

I cannot conclude this part of the subject without adding one word on the injurious effects of mercury, as affecting this organ, under whatever form or name administered, if long continued. It becomes then most destructive, and with persons advanced in life its exhibition should be circumspect. They rarely have the power of reproducing that new state of sensibility which this poison destroys. I witness almost daily cases of persons afflicted with other infirmities besides deafness, to whom mercury in the shape of the blue pill is administered, and who perceive their deafness increased whenever they take it.

CHAPTER III.

"How beauteous mankind is! O, brave new world
That has such people in't."

SHAKESPEAR.

THE exclamation of Miranda, as her knowledge of the human race increased, is only such as the contemplation of our frame universally occasions; and those who devote their attention to its separate parts, generally discover in them objects equally deserving of admiration.

In a treatise recently published by Mr. Patterson Clark, a celebrated dentist, the following observation occurs, relative to

the first set of teeth. "About the end of the second, or beginning of the third year of age, when the first teeth are completely developed, perhaps no object in nature can look more beautiful than the mouth of a child. The form of the jaws is semi-circular, the gums are of one uniform healthy colour, the teeth of beautiful shaped ivory, without the appearance of a flaw." Nothing can exceed the justice of this remark, which Mr. Clark's peculiar practice has enabled him to point out so forcibly; but at that period, every feature seems formed in loveliness; and while the eyes and lips also become just objects of admiration, I feel constrained to claim a similar tribute, in a degree very little inferior, for the ears. Their semi-transparent and shell-like form; the beautiful curvatures into which they are shaped; the smoothness of their glossy surface; and that expansion which gives expression to the countenance, render them objects nearly as attractive; and though in after life, when injured by accident, or shrivelled by age,

they no longer deserve this commendation; it is to be observed, that my remark, like that of Prospero's daughter, is only applied to the period,

> "Before Decay's effacing fingers
> Have swept the lines where Beauty lingers."

But a prejudice exists on this subject, that requires a little sober reflection, and some argument to remove. It may be difficult to define what ought to be esteemed beautiful; but the standard should be sought amongst the works of Nature. That which is symmetrical, conjoined with usefulness to a particular purpose, ought to obtain the meed of pre-eminent fitness and beauty. It is thus we determine on all other occasions. The beauty of a horse is not that of a deer; but the knowledge of what principally contributes to his usefulness, has induced us to attach the idea of beauty to those parts in which that quality resides; and consequently the description of that animal given by Shakespear, differs from that of Mr. Tattersal, in harmony

of language alone. Still if we look to lightness of figure, and ideal elegance of structure, we might prefer the slender limbs and gracefulness of the deer, his arching neck, and magnificent antlers; but we can with propriety ascribe beauty to both, and justly attribute that charm to their very different proportions. If, therefore, a peculiar adaptation of parts to a particular use, constitutes that symmetry of shape generally considered beautiful, every parent, at the birth of a child, has placed before him an object of admiration and correct taste in the shape of the ear; and it is not less absurd to interfere with its perfect development, than it is in China to confine the foot in an iron shoe.

This organ is particularly well defined in almost all the Greek and Roman sculpture, which proves that in those ages it was deemed an ornament; and it is further represented as prominent as is necessary to perfect hearing. The head dresses, of parts of modern Europe,

have been the principal causes of its compression, and consequently of deafness, by depriving the ear of its natural power; and this injury has been aggravated by seeking its restoration in appliances to the parts not injured. From the description of its structure given in the preceding chapters, it will be found, that it is composed of a vast variety of mechanical aids. The power of the auricle may be compared to a wind-sail; the cerumen to thickened oil, and the principal membrane to a drum-head; the cavity of the tympanum to the hollow of a drum, the small bones to the minuteness of watch-work, and their limbs to levers or balance-weights; the stapes and the membrane it covers, to the piston of a pump, the labyrinth to an hydrostatic press, and the nerves to the strings of a musical instrument; the whole of these various parts and powers being subject to one general law, that of Pressure.

It may therefore excite our wonder, that so complicated a piece of mechanism should

be required; but when it is remembered that the lowest tone, to be audible, makes thirty vibrations in one second, and the most acute above eight thousand,* it might then appear doubtful whether such a combination of parts, wonderful as it is, would be equal to accomplish the purpose. And, doubtless, this latter reflection would be just, if the ear depended altogether on the mechanical aids already detailed. Of these more may exist than have hitherto been discovered, but all would be insufficient to accomplish the phenomenon of hearing, if there was not superadded the principle of life. This accommodating power, which defies description, forms the invisible union between the material objects we have described, and that peculiar faculty, by which, through some slight impression made upon the air by the motion of our lips, the exact

* Dr. Arnott says, in his Elements of Physics, page 472, that "the lowest note which is perceptible to the human ear has about thirty beats in a second, and the highest about thirty thousand," and this calculation is mathematically correct; but that which I have given is the number of vibrations in a second, which may be produced by most musical instruments, and which might be stated as high as fourteen thousand.

idea existing in one mind is communicated to that of another. Breath thus impressed by thought, forms a more lasting link than iron; by it nations have been bound in ties of friendship, or urged to unconquerable hate; while domestic maxims have survived the wreck of empires, and still unite the earliest ages with the present.

The parts composing the Structure of the Ear, which, throughout this work, are represented of their natural dimensions, seem scarcely to resemble the description of them, that being the result of minute, and in some cases, of microscopic observation, by which those not generally perceptible are defined; and though the mechanism of the ear, regarded as a whole, as in page 41, appears small, that portion on which the sound is ultimately impressed before it can be conveyed to the mind, is a mere point. But though the parts are thus minute in themselves, they are gigantic in relation to that power to which they are subservient. The oxy-hydrogen microscope magnifies three mil-

lions of times, and yet the individual particles of water have not been rendered perceptible. Air is eight hundred times lighter than water; consequently the number of parts which may be concentrated, even on so small a visible space as the membrane covered by the stapes, is infinite. This accounts for the variety of sound of which the ear is susceptible; being able not only to distinguish all language, but to define that of every province, and of each individual. We become also sensible of that of the inferior animals; the moan of suffering, the cry of triumph, or the song of delight, being equally cognizable by man. In fact, the minuteness of his discrimination of sounds is more diffuse than words to express it; consequently an appeal must be made to all the observers of Nature for those further illustrations which perpetually surround us, and greatly contribute to our gratification. This sense seems to create a more lasting impression on the mind than any other; for persons who have been at the same school, meeting in after life,

though unable to recognize the appearance, at once remember each other by the voice; and it is a further beneficent arrangement, that language is the most perceptible of variable sounds; for when the ticking of a watch is undistinguishable, language will still be heard with tolerable facility.*

With this view of the importance of the organ, I find it necessary to entreat on the part of parents, an endurance of its rather disproportioned development in infancy. This ugliness, as it has been called, has led to attempts to destroy its prominence, which have involved that

* Our organs would be insufficient for hearing in air of much less than its usual density. I have been favoured with the observations of a physician, who made a recent ascent with a balloon, who found, at the altitude of about one mile, that he was scarcely able to hear his companion: at the same time he experienced great pain in his ears, which he attributed, and I think with justice, to the expansion of the air he took up with him. The narrative by Mr. C. Green, of his ascent on the 17th of October, 1836, further accounts for this sensation. "I took up with me a copper vessel, the outlet being regulated by a valve, containing 70 lb. weight of water, for the purpose of using as ballast. The whole of the water being discharged at first ascending, and the valve then closed, the vessel of course became filled with the air of that altitude; and on the valve being opened at the greatest elevation we attained (about five thousand feet, or nearly a mile), the air in the interior of the vessel immediately expanded (being surrounded by an atmosphere of diminished density) and rushed out with a hissing noise."

of its usefulness; and if we consider further, how the Creator has departed from his general laws in its construction, we may be inclined to attribute more importance to its structure, than a casual observance would lead us to imagine.

The small bones of the ear are formed, even before birth, of the full size they ever attain; a phenomenon having no parallel in the human economy. The nearest approach to it is in the construction of the teeth, which are fully formed before their protrusion from the gums; the enamel necessary to their usefulness being of so brittle a nature, as to prevent their future enlargement without causing their destruction; but nature in this case has constructed two sets, one for the size of the jaw till it attains its full growth, when the first teeth fall out, and are succeeded by those which are to last for life. But though every other bone (with this exception) increases in growth till the proportions of the body become perfect, it will be seen, that those of the ear

are created at maturity of size; and while this fact is undeniable, shall we complain of the disproportionate extension of the auricle, which seems a necessary consequence of it? It is difficult to explain this peculiarity in our construction; but it may be, that a less perfect shape in infancy would retard our acquisition of that information which is the parent of all other; or that the growth of parts, not yet formed, renders the early perfection of this necessary.

I have endeavoured to construct

A Scale of Perfect Hearing,

showing the relative strength with which sound ought to be distinguished. It is the result of much experiment and observation, but it does not follow that the sense should be deemed impaired, if the same exact degree is not observable in all. In defective hearing, this proportion is never observed; in some of the instances adduced, the perception will be

wholly wanting; in others, a lesser gradation of sound may exceed a greater; and as all these irregularities have a cause, their nice discernment forms the best index to the successful mode of treatment.

Assuming the lowest perceptible sound, and perfect hearing, to be comprised within fifty degrees of comparison, I classify them as follows:

DEGREES OF COMPARISON.

1. Sound perceptible.

5. A watch heard, if wholly supported by the tongue, without touching the teeth. When this is the case, sound is principally conveyed through the Eustachian tube.

15. ..... placed against the lower teeth. The articulation of the jaw renders this less perceptible than

20. ..... placed against the upper teeth, which communicate almost uninterruptedly with the labyrinth.

35. ..... placed against the temporal bone, *i. e.* immediately at the back of the top of the ear,

38. A watch, placed against the mastoid cells, which is the angular projection near the lobe. (See Plate I A., page 39.)

50. . . . . placed at the auricle, or outward ear.

Mastoid Cells.

In the preceding chapter I have ventured to suggest, that functions of considerable importance are attached to the mastoid cells, which I will now endeavour more fully to develop. Nearly every writer who has thought upon this subject, is of opinion, that sound is received by some other channel than by the outward ear. This is faintly shadowed forth in all their productions, but the difficulty of ascertaining how it is obtained, and in what way transmitted, has cut short the pursuit, seeing that the establishment of such a fact must be in opposition to theories apparently too well established to be overthrown.

But no opinion, however well supported,

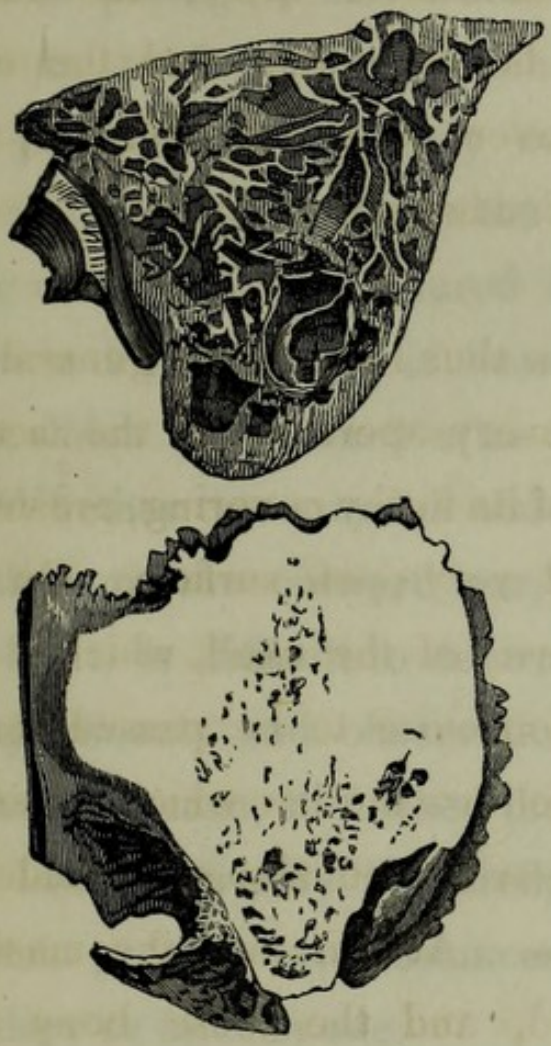
ought to exclude enquiry, and if a new fact can be elicited, more value ought to be attached to it than to one hundred theories, which, if not reconcilable with truth, are only so many false lights, which for the benefit of mankind cannot be too soon extinguished. However, it is possible to extend our investigation, and add new properties to well known objects, without the destruction of any with which they were previously invested; and such I consider the case as regards the structure of these cells. They present many and peculiar claims to our deliberate investigation. The small bones within the tympanum, as has been previously observed, are at birth of full size; the mastoid cells are not completely formed till ten years of age; in these facts is there nothing to excite our curiosity? The cells also form, with the exception of the auricle, the largest part of the machinery of the ear; and with the consciousness that nature "has made every thing perfect, and nothing super-

fluous," is no importance due to this physiological fact?

I therefore venture on a new theory as regards their use, by the assumption, that the ear is a compound instrument of disproportioned parts, but that sound is made audible both by the external apparatus, and also through the medium of the cranium. I assume that sound pervades every material substance, but some are more favourable to its passage than others. That where to peculiarity of figure, is added impermeability of structure, as in the formation of caves, whispering galleries, &c., the sound is altogether prevented from passing onwards, and consequently diffuses itself along the sides of such bodies till its force is expended. Now the cranium seems to form a more complete barrier to its progress than any other shape or substance; the two plates of which it is composed presenting the most impenetrable materials; and even if it passed through the

first or innermost layer, the loose bony structure between that and the outer one would prevent its passage further, as double windows deaden sound.

Sound is thus received by general pressure through every aperture of the face, which, divested of its fleshy covering, presents nearly a flat and very open surface. On reaching the concavity of the skull, which I have assumed is too close to be passed through, it naturally follows the law which governs Echo, and is reverberated along the sides to the extremities. At this part the mastoid cells are placed, and the loose bony structure becomes considerably widened; indeed, the internal ear is closely enveloped by it. But there is a portion forming the lower angle of the temporal bone where this is particularly observable, and the upper drawing shows its appearance in a healthy state, and is taken from the drawing, page 39, of Mr. Saunders. This very loose structure frequently becomes obstructed and osseous, presenting the ap-



pearance given in the second figure, taken from a specimen of my own, which came into my hands without any history of the state of hearing of the possessor. However, it must be apparent that a difference so striking in the structure of the mastoid cells, must have had an effect on the perception of sound in the person to whom it belonged; and I

venture to give this elucidation of their functions, deduced from facts which are of constant recurrence.

I imagine that the cells, in their healthy state, condense the sound reverberated through the cranium, but which forms a very inconsiderable proportion to that obtained through

the auricular passage; and when the outward ear is perfect, the much greater power it possesses completely counteracts the lesser sensation obtained by the head; as the ticking of a watch is rendered imperceptible when a loud rattling is heard in the street, but which is re-heard after the noise ceases. Whether this sound is added to that obtained through the outward ear, or overpowered by it, is difficult to determine; but several experiments and observations contribute to the inference, that when the external power is lost or greatly impaired, we can, under certain peculiar circumstances, hear by the secondary or inferior one.

The following case, of common occurrence, will serve to elucidate the subject:—Two ladies, both of whom were unable to hear in a room, were able, when in a carriage, to converse with each other distinctly, while another lady accompanying them, who ordinarily heard well, was unable to hear at all.

The explanation I put on this phenomenon is, that the particles of air, rendered sonorous by the motion of the carriage, were further increased in power by their conversation; and thus obtaining a higher tone, were rendered audible through the cranium impressing the inner ear; the outward one, which was nearly deaf on all other occasions, affording no opposing force; but in the case of the other lady, the noise collected by the skull antagonized that obtained through the outward ear, and thus rendered sounds conveyed by both channels, undistinguishable.*

It may be asked, why should the mastoid cells be the cause of this increased perception in the deaf persons—might not their organs be affected through the outward ear? I

* I have just heard of an instance, recorded by Dr. Willis, of a gentleman who kept a drummer in his employment, being unable to converse with his wife but while the drum was beaten. As the printer is waiting for this sheet, I cannot refer to the case at present, but imagine, if the increased sound she required for hearing could have been obtained through the outward ear by a trumpet, he would have dispensed with this noisy attendant, and consequently she could only have heard through the secondary channel I have pointed out.

reply, if this latter supposition was correct, it ought, at the same time, to have rendered the impression greater in the lady who heard well, instead of which it destroyed it; and secondly, this effect cannot be produced unless the mastoid cells are open, and as susceptible of sound as ever. In the table at page 104, it will be observed, that I have described perfect hearing to consist in perceiving the sound of a watch almost as well at the temporal bone (or behind the top of the ear) as at the mastoid cells; but in all cases where the effect before described is produced, that sound is imperceptible at the temporal bone, but is heard undiminished at the mastoid cells. This consequently connects the cells with the peculiar sensation experienced in a carriage, and which it is difficult to produce in any other way. The sound occasioned by the friction of four wheels, in the centre of which the ear is placed, creates a sensation which is seldom experienced except in this situation; but is still so common that

there cannot be a doubt of its existence; and the explanation I venture to make, seems to me the most probable cause of it.' It is certain, that if the same degree of sound had been heard by the same parties outside of the vehicle, it would neither have caused the deaf to hear, nor have injured the sense in the person who heard well. The only difficulty that apparently remains is, to define by what channel these opposite consequences were obtained; but as the phenomena and structure of the ear have been the subject of discussion for two thousand years, it is not to be expected that the solution of this problem should lie upon the surface.

There certainly seems a difficulty, on contemplating the formation of the skull, to perceive any direct channel for such communication, but the most probable appears to be the foramen rotundum; and I have copied the opinions of Sir Charles Bell at length, as they indirectly bear upon this subject, and in my

opinion, with the limitation I affix below, seem not opposed to my own. Sir Charles observes, "that the strength of the vibration received by the two foramina is not the same; that the lesser vibration impressed on the foramen rotundum is overpowered by the greater force impressed by the whole external organization on the foramen ovale;" and *while this greater power lasts,* I admit the truth of the remark; but, when the outer apparatus no longer supplies this superiority of impression, may not the lesser power then become the greater, and convey the inferior degree of hearing thus experienced?

Another part of the argument strengthens this supposition. He says, that "an absolute confusion of ideas has led to the opinion that the foramen rotundum receives the undulations of air, for the foramen ovale is directly opposite to the membrane of the tympanum, and the foramen rotundum turned away from it." In which way is it turned? Towards

the mastoid cells, thus presenting the most direct medium of communication when the first and greater one is lost.

The principal difficulty in which this subject is involved, is the supposition of the existence of some single and integral power, to which any other must be prejudicial; but if this inferior one is so regulated, as to bear against the greater but in the proportion of one to six or eight; or if the ear when perfect should be able to reject it altogether; or even through some unknown agency convert it to usefulness, as may fairly be supposed to be the case; then these objections, which are theoretical, vanish; while the fact remains undisputed of some secondary power, which only becomes perceptible when the greater one is impaired.

That such secondary power exists I can vouch from my own experience; and though reluctant to obtrude any remarks of a personal nature on my readers, such observations,

when faithfully recorded, present the most valuable data. Having a sore throat, which caused considerable irritation in the left ear, I requested my servant to syringe it; but though I regulated the heat of the water with a thermometer, and he is daily in the habit of witnessing the operation, he was so inattentive as to let the temperature fall one degree below the proper standard, and I immediately perceived a great sensation of deafness. This continued much beyond the period leading to the subsequent remarks. The inflammation in the throat remaining unsubdued, the right ear became affected, so that I could not hear a watch at above two inches from it, and not at all with the other. In this state I had occasion to call upon a friend; and walking to his house, I found the impression of each footstep was conveyed through the bones to the cranium, and produced a heavy sound like the rammer of a pavior; or the representation in the opera, where the statue of Don Juan's father dis-

mounts and crosses the stage in his marble boots; a delusion generally effected by strokes of a hammer.

This sensation was not perceptible till both ears became deaf; and it may consequently be asked, how it was I did not perceive some part of the sensation while one ear alone was injured? To this I reply, that previous and subsequent experiments have convinced me, that where the sound is single, we only apply that ear which is most favourably placed for its reception. Any person who hears equally well with both ears may convince himself of this by a simple experiment. On taking a watch in the right hand, and passing it slowly before the face, it will be heard distinctly on the right side till opposite the nose, when the sound will become a little fainter; but when carried one inch further onwards towards the left, the sound will be lost entirely by the right ear, and wholly received by the other.

This concentration of aerial impressions on the most favourable organ to receive them, enables us to account why the secondary power in one ear affords no interruption while the other is perfect; but when both become impaired, Nature has no resource, and the influence of sound obtained through the bones cannot be excluded. In my own case, and every other I have witnessed with such symptoms, the mastoid cells were unimpaired; and when the sound, as in walking, does not acquire such an accession of strength as to become audible, it occasions a noise like the boiling of water, or the rustling of leaves; but when the mastoid cells become ossified, the sound is greatly increased, and then resembles the clashing of hammers, the roaring of the wind, the rushing of a waterfall, &c., the nerves of hearing, like the strings of an Eolian harp, being responsive to all impressions, and conveying to the sensorium those discordant and inexpressible sensations this altered state of the organs create.

Where ossification has taken place, though unwilling to exclude all hope of relief, I fear there can be little expectation of a remedy; but where the cells are open, the course is clear to observation, though perhaps difficult of attainment; namely, by every endeavour to strengthen the outward ear by a full expansion of its powers, and such judicious appliances to the impediments within it, as shall restore its ascendancy, when the former tormenting phenomena will disappear.*

I am aware I have yet to remove certain opinions which assume that this imperfection, or rather liability of the sense, is unlike the other works of the Creator. But this is an assumption to which I cannot assent. What part of our frame is free from injury, or, when deranged, does not act prejudicially on some other? The Almighty having determined, as part of his general laws, that sound should be conveyed through the medium of air, it

* Wherever this phenomenon has been attempted to be explained, it has been attributed to a nervous origin, whereas it is clearly structural.

follows, as a necessary consequence, that those laws cannot be abrogated in any particular instance, and the utmost we can expect is some counteracting agency where their operation is prejudicial; this I conceive is provided in the mastoid cells terminating in the cavity of the tympanum, where the sound so conveyed may be dispersed, or rendered nugatory by the application of a greater. Thus, while the original construction remains uninjured, the sense remains perfect; and it is only by the accidents to which every other function is exposed, that we experience the evils of its derangement.

This argument is so ably discussed by Dr. Paley, with reference to similar objections relative to the eye, that I beg to transcribe part of it. He presumes the question asked is, "Why make this difficulty in order to surmount it?" to which he replies, "These are general laws; and when a particular purpose is to be effected, it is not by making a new law, nor by the suspension of

the old one, nor by making them wind, and bend, and yield to the occasion (for Nature, with great steadiness, adheres to and supports them); but it is by the interposition of an apparatus corresponding with these laws, and suited to the exigency which results from them, that the purpose is at length attained."*

Before I close this chapter I must be permitted to advert to what I can only designate as the unreasonable expectations of many persons afflicted with deafness. Those who have had their hearing impaired for ten or even twenty years, expect to be cured in one day, and sometimes in one minute: a feeling which greatly encourages quackery and desperate experiments; for the promise of a speedy or immediate cure is sure to be well received by those who think so little of the mode by which it is to be effected. If I have made myself understood in describing the structure of the ear, it will be apparent, that in most

* Paley's Nat. Theology, vol. i., p. 51.

cases where the deafness has been of long continuance, though the most judicious mode of treatment be adopted, a perfect recovery cannot be instantaneous. Parts may have lost their tone from disuse, from obstruction, or from injuries to which only Nature can apply the remedy, and for which the healing hand of Time, as well as Art, is required; but the analagous treatment of other parts seems to have no influence on the expectations indulged in for this, and I am frequently obliged to recur to the observation of Iago,

"We work by Wit, and not by Witchcraft."

A frequent cause of complaint is, the inability to hear general conversation at table. This is certainly a desirable acquisition to attain if possible, though the want of it should not occasion dissatisfaction; particularly as dinner parties are frequently so large that conversation, instead of being general, is broken into little knots; and if it is considered that each of these separate *converzationes* is

making its circle, and impeding that of others, the confusion attendant on voices proceeding from so many directions will bid defiance to the quickest ear to collect.

It was the knowledge of this certain effect, which induced LordChesterfield to recommend, that no party should be less in number than that of the Graces, nor exceed that of the Muses; he also advised that the table should be round; and, confined within these limits, hearing which now seems defective, would be esteemed perfect.

Sometimes expectations are raised for which no sober reason can be assigned. On one occasion, I was visited by a young gentleman, whose handsome ears and cheerful air, induced me at once to remark, "You require no assistance from me." He replied, "No, I hear well, but have a sister who is very deaf. In the day it is not of much consequence, as she knows by the motion of my lips what I say;

but she thought you might have some invention to assist her hearing at night, when she cannot see."

Though several thus indulge in vain expectations; on the other hand, many submit to deafness which might easily be relieved. Cases perpetually occur where persons are so self-condemned. They commonly adopt the idea that their deafness proceeds from deficiency of wax, or is a nervous defect; opinions frequently based upon the observation of a professional person some years before, when such might have been the case; but time having effected a change, which with a little aid would restore their hearing, they continue under the old interdiction, till total deafness, or the persuasion of some friend, drives them to seek relief, which sometimes is obtained even in a single visit.

As the love of life is known to prolong it, so the desire to be relieved of deafness will be one of the best aids the practitioner can

receive ; but that irritation which frequently characterises some stages of the complaint, and the despondency which is attendant on some others, often prevents relief; as, though some causes of deafness are mechanical, many are mental ; and others depend on the proper functions of the body, which the absence of Hope materially impairs.

CHAPTER IV.

OF THE OTAPHONE.

"If from great Nature's, or our own abyss
Of thought, we could but snatch a certainty,
Perhaps mankind might find the path they miss,
—But then t'would spoil much good philosophy."

BYRON.

IN the preceding chapters, I have pointed out the difficulties attendant on the study of the ear, described its construction, and attempted to elucidate some of the unexplained phenomena which still involve the causes of its most frequent complaints in obscurity; it will be my present endeavour, by describing the principles on which the Otaphone acts, and the success which has attended its application, to remove much of that disregard to which the auricle has been subject from erro-

neous opinions respecting its relative importance.

I hope my reader is now sufficiently acquainted with the general principles by which hearing is effected. The auricle supplies the moving power; the intermediate parts, or second Division, gradually lessen in dimensions, till the whole force of sound is concentrated on the point opening into the third Division, where it first becomes sensible to the mind. Of the parts to effect this purpose, the three first, namely, the auricle, meatus, and membrane of the tympanum, are open to inspection; the intervention of this latter boundary prevents a further view; but the state of the two important parts opening into the cavity behind it, namely, the Eustachian tube and the mastoid cells, may be judged of from certain symptoms that define their healthy or imperfect state. The inner ear is altogether hidden and unapproachable, Nature having placed it within the hardest bone

of the body, called the petreous, or stony portion of the temporal bone, which lies at the base of the skull, and is thus most effectually protected from external injury. Still the state of the auricular nerves may be ascertained with some degree of correctness, and remedies applied, which, acting on them, before their entrance into the ear, can promote their strength, or relieve them from pressure, as either of these equally injurious defects may derange their functions. Thus, though the ear is a complicated organ, and many of its affections obscured from view, sufficient indications exist to guide us in its suitable treatment, if this is founded on a correct knowledge of its parts, and a due consideration of their mutual dependence.

The auricle supplies the moving power to the ear, as the fliers give motion to a mill, or the sails to a boat; and in the same degree as these will act with a diminished quantity of that impetus which is essential to their perfect

performance, so the ear will be responsive to sounds, though deprived of a considerable part of its natural expansion. But this diminution of power operates in each of these instances alike; the functions are inertly performed, and any small impediment will interrupt-them altogether, which their undiminished force would overcome. It therefore forms a preliminary consideration in diseases of the ear, whether the impediment to hearing arises from internal injury, or the loss of external power; and this is so obvious, I can scarcely conceive that any person has taken a correct view of the subject, or treated deafness properly, who has overlooked this essential consideration. Even a common mechanic, if employed to repair a pump, would, if an honest man, first consider whether the handle was of its proper length; and if deficient, he could not, without its previous restoration, judge whether the machine was out of order or not.

It is precisely thus with the ear; it is subject

to injuries from the derangement of every one of the many parts of which it is composed; but that which is the first in order, the most exposed to view, and the easiest to relieve, has hitherto been the one which has excited the least attention.

To effect this preliminary purpose, which will frequently render all other applications unnecessary, the invention called the Otaphone is constructed; it supports the depressed parts of the auricle, and thereby conveying more vibrations to the inner ear, derives its name from οτα (ota) the ear, and φωνη (phone) sound. It is formed of pure silver, doubly gilt, which, taking the exact shape of the back of the ear, when supported in its most capacious form, spreads as it were a sail for the collection of sonorous impressions. A small hook, projecting over the top of the ear from behind, is the only part that can be seen on looking at the face, and the hair is generally so profuse on the temples as to hide it altogether. The

Otaphones have this advantage over spectacles, that while the latter add an expression of age to the countenance, the former, by restoring a more youthful figure to the head, increase its intellectual character. The invention was first suggested by observing persons at church, and other large assemblies, supporting the ear with the hand; which induced the author to consider whether the same advantage might not be obtained by means less troublesome and unsightly. His own experience, and subsequent experiments in which he was assisted by his friends, soon convinced him of the correctness of his inductions; since which the Otaphones have been worn in both Houses of Parliament, on the Bench in the three divisions of the empire, at places of Public Worship, the Theatres, and every public arena. The principle on which they act is so natural, as to be almost instinctive; Dr. M'Diarmid, who attended the last polar expedition having informed the author, that the only two Boothians who were deaf, adopted this practice·

The Otaphones possess also an incidental advantage scarcely inferior to the principal one, which is the genial warmth they promote behind the ear. This is frequently endeavoured to be obtained by embrocations, which sometimes succeed while the volatile stimulus lasts; but these instruments preserve this action throughout the day, and by continued use add new life to the internal functions. The warmth is also favourable to the secretion of cerumen, when the sebaceous glands are not totally destroyed. Sometimes when the ear is very rigid, as is often the case with men, the Otaphones cause a small crack in the under surface. This should be hailed as an advantage, Nature supplying the best medicament to heal the wound, which, when it closes, unites the auricle in a new and better position. When the ear is greatly depressed it is necessary, to obtain the best position for hearing, to turn the face away from the source of the sound; but the Otaphones, by projecting the ear, obviate this necessity,

and enable the speaker to be seen as well as heard.

As it was found that a further improvement might be made to assist the hearing, where the meatus, from the want of cerumen, had become disproportionally enlarged; the inventor for such cases constructed an elastic tube, intended to occupy the space the secretion formerly filled. Great difficulty attended this part of the invention. It was necessary that the material composing it should be pliable, to preserve the shape of the passage, and none presented itself that would not by the warmth of the ear collapse. Caoutchouc offered the most probable material, but no tube had hitherto been formed of so small a size as this passage required. On overcoming this difficulty, it was found to stick together so close as to be useless; this was remedied by combining a metallic substance with it, and in some cases where the passage is very straight this succeeds; but in the generality, the compression of the ear

is still too great. This further difficulty has been overcome by the introduction of spiral wire, generally silver, within the tube, which has a sufficient power of resistance to keep it open, and flexibility enough to meet the original intention. Thus the only parts that are exposed to observation, and where a departure from the first formation can be perceived, have been attempted to be restored; and I shall intersperse a few cases, showing the separate and conjoint usefulness of these patent instruments.

Case I.—Samuel Bellingay, aged thirteen years, is a scholar in Christ's Hospital. This little blue-coat-boy was acquainted with my principal manufacturer, and being at the manufactory during a holiday, put a pair of Otaphones on in play. Finding they improved his hearing, he obtained a pair, with permission to wear them at the school; but my attention was only called to the case two months after he had been supplied, by a gentleman from

Guy's Hospital, where the success of their application had become known. I therefore called in Newgate-street, on the 7th July, and saw the boy for the first time. His ears presented the shrivelled appearance indicative of a loss of nervous influence to the auricle, but he had so far recovered, that he conversed with me without the slightest difficulty, and had the instruments in his pocket. On the 26th September, I saw this lad for the second time. His left ear had recovered from the shrivelled appearance before described, and his hearing was perfectly restored on that side. The right one was subject to a discharge, and Mr. Stone, the surgeon of the establishment, informed me, he had extracted a piece of cotton from it some time previously. This ear had not recovered the healthy external appearance of the other, nor did he hear so well with it.

It thus appeared that the internal improvement, and the external appearance, were effected by the same means, and dependent

upon each other; which serves to confirm the opinion I have before expressed (page 87) that though the two portions of the auditory nerve have separate functions, they have a strong sympathy with each other.

Case II.—In June, I sent to the Lord President of the Court of Session, in Scotland, a pair of Otaphones, which, being supplied by guess, did not exactly fit; however they were worn and found useful, and on furnishing others in exchange, I had the pleasure to receive the following note.

Edinburgh, 25th July, 1836.

The Lord President presents his compliments to Mr. Webster; his packet containing the Otaphones arrived by the mail, and fit him exactly, and he therefore returns the first pair. He continues to find the Otaphones of great use, both in Court, and in Church; at other times he only puts them on at breakfast-time, and wears them for two or

three hours, and he finds his hearing improved for the rest of the day.*"

Case III.—William Ling, aged forty-two, has been in the service of Messrs. Forsyths, Leicester-place, for the last twenty years; had been at intervals for one year and a half in the Dispensary for Diseases of the Ear, without receiving any advantage. I recommended him a simple remedy, which he applied three times within a week, and he declared he derived more benefit from it, than from all his previous treatment. By the use of the Otaphones he is much better than he has been for years, but being often in attendance on gentlemen trying

* This case affording a striking exemplification of the use of the Otaphones, where I had not seen the party, I applied to his Lordship for permission to insert his letter in my publication; and received the following reply, since this Work has been in the press, which shows that the benefit still continues. "I do not remember the terms of my last letter to you, but I can have no objection to your making any use of it you please, with a view to showing the utility of your invention for improving the sense of hearing. I continue to reap benefit from the use of your Otaphones, &c.

I am, Sir, your most obedient servant,

Edinburgh, 27th. September, 1836. C. Hope."

guns in the fields, his employment is unfavourable to perfect recovery.*

It is astonishing how slight a departure from correctness of shape will impair the hearing, as will be shown in the following case.

Case IV.—Admiral Sir R—— S —— called on me, stating that he began to feel deaf in one ear. I immediately replied, "I will point out which it is; the right;" which he admitted was the case. I had no other guide to this judgment than the observation that the cavitas innominata, which is formed by the turning over of the helix, was wanting on the defective side, and perfect on the other. On inspection of this gentleman's ears, I never observed any more exquisitely formed internally, and feel certain that, but for this unusually perfect

* Having found myself under the necessity of alluding to a Public Institution, and knowing the frequent incorrectness of patients as to dates, I have procured, through a subscriber, an official statement of Mr. Ling's attendances, which commenced on the 15th August, 1834, and terminated on the 19th April, 1836.

shape, the deafness on one side would have taken place at forty, instead of being barely felt at twenty or thirty years later.

These instances, and many more of persons who have favoured the author with testimonials of their continuing to receive benefit from the use of these Instruments, apply only where the Otaphone or metallic prop was used singly ; the following cases have been effected by the tubes united with the Otaphones.

Case V.—Mr. Joseph Carter, who has held the situation of cook at the Albion Tavern, Aldersgate-street, for the last twenty-six years, lost the use of one ear by the discharge of a gun near his head, at the rejoicing for the general peace in 1814 (twenty-two years ago), since which, that ear had become useless, and he heard very imperfectly with the other. I applied the tube, when he immediately said he could hear. As I hesitated to believe so instantaneous and wonderful an effect, I

requested him to call in three days, when the Otaphones would be ready, and to keep the tube in till he came again.* When he returned he assured me he could hear himself shave with the defective ear. He has now worn the Instruments five months, and occasionally calls, having had his hearing on both sides completely re-established.

Case VI.—About the same time I had for a patient a young lady of nineteen, who, at the age of four, lost the membrana tympani of both ears, by two successive attacks of scarlet-fever. Being remarkably clever, she had contrived, by the aid of an invention of her own, introduced within the meatus, and the application of a small metallic concave without, to hear very well, but was desirous of making something of a more permanent material than the one she employed. From the success I had observed of an inven-

* At this period it was necessary to take a model of the ear; but the number since obtained, enables the Inventor to supply any person on application—or at furthest, by waiting one day.

tion used by a general officer, I had been endeavouring to contrive something of the nature of her's. We were therefore happy to exchange inventions; but I find that her's requires considerable tact for its proper adjustment, and would I fear not succeed in hands less adroit. The result of my invention, as stated by herself in a note, is, that she "can hear herself breathe when she has the tube in the left ear, which she rarely does without mechanical aid, but in the other, her own continues to answer best." I attribute the success of her invention to its absorbing more of the moisture within the ear than mine; and think that the success in the other ear would be greater, if the perforation was more extensive. In these cases of ruptured membranes, the tube is sufficiently long to extend to, if not to reach beyond, the injured part; and by throwing the sound directly on the membrane covered by the stapes, without permitting it to be dispersed in the cavity of the tympanum, the hearing becomes restored.

Ear trumpets, which are formed on the principle of collecting a larger body of sonorous vibrations, are open to many objections, and should be avoided as long as possible. Their first disadvantage is, that the sound is generally received on metallic surfaces, and consequently is not so congenial to the organs as that obtained by the auricle; next, that its proportion to the internal parts cannot be so well defined as it is by nature; and lastly, that the force thus obtained is so powerful as to render any other, afterwards applied, ineffectual; consequently an ear trumpet is a companion for life. Where it is obliged to be adopted, the long elastic India rubber tube is the best; but some ears are so sensitive as to be able to bear no other assistance than a roll of paper, formed in the shape of a funnel or trumpet.

The restoration of the hearing frequently depends on such inexplicable causes as never totally to exclude that expectation, unless forcible means have been employed, and the

functions deranged by injudicious attempts to improve them. One gentleman informed me, he had been occasionally deaf for twenty years, but during that period had perfectly recovered his hearing five times, one of which lasted for four years, and that without any perceptible difference in his health, or being able to attribute it to any cause.

The instances I have selected of improvement to the hearing arising from the use of the Otaphones, or the Tubes, or when combined, are such as present some small variety of character: but numberless noblemen, magistrates, and ladies of distinction, who have derived similar benefit, have favoured me with their testimony of the advantage they have obtained.

Though the Otaphones are not recommended as available in all cases of deafness, they may safely be adopted wherever an improvement in hearing is experienced by supporting the ear

with the hand, as the Instrument does that without fatigue ; they may also be assumed to be of use where the auricle is depressed, and the person still hears, though imperfectly ; for if the organs are sufficiently active to convey sound with only half the power that nature has provided, an increase to the full extent must be advantageous. This is peculiarly the case in advanced life, and necessarily must be so ; the longer we live the more we depress the auricle upon the pillow ; and as the inward sensibilities also decline with the functions of the body, a double disadvantage is thus placed upon the ear. But from some peculiarities I have before pointed out, in which it seems to escape from injuries to which the other senses are liable, it is frequently astonishing to find the perfection in which hearing is possessed in old age. To a third class of persons the Otaphones must be of advantage. They are those whose avocations oblige them to attend in Parliament, Courts of

Law, Public Meetings, and even in large Places of Worship. The range of the ear, which is suited and attuned to our domestic habitations, is unequal to the increased space of these assemblies, and consequently the ordinary power of hearing becomes insufficient. The Otaphones enable persons so situated to hear as well at thirty benches from the speaker, as they ordinarily do at twenty, and thus enable the ear to keep pace, in some degree, with the size of modern public buildings. A great error seems to pervade the principle on which these are constructed; in proportion to the increase of population it has been supposed that buildings should be enlarged to receive it; but as the human faculties remain the same, the remedy consists in making more places of the ordinary size, rather than a few of unsuitable proportions. This has been particularly observable in theatres, where the delineation of the passions on the countenance is no longer observable beyond the first few rows, and singing has in consequence degenerated to

mere notes without the incumbrance of words, while spectacle has usurped the place of tragedy and comedy.

In all other cases but those enumerated, the application of the Otaphones must depend on the judgment of the practitioner in a just discrimination of the part affected. Nature requires to be solicited, and very gently urged; the decline of parts being gradual, their restoration to activity must be effected by correspondent means. Writers of the first character admit the difficulty of the subject, and general practitioners, the best qualified, seldom undertake "Ear Cases;" the consequence is, that the following remark of the late Mr. Saunders, is as applicable at the present time, as when it was first written: "A clear and distinct recital of symptoms is rarely obtained from the deaf. They are conscious of their infirmity, but very few are impressed with a notion that hearing may be impaired by a variety of causes. The

approach of deafness is insidious, and often unattended with pain. Few strong impressions are made on the mind of the patient, and he loses his faculty of hearing so imperceptibly, that in general his friends sooner discover his misfortune than himself.

"Here then the labour and the difficulty commence, *but the field is open*. Anatomists have, to the present day, avoided this subject, some doubtless convinced of the impracticability, and others disgusted at the difficulty of the inquiry. As anatomists have neglected the investigation of these diseases, so practitioners have either abandoned such patients to quacks, or consigned them to the care of Providence *."

I have sent this little work rather hastily to the press, feeling convinced that to wait until all the inquiries and experiments are completed, which this interesting subject suggests,

* Saunders on the Ear. Page 39.

would be to defer it for ever; and being willing to avail myself of the suggestion of the noble poet in my motto, and "snatch a certainty;" for such I conceive is the character the Otaphone possesses, as respects its assistance to the ear. It is simple in its operation, incapable of becoming injurious, and effectual in those cases in which it is recommended to be applied.

But I have another motive in making its efficiency further known, which is, the prevention of those injuries that commonly arise in the attempt to restore defective hearing, and which these instruments may prevent. In the great number of cases that have been brought under my notice since the date of this invention (amounting to upwards of one thousand), several hundred had been under previous treatment; and though I have been anxious to obtain evidences of success, I am sorry to say I could not, in scarcely any of these instances, procure the

admission that the parties had received any benefit; in almost every case they had been made worse. The membrane of the tympanum, which I have before described, as presenting the appearance of a large opal bead, was frequently reduced both in size and colour to the resemblance of a mustard-seed; the burning substances which had been put within the ear having effected that change. By the momentary excitement escharotics produce, the practitioner obtains a reputation for skill; but subsequent attempts cannot renew the increased perception; and when the really diseased part recovers its function, the new infliction has deprived it of all usefulness. These applications, by destroying the ducts which supply cerumen to the ear, prevent the accumulation of that necessary provision of nature; and thus the membrane, if it escapes, is exposed to such an unmodified pressure of the external air, as renders the counter-balancing power of the Eustachian tube insufficient. In every view of the case this practice is to be

deplored; the governing principle for the treatment of this sensitive organ should be forbearance—to do too little rather than too much, for while many may supply our deficiencies, few, if any, can remedy our mistakes.

THE END.

ADVERTISEMENT.

THE recent law, introduced by Lord Brougham, having greatly tended to increase the value of Patent property by preventing fraudulent imitations, has induced the Inventor of the OTAPHONE to obtain a Patent for it, and for his INVISIBLE TUBES.

The numerous applications from all parts of the country, lead to the conclusion that Deafness is very prevalent, and that the treatment of the Ear presents a lucrative field for the country practitioner, particularly if aided by the advantage of supplying the only patent instrument constructed for its assistance.

Under this impression, Mr. Webster is willing to treat with any gentleman desirous of securing to himself the exclusive right of employing his inventions in any large town, and the contiguous district or county, for upwards of thirteen years, which time the Patent has still to run.

Further particulars may be obtained by addressing a letter (post paid*) to Mr. Webster, 102, New Bond Street, London, containing a reference to some person of respectability in town; but as the full advantages can only be obtained by medical practitioners, it is requested that none but such will apply.

* The number of letters daily transmitted by the post, several of which are *unpaid*, have obliged the adoption of a general rule, namely, to decline receiving *all such*.

WHITING, LONDON.