A familiar treatise on the five senses : being an account of the conformation and functions of the eye, ear, nose, tongue, and skin ... / by Charles Bell.

Calaston
31 Dec '59

$1,200

Plate 4.

ADVERTISEMENT.

THE First Edition of this little work, (published under the title of "The Organs of the Senses,") having been disposed of, the present publisher has made some trifling alterations, thereby rendering the title more appropriate to its contents.

Salisbury Square,
December, 1840.

REFERENCES TO THE PLATES.

A

FAMILIAR TREATISE

ON

THE FIVE SENSES,

BEING AN ACCOUNT OF

THE CONFORMATION AND FUNCTIONS

OF THE

EYE, EAR, NOSE, TONGUE, AND SKIN.

ILLUSTRATED BY TWENTY COLOURED PLATES.

BY CHARLES BELL.

SECOND EDITION.

LONDON:

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CONTENTS.

INTRODUCTORY PREFACE.

THAT the organs of the senses are most wonderfully contrived, is so generally known as to amount to a truism: but how few are those who have even the slightest idea of their structure. The exercise of our senses is so familiar to us, and their operations so sudden and without effort, that they scarcely raise in us a thought as to the conformation by which the effects are produced. We leave the eye uncurtained, and we *see;* we leave the ear open, and we *hear;* yet it is seldom, except when some defect or other befals these organs, that we at all drop a thought upon the nature of their faculties.

There may be some little excuse, perhaps, for this want of wholesome curiosity,

in the difficulty which has existed in its being gratified. Voluminous and expensive anatomical works have been nearly the only means by which the inquiry would have been answered; and these, being intended for professional students, are usually filled with such dry and minute details, and such hard technicalities, as, independently of the dislike which persons in general have to the idea of anatomy, to deter them from pursuing any examination. But, it is hoped, that a short treatise, describing in plain and common terms the several parts and connexions of these organs, to such extent as will afford a general and easy comprehension of their nature, and accompanied by numerous coloured plates, (without which, descriptions of such matters are of little avail,) will not be either uninteresting or uninstructive.

The sensation which we have of surrounding objects arises from the impres-

sions which these objects make upon the organs destined by nature to receive, and convey them to the mind: and each of these organs has its own proper kind of sensibility. Thus, the eye is for the sense of sight; the ear for hearing; the nose for smell; and the tongue for taste: the sense of touch is wisely distributed throughout the whole body, having no peculiar residence in one spot, although its chief sensibility is seated where it could be most beneficially exerted; viz., at the finger-ends. These five organs afford the connecting link between mind and matter. They are at once our safeguard and our pleasure. Without them, we should have no intellectual enjoyment; nor should we even be able to protect ourselves from advancing dangers or lofty precipices.

Having been blessed with these provisions, let us observe the work of the great Maker who bestowed them. The more we shall do so, the more we shall admire;

and the more we shall admire, the more we shall be grateful. Pleasure and gratitude will thus walk hand in hand, and who shall seek for better company, or desire a better excitement?

Plate 5.

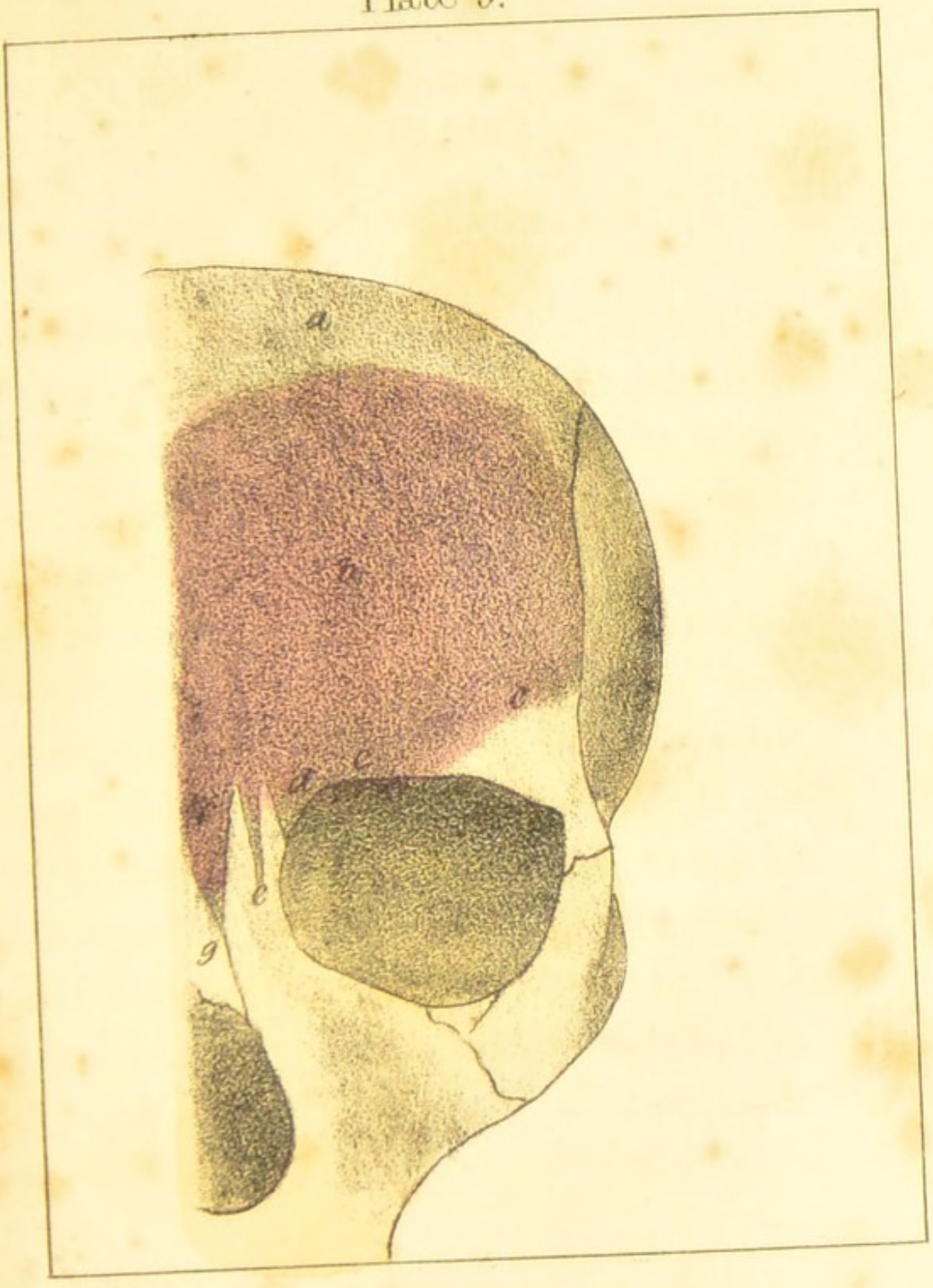


Plate 6.

THE

ORGANS OF THE SENSES.

CHAPTER I.

THE EYE. THE ORBITS.

THE simplest method of description will be to commence with the orbits in which the eyes are placed, or, as they are more familiarly termed, their *sockets*. These are each formed by portions of as many as seven different bones belonging to the head. The cavities are rather conical or funnel-shaped, the base or external opening whereof is an oval somewhat squared, and distant from the apex or pointed end about two inches. Towards the depth of the cavity, it becomes more triangular. The axes of the orbits are not parallel, but

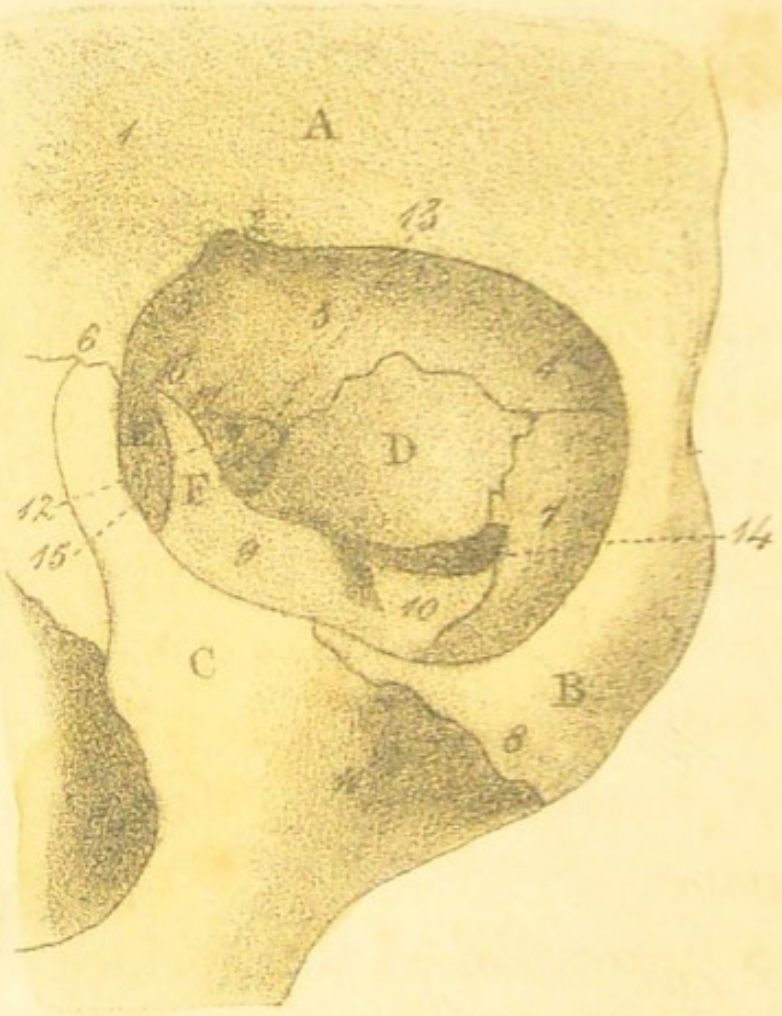
so converge that, if carried on about an inch and a half beyond the apices, they would meet within the skull.

In these bony caves the eyes are almost entirely enclosed, secure from any external injury, except such as may offer in front, where great protection is also provided by the construction of the conjunctiva, &c., of which hereafter. Indeed, in front, so far only are these delicate organs unshielded by bone, as to admit of the power of vision; the extent of which laterally is greatly increased by the conformation of the outer or temporal side of the orbit, which, it will be seen from Plate 1, is less forward than the nasal side, and therefore permits a wider expanse of sight.

It will be unnecessary for our purpose to offer a general description of the bones which compose the orbits: our limits will therefore extend only to those parts which relate to the organ on which we treat, and which will be found in Plate 2: where the

Plate 1.

Plate 2.



line *a b* cuts the face vertically down the centre; and *a c* horizontally, just above the eyebrows.

A, is the frontal bone.

1. The superciliary ridge on which the eyebrows are placed.
2. The superciliary hole: this is sometimes only a notch in the edge of the orbit.
3. The orbitary plate,—a thin semi-transparent bone, the upper surface of which supports a portion of the brain.
4. A depression for the lachrymal gland.
5. A depression for the trochlea.
6. 6. The transverse suture, or that by which the frontal bone is joined to the other bones.

B. The malar, or cheek bone.

7. Its orbitary surface.
8. Its junction with the upper maxillary, or jaw bone.

C. The upper maxillary bone.

9. Its orbitary surface:—this, as well as the orbitary plate of the frontal bone, is as thin as a wafer.

10. The infra-orbitary canal, having its exit upon the cheek at

11. The infra-orbitary hole.

D. The sphenoid bone.

12. The optic hole, for the admission of the optic nerve. This would appear to be in a different bone from the one marked D: the sphenoid bone, however, is situated between and behind the two orbits, and has three wings, one spreading out on each side and forming D, the third shooting forwards horizontally, and containing this hole. The opening between the horizontal and lateral wing, marked

13, is the superior orbitary fissure. It is wide at the bottom, but grows gradually narrower, terminating in a slit.

14. The spheno-maxillary fissure; an

opening between the sphenoid and maxillary bones.

E. The lachrymal bone, or unguis.

15. The groove for the lachrymal sac and nasal duct.

F. The ethmoid bone.

16, 17. The anterior and posterior orbitary holes. These are in the junction between this and the frontal bone.

A small triangular knob of the palate bone enters the back part of the orbit, behind the ethmoid bone, but is not visible.

CHAPTER II.

THE MUSCLES OF THE ORBIT.

As yet we shall view the eye simply as a globe, and proceed to consider the muscles in the orbit, or those which act in moving the ball. These are six in number.

Four of these are so similar, that they may be described together. They arise by small flat tendons at the bottom of the socket, from the margin of the optic hole; where they surround the optic nerve as it comes forward. Each gradually expands into a fleshy belly, together surrounding the middle of the eyeball, one being above, one below, and one on each side—and thence continuing to expand, they terminate each in a broad, flat, white tendon, covering the whole of the forepart of the eye as far as its transparent front. These white tendons form that beautiful surface

resembling enamel, which is vulgarly called the *white of the eye.*

These four muscles are all called by the name of *rectus**, and are distinguished by their position, as the upper, lower, internal, and external. The contraction of the upper rectus lifts the eye upwards, the lower pulls it downwards, the internal draws it towards the nose, and the external turns it outwards. When they all act simultaneously, they fix the eye firmly in front: and when they act successively, they roll the eye.

The two other muscles are called the upper and lower oblique. The former has a contrivance well worthy of observation. It arises by a small tendon, also from the edge of the optic hole, and sends its long slender body to that part near the inner angle of the eye, marked 5 in Plate 2, which is above and more forward than any

* Rectus, Lat., straightforward.

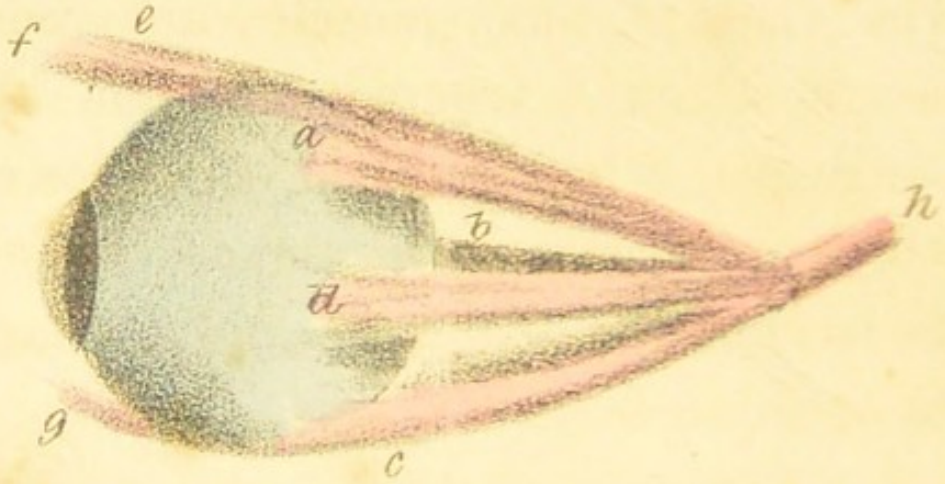
portion of the ball. In this spot is fixed a cartilaginous pulley, called the *trochlea**. The muscle here becomes a small round smooth tendon, which passes through the ring of the pulley, and thence returns at an acute angle, downwards and backwards, to the globe : it then slips itself under the upper rectus, and is inserted upon the eye-ball about halfway between this rectus and the optic hole. By this elongation, its power of contraction is much increased.

The lower oblique is a short, flat and broad muscle, with a strong fleshy belly, arising from the orbitary plate of the upper maxillary bone, near its union with the unguis. It goes obliquely backwards and outwards, under the eyeball, and is inserted exactly opposite to the upper oblique muscle.

As the recti muscles jointly tend to pull the eye backwards, so these two tend to

* Trecho, Gr. to run round.

Plate 5.



pull it forwards, and thus give the eye a steady position. The upper oblique acting singly pulls the eye at once downwards and towards the nose ; the lower oblique reverses this action, and directs it at once upwards and outwards.

The whole of these muscles are exemplified in Plate 3, where *a* represents the upper rectus, *b* the internal, *c* the lower, and *d* the external ; *e* the upper oblique, *f* the trochlea, *g* the lower oblique, and *h* the optic nerve.

CHAPTER III.

APPENDAGES OF THE EYE.

THE appendages to be described in the present chapter are, the eyebrow, tarsus, eyelid, palpebral ligament, eyelashes, Meibomean glands; lachrymal gland, puncta, caruncle, and duct; semilunar membrane, and the conjunctiva. The external muscular appendages will form the subject of the next chapter.

The supercilia, or eyebrows, are too simple to require any detail. They consist of loose skin, covered with hair, placed over the superciliary arch: and by aid of the muscles greatly assist in expressing the passions of the mind.

The tarsus is the cartilaginous rim surrounding the opening of the eyelids, fastened at the inner and outer angle, by which the lids are kept of a regular figure,

and made to close neatly over the eye. It has a triangular edge; and the base forming the flat surface of the margin, the lids meet with the most perfect accuracy.

The palpebræ or eyelids are two semi-oval curtains placed over the eye, to protect the surface, and regulate the admission of light. They are chiefly composed of the orbicular and levator muscles, covered with very delicate skin, which is slightly attached by very loose cellular tissue. Nearly all the motion of the eyelids is confined to the upper one : indeed the lower has scarcely any apparatus for the purpose.

The palpebral ligament is a ligamentous structure which extends from the margin of the orbit to the tarsus. It is thick and strong near the orbit, but progressively diminishes in substance.

The cilia or eyelashes are short, stiff, curved hairs, occupying the borders of the tarsus. They are a great guard, as well as ornament, to the eye.

The Meibomean* follicles are rows of little glands which lie under the inner membrane of the eyelids. About twenty or thirty small ducts open upon the tarsal rim of each eyelid, and each duct has about twenty of these minute glands. They exude a white fatty matter, which lubricates the eye, and defends it from acrid tears.

The lachrymal gland is a flattened body, situated in the orbit at the part marked 4 in Plate 2. Several ducts open from it, upon the inner surface of the upper lid, towards the outer angle. It secretes the tears for moistening the eyeball, and cleansing it from particles of dust; for which its situation is peculiarly adapted, since the secretion is made at the outer angle of the eye, and a groove being formed by the junction of the upper and lower tarsus when the eye is closed, the moisture

* Named after Meibomeus, their discoverer.

passes along this channel to the puncta lachrymalia at the inner angle, thus not only coursing the whole breadth of the eye, but enabling the lids, by the operation of winking, to wash and moisten the whole visible surface.

The lachrymal puncta* are the mouths of two ducts which form the beginning of a canal for drawing off the tears into the nose. They are like pin-holes, placed on little eminences near the inner corner of the eye, one on the upper tarsus, the other on the lower. They have a slight cartilaginous rim, which keeps them from closing: and the upper and lower duct unite at the corner of the eye, and lead to the lachrymal sac.

The caruncle† is the little red prominence at the inner angle. The semilunar membrane is connected with this, appearing

* Lachryma, a tear; punctum, a pin-hole.

† Dim. of caro, Lat. flesh; from its appearance.

like a little red web, spreading towards the front of the eye. When the eye is turned outwardly, this membrane is drawn from under the caruncle, but by the return of the eye towards the nose, it is again accumulated. It thus throws out any dust from the eye, guarding the puncta from the absorption of the particles, which might irritate or obstruct them.

The lachrymal sac is an oval bag, situated at 15, Plate 2. It is the dilated upper end of the lachrymal duct, which latter descends into the cavity of the nose.

The conjunctiva* is the skin which lines the inner surface of the eyelids,—a description of which will, however, be more advantageously given when we speak of the coats of the eye.

These appendages are, for the most part, illustrated in Plate 4, the references being as follows :—

* Conjungo, Lat., to join together; because it conjoins the globe with the orbit and lids.

1. The eyebrow.
2, 3. Upper and lower tarsus.
4, 5. Upper and lower eyelid.
6. Eyelashes.
7. Lachrymal puncta.
8. The caruncle.
9. Semilunar membrane.
10. Inner canthus or angle.
11. Outer canthus or angle.

CHAPTER IV.

THE MUSCLES EXTERNAL TO THE ORBIT.

THESE are the occipito-frontal muscle, the orbicular muscle of the eyelids, the corrugator of the eyebrows, and the levator of the upper eyelid.

The occipito-frontalis* extends from the back part of the head to the orbits of the eyes, but it is only the front portion which belongs to our present subject. Along the top of the head this muscle is only a sheet of flat tendon; but on the forehead it becomes a fleshy expansion, as represented at *b*, Plate 5. At the nose and near the inner end of the orbitary ridge it is attached to the bone, but its insertion is chiefly to the skin and eyebrows, which are raised by the

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* Occiput, the back part of the head; frons, the forehead; over both of which the muscle extends.

contraction of its body, and are, however, brought down again by the contraction of the slip *g* attached to the nose.

In Plate 5 :—

a, is the sheet of flat tendon.

b, the fleshy part of the muscle.

c, its termination over the orbicular muscle.

d, a slip inserted at the inner corner of the orbit.

e, a slip which joins the muscle which raises the nostril.

f, *g*, slips inserted upon the nose.

By raising the lower portion of the frontal muscle, we gain an uninterrupted view of the corrugator and orbicularis.

The corrugator is clearly shown by *a* in Plate 6: *b* is its origin. It gradually grows narrower, and is inserted into the eyebrow. Its action is to knit the brows towards each other.

The orbicular muscle of the eyelids is a circular muscle covering the orbit. In

Plate 6, *c* is the portion belonging to the eyelids, *d* is a stronger portion surrounding the orbit, which acts only on violent occasions, as when the eye is irritated by dust, at which time its forcible compression of the lids causes the eyeball to press upon the lachrymal gland, and force out a supply of tears. The muscle arises from the small tendon *e*, which is both its origin and insertion; for after having proceeded thence to the outer corner of the eye, it returns by the lower lid to the same starting-point. The fibres of the lids cross each other a little at the outer corner. The action of this muscle is to close the eye; and its point of action is the short tendon by which it is fixed near the inner canthus.

The levator of the upper eyelid arises by a small flat tendon from the upper margin of the optic hole. It grows gradually broader as it passes over the eyeball, and having fully expanded over the space of the upper eyelid, ends in a broad, flat, very

thin tendon, which is inserted into the whole length of the upper tarsus. It lies under the orbicular muscle, and by contraction raises the upper lid.

CHAPTER V.

THE PROPER AND ADVENTITIOUS COATS OF THE EYE.

THE eyeball is almost a perfect globe, having a spherical projection in front. It is imbedded in the orbit in fat, and very loose cellular tissue, which fills the whole of the otherwise unoccupied space, and thus affords an equable support, while it permits the greatest freedom of motion.*

The globe of the eye has several coats. These are divided into three classes : viz.,

The proper coats, called the sclerotic, choroid, and the retina.

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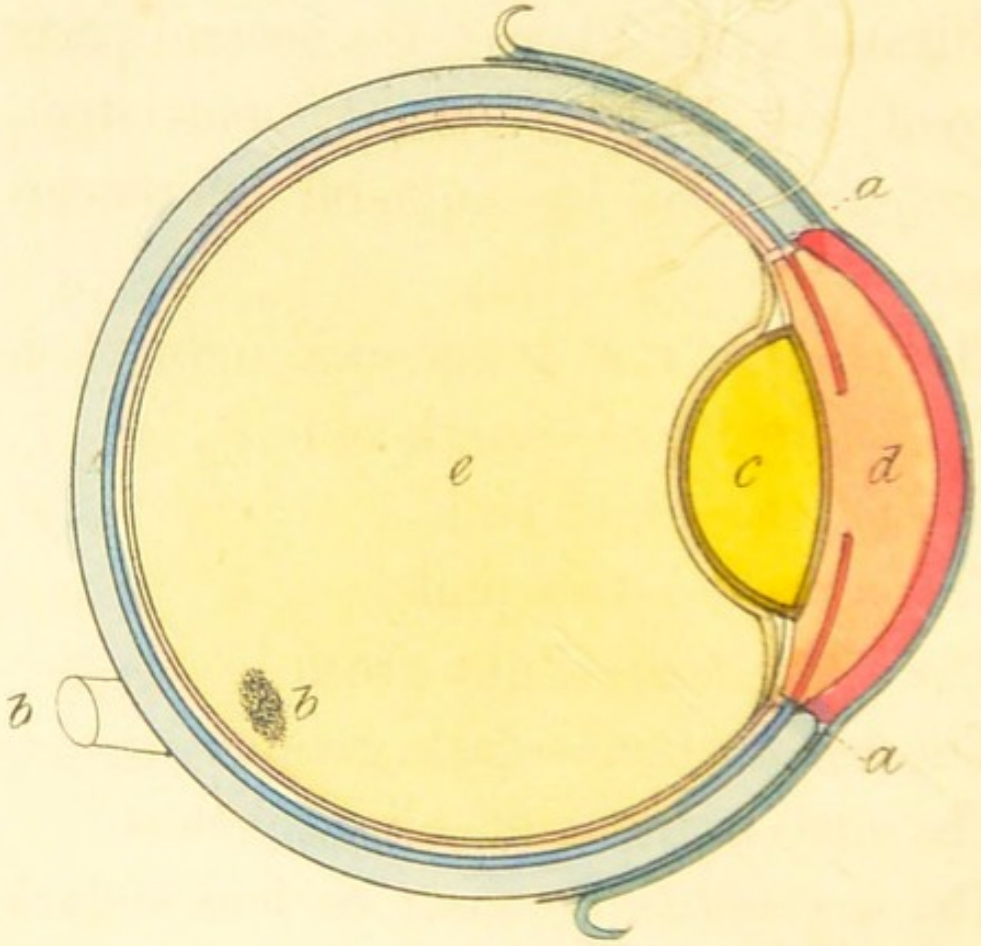
* The *common cellular tissue* is formed of several membranes irregularly united at various parts, so as to form between the parts of union, cells freely communicating with each other. It is very elastic, and may be either drawn out or condensed to a great degree. Its cells contain a fluid, and in many parts are filled with fat. Being of this soft and elastic nature, it is especially adapted for the purpose of filling up the spaces between the muscles. The *condensed* cellular tissue forms tendons, &c.

Plate 7.



The adventitious,—the albuginea and conjunctiva: and

The coats of the humours,—the vitreous and crystalline membranes.

If we make a vertical section of the globe from back to front, we shall find it constituted as in Plate 7, the several parts whereof will be more clearly understood by colours than by numeral references. Hence—

The sclerotic coat is coloured light blue.

The choroid coat,—dark blue.

The retina,—light pink.

The cornea,—dark pink.

The albuginea,—light green.

The conjunctiva,—dark green.

The vitreous humour,—light yellow.

The crystalline humour or lens,—dark yellow.

The aqueous humour,—orange.

The vitreous membrane,—brown.

The crystalline membrane,—purple.

The iris,—scarlet.

The ciliary processes,—black.

The ciliary ligament is marked *a a*.

The optic nerve and its entrance, *b b*.

The sclerotic* coat is the strong external coat which forms the bulb of the eye. It somewhat resembles very thick parchment, both in substance and colour, and gives the globe its strength. It is opaque until it reaches the front projection, where it suddenly becomes beautifully transparent; and this glassy projection is termed the *cornea*. The whole of this coat is so exceedingly tough, as not to be cut, or even pricked without some difficulty.

It defends the internal parts from injury: and as it is but little vascular, and not prone to disease, is a shield against the progress of inflammation. The inflammation of the eye is generally in the external coat, called the conjunctiva. If the internal parts, however, become diseased, the

* Scleros, Gr., hard.

unyielding nature of the sclerotica is the cause of great pain.

The cornea is often described as a separate part, and indeed after long maceration it is easily separable from the sclerotica. It is so named from its resemblance to horn,* and is that pellucid circle on the fore part of the eye, which seems variegated with colours, but this appearance is simply owing to its perfect transparency, by which the iris is so clearly seen through its substance.

The cornea is also different in structure from the proper sclerotic coat. It is composed of about six different laminæ placed over each other, between which is interposed a cellular tissue, filled with a perfectly clear fluid, which evaporating or becoming clammy at the approach of death, gives a filmy appearance to the eye. The laxity of the connexion of these laminæ

* Cornu, Lat., horn.

may be demonstrated by moving the coat between the finger and thumb, when we shall feel that the layers glide partially on each other.

There are minute vessels which pierce the cornea, but are not visible in health, since they carry a pellucid fluid; but in disease they become dilated, and thus admit red blood, chiefly round its outer circle.

The choroid* coat lines the sclerotic as far as the cornea. It is fast at the entrance of the optic nerve and near the cornea; at its other parts it may be easily separated from the sclerotic. It is divisible into two laminæ; the outer, or that next the sclerotica, is a tissue of blood-vessels and nerves, connected by very fine cellular membrane; the inner, called the tunica Ruyschiana†, has, when seen through a microscope, a fleecy appearance, from the

* Chorion, Gr., one of the fœtal membranes; and eidos, like.

† After Ruysch.

projection of an immense number of minute villi, which secrete a dark paint that covers its surface. This villous surface is called the tapetum*; and the pigment, from its being usually black or deep brown, is called the pigmentum nigrum. The paint does not strongly adhere, but may be washed away by water, and a camel's hair pencil. Its use is to absorb the rays of light.

The retina† is a membrane of the most delicate texture: it is transparent in the recent state, and so tender as not to support even its own weight. When the optic nerve has entered the globe, it expands its nervous pulp between two almost imperceptible membranes, over the internal surface of the choroid coat, and thus forms the retina; the nervous matter extends forward to the ciliary processes, and here it terminates; but the transparent membrane is continued over the back of the

* Tapetum, Lat., tapestry. † Rete, Lat., a net.

lens, and thus forms a sack enclosing the whole of the vitreous humour. The reticulated vessels run on the inner of its membranes. The retina is the nervous coat, upon which the rays of light create their sensible impression, which is thence communicated to the brain.

Of the two adventitious coats, the albuginea* and conjunctiva,—the former is the expansion of the recti muscles, described in Chapter II. as forming the *white of the eye*.

The conjunctiva is the inner skin of the eyelids, and its continuation. It adheres closely all round the margin of the tarsus, and goes thence backwards a little way into the orbit, covering the inner surface of the lids, to which it is connected by a lax cellular membrane. Having reached this part, it is reflected completely over the whole front of the globe. It thus forms

* Albugo, Lat., whiteness of the eye.

a pouch, which, by the reflection of the skin, prevents any extraneous particles from getting within the orbit, where there would be great difficulty of extraction. Where it lines the eyelids, it is of a pale red and vascular appearance; upon the albuginea it is so clear that the white coat is seen through it; and over the cornea, it is perfectly transparent. In health, its blood vessels carry no red particles over the globe, and they are thus invisible; but in disease, they become of a deep red colour, and gradually shoot towards the cornea, producing what is called a *blood shot* eye. The conjunctiva is the common seat of inflammation of the eye.

CHAPTER VI.

THE HUMOURS AND THEIR MEMBRANES.

THE three humours are the aqueous, crystalline, and vitreous: the first so named from its resemblance to water; the second to crystal; and the last to glass. They are all beautifully clear.

The crystalline humour is situated at *c*, Plate 7. Its form is that of a double convex, or strongly magnifying lens, which property it possesses, and hence is usually called the crystalline lens. The convexity is unequal, the most convex side being towards the back of the eye. It is scarcely to be called a humour, as it is nearly a solid body. It is of a splendidly clear transparent white, like crystal; but in old age acquires an amber tinge. It is composed of concentric layers, one over the other; and gets gradually firmer and more compact towards the centre.

The lens is enclosed in a capsule or membrane, to which it but slightly adheres, and which contains a small portion of fluid. This capsule is thicker in front than posteriorly; and its hinder portion is so firmly connected with the vitreous membrane, as to be with difficulty separated. Both this and the vitreous capsule are perfectly transparent.

The aqueous humour, *d*, fills the space in front between the crystalline lens and the cornea. The iris hangs as it were in this humour, and divides the space into two chambers;—that before the iris being called the anterior chamber; and the one between the iris and the lens, which is however very small, the posterior chamber. This humour, if evacuated, as is sometimes the case, from puncture, is quickly restored: it will again fill its space in about a day. Its watery nature allows free motion to the iris.

Some imagine this humour to be also

enclosed in a capsule, since a slight membrane has been observed in its front over the cornea, but dissection has not yet been able to trace it further backward than the iris.

The vitreous humour, *e*, fills the whole of the bulb from the lens backwards, and occupies more than three fourths of the eye. The lens is in a manner embedded in the fore part of this humour. It appears to have the consistence of a thin jelly, but this is owing to almost imperceptible membranes interspersed through its substance, that hold the humour, which is but slightly denser than the aqueous, in numerous cells communicable with each other. The whole is enclosed in a sac or capsule of extremely fine membrane. When this humour escapes, it is seldom regenerated.

The comparative specific gravities of these humours, water being 1000, are calculated to be thus: aqueous, 1009; vitreous, 1016; crystalline, 1114.

CHAPTER VII.

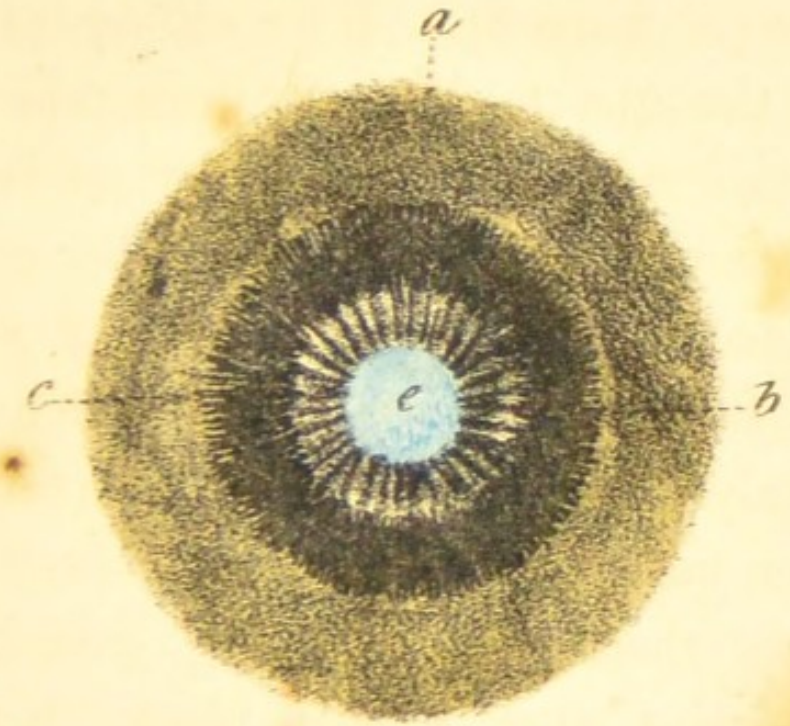
THE CILIARY LIGAMENT AND PROCESSES—THE IRIS—PETITIAN CANAL.

WITHIN the ball, a little posterior to the circumference of the cornea, a narrow ring of whitish substance runs round the eye. This is the *ciliary ligament.* Here the choroid coat is attached, and seems to terminate ; the ciliary processes commence ; and from it also the iris is suspended.

The ciliary processes arise from the ciliary ligament, and form a beautifully radiated circle, (thence called *corona,*) proceeding downward and rather backward towards the edge of the lens. We may here remark that when the vitreous capsule arrives at the ciliary ligament, it sends off a lamina, which is accompanied by one also from the retina ; and these are both inserted into the fore part of the capsule of the lens, immediately before its edge.

This lamina is called the *ciliary zone*. Upon the retinous lamina, the radiations of the ciliary processes proceed, until they arrive at its junction with the lens; they then terminate in little points, hanging loose, like a fine liliputian fringe, in the aqueous humour. The ciliary processes are thought to be a continuation of the choroid coat; and the radiations the folds occasioned by its inflection. Its posterior surface is covered with a similar pigment, the folds and stains from which are so plainly impressed upon the vitreous coat, when taken out, as to resemble the processes themselves. Being covered with this paint, they appear black; but when this has been washed away, their natural colour is seen to be nearly white. Their nature and position are shown in Plate 8, which is a back view of a section of the eye, cut off a little behind the circumference of the cornea, the vitreous and crystalline humours being removed.

Plate 8.



a, is a portion of the choroid coat.

b, the edges of the ciliary processes adjoining the ligament.

c, their terminations close to the margin of the lens which fills this circle.

d, part of the iris seen through this opening.

e, the pupil.

The iris, so named from its variety of colour, being in some black, others grey, hazel, brown, &c., is a circular membranous curtain, which hangs in front of the lens, and is the only coat of the eye possessing motion. It is united all round to the ciliary ligament, which is close behind the circumference of the cornea, so that nearly the whole of the iris is seen on looking at the front of the eye, (12, Pl. 4.) It is perforated in the centre with a large circular hole called the pupil, (13, Pl. 4). Its posterior surface is also covered with a dark pigment, (called *uvea*, from its colour resembling the black grape,) which adheres

rather strongly to the membrane : it otherwise would be washed off by the motion of the iris, and obscure the aqueous humour. The motions of this membrane are supposed to be excited by the sensibility of the retina.

The iris contains an innumerable set of very slender fibres, radiating in straight lines towards its centre : it is believed also to contain circular ones, acting as a sphincter. The contraction of the straight fibres dilates the pupil ; the tendency of the circular ones is to close it. See Plate 10.

Where the laminæ just described of the retina and vitreous coat join at the edge of the lens, a small empty canal runs round it, which becomes easily discernible by piercing and passing the breath into it. This is named the Petitian canal, after its discoverer, Petit.

CHAPTER VIII.

THE NERVES, ARTERIES, AND VEINS.

NERVES are bundles of white fibrous cords, enclosed in a sheath, proceeding from the brain or spinal marrow, to the various parts of the body, conveying the impulse of the will to the muscles, or, on the contrary, receiving impressions from external objects and conveying them to the brain.

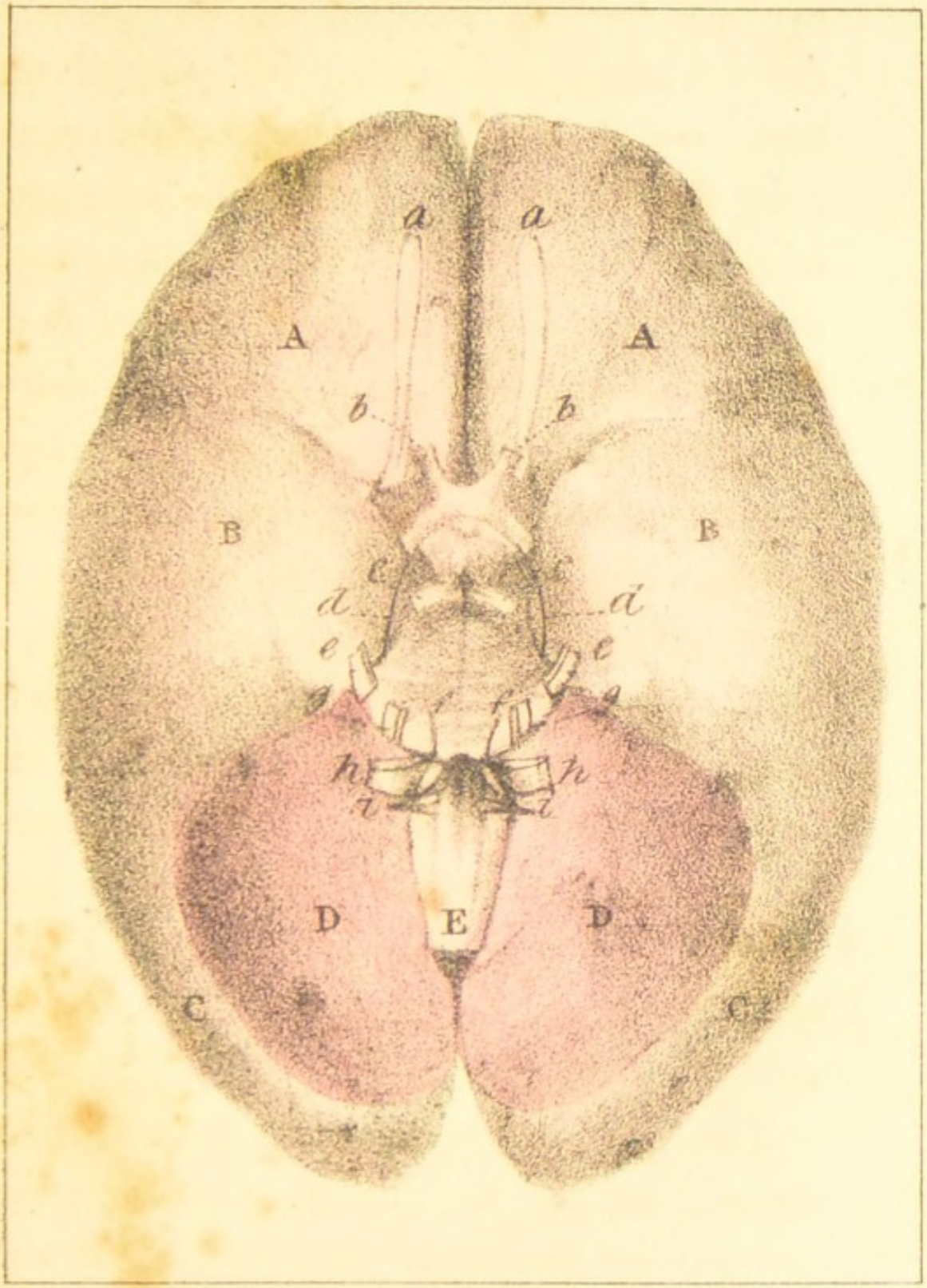
In a work like this, professedly written for popular reading, an attempt to trace the minute ramifications, either of the nerves or blood vessels, would be only to bewilder. Verbal descriptions of their obscure peregrinations are entirely futile, unless accompanied by numerous and accurate plates: and as, out of the nine pair of nerves, which spring from the brain and medulla oblongata*, those belonging to the

* The medulla oblongata is, as it were, the upper part of the spinal marrow, or that portion of it which is within the skull.

eye are half in number, viz. the second, third, fourth, and sixth, and part of the fifth, we shall merely describe the optic pair, or that which conveys the sensation of *sight*, and refer the reader to some work descriptive of the human brain, for an account of the remaining ones; premising only that the rest enter the orbit through the superior orbitary fissure, and thence spread chiefly to the muscles of the eye, to give them motion. Plate 9, which is a view of the under side of the brain, will assist in comprehending the origins of the several pairs. A, B, and C, respectively represent the anterior, middle, and posterior lobes of the great brain; D, the cerebellum or lesser brain; and E the medulla oblongata.

The *optic nerves* are the second pair, and are marked *b*. The spot whence they arise, is not visible in the plate, but it will be seen that, after diverging from their origin, they approach together, at length

Plate 9.



unite, and afterwards diverge, to pass through the optic holes into the orbits. They give out no branches in their course, but having entered the globe of the eye at its back part, rather to the nasal side, they expand over the interior of the globe, and there become the retina. They are nearly the size of a tobacco pipe, and are the largest nerves which arise from the brain, excepting the fifth pair.

The various pairs shoot forth from the brain as follows:—

a, the first pair, or olfactory nerves.

b, the second, or optic.

c, the third, or common oculo-muscular.

d, the fourth, or superior oblique oculo-muscular.

e, the fifth, or threefold.

f, the sixth, or abducent oculo-muscular.

g, the seventh, or facial and auditory.

h, the eighth, or par vagum, &c.

i, the ninth, or lingual.

Arteries and veins are elastic canals, the former conveying the blood from the heart to the various parts, and the latter are the channels by which it returns to it. The arteries are distinguished from the veins by their pulsations, which power the veins do not possess.

The chief artery of the eye is the *ophthalmic**, which is a branch from the internal carotid, and enters the orbit with the optic nerve through the optic hole. It gives off, among others, a branch called the *central artery of the retina*, which perforates the optic nerve a little before it reaches the sclerotic coat, runs through the centre of this nerve into the globe, and there spreads into many network branches on the retina.

* Ophthalmos, Gr., the eye.

Plate 10.

It also gives off the *ciliary arteries*, distinguished as the short and long. The short ciliary arteries penetrate the sclerotic coat around the optic nerve, and thence chiefly go forward to distribute themselves upon the choroid coat, in very minute branches. The long ciliary arteries are generally two trunks, which enter the sclerotic coat further from the nerve, and go forward chiefly to the iris.

The veins are somewhat similar in arrangement to the arteries. The short ciliary veins, after piercing the sclerotic coat, whorl themselves about from their trunks, so as to appear like weeping willows, and in consequence are here named the *vorticose** veins. The beautiful appearance of these whorls is distinctly shown in the dissected view, forming Plate 10.

a, is the optic nerve.

b, the sclerotic coat laid back.

* Vortex, Lat., a whirlpool.

c, the parts of the cornea.

d, the vorticose veins.

e, the holes through which their trunks passed.

f, the ciliary ring.

g, the outer ring of the iris, having radiated serpentine fibres.

h, the inner ring, with straight fibres.

i, the circular fibres.

k, the pupil.

Plate 11.

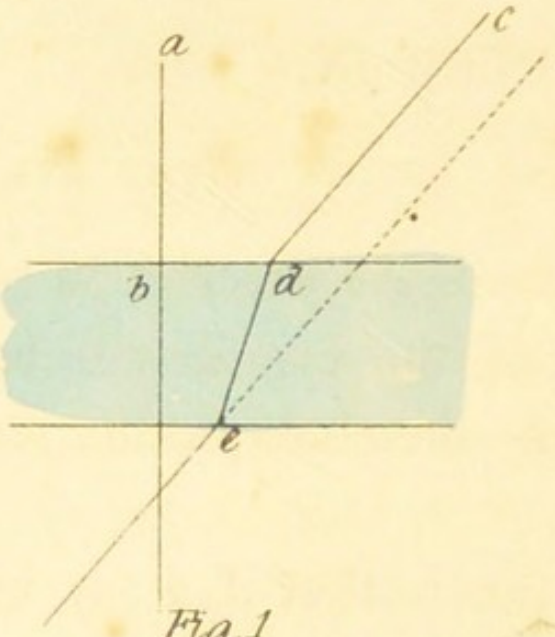


Fig. 1

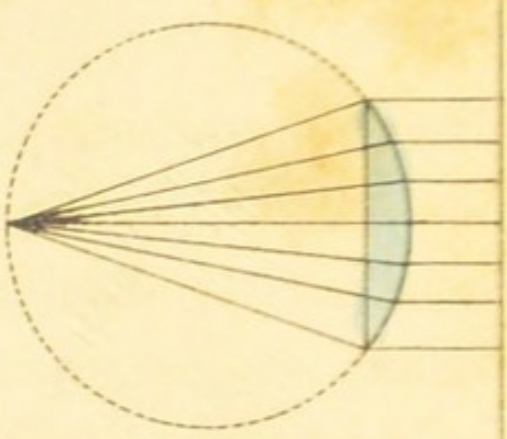


Fig. 2.

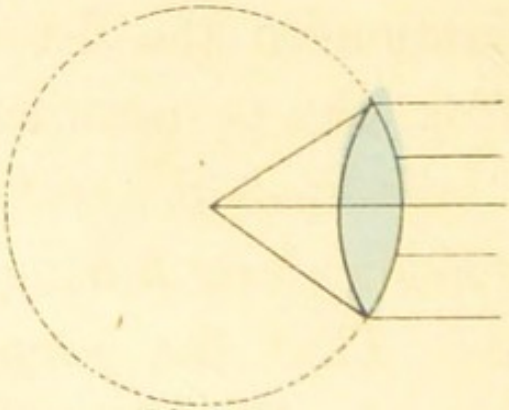


Fig. 3.

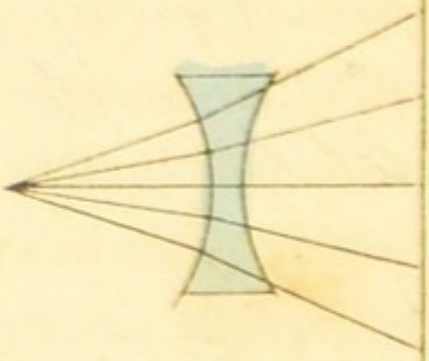


Fig. 4.

CHAPTER IX.

ADAPTATION FOR VISION. REVIEW OF THE EYE

HAVING now completed the description of the several portions of the eye, it will be beneficial to examine their adaptation for vision.

It is generally known that if a ray of light, after passing through the air, enters water or glass, or any transparent medium of different density, its path is changed, and it becomes bent; or, as it is termed, refracted:—and this the more or less, according to the alteration in the density, and the deviation from the perpendicular with which the ray falls upon the surface, those which fall perpendicularly having no refraction whatever. Thus the *perpendicular* ray, *a*, Plate 11, Fig. 1, falling through air upon the flat surface of the glass, *b*, will pass straight onwards; but the inclined ray, *c*, will be refracted at *d*,

pass in its new course through the glass, and on again reaching the air at *e*, be again refracted into its former direction.

If rays proceeding parallel from an object, fall upon a spherical surface, as is the case with a magnifying lens, they will be conveyed into a point, called the focus, where an image of the object will be formed. In a lens flat on one side, and convex on the other, the distance of this focus equals the diameter of the circle of convexity; and in a lens equally convex on both sides, it will be in the centre of the circle: as in Figures 2 and 3. If, on the contrary, rays pass through a concave or diminishing glass, they become diverged as in Fig. 4.

Now, if we observe the structure of the eye, we shall find that the rays of light, on entering the organ, fall upon the spherical surface of the cornea, and pass through the aqueous humour to the crystalline lens, —having thus commenced their convergence. They then pass through this lens,

which is like a magnifying glass of strong power, and very greatly converges them. Thence, they pass on through the vitreous humour to the back of the eye, where they unite into a focus, and form an inverted image upon the retina, from whence the sensation of the object is conveyed to the brain by the optic nerve. The vitreous humour, by preventing the collapse of the eye, preserves the retina in its place, and at the same time secures the length of the axis of the globe.

It is a practice with opticians in forming their telescopes and microscopes, in order to perfect the image, to divide the tube by a cross partition, which allows those rays only to pass which proceed through the perforation in the centre. The iris is similarly contrived. It moreover regulates the quantity of light admitted, for the pupil contracts in a strong light, and dilates in a dim one; which it can the more easily do, since the liquid in which it

floats is of a free and watery, instead of a viscous nature.

Another contrivance for perfecting the image, is to blacken the tube, since that colour absorbs the rays, and prevents any disturbance from reflection. We find this in the choroid coat under the retina.

Perfect vision takes place only when a perfect image is formed *upon* the retina, and a perfect image of an object is found only in the focus. If therefore the focus is either *before* or *behind* the retina, instead of upon it, the vision is indistinct. The former is the case with a near-sighted person; the latter with one long sighted. Thus, in Plate 12, Fig. 1, the focus being formed too soon, as at *a*, the rays begin to diverge, and the image upon the retina is imperfect. To remedy this, and fling back the focus, a concave glass should be interposed*; or in other words, the person

* If the object be portable, bringing it closer to the eye will have the same remedying effect, as the rays from it then fall

Plate 12.

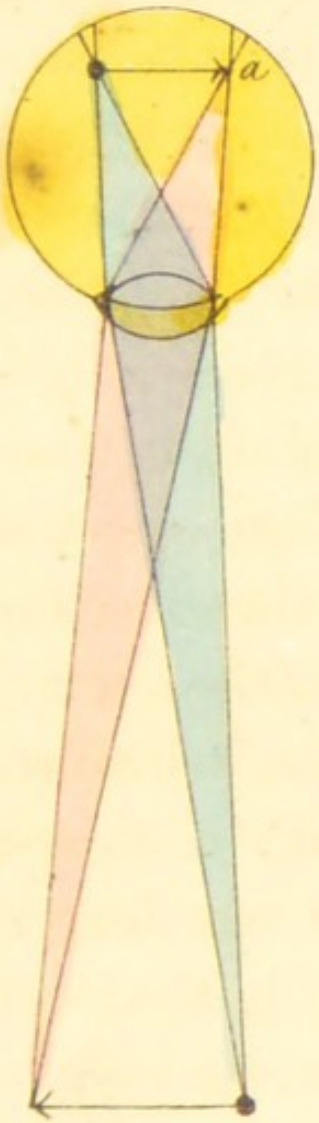


Fig. 1.

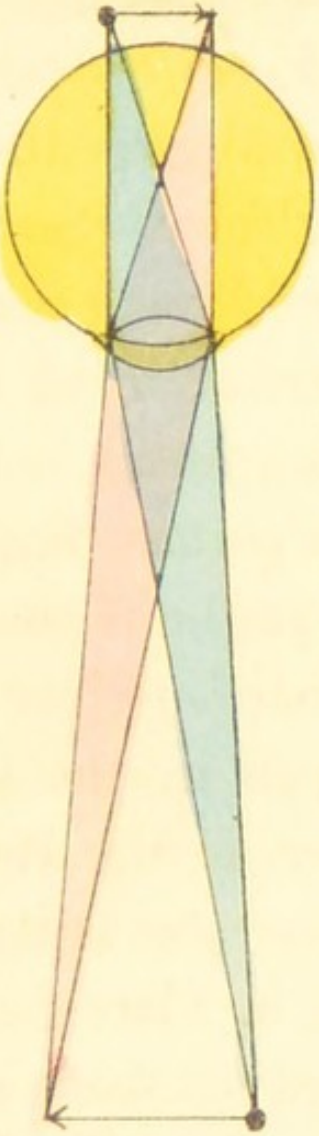


Fig. 2.

should wear concave spectacles. If the focus be behind the retina, as in Fig. 2, the remedy is a convex glass, which assists in converging the rays at an earlier point. It is thought that the eye possesses a small power of rectifying these defects, by altering the length of its axis, or of sending the lens more forward.

The image formed upon the retina is inverted—that is to say, the top of the object forms the lower part of the image, and *vice versa*; but notwithstanding, the object is seen in its proper position, because we always see objects in the direction in which the rays come from them to the eye. Some speculations have been offered in explanation of why this is so, but they are not by any means satisfactory.

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more divergingly upon the lens, and consequently cause the focus to be more distant. With a perfect eye, however, objects are not seen distinctly, if brought within the distance of about six inches, as the rays then fall too divergingly to be concentrated upon the retina.

A few words now in review of the more external parts. As the humours of the eye expand the coats, so the coats protect the humours: the whole globe is ensured an easy motion by lying in a bed of soft fat, and a safe shield by being encased in bone: the conjunctiva prevents annoying particles from getting backwards: there are muscles to move the eye in every direction: moisture to lubricate its front: lids, which not only act as a means to spread the tears and wash it clean, but also defend it in sleep: canals to carry off the tears: eyelashes, preventing the entry of insects, &c., and affording ornament: and eyebrows, which give to the eye its great expression. Moreover, these organs are two in number, one being placed on each side of the nose, so that where the vision is obstructed on one side, the other eye obtains a free field:—and the entrances of the optic nerves (at which there is a point defective in vision) being on the nasal

side, instead of in the axis of the globe, the view of an object is not lost, since the rays from any one part cannot fall on the two entrances at the same time.

CHAPTER X.

DISSECTION OF THE EYE.

If this simple account of the wonderful conformation of the eye shall have caused in the reader a curiosity for knowing its various parts by ocular demonstration, he may do so by the dissection of the eye of a sheep, which he may easily obtain. In a few moments the eye can be dissected from the socket, and the position of the muscles will then be seen. After having cut away the quantity of fat which surrounds the eye, and examined the muscles, he will have simply the globe and the optic nerve. He should be provided, in default of better means, with a strong needle, a sharp penknife, and a sharp pair of scissors; such as are called nail-scissors are very serviceable. He should then gradually and carefully make an incision with the knife about a quarter of an inch

posterior to the cornea, until he has cut through the sclerotic and choroid coats; by then inserting the scissors cautiously, he will be able to make a circular incision, separating these coats from the rest of the eye: the nature of the vitreous humour and its capsule will then be manifest. Having taken this portion of the coats away, he may then examine their nature, and he may also notice the entrance of the optic nerve, and the expansion of the retina*. By separating the choroides and the sclerotica, he will not only see the pigment, but also the nerves, &c., which, having passed through the sclerotica, extend to the iris. By cutting away the choroid coat, washing away the pigment with water and a camel's hair brush, and holding it

* The retina is too delicate for common dissection; but if, while it hangs suspended from the optic nerve, it be continually dipped and shaken in water, its nervous matter will be gradually dispersed, and the threads of its vessels will be visible. A little alkali in the water facilitates the dispersion.

against the light, the vorticose vessels will be observable.

The remaining parts may be now taken: and a gentle pressure will separate the vitreous humour, bringing away with it the crystalline lens. Having observed the stains from the ciliary corona round the lens, and the delicate fringe formed by the lower ends of the processes upon its margin, he may proceed to take the lens from its capsule. He will find this a most perfect magnifying glass, if fresh, for after a day or so, it begins to decompose. He may now look to the vitreous humour, which he will observe is enclosed in a most delicate skin, on pricking which, the contents will flow out almost like water. Looking to its front he may trace the ruptured capsule of the lens.

Now taking the other portion into view, and looking from back to front, he will see the ciliary processes, plaited and projecting from the edge of the cornea to where they

reached the lens. By washing off the paint, their structure will more visibly be perceived. If these be raised, he will find at their roots the ciliary ligament: and at the same part, the commencement of the iris. Observing still further, he will trace the iris to the pupil, covered also with the black pigment, and by the aid of magnifying power, may trace its fibres. Finally, he may examine the cornea and its junction with the sclerotica; and the tunicæ albuginea and conjunctiva.

A second dissection, commencing by cutting off the cornea a little anterior to its circumference, and proceeding backwards, will not be unprofitable, as correcting any doubt or error which may have arisen in the former operation.

CHAPTER XI.

THE EXTERNAL PARTS OF THE EAR.

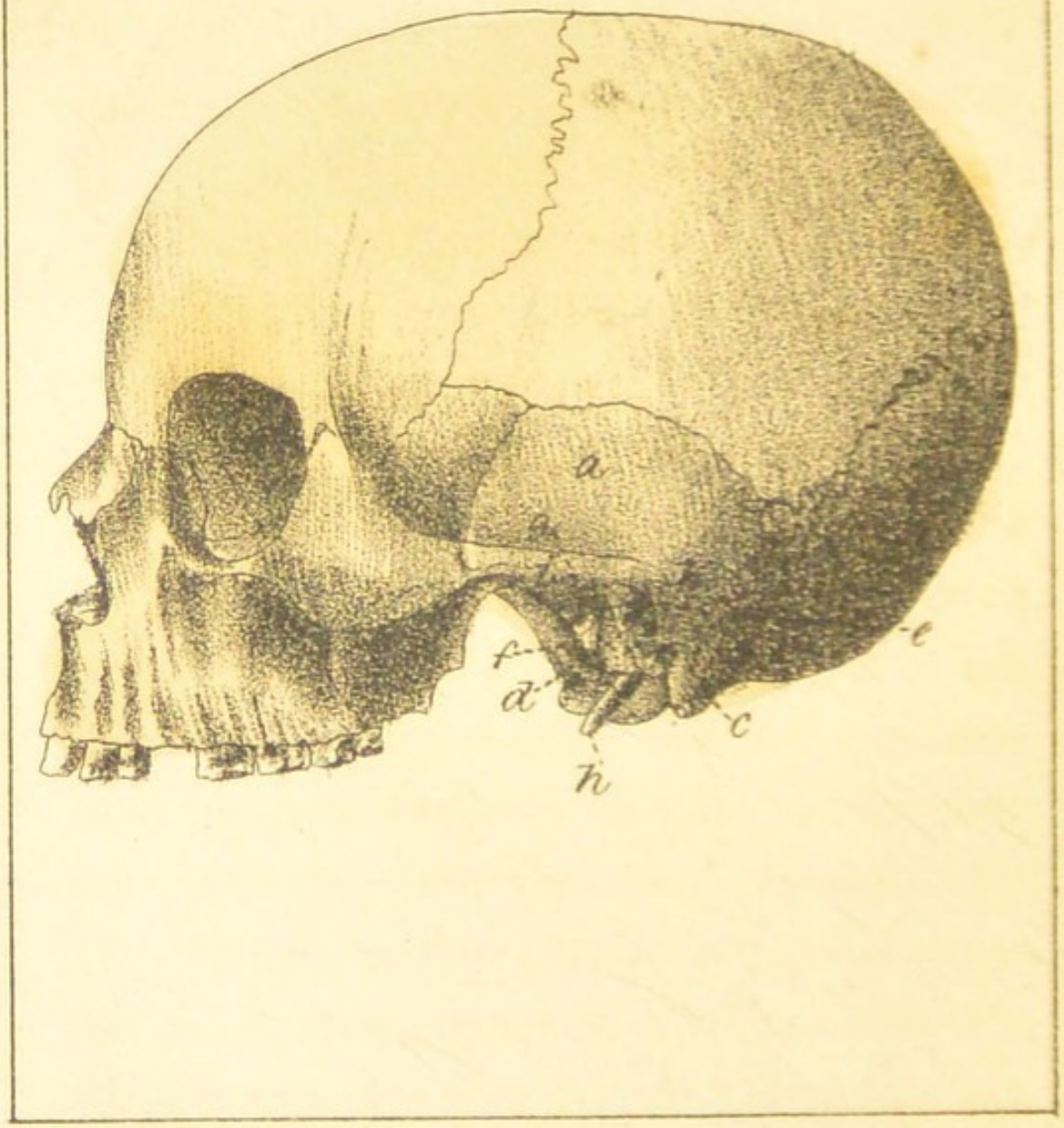
THE natural appearance of the outward ear needs no description. The lower part, which hangs down, and is pierced for the ear ring, is called its *lobe*. When this is taken away, and the ear is divested of its skin, a gristly framework remains, like that shown in Plate 13, the several parts of which, bear the following names:—

A, the helix.
B, the unnamed cavity.
C, the antihelix.
D, its cavity, called the scapha.
E, the tragus.
F, the antitragus.
G, the concha, or great cavity.

At the part H is the tube called the external auditory passage, which is cartilaginous at its outer portion, but its inner end is formed by a channel in the temporal

Plate 13.

Plate 14.



bone. From the skin lining this passage, many small hairs stand across: and underneath it, is a set of small glands, which secrete the wax of the ear, and send it through their little ducts into the passage. This wax, which is viscous and bitter, assisted by the hairs, guards the internal parts from insects.

The bone belonging to the ear, and in which the whole of the internal ear is contained, is called the temporal bone. Its outer form and situation are shown in Plate 14. It is distinguished into two parts: the upper one, *a*, is thin and like a scale, and is thence called the squamous portion; the lower, *b*, is thick and stony, and thence called the petrous portion, (the difference of these parts is more discernible on the internal side of the bone;) *c*, is the mastoid process, containing the mastoid cells; *d*, the auditory ring, for the attachment of the cartilage of the ear; *e*,

the external auditory passage, leading to the tympanum; *f*, the part where the Eustachian canal is situated; *g*, the glenoid hole; *h*, the styloid process; *i*, the zygoma.

The inner side of the temporal bone, or that next the brain, is shown in Plate 15.

A, is the squamous portion.

B, the petrous or stony portion.

C, an eminence, marking the situation of the upper semicircular canal.

D, the aqueduct of the vestibule.

E, the internal auditory passage.

The external ear is very slightly acted upon by muscles; but there are, nevertheless, thin fibrous expansions inserted behind the ear into the fore, upper, and hinder parts of the cartilage, and consequently bearing the names of the anterior, superior, and posterior muscles. The *anterior* arises from about the zygoma, I. Plate 13, and is inserted by a tendon at that emi-

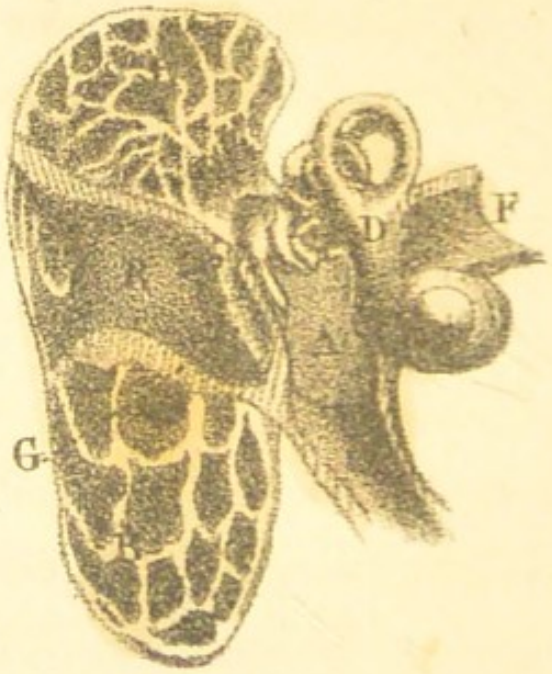
Plate 15.

nence of the helix which divides the concha. The *superior*, K, arises broad and circular from the sheet of expanded tendon of the occipito-frontalis, which covers the top of the head, and is inserted into the upper part of the root of the cartilage. The *posterior*, L, arises by three (sometimes two) narrow distinct slips from the mastoid process, and is inserted by two small tendons into the back of the concha. These muscles rather stretch, than move, the parts of the ear to which they are affixed.

In addition to these muscles, there are delicate fibres stretching along various parts on the front and back of the cartilages, the purpose of which is supposed to be, the preparation of those cartilages for receiving and propagating the vibrations of the air inwards along the tube. They are dignified into muscles; and from their positions are named, helicis major, helicis minor, tragicus, antitragicus, and trans-

versus. The first four are on the front of the ear, at the spots marked respectively 1, 2, 3, 4 (Plate 13); the fifth is on the back part, and scatters its fibres from the concha to the outer side of the antihelix.

Plate 16.



CHAPTER XII.

THE TYMPANUM:—ITS CAVITY AND MEMBRANE; EUSTACHIAN TUBE AND MASTOID CELLS.

THE external parts being described, we may commence our explanation of the internal ear. This is divided into two portions; called the tympanum and the labyrinth.

If we remove the bone which obstructs our purpose, the conformation hown in Plate 16 will be brought into view. These parts are here somewhat magnified, in order to render them more distinct. The tympanum comprises the three portions marked A, B, and C, the former of which is called the cavity of the tympanum; the second, the mastoid cells; and the third, the Eustachian tube, or passage to the palate. D, is the labyrinth; E, the external auditory passage; and F, the internal one.

At the opening of the outer ear, the cartilages form a gristly tube, which, being fixed upon the auditory ring, *d*, Plate 2, forms the commencement of the external auditory passage : the remainder is a canal perforating the bone itself. At the lower end of this canal, its opening is stopped by a thin membrane extended over it, as the parchment is stretched over a drum. Beyond this is the open space, called the cavity, or chamber of the tympanum*, deriving its name from the circumstance just mentioned. This cavity contains four very diminutive bones, of which we shall speak hereafter.

On the opposite side of the tympanous cavity to that which contains its membrane, are two holes, the posterior one oval, the other round : both lead into the labyrinth ; the former to the vestibule, the latter to the cochlea. At the back, the chamber opens

* Tympanum, Lat., a drum.

to the mastoid cells ; and at the front to the Eustachian tube. Near the oval hole, and rather behind it, is an eminence called the *pyramid*, perforated in its centre.

The membrane of the tympanum, G, Plate 16, is transparent and nearly circular. It is placed somewhat obliquely, so that its lower margin is further inward than the upper. It is not stretched uniformly flat, but is slightly drawn into a shallow funnel, by the adhesion of the first of the diminutive bones, the malleus.

The Eustachian tube extends from the chamber to the back part of the nose, behind the palate. On quitting the temporal bone, it becomes a cartilaginous tube, widening into a trumpet shape. In the upper part of this tube, within the bone, is a small canal, ending like a spoon, and termed the spoonlike cavity.

The chamber of the tympanum is filled with air, and the use of the Eustachian tube is for admitting its easy access, so that the

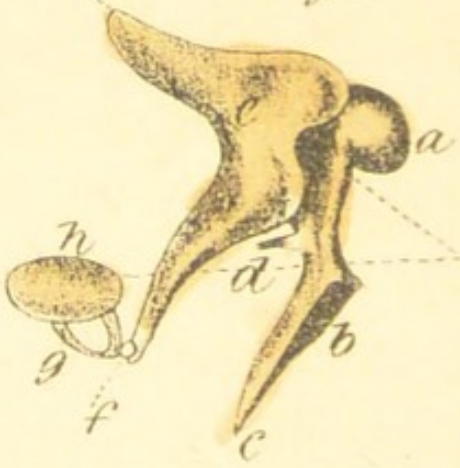
membrane may have a free motion: for it is by this membrane that the vibrations of the atmosphere, causing sound, are communicated to the diminutive bones, and thence eventually to the brain.

The mastoid process, *c*, Plate 14, although it appears externally solid bone, is nevertheless full of little bony cells, communicating with each other. These are the mastoid cells; brought into view in Plate 16, by a vertical section of the bone. They are thought to strengthen the effect of the sound, by reverberating the air from the tympanum.

Plate 17.

Fig. 1.

Fig. 2.



CHAPTER XIII.

THE SMALL BONES OF THE TYMPANUM, AND THEIR MUSCLES.

THE four little bones which are contained in the cavity of the tympanum are named the malleus, incus, os orbiculare, and the stapes,* from their supposed resemblance to these articles. They unite one with the other, by ligament; and reach across the cavity, the malleus or hammer being united to the membrane of the tympanum, and the stapes or stirrup to the membrane which covers the oval hole. The natural size of these bones is shown in Fig. 1, Plate 17, (the orbicular bone being less than a mustard seed,) and a magnified view,

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* Malleus, Lat., a hammer; incus, an anvil; os orbiculare, a round bone; stapes, a stirrup: the first two have but little resemblance to the names given them. Their nearest resemblance is, that the force of the former is received by the latter.

with their mode of union, in Fig. 2. In the latter figure, *a*, is the hammer; *b*, its handle; *c*, the end attached to the membrane of the tympanum; *d*, the long process; *e*, the anvil; *f*, the orbicular bone; *g*, the head of the stirrup; and *h*, its base attached to the membrane of the oval hole. The centre of motion of the hammer is shown by a horizontal dotted line, and that of the incus by the sloping line. It will be seen by these that the small motion received at *c*, is greatly increased at *f*, and that the vibration transmitted to the seat of the auditory nerve is thus greatly strengthened.

The hammer and stirrup have small muscles connected with them; the intermediate bones have none. Those of the hammer are the laxator and tensor tympani, that of the stirrup is the stapedius.

The laxator runs along the bony groove at the *outer* and upper side of the Eustachian tube, called the spoonlike cavity, and

is inserted into the long process of the hammer. It relaxes the membrane of the tympanum. The tensor is a long slender muscle running along the Eustachian tube in a canal on its upper and *inner* side. It sends off a slender tendon, passing outward to be inserted into the hinder part of the handle. It pulls the malleus inward, and thus makes the membrane more tense. A small muscle or ligament also reaches from the upper part of the tympanum to the neck of the malleus. The stapedius arises from a small hole in the centre of the pyramid, and is inserted into the back part of the head of the stapes, which is thus drawn by its action obliquely backwards and upwards.

CHAPTER XIV.

THE PARTS OF THE LABYRINTH.

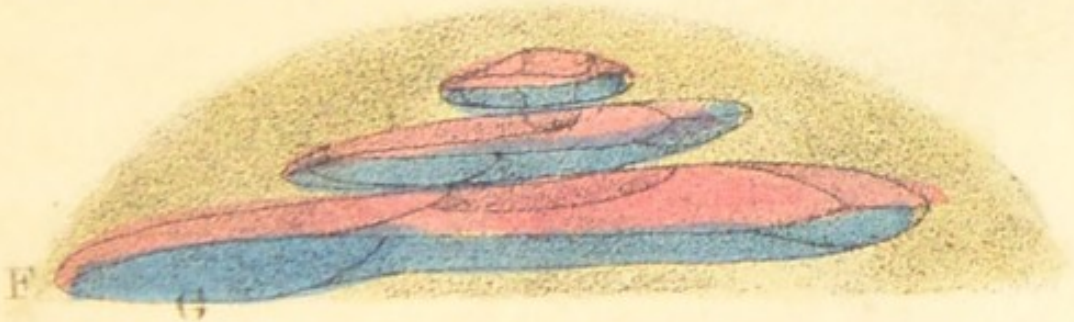
It is a difficult matter to give a clear illustration of the labyrinth upon paper, in consequence of the mazes and intricacies in its formation,—from which its name is derived. It is distinguished into three portions; the vestibule, the semicircular canals, and the cochlea: all of which cavities are filled with a fluid similar to the aqueous humour of the eye.

The vestibule is so called, as being a chamber into which the others lead; it is the middle portion. The oval hole passes into it from the tympanum; and if we remove the bony wall which contains this hole, we shall easily perceive five holes near to each other, upon the hinder part of the cavity, situated as exemplified in Plate 18, Fig. 1. by the references *a*, *b*, *c*, *d*,

Plate 18.

Fig. 1

Fig. 2.



and *e*. These are the openings into the semicircular canals.

The semicircular canals are distinguished as the vertical, oblique, and horizontal. The vertical and oblique unite before they enter the vestibule: the openings would else be six. A bristle sent through these canals will clearly show their respective openings. Thus, one sent into the vertical at *a* will protrude from *b*, as will also one sent into the oblique at *c*; and a bristle sent into the horizontal at *d* will make its exit at *e*. The course of these canals appears simple enough from the plate, without passing the bristle; but it is to be noted that the canals are formed in a solid lump of very hard and stony bone, and that those represented are merely the membranous tubes which fill the channels.

The cochlea is named from its similitude to the shell of a snail. It is the most difficult part of the ear to be described. It is in the anterior part of the bone, and

is pyramidal. When cut open, as in Fig. 2, of the Plate, it appears like three compartments, but the spiral turnings lead from one into the other. The spiral tube takes two turns and a half from the base to the narrow end.

The spiral lamina runs round the central part like a winding staircase, so as with the addition of its membranes to divide the cavity into two tubes, perfectly distinct, termed the scales of the cochlea. These, for greater distinction, are here tinted red and blue. They run into each other at the apex: but at the wider end one runs into the vestibule, as at F, the other into the tympanum by the round hole, as at G. The bone which constitutes the central pillar, H, is called the modiolus: it opens towards the apex like a little funnel, which latter part is hence called the infundibulum.

The auditory nerve is the soft portion of the seventh pair; see Plate 9. It passes from the brain through the internal auditory

passage, and spreads itself through several small holes, upon the various parts of the labyrinth, in minute branches. Upon the spiral lamina, its fibres are most beautifully spread into a delicate network.

CHAPTER XV.

ACTION OF THE PARTS IN THE COMMUNICATION OF SOUND.

As rays of light dart forth in all directions from a luminous body, so rays of sound, as they may be termed, issue in every direction from a sonorous body. The rays of light may be collected into a focus by the power either of refraction or reflexion, for the former of which I have already shown the adaptation of the eye. Sounds obey the laws of reflexion; and although no part of the ear is adapted absolutely to bring them to a focus, still its external cartilages are understood by their form and slight motion, to have the power of collecting the vibrations and reflecting them onwards to the tympanum. Neither the outward ear, nor the tympanous membrane

are essential to sound*, although they assist in the effect: it has been ascertained that where the membrane has been greatly destroyed by disease, the power of hearing has remained, though not to so perfect a degree.

The theory of the faculty of hearing is, that the vibrations of air striking upon the concha, are reflected to the membrane of the tympanum. The cavity behind, being filled with air, yet not tightly distended, because of the escape through the Eustachian tube, allows of the yielding of the membrane to even a slight impression. The end of the malleus being fixed at the centre of the membrane, of course receives motion when the membrane is acted upon; and this action is communicated to the incus. The movement of the incus not only opens a communication to the mastoid

* Air is essential to sound, though not to light: sound is in fact the vibration of the air communicated to the brain.

cells, which reverberate the sound, but by the nature of its union with the malleus, the motion of its lower end is materially increased, so that a slight vibration on the membrane is comparatively powerful at the stapes.

It is now to be noted that the labyrinth is not filled with air, like the tympanum, but with a fluid, having no escape, although the membrane of the round hole gives a partial yielding,—so that a slight impression upon any part is communicated throughout its contents; for, with liquids, which are inelastic, the communication of any pressure or escape is so rapid, that if pressure were given at one end of a full tube of great length, its effect would be immediately felt at the opposite end; as it would also in case of the escape of any small portion of its contents.

The stirrup, then, acting upon the membrane of the oval hole, of course affects the fluid contained within the labyrinth; and

this, again, has its effect upon the nerves which are so delicately expanded over its parts. The mode in which these last exert their efforts is inexplicable; but by some mysterious law the result is carried to the brain; and the ultimate consequence is that we are blessed, not only with a sense of hearing, but one of that extreme perfection which enables us to distinguish even the small, and it might perhaps be said, the gradually imperceptible differences, which exist in the thousands of variations of sounds, produced by the tone and temper of the speaker, the nature of the musical instrument, the species of bird, beast, or insect, and in fact, by nearly every thing either animate or inanimate, in all the several degrees of strength.

Valuable as is the sense of hearing in itself, it is doubly so with those born deaf, as it usually involves the loss of speech. This appears to be a natural consequence, since from the party being unable to hear

the words which are uttered, he can scarcely be supposed to comprehend the sounds by which our sentiments are conveyed to each other.

CHAPTER XVI.

THE ORGAN OF SMELL—ITS PARTS DESCRIBED.

THE organ of smell is the nose. Externally this is bony as far as the bridge. Beyond this the parts are cartilaginous; from the nature of which substance the openings are kept extended for the entrance of the air, without such a liability to accident existing as would have been the case from such a prominence of bone.

The internal nose is divided into two cavities, called the nostrils, by means of a thin bony partition which reaches from the top of the nose to the roof of the mouth: and this division is carried on to the very tip of the nose by a continuation of gristle. The nostrils open backwards into the throat, and thus enable us to breathe whilst the mouth is closed.

Between the two eyes, a bone is situated,

forming a part of each socket*, called the ethmoid bone, because its upper part is perforated with numerous small holes, like a sieve†, as shown in Plate 19, Fig. 1. From the middle line of this bone hangs the thin plate, called its nasal process, *a*, which forms the upper portion of the bony division just described. On each side of this (see Fig. 2) hangs a very spongy bone, *b*, which curls round outwards from the central partition, after the manner of a turban, and called the upper spongy or turbinated bone. By removing the thin plate of the ethmoid bone which forms part of the socket *c*, we find numerous cells underneath, called the ethmoid cells. These are part of a train of cells, commencing at the forehead between the eyebrows, and extending through portions of the ethmoid, sphenoid, and upper jaw-bone.

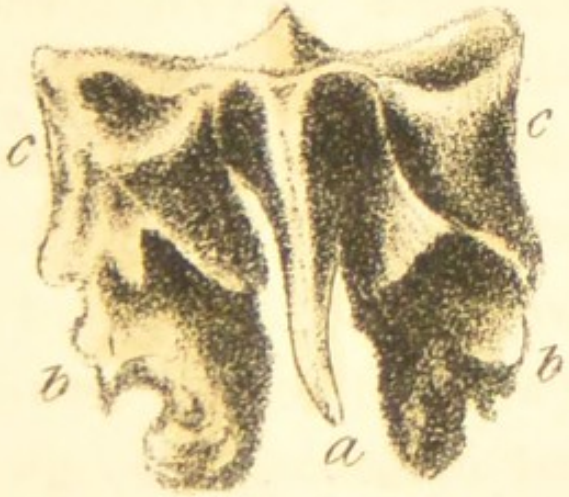
* Marked F. in Plate 2.

† Ethmos, Gr. a sieve.

Plate 19.

Fig. 1.

Fig. 2.



Below each of the upper spongy bones is a lower and smaller one, projecting from the nostril at its external side: and close under the forepart of this is the opening of the passage leading from the eye into the nose.

All the internal parts of the nose are covered with a glandular membrane, called the pituitary or Schneiderian membrane, which secretes a moisture, defending it from the effects of the air, preserving its sensibility, and acting in some degree as a solvent to introduce the odorous effluvia more intimately to the nerves.

The nerves which communicate the faculty of smell, are the first pair or olfactory nerves, the position of which is shown in Plate 9. Each nerve expands in a bulb on the upper or perforated surface of the ethmoid bone, and its fibres proceed through the perforations, and spread themselves upon the membrane. It seems, then, that the effluvia from odorous bodies act upon

the expanded fibres in the nose, and are thence conveyed to the sensorium of the brain. By a wise provision, the power of smelling is seated in the entrance to the canal of the lungs: for thus the organ acts as a guard against noxious air, as the sensibility of the tongue is a guard to the stomach.

Plate 20.

CHAPTER XVII.

THE ORGAN OF TASTE—ITS PARTS DESCRIBED.

We now come to describe the organ of taste, which is the tongue. Its hinder portion, *a*, Plate 20, is called its base; the upper surface, *b*, its dorsum or back; and *c* is the apex or tip. It is covered with skin, and consists chiefly of the fibres of the muscles, which serve for its motion. On the upper surface may be observed a middle line dividing the tongue into a right and left portion, the one of which is the counterpart of the other, and towards the base may be observed a depression, marked *d*.

The upper surface is entirely covered with numerous papillæ of various kinds; the larger are situated at its base; but the smaller and redder ones, placed at the tip, and along the edges of the tongue, are

those which are chiefly endowed with the sensibility.

The tongue possesses great power of motion. It can prolong or shorten its length; move sideways, upwards or downwards; form a channel down its centre by raising its sides, or a rising along the centre by depressing them; and even has the power of curling back upon itself to a certain extent, so as to convey the food to the gullet. It is prevented, however, from a dangerous degree of this last action, by the skin underneath doubling back again towards the chin, and forming that part which is well known as the *bridle*, without which arrangement the tongue itself might get into the throat.

There are four pair of muscles belonging to the tongue, named genio-hyo-glossi, hyo-glossi, linguales and stylo-glossi.

The first pair arise from the inside of the chin, at the centre, and from this point they spread out like a fan towards the root

of the tongue. The fibres then radiate in different directions, those going to the point of the tongue, pull it backwards ; those to its base, force the tongue forwards ; and the middle fibres depress the middle portion of the surface into a groove. These muscles form the chief substance of the tongue, and lie in its centre.

The hyo-glossi arise from the bone of the tongue at its base, and proceed to form the sides of the organ. They pull down the edges, and thus render the upper surface convex.

The linguales arise laterally from the root of the tongue itself, and go forwards to the tip, passing between these other muscles. They raise the point of the tongue and bring it backwards.

The stylo-glossi proceed from behind, and are inserted into the root of the tongue, whence they run along the side of the hyo-glossi towards the apex. They draw the tongue backwards, or to either side.

There are numerous glands about the mouth, which supply the tongue with saliva. The chief is the *parotid* gland, which is a collection of many smaller glands, occupying the space from the ear and mastoid process to the angle of the lower jaw. Their secretions are conveyed to a duct, which opens upon the inside of the cheek, near the second grinding tooth. The next in size are the sub-maxillary and sublingual glands, which open under the tongue in the neighbourhood of the bridle.

Above the base of the tongue, the roof of the mouth has a fleshy membranous curtain, with a pendulous body, *e*, hanging from its centre. This body is the *uvula*: it is like a little tongue, and has the power of darting forth, or drawing itself up. The partition, *f*, is called the *velum of the palate*. When we swallow, it covers the openings from the nostrils, and prevents any of the food from passing that way.

Near the uvula, it will be seen that four arches meet; these are the *arches of the palate*. The anterior ones, *g g*, go down to the root of the tongue; and behind these the cavity is called the *fauces*. The posterior ones, *h h*, go downwards to the sides of the gullet.

The sense of tasting takes place thus. The substance being received upon the tongue, gives out, by the pressure of mastication or otherwise, its sapid particles to the saliva, in which they become dissolved. By this solution, they arrive intimately at the exquisite papillæ on the tip and sides of the tongue, and reach the extremities of the gustatory nerve*, which terminates in them. The difference of sensibility in these papillæ, and those on the other parts of the tongue, may be easily tested by a drop of vinegar, or any sour or bitter particles.

* A branch of the 5th pair.

CHAPTER XVIII.

THE ORGAN OF TOUCH—DESCRIPTION OF THE SKIN.

THE fifth and last sense is that of *touch*, which resides in the skin.

The skin is divided into three coats,—the cuticle, rete mucosum, and the true skin.

The *cuticle* is the outer coat. It is transparent, and by its insensibility blunts and defends the acute sensation of the true skin. It is in general thin; but over certain parts, as the heels and soles of the feet, and the palms of the hands, it is thicker; and instead of becoming thinner by labour or repeated pressure, it thickens and becomes more insensible. If, however, this skin be too quickly exerted, it throws out a watery fluid and causes blisters; and if exerted in a less degree, the friction causes repeated layers of cuticle, and thus forms corns. It has several per-

forations, for perspiring and absorbent vessels, excretory ducts and the hair. The cuticle is continually wearing off on its upper surface, and a new formation going on underneath. The nails are considered to be a continuation of this skin.

The *rete mucosum* is the middle coat, and is the seat of colour in the skin. It is light in the inhabitants of temperate climates, black in the negro, and copper-coloured in the mulatto. It is a mucous layer, pervaded by the little fibrils which pass between the true skin and cuticle, which it defends; and it is thought to form in its turn the cuticle.

The undermost coat is the *cutis* or *true skin.* It is formed of fibres intimately interwoven, and running in every direction; and is plentifully supplied with nerves and blood vessels, so that the smallest puncture cannot be made in any part, without occasioning pain and a discharge of blood. It is dense on the outer surface, but the in-

ternal layers are loose, and gradually degenerate into the cellular substance. It is not uniform in thickness: on the soles and other parts it is thickened, while on the lips, &c., it is remarkably thin.

The cutis has numerous pores, transmitting the perspiring and absorbing vessels, the ducts of the sebaceous glands, and also the hairs. Into these pores, little sheaths project from the cuticle, through the centre of which the perspiration exudes.

Its upper surface is covered with very numerous vascular papillæ, which conduct the extremities of the cutaneous nerves to form the organ of the sense of touch. These little eminences are so fine, in some parts, as to resemble the pile of velvet, and are thence called the *villi*. They are protected by being situated in a soft bed in the furrows between the ridges of the skin, such as in the tips of the fingers are so observable. The action of external bodies upon the ends of these nerves, so plentifully

supplied and terminating in the papillæ, cause in us the sensation designated by the name of *touch*.

That our nerves are the means of sensation is, from actual experiment, beyond dispute; but how they act, and how each class communicates its own peculiar sensibility, is a subject too mysterious for explanation.

THE END.

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