Compendium of the diseases of the human eye : with practical observations on their treatement : to which is prefixed an account of the anatomy and physiology of that organ / by Alexander Watson.

PRESENTED

BY

J. A. Dunneley Esq.

1900

COMPENDIUM

OF THE

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AN ACCOUNT

OF THE

ANATOMY AND PHYSIOLOGY

OF THAT ORGAN.

ILLUSTRATED BY ENGRAVINGS.

BY ALEXANDER WATSON, ESQ.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS EDINBURGH, MEMBER OF THE MEDICO-CHIRURGICAL SOCIETY, SURGEON TO THE ROYAL PUBLIC DISPENSARY, &c. &c. &c.

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PREFACE

TO THE

THIRD EDITION.

The very flattering manner in which the preceding editions of this work have been received, has afforded a gratifying proof of its utility, and the estimation in which it is held. This has induced the author to offer another edition to the public, upon a somewhat extended plan.

The following Treatise comprehends an account of the Anatomy, Physiology, and Diseases of the Human Eye. But its chief object is to elucidate the nature and proper treatment of these diseases.

The Anatomy and Physiology have been prefixed, to render the work more complete as a book for study, as well as for reference.

When the great importance of a correct anatomical and physiological knowledge, to the right understanding of the nature and

treatment of the diseases of any part of the body, is considered, the length and minuteness of the description of the structure and functions of the eye here given, will not be thought superfluous, or too great. Indeed, without such a thorough acquaintance with the Anatomy and Physiology of the Eye, as is here alluded to, no description of its diseases could be understood, nor could any proper treatment of them be applied on scientific principles. For, every fact regarding the structure and functions of this organ is important, and consequently necessary to be attended to, in explaining the nature and treatment of its diseases.

The *Anatomical Description* of the Eye here given, and the greater part of the plates illustrating it, have been taken entirely from nature, after the most careful and frequently repeated dissection of the different parts. And the *Physiology* contains, what is either obvious, or matter of inference, concerning the functions and uses of these parts. In this latter part of the work, the author has also endeavoured to include and

apply what information the other sciences have contributed, towards the elucidation of the functions of the eye and of vision.

The descriptions of the *Diseases of the Eye* here given, are brief—are the result of actual observation—and are illustrated by numerous cases. No disease has been described, which the author has not repeatedly seen; and he has been careful to notice every circumstance necessary, either for forming a correct diagnosis, or for elucidating the nature of each disease; and the treatment recommended, is that, which considerable experience has shown to be the best.

It is remarkable that many of the diseases here mentioned, though common, have neither been described nor delineated by any authors. Some have been described as involved in much obscurity; of others, most absurd explanations have been given; while others have been confounded with diseases essentially different. But, without attempting to expose or to combat prevailing errors, whether theoretical or practical, the author has stated what, either from experience, or

after mature consideration and reflection, he conceives to be correct.

The Diseases of the Eye, consist chiefly of derangements of structure. These changes are, in most cases, minute and not at first easily perceived, so that their distinctive characters, are not readily recognised by an inexperienced observer. They not only admit of being delineated, however, but, like diseases of the skin, they cannot well be understood from verbal descriptions alone. Hence, plates, though adding much to the price of the work, have been considered indispensable.

The greater part of the cases of disease, by which the work is illustrated, are delineated in the plates. They are not given as rare and extraordinary cases, but have been selected from a large collection, as well marked examples of the diseases they are intended to represent.

The arrangement of the present work, is neither strictly Anatomical, nor strictly Pathological, but partly both, and has been adopted as that best suited to the objects in view.

To give a complete and condensed view of the subject, in the following treatise, has been the chief object of the author. The success which has attended his labours, has already been acknowledged in a degree which has exceeded his most sanguine expectations. And he again ventures to present himself to the public, as a candidate for their favourable consideration. To obtain the approbation of the profession, he has adhered to the simple exposition of *nature*, upon which alone he relies for the interest and utility of his work. He has, therefore, rarely deemed it necessary to canvass the opinions of others, conceiving that nature and truth speak for themselves. A more critical inquiry would have been tedious, foreign to the present purpose, and of questionable utility. The author has adhered simply to facts and concise descriptions of disease; and, even without the introduction of any extraneous matter, the treatise has extended much beyond the dimensions anticipated.

Though the author has frequently alluded to the opinions of the most eminent writers, he

has, in general, preferred giving the result of his own observations, to any *detail* of those of others. The observations and experience of others, are already before the public. To transcribe them, therefore, is unnecessary. Where they agree with those in the present work, the public has a strong proof of the accuracy of both;—where they differ, let *nature* be appealed to, which is the true standard of comparison. But although the author has endeavoured to render his descriptions of the diseases more complete, and has carried his investigations and observations farther, upon many subjects, than others have done; yet he is far from thinking, that they may not be carried still farther, by more extensive experience.

The great ambition of the author now is, to know that his treatise has either tended to improve, or extend a knowledge of the subject which has engaged so much of his attention; and that his labours have been, in any degree, instrumental in alleviating the sufferings of humanity, by the preservation of an organ which is of so great importance to every living being.

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ERRATA.

Page 32, 2d line from foot, *for* " insensibly rolled" *read* " insensibly rolled upwards"

—— 96, line 6, *for* " and a diminution" *read* " and cause a diminution"

—— 96, 4th line from foot, *for* " could it produce" *read* " could this produce"

—— 117, line 7, *for* " As eyelashes" *read* " As the eyelashes"

INTRODUCTION.

VISION, or the sense of sight, is the faculty by which we observe and distinguish external objects, or by which their external appearance is manifested in the mind. Vision, therefore, is to be considered as a mental function or perception of the mind; and it is one of the faculties by which we are connected with external objects.

It is quite unnecessary to speak of the importance of vision to man, either as it contributes to his convenience or enjoyment.

The EYE is the organ which is adapted to receive the peculiar impressions from external objects which are requisite for the production of vision. These impressions are conveyed to the mind by the

other parts of the organ proper to vision which are situated within the cranium. The eye, therefore, is only to be considered as an accessary and indispensable part of the apparatus of vision ; for, by the eye alone, are the impressions of light received, upon which the exertion of this faculty depends ; but the eye of itself, without the sensorium, is incapable of producing the sensation of sight.

The eye forms one of the most complicated, delicate, and sensible organs of the body. It is composed of a great variety of minute parts, so connected with each other, and so dependent on each other for nourishment and preservation, that the structure of none of these parts can be deranged, without more or less injury to vision. This faculty, therefore, can be enjoyed in perfection only, when all the different parts of the eye are in a sound and healthy state.

The eye being composed of so many different parts of the utmost delicacy, it is liable to many accidents and diseases in common with other textures of the body, as well as to others incidental to its own peculiar structure and function; hence the consideration of the diseases of this organ forms an important subject of surgical inquiry.

The diseases of the human eye are extremely numerous, and very various in their nature. Some

of them are acute and of short duration; others are chronic and may last for years. Of some the attack is sudden; others slowly and insidiously creep on. Many seem to arise spontaneously, others are the effect of a specific exciting cause. Many are peculiar to the eye, many common to it with other textures of the body. Some diseases of the eye are attended with pain. In others, loss of vision is the only symptom. Some consist of derangement in the functions of the organ; others are organic, being attended with alteration of structure. Some undergo a spontaneous cure; some are cured by constitutional medical treatment; while others absolutely require surgical operations. The cure may be complete and permanent, or it may be only palliative and temporary. Some of the diseases destroy only the organ; others are inevitably followed by the death of the patient.

Such being the variety in the nature, progress, and effects of the diseases of the eye, a short account of their history and modes of treatment is the important object of the following treatise.

No organ is more frequently attacked by disease than the eye; and there are no diseases which require more accurate discrimination, or more care and attention on the part of the surgeon, than those of the eye. For, in the investigation of

many of the most important cases, the only symptom of which the patient can give any account, is the partial or complete loss of sight. The surgeon is thus left to his own observation and experience to determine upon the nature of the disease. But, as partial or complete blindness may be the effect of many pathological states, it is only from a perfect knowledge of each of these that he can form a decided and satisfactory opinion in any given case. Such a perfect knowledge is the more necessary, because many of the diseases of the eye have a great resemblance to each other, though very different in their nature, and requiring different and even opposite remedies and operations for their cure.

He, therefore, who would practice this branch of the healing art, to his own honour and to the benefit of his patients, must have a minute knowledge both of the structure and of the diseases of the eye,—a knowledge, however, not to be obtained without a larger share of attention than is usually bestowed upon it, but which is absolutely necessary from the importance and extent of the subject. No branch of medicine, surely, can more worthily engage the attention of the student, than that which has for its object the preservation and restoration of sight.

Ever since the days of Hippocrates, some attention has been paid to the diseases of the eye by surgeons in all ages; but even the distinguished surgeons of the last century had a very imperfect knowledge of the anatomy of the eye. Hence they entertained exceedingly erroneous notions of its diseases, and practised absurd and often dangerous operations upon it. No class of diseases, therefore, as might be expected, has given rise to more empiricism. In none have the arts of the *quack* been more insolent and audacious, or met with more encouragement than in this department, on account of the unfortunate ignorance of the regular practitioners.

Ophthalmic surgery has of late years been studied with great attention on the Continent, especially in Germany, and still more recently in our own country. Many men, who have risen to the highest eminence in their profession, have greatly improved and augmented our knowledge of the anatomy and diseases of the eye. So that a degree of certainty and perfection has been attained in this branch of the healing art which is not exceeded in any other.

The treatment of the diseases of the eye has been frequently professed by persons calling themselves

oculists, who laid no claim to a knowledge of any other branch of surgery. The greater number of these individuals have been *empirics,* who have concealed their remedies and operations. Some of them, however, with more candour, or with the hope of reward, have explained their modes of treatment, which have just proved to be the remedies and operations of the regular practitioners.

It is from the labours of men regularly educated to all branches of the profession, but who have devoted themselves in a particular manner to ophthalmic surgery, that we have derived our most valuable information respecting diseases of the eye. Some of these benefactors of mankind have passed away, but they survive in their works to instruct and direct their successors, who still look with respect and admiration to the splendour they have thrown around themselves and their country.

In curing the diseases of the eye, he only who is well acquainted with the general principles of surgery, as well as with the peculiar remedies required for many ophthalmic diseases, and can apply such principles by analogy to the structure, functions, and diseases of the organ of vision, can hope to practise with safety and success. And no one can expect to succeed as an oculist, who is not well

acquainted with the constitutional, as well as local, causes of disease, and with the effects of remedies as they operate on the general system.

In treating of the Anatomy, Physiology, and Diseases of the Human Eye, it will be necessary, for the sake of arrangement, to divide the present work into three parts ; the *first* comprehending the Anatomy and Physiology of the Eye and its Appendages. *Second*, The Diseases of the Eyelids, Lacrymal organs and other appendages. *Third*, The Diseases of the Eyeball, including those of the optic nerve and cerebral part of the visual apparatus.

PART FIRST.

ANATOMY AND PHYSIOLOGY

OF THE

HUMAN EYE.

PRELIMINARY REMARKS.

ANATOMY teaches the structure and organization of any part or parts of the body; while Physiology treats of the functions and uses of these parts.

Of all the organs of animal bodies, those destined for sensation, or the exercise of the senses, are among the most important; the senses being the faculties by which the qualities of external bodies are conveyed or made known to us, and by which our relation with surrounding objects is manifested and established.

The brain is the organ by which sensations are perceived; the external organs of sense, form the medium of communication between the object perceived and the percipient mind.

Sensations which are conveyed to us by the organs of sense, are those impressions from external objects which, operating on our bodies, affect the mind, or become sensible to us. The organs of sense receive these impressions and transmit them to the mind.

All parts of the body may be said to possess the capability of manifesting sensation of some kind or other. But the organs of sense are limited in common language to those of smell, sight, hearing, taste and touch. And it is only of the organs by which the sense of sight is exerted, or of the apparatus of vision, that we are now to treat.

Vision, or the faculty of sight, is one of the most important of our senses. And it is to be considered entirely as a mental function, or perception of the mind, produced or excited by the influence of external impressions made upon the organ of sight, and conveyed by it to the sensorium.

The organ of vision, (if it may be so called,) like the other organs of sense, consists of three distinct parts. *First,* of an *external* part, adapted for receiving peculiar impressions from external objects, which is called the EYE. *Second,* of an *internal* part within

the cranium, where the consciousness of the external impression is felt or perceived by the mind. *Third,* of a nerve or medium of communication which connects the two parts already mentioned; namely, the external or ocular part, and the internal or cerebral part of the organ. * This nerve connecting these two parts of the organ of vision, is called the optic nerve.

The optic nerve, and its expansion in the eye, called the retina, therefore, are only to be considered as ramifications of the brain, sent out, and adapted by the addition of auxiliary apparatus, for receiving and conveying to the sensorium the impressions from external objects, necessary for vision.

Vision, therefore, or the sense of sight, being a mental function, the eye is only to be considered as the organ peculiarly fitted to convey certain impressions to the brain, by which this faculty is exerted. Hence the eye is only a subordinate organ to the cerebral part of the apparatus of vision; it is essential as an accessary part, and possesses a structure and functions which are both complicated and peculiar. By the eye alone are the impressions necessary for vision received; so that, when this organ is either destroyed or imperfect, vision is either destroyed or impaired. And in like manner the eye

* See Plate V.

alone, without a perfect state of the cerebral part of the visual apparatus, is useless. So that vision depends on the mutual functions of the ocular and cerebral parts of this apparatus.

To render the description of the Anatomy, Physiology and Diseases of the Human Eye complete, it is necessary to include an account of each of the parts of which the apparatus of vision is composed; namely, the Eye, the Optic Nerve, and that part of the Brain from which it takes its origin.

The eye or external part of the apparatus of vision, forms of itself an organ of very beautiful, delicate and complicated structure, by which it is admirably fitted for its peculiar and important functions.

There is no part of the animal frame more beautifully constructed than the eye. It is an organ which is common to almost every animal that exists, and its structure and functions are various in their degree of perfection, according to the nature and habits of the species to which each animal belongs.

Though the comparative anatomy and physiology of the eye have tended in a considerable degree to illustrate the structure and functions of the human eye, it is only to the latter that the present description shall be confined; and allusion to that of the lower animals shall only be made, when this assists us in the investigation of its more minute and complicated details.

In man the external part of the organ of vision is double, or consists of two eyes. These are symmetrical organs, and are situated at the anterior part of the cranium, within the bony cavities called the orbits. But though the external or ocular part of the organ of vision is double, the internal part is only single; and the eyes are so constructed that objects viewed, are not seen double. Thus, both eyes perform the office of one; and when one is destroyed the other performs the office of both.

Besides its connection with the brain, the eye has connected with it, several parts of minor importance, called its Appendages. These are destined for its protection and motion. They consist of the eyebrows, the eyelids, lacrymal organs and muscles which move the ball or globe of the eye.

In treating of the Anatomy of the Eye, its external appearance, the bony cavity or orbit in which it is contained, and the other appendages of the eye will be *first* described; and, *secondly*, the globe of the eye or eyeball.

Along with the anatomical description of each part, a short account of its functions will be added; after which, the combined function or *faculty of vision* will be treated of separately.

CHAPTER I.

ANATOMY AND PHYSIOLOGY OF THE APPENDAGES OF THE EYE.

THE appendages of the eye are those parts connected with it, by which it is protected, moved, lubricated, and nourished.

The appendages of the eye consist of the eyebrows,—the eyelids,—the muscles which move the eyelids and eyeball,—and of the lacrymal organs, with their blood-vessels and nerves. Of the structure and functions of each of the parts of which these are composed, we shall now proceed to give a description.

The different parts, which have been now enumerated as contained in the orbit along with the eyeball, are surrounded by fine cellular tissue and adipose substance. This fills up the spaces between the different parts, lubricates them, facilitates their motion, and also forms a protection to the blood-vessels and nerves situated within the orbit.

SECTION I.

OF THE EXTERNAL APPEARANCE OF THE EYE.

THE eyes of men differ in size and external appearance from those of women. In men the eye is larger, and possesses a more bold and determined look than in woman. This arises from the marked and expressive form which is produced by the greater size of the parts which surround it. In women the eye is of a smaller size than in men; and though it possesses an equal vivacity of motion and expression, by which it exhibits that grace and beauty which adorn the fair sex, it wants the boldness which is given to it by the greater size of its external appendages in men.

The eyes of different nations, and of different tribes of men also, have each different and peculiar external characters. The eyes of the nations on the Continent of Europe are somewhat different from those of the British nation. The former are in general small—deeply sunk in the orbit, and of a dark colour; whereas those of the latter are large, project more from the orbit, and are most commonly of a light colour.

The different appearance of the eye which is possessed by the tribes inhabiting other regions of the globe, arises chiefly from the peculiar expression of countenance given to them from the structure of the eyebrows and eyelids.

In that peculiar race called the ALBINO, the internal parts of the eye possess a red colour, which will be afterwards explained.

The external parts of the human eye are exhibited in Plate I, both as they appear in an open and closed state of the eyelids; and the technical names are given to each of its different component parts. See *explanation of the plate.*

SECTION II.

OF THE ORBIT, OR BONY CAVITY WHICH CONTAINS THE EYE.

SEVEN bones enter into the formation of each orbit. Three of these, the frontal, ethmoidal, and sphenoidal, are common to the cranium and face, and being single bones enter into the formation of both orbits. The other four bones of which each

orbit is composed, viz. the malar, superior maxillary, palatal, and lacrymal, are bones proper to the face.

The orbit has the form of a cone, the apex of which projects into the interior of the cranium, its base opening externally at the face.* Its interior surface is irregular, being perforated by several foramina for the transmission of blood-vessels and nerves, and other depressions for the lodgement of the ocular appendages.

The foramina of the orbit are, *first*, the foramen opticum of the sphenoid bone, which gives passage to the optic nerve and a branch of the internal carotid, called the ophthalmic artery. *Second*, The foramen lacerum anterius, common to the sphenoid and frontal bones, which gives passage to the third, fourth, first branch of the fifth, and greater part of the sixth pairs of nerves, as also to a small artery. *Third*, A small foramen in the frontal bone, which gives passage to a small branch from the first of the fifth pair, along with an artery and vein to the nose. *Fourth*, Another small foramen through which an artery and vein pass. *Fifth*, The supra orbitar foramen through which the first branch of the fifth pair of nerves and the ophthalmic artery pass from the orbit to the forehead.

* See Plate IV.

The remarkable depressions in the orbit are, *first*, the bony canal or groove of the lacrymal bone for the lodgement of the lacrymal sac and nasal duct; and, *second*, the cavity or pit, formed by the temporal process of the frontal bone, for the lodgement of the lacrymal gland.

The orbit contains the eyeball, along with its muscles, blood-vessels and nerves, the lacrymal organs, and the cellular tissue which surrounds these parts.*

The orbit is lined by periosteum closely connected to the bone. From the margin of the orbit all round, this periosteum sends a process or ligament towards the anterior part of the eyeball, which becomes lost in its cellular tissue.† This ligament or process of the periosteum, by stretching across the external opening of the orbit beneath the eyelids, tends to retain its contents in their proper place and to protect them.

* See Plate IV.

† See Plate IV. O. Q.

SECTION III.

OF THE EYEBROWS.

THE Superciliæ or eyebrows consist of those eminences above the eyes which cover the superciliary arches of the frontal bone.* They vary in size in different individuals. In men, they are larger than in women—in old, than in young subjects. They are covered with strong hair, corresponding in colour to that of the head. In some individuals, the space between the eyebrows is so small that they are continuous; but in general there is a space equal to the breadth of one of the eyes between them.

Functions.—The eyebrows are moved by the fibres of the orbicularis palpebrarum—by the frontalis muscle and by the corrugator supercilii.

The eyebrows have a great effect on the expression of the countenance. They can also be made to project over the eyes so as to prevent the light from above falling upon them.

* See Plate I. Fig. 3, *a*, *b*, *c*.

SECTION IV.

OF THE EYELIDS AND THEIR COMPONENT PARTS.

THE eyelids form the anterior covering of the eyeball.* When closed, they completely shut up the eye in the cavity of the orbit, of which they form the anterior boundary. The eyelids can be partially separated from each other, by opening at the transverse slit which divides them. By their separation at this slit, the orbit is partially opened, and the anterior part of the eyeball is exposed.† By this transverse opening, the eyelids are divided into the upper and lower lids, of which the upper is much larger than the other. The margins of the eyelids which are opposed to each other at this opening are straight; and at their exterior edges they have inserted into them, a row of hairs, called the ciliæ or eyelashes, which project outwards from the eye.‡

As we see only that part of the eyeball which is exposed by the separation of the eyelids, the size

* See Plate I. Fig. 2. † See Plate I. Fig. 1.

‡ See Plate I.

which the eye appears to have, depends on the extent to which the eyelids are separated from each other, and the degree to which the eyeball projects from the socket.

The eyelids are made up of several component parts, namely, skin and cellular tissue, the eyelashes, muscles, a palpebral ligament, fibro-cartilages, the Meibomian glands, and a lining membrane formed by the conjunctiva. Of each of these a particular description will now be given.

1. *Of the skin and cellular tissue of the eyelids.*—The skin and cellular tissue covering the eyelids is extremely soft and delicate. When the eyelids are closed the skin is quite smooth, but when they are open it forms itself into folds and wrinkles, more particularly in elderly persons.

2. *Of the Ciliæ or Eyelashes.*—These consist of a row of strong hairs at the margin of each eyelid.* Those of the upper lid are the longest and most numerous. They are curved upwards, while those of the lower eyelid are curved downwards.

The eyelashes do not perform any very important function; they prevent superfluous light, floating particles of dust, &c. from getting into the eye.

* See Plate I. Fig. 3, *d. p.*

3. *Of the Muscles of the Eyelids.*—a. *Orbicularis palpebrarum.*—The eyelids are covered externally by the common integuments and cellular tissue. When these are removed, a circular or sphincter muscle surrounding the eyelids is exposed, having a slit or aperture in its middle for the opening of the eyelids.* The fibres of this muscle, the orbicularis palpebrarum, have an eliptical course, they completely surround and cover the orbit as well as the eyelids. The fibres arise from the orbitar process of the superior maxillary bone; running downwards and outwards they cover the margin of the orbit and lower eyelid, and are loosely connected only to the skin and its subjacent cellular tissue. The fibres then proceed in their course round the external angle of the eye, covering the superciliary ridge of the frontal bone and upper eyelid. The fibres at the circumference of the muscle intermix with those of the occipito-frontalis and corrugator supercilii, and in some cases send down fibres to join with the levator labii superioris alæque nasi. The whole of the fibres of this muscle are disposed in an elliptical form around the opening or division between the two eyelids, and become concentrated into a round tendon at the nasal extremity of the eyelids; which tendon is inserted into the

* See Plate II. Fig. 1.

nasal process of the superior maxillary bone. This muscle covers the anterior part of the orbit, by which it conceals the eyelids and eyeball, the lacrymal gland and the lacrymal sac.

Function.—The action of the orbicularis palpebrarum muscle is to close the eyelids, by bringing them completely together over the forepart of the eye. In this action the external angle of the eyelids is drawn towards the tendinous insertion of the muscle at their nasal or internal extremity, which is a fixed point. By this action the eyelids are closed and are more or less wrinkled and corrugated. This muscle, therefore, acts as the antagonist of the levator palpebræ superioris.

b. Levator palpebræ superioris.—This muscle lies within the orbit at its upper part. It is attached by a short tendon in common with the levator oculi and trochlearis muscle, to the upper margin of the foramen opticum of the sphenoid bone. Becoming fleshy it proceeds forwards, in the upper part of the orbit, when it makes a curve downwards over the eyeball, and again becomes tendinous. This tendon, expanding in breadth like a fan, is inserted into the superior margin of the tarsal cartilage of the upper eyelid.*

* See Plate II. Fig. 3. *c*, also Plate IV. 1, 2, 3.

Function.—The levator palpebræ superioris muscle raises the upper eyelid, by drawing the tarsal cartilage upwards and backwards into the orbit upon the upper part of the eyeball. It acts as the antagonist of the orbicularis palpebrarum, so that the eyelids are opened partly by the action of this muscle, and partly by the relaxation of the orbicularis palpebrarum.

4. *Of the Fibrous membrane of the Eyelids or Palpebral Ligament.*—This membrane exists behind the orbicularis muscle. It arises from the bony margin of the orbit. In the upper eyelid it passes down between the orbicularis and the tendinous expansion of the levator palpebræ superioris; in the lower, between the orbicularis and the conjunctiva. The fibrous membrane becomes lost upon the tarsal cartilages. The inner surface of it is coated with adipose and cellular tissue.*

4. *Fibro-cartilages of the Eyelids.*—Situated immediately beneath the orbicularis palpebrarum, there is in each eyelid, a thin cartilage of a semilunar form.† These are called the Tarsal Cartilages. That of the upper eyelid is much larger than that of the lower. Their ciliary margin, or that

* See Plate IV. O. Q. † See Plate II. Fig. 3. *m. n.*

in which the eyelashes are attached, is straight; their other margin forms the segment of a circle. Their surfaces are convex externally, and concave internally, for their adaptation to the surface of the eyeball. They are broad at their middle part, and narrow at their extremities, where they unite together. Their inner surface is covered by a mucus membrane called the tunica conjunctiva; having interposed between the cartilage and this lining membrane, numerous minute glandular bodies called the glands of Meibomius.

Functions.—These cartilages give form and firmness to the eyelids; and they tend to obviate the inconvenience that would have arisen from the transparency of the other parts of the eyelids, when in a closed state.

5. *Of the Meibomian Glands.*—The glands of Meibomius which are situated upon the inner surface of the tarsal cartilages, are disposed in minute clusters; and these clusters are arranged in perpendicular lines running to the margin of each eyelid.* Each line of these glands sends an excretory duct to the margin of the eyelid; which ducts open by a row of orifices along the margin of each eyelid.

* See Plate II. Figs. 2 and 3.

Function.—These glands secrete a fluid which exudes from their ducts, and lubricates the eye by being diffused over it, by the motion of the eyelids.

SECTION V.

OF THE TUNICA CONJUNCTIVA, OR MUCUS MEMBRANE OF EYEBALL AND EYELIDS.

THE conjunctiva forms a partial covering to the eyeball at its anterior part, and covers the inner surface of the eyelids.* It is a mucus membrane, thin, transparent, and highly organized by blood-vessels and nerves. It forms a bag or pouch, placed upon the anterior of the eyeball, having a transverse opening anteriorly at the separation of the eyelids. When it is examined internally therefore, by opening the eyelids, it appears to be reflected from the eyelids over the forepart of the eyeball, forming at the point of reflection a sort of fossa around the eye, at the distance of about half an inch from the margin of the cornea.

* See Plate II. Fig. 3, *f. g.* and Plate IV. *r. s. t. l.*

The conjunctiva forms the only connection which the eyelids have with the eyeball. It covers the insertions of the four straight muscles, the sclerotic coat, and cornea, at the anterior part of the eyeball; which parts are seen through it from its transparency. The conjunctiva is loosely attached to the eyeball and eyelids by fine cellular tissue, except at the tarsal cartilages, where this connecting tissue is much more dense. That part of the conjunctiva also which covers the cornea, is more condensed and intimately connected to the subjacent parts than the rest. See Anatomy of the Cornea.

Functions.—The conjunctiva protects the anterior surface of the eye. It secretes a fluid which, mixing with the tears and secretion from the meibomian glands, lubricates the eye and maintains the transparency of the cornea. It facilitates the motion of the eyeball and eyelids; preserves the eye from the contact of the atmosphere; and by its sensibility, gives notice of the application of hurtful matter to the eye.

SECTION VI.

OF THE USES AND FUNCTIONS OF THE EYELIDS.

THE eyelids when closed protect the eye from light and extraneous matter. The greater part of the eyeball is covered by the upper eyelid, which is by far the largest and most moveable of the two. The eyelids, by their constant motion in the act of winking, diffuse the fluids over the eyeball, which are poured out upon the inner surface of the conjunctiva, to moisten and lubricate it. By this motion, they also remove particles of dust or other extraneous matter which may have got upon the eye. The eyelids also modify the quantity of light admitted to the eye, by the degree to which they are separated from each other.

When the edges of the eyelids are closed together, they form two sides of a narrow triangular space or canal, of which the eyeball forms the posterior boundary. This canal serves to conduct the tears to the *puncta lacrymalia* during sleep. The eyelids, therefore, protect the eyeball, and maintain it in a proper state, for the exercise of its functions.

SECTION VII.

OF THE MUSCLES OF THE EYEBALL.

THE eyeball has six proper muscles for its motion; four of which are termed straight muscles, and two oblique.

1. *Of the Straight Muscles and their functions.* The straight muscles surround the eyeball, one of them being situated upon each of its sides; one at its upper, and another at its lower parts. These muscles have a tendinous origin at the posterior extremity of the orbit. Immediately becoming fleshy they proceed forwards at each side of the eyeball till they come into contact with the sclerotic coat. Here they again become tendinous and proceed along this coat to their insertion into it, at the distance of two or three lines before arriving at the margin of the cornea.*

The two of these muscles which are situated at the sides of the eye, by acting as antagonists to each other, move the anterior part of the eyeball laterally from side to side; hence, the one, which is

* See Plate II. Fig. 4. also Plate IV.

situated towards the internal angle of the eye and moves it inwards, is called the *adductor oculi;* the other, which is situated towards the external angle and moves it outwards, is called the *abductor oculi.* The two which are situated at its upper and lower parts, move the anterior part of the eyeball upwards and downwards. The former of these is therefore called the *Levator oculi,* the latter the *Depressor oculi.*

These muscles, from their insertion into the globe, move its anterior part in different directions by rotating the eye upon its axis, and thus they direct it to different objects.

The tendinous extremities of the recti muscles which are inserted into the sclerotic coat of the eyeball, are covered by an aponeurosis of condensed cellular tissue, having tendinous fibres stretching through it. This tendinous expansion proceeds forwards nearly to the cornea, and has been termed the *Tunica Albuginea.* Upon the anterior part of the eye, both the muscles and their aponeurosis are covered by the *tunica conjunctiva.*

The functions of the straight muscles of the eyeball are very important. The action of any one of them, moves the eye upon its axis in the direction of the fibres of the muscle. The action of two, moves the eye in the intermediate direction between them.

And by the combined action of the whole four, the eyeball is kept steadily fixed, and drawn somewhat backwards into the orbit.

2. *Of the Oblique Muscles.*—The other two muscles proper to the eyeball, which are called the *Oblique Muscles*, are also situated within the orbit; the one at its superior, the other at its inferior part; hence the one is called the *Superior Oblique* muscle, the other the *Inferior Oblique*.

The Superior Oblique muscle arises in common with the straight muscles, from the superior edge of the foramen opticum, between the levator and adductor oculi. It then passes forwards along the upper part of the orbit to the internal angular process of the frontal bone, where it becomes tendinous. Passing through a cartilaginous or ligamentous pully attached to the internal angular process of the frontal bone, where it forms the margin of the orbit, the tendon of the superior oblique muscle turns off at a right angle to be attached to the upper part of the eyeball. Its tendon being inserted into the sclerotic coat, behind the insertion of the levator oculi and nearer the temporal side, after passing under this muscle.*

Functions.—The action of this muscle is to roll

* See Plate II. Fig. 4. *i*.

the eyeball upon its axis by pulling the upper part of it towards the nose, and somewhat forwards.

The Inferior Oblique muscle arises from the anterior and lower part of the orbit, near the junction of the orbiter process of the superior maxillary with the lacrymal bone. This muscle then passes along the lower part of the orbit to the temporal and lower side of the eyeball, and is inserted into the sclerotic coat a little behind the insertion of the abductor muscle.

Functions.—This muscle acts as an antagonist to the superior oblique. It rolls the eyeball upon its axis by pulling its lower part inwards and downwards towards the nose. The combined action of the two oblique muscles, is to pull the eye towards the nose; and in drawing the eye forwards, is opposed to that of the recti muscles.

These oblique muscles seem to keep the eyeball steady by the combined action of both, along with that of the recti muscles. Their chief and proper function, according to Mr. C. Bell, is that of involuntary muscles.* He supposes that when the eyelids are closed in winking, the eyeball is insensibly rolled, by which the cornea is cleared of extraneous matter, and its lubrication renewed by

* See Essays on the Nervous System.

being brought into contact with the orifices of the lacrymal ducts. I do not conceive the proofs of this position to be satisfactory. Upon the whole, I am inclined to think, that they do not exert much influence in moving the eye; but, like the stays of the mast of a ship, they keep the eyeball steady after it has been adjusted by the straight muscles. In very few subjects have I ever seen any degree of the lateral rotatory motion, which has been considered the proper function of these muscles. I have observed it very distinctly in a child, who had an involuntary mobility of his eyes.

SECTION VIII.

OF THE LACRYMAL ORGANS.

THE lacrymal organs, or those parts destined for supplying a fluid to keep the anterior surface of the eyeball constantly moist, consist of the lacrymal gland,—the lacrymal canals, sac and duct,—and the lacrymal caruncle.

1. *Of the Lacrymal Gland.*—The lacrymal gland

is situated within the orbit, in the pit or depression formed in the temporal process of the frontal bone.* It belongs to the class of conglomerate glands. It consists of three lobes. The lowest of these is anterior; the greater, superior; and the lesser, posterior. These lobes are composed of small lobules, each of which sends from it an excretory duct. These ducts, by uniting, concentrate into six or seven larger ducts, which pass downwards and forwards to penetrate and open upon the conjunctiva, or mucous membrane lining the upper eyelid, at its temporal side.†

Function.—The function of this gland is to secrete that watery fluid called the tears, which is conveyed by its excretory ducts to the inside of the eyelids.

2. *Of the Lateral Lacrymal Canals, Lacrymal Sac, and Nasal Duct.*—Near to the nasal extremity of each eyelid, and upon the apex of the small eminence which is perceptible there, a small orifice can be perceived into which a small probe can be introduced. These two orifices are called the *puncta lacrymalia.*‡ They are the extremities of two small

* See Plate II. Fig. 2. *o*, and Fig. 3. *d.*

† See Plate II. Fig. 3. *h.* ‡ See Plate II. Figs. 2 and 3.

tubes, called the *lateral lacrymal canals*, which pass to the nasal extremity of the eyelids under the tendinous insertion of the orbicularis muscle. There, they either unite forming an orifice, or open severally by two distinct orifices into a pouch, which is called the *lacrymal sac*. Between these two tubes there is a small fleshy body at the internal angle of the eye, called the *lacrymal caruncle*, covered by a fold of the conjunctiva. Upon its surface, small hairs in some cases grow, and the orifices of excretory ducts, similar to those of the Meibomian glands, open. The lacrymal sac is lodged in the perpendicular groove of the lacrymal bone, and forms the upper part of a tube of about an inch in length, which passes down to the nose, called the *nasal duct*. The part of this tube which is called the lacrymal sac is that which is situated above the lower margin of the orbit, and is therefore only partially surrounded by bone. The nasal duct descends through the bony canal formed by the lacrymal, superior maxillary, and inferior turbinated bones. The lower extremity of the nasal duct opens into the nose, at the hollow formed by the inferior turbinated and superior maxillary bone. This orifice is opposed to the lower part of the inferior turbinated bone, so that a probe, to be introduced into this orifice, must be passed between these two bones.

The lacrymal canals, sac and duct, are lined by a continuation of the mucous membrane of the eyelids. A fold of this membrane forms a valve at the lower extremity of the nasal duct, which prevents fluid or air from passing upwards.

Functions.—The fluid from the lacrymal gland, which lubricates the anterior part of the eyeball, after being distributed over the eye, is collected at the nasal angle of the eye, and absorbed by the puncta lacrymalia into the lateral lacrymal canals. It is then conveyed by the lateral lacrymal canals into the lacrymal sac, and from thence into the nose by the nasal duct.

The fluid taken up by the puncta, is probably a mixture of four distinct excretions; consisting partly of the secretion from the Meibomian glands, partly of mucus from the surface of the conjunctiva, partly of aqueous humour exuded through the cornea of the eyeball, and partly of the tears. These secretions mix together and lubricate the anterior surface of the eyeball and inner surface of the eyelids, after which they are taken up by the puncta and conveyed into the nose.

3. *Of the Lacrymal Caruncle.*—The small projecting body situated at the internal canthus of the

eye, is called the lacrymal caruncle.* It is composed of a mass of small mucous follicles with their excretory ducts, covered by the conjunctiva. This membrane forms, on the outer side of this body, a semilunar fold which resembles the *membrana nictitans* of birds and other animals. A few fine hairs sometimes grow from the surface of the lacrymal caruncle.

SECTION IX.

OF THE BLOOD VESSELS AND NERVES OF THE EYE AND ITS APPENDAGES.

The arteries which supply the eyelids, are derived chiefly from three sources. The ophthalmic branch of the internal carotid—the facial, and the temporal arteries. These arteries innosculate freely with each other, and have corresponding veins accompanying them.

The arteries of the parts within the orbit, are derived almost entirely from the ophthalmic branch

* See Plate II. Fig. 2, *g*.

of the internal carotid artery which enters the orbit at the foramen lacerum anterius. The branch called the ophthalmic artery, after entering the orbit passes forwards and upwards to the supra orbitary foramen, where it makes its exit from the orbit to be ramified upon the forehead. In passing through the orbit, it sends off branches to the various different parts around it—to the muscles—lacrymal gland, and to the eyeball. Each of these are accompanied by corresponding veins.

The nerves of the orbit are numerous and considerable. The 2d, 3d, 4th, the 1st branch of 5th and 6th pairs of cerebral nerves pass into the orbit, to be distributed upon the eyeball and its appendages. Of these the 2d or optic nerves go entirely to form the retinæ or parts of the eye which are sensible to the impressions of light; * the 3d supply all the muscles of the eye except two, and a branch of this pair uniting with a branch of 5th, forms the ophthalmic ganglion which sends nerves to the eyeball; the 4th goes to supply the superior oblique muscle; the 1st of 5th, the lacrymal gland, superior eyelid, and ophthalmic ganglion; and the 6th supplies the abductor muscle.

* See Plate V.

SECTION X.

OF THE OPTIC NERVES AND THEIR ORIGIN.

CONSIDERING the eye as part only, though no doubt, an indispensable and highly important part, of the apparatus of vision, it is proper that we should trace back the optic nerve to its cerebral origin, or to that part which I have termed the cerebral part of the organ of vision.

A distinct connection between all the different parts which compose the brain can be traced, so that they may all be considered as parts of one complete organ. All we shall attempt at present, therefore, is to trace and describe that portion of the cerebral organ, which seems exclusively devoted to the function of vision.

In tracing the optic nerves backwards from the eyeballs, immediately after entering the cranium we find them united together, and occupying the indentation called the sella tursica of the sphenoid bone. This body, formed by their union, is called the commissure of the optic nerves, and from it these nerves may be said to commence or take their origin.*

* See Plate V.

Tracing further back we find this commissure formed by two white cords, one to each side, called the *tractus opticus.* These have their roots or origin from the *corpora geniculata* (externum and internum) the *corpora quadrigemina,* and the *thalami nervorum opticorum.*

The parts we have now described as the origins, or ultimate parts of the optic nerves, are to be considered as the cerebral part of the apparatus of vision. But from the nature of this function, and the connection that exists between these parts and the other parts of the brain, as well as the connection of vision with, and its dependence upon, the other functions of the brain, we are to consider the apparatus of vision not confined to these alone. We are to consider that the other organs and parts of the brain, connected with the functions of perception and reason, form also necessary and essential parts of the apparatus by which the faculty of sight is exerted.

The manner in which the nervous filaments are disposed or arranged in the optic commissure, has been hitherto a matter of uncertainty and dispute among anatomists. Some having conceived that a complete exchange takes place from the left to the right side; others, that a complete mixture and interlacing of the fibres existed; while it is contend-

ed by others, that a mutual exchange takes place; so that one half of the filaments of the tractus opticus of the right side, go to form the left optic nerve, by uniting with one half of the filaments of the left; the other half of the left passing in like manner to the right side, to form the right optic nerve. Thus, by a mutual exchange, the optic nerves are made up by one half of each of their filaments being derived from each side of the brain. So that it is further supposed, that the right side of the retina of each eye, is formed by nervous filaments derived from the tractus opticus of the right side; while the left side of each retina is derived from the tractus opticus on the left.

This exposition is both ingenious, and quite conformable to the functions of the retinæ and optic nerves; but from the nature of the parts, it can never be established with absolute certainty, as distinct fibres and filaments cannot be traced in them. It is also in favour of this supposition, that we can discover nothing in the structure and functions of these parts, either to confute it, or which may be said to be incompatible with it.

Function.—The optic nerves form the medium of communication between the brain and the eye.

CHAPTER II.

ANATOMY AND PHYSIOLOGY OF THE EYE-BALL OR GLOBE OF THE EYE.

SECTION I.

GENERAL REMARKS ON THE STRUCTURE OF THE EYEBALL.

THE eyeball, when denuded of its muscles and those partial coverings derived from the conjunctiva and eyelids, is nearly of a globular form; but it is evidently formed by two unequal segments of different spheres.*

This spherical body, or eyeball, is composed of coats which surround and protect the internal parts of the organ. The external coat, which forms the segment of the larger of these spheres, is opaque, of a whitish colour, and is called the *sclerotic coat.* This forms the posterior part of the eyeball. The

* See Plate III. Fig. 1.

portion of the smaller sphere, which forms the anterior part of the eyeball, is transparent, and is called the *cornea.* These two coats being firmly united to each other, form a complete and firm incasement for the other more delicate parts which are contained within them. The other more internal tunics are of much more delicate structure than those external coats; and are adapted for other purposes rather than the protection of the eye.

All the coats and other parts of the eye, are adapted for the proper development and protection of the sentient part of the organ, the expansion of the optic nerve, called the *retina.* They are transparent on one side of the eye to admit the light, the necessary stimulus of vision, to enter and proceed to the retina. The coats also contain the transparent humours of the eye, and other parts which effect a proper modification of the light in its transmission to the retina. By the firmness of their texture and their construction, the tunics also maintain the proper form of the eyeball.

None of those parts of the eye, commonly called its coats, completely surround the eyeball; while they each contribute a partial covering to it. Thus, the conjunctiva, cornea, sclerotica, choroidea, iris, and hyaloid membrane, when conjoined, combine completely to surround, nourish, and preserve

the retina and humours of the eye. A description of each of these parts which form its coverings will therefore now be given, before describing the retina and humours of the eye.

SECTION II.

OF THE COATS OF THE EYE.

1. *Of the Cornea.*—The cornea or portion of the smaller or anterior sphere, consists of a circular segment, which forms the anterior tunic or boundary of the eyeball.* The cornea is convex anteriorly—concave posteriorly—tough—somewhat elastic, but firm and unyielding, transparent, and intimately connected to the sclerotic coat at its circumference, into which it is inserted like the glass of a watch. It forms the anterior boundary of the cavity or chamber of the aqueous humour, so that this humour is in immediate contact with its posterior surface.

The cornea is considered by most anatomists, to

* See Plate III. Figs. 1, 2, and 3.

be composed of three distinct layers. These are intimately connected and condensed together, by which sufficient strength is combined with transparency. This intimate connection between these layers, causes them to be with difficulty separated from each other.

The anterior layer of the cornea is a continuation of the *tunica conjunctiva*, which covers the anterior part of the eyeball. The part of this membrane which covers the cornea becomes thinner, more condensed and transparent than the sclerotic conjunctiva; and in place of being loosely attached, the corneal conjunctiva becomes firmly and intimately connected with the subjacent texture. The continuation of the conjunctiva over the cornea cannot, in a satisfactory manner, be demonstrated in the recent eye; but by maceration, and in many cases of disease,* this may be effected. In the eyes of many of the lower animals, however, the corneal conjunctiva is so loosely attached to the parts beneath, that it can be easily separated and raised along with the sclerotic conjunctiva.

The *cornea propria*, which is the second or middle layer of the cornea, appears to be a texture *sui*

* The diseased states of the conjunctiva of the cornea, by which this is demonstrated are inflammation, abscess, ulcer, opacity, pterygium, pustules, and fleshy growths.

generis. It is capable of being subdivided into several layers. And when affected with disease it exhibits appearances, different from those of its investing tunics.

The interior layer of the cornea, which lines the anterior part of the cavity occupied by the aqueous humour, is conceived to consist of a serous membrane. In the healthy state it is not capable of very distinct demonstration, but its existence may be inferred from the secretion of the aqueous humour and from disease. Hence it is called the *capsule,* or *membrane of the aqueous humour.**

In the eye of the whale, the three parts of which the cornea is composed, can be easily separated from each other.

These three different parts of which the cornea is composed, are supplied by distinct sets of blood vessels, which may be seen when the individual parts are in an inflamed state. From the phenomena then observed, the vessels of the external or conjunctival layer of the cornea, are continuous with the vessels of the sclerotic conjunctiva. Those supplying the middle layer run forward upon the sclerotic coat, so that the conjunctiva can be detached without raising them from their subjacent

* See Diseases of this Membrane.

attachment. While the vessels of the internal layer or membrane of the aqueous humour, are derived chiefly from the ciliary circle.*

The cornea by age undergoes several changes. As individuals advance in life, the texture of the cornea becomes more dense and tough than previously, so that it is with more difficulty cut with a knife. In elderly persons the form of the cornea gradually becomes less convex, by which most people become long-sighted, and require the use of convex glasses to obviate the change. In some persons the form of the cornea is too convex, so that such individuals are short-sighted, and require the use of concave glasses to obviate their defect.

In old age, and sometimes at an earlier period of life, a portion at the margin of the cornea becomes opaque; and this opacity is known by the name of the *arcus senilis*.†

Functions.—The cornea forms a very important part of the exterior coat of the eyeball. By its structure it serves both to contain the humours and to maintain the spherical form of the eyeball. By its transparency the light is admitted into the interior of the eye; and by its exterior convexity

* See Inflammations of the different layers of the Cornea, and of the Iris.

† See Plate XII. Fig. 10.

the rays of light are refracted and concentrated to a focus. In its healthy state, the cornea is almost insensible, but when it is inflamed or ulcerated it becomes highly sensible. When cut or wounded, the cornea heals readily. The retina seems to have a remarkable sympathy with it; for, when the cornea is inflamed the intolerance of light is always considerable, and sometimes takes place to a very extraordinary degree.

2. *Of the Sclerotica.*—The sclerotic forms the outer coat of the posterior segment of the eye-ball.* This is by far the thickest and firmest coat of the eye. It is of a firm fibrous texture—somewhat elastic—unyielding—of a whitish colour, and seems well fitted for containing the other parts of the eye, and for maintaining its spherical form. This coat is but sparingly supplied by blood vessels and nerves; but those, which proceed to the internal parts of the eye, pass through it. The sclerotica does not form a complete sphere. It has an aperture anteriorly, which is occupied by the transparent cornea; and one of a smaller size posteriorly, through which the optic nerve passes to the interior of the eye. This

* See Plate III. Fig. 1.

coat is thickest at its posterior part, and becomes gradually thinner anteriorly. Into this coat the muscles of the eyeball are inserted at a small distance from the cornea. It is covered anteriorly by the tunica conjunctiva, which is reflected upon it from the eyelids.

Functions.—The sclerotic coat surrounds nearly the whole of the eye, the remainder being occupied by the cornea. By the firmness and unyielding nature of these coats, they are well adapted for containing the other parts of the eye, as well as for maintaining its spherical form. This form of the eye being preserved, by the distension caused by the humours on the one hand, and the unyielding nature of these coats on the other.

3. *Of the Choroidea.*—The choroid coat lines the inner surface of the sclerotica.* It is attached to the sclerotic coat by fine delicate cellular tissue, and by the blood vessels and nerves which pass to it through the sclerotica. The choroid coat is thin and delicate, and is composed of two parts; the one, a thin highly vascular membrane; the other a fine cellular tissue, filled with black pigmentous matter, called the pigmentum nigrum.

* See Plate III. Figs. 1, 2 and 4.

This pigmentous tissue covers both sides of the vascular membrane forming the choroid coat; but it is most dense upon its internal surface. By maceration in water the choroid coat may be freed from this black matter and rendered transparent. Proceeding anteriorly, this coat terminates at a short distance before arriving at the anterior extremity of the sclerotica; it there becomes thicker, of a firmer texture, and of a white colour, forming what has been termed the ciliary ligament. This ligament is very distinctly seen in Figure 2d, *g*. of Plate III.

The chief part of the choroid coat is very vascular; when successfully injected it becomes almost completely coloured by the injection. The arteries run in a straight direction to the ciliary circle. The veins present an arborescent appearance. The ciliary nerves, 7 or 8 in number, which penetrate the sclerotic coat, proceed along between it and the choroid coat to the ciliary ligament, iris, and ciliary processes. See Fig. 2d, *i*.

Functions.—Almost the whole blood for the nourishment and reproduction of the different internal parts of the eye, is transmitted through the choroid coat. The black pigmentous matter with which it is covered, absorbs the light which passes into the eye after traversing the retina.

4. *Of the Ciliary Ligament.*—The ciliary ligament is a whitish body within the sclerotica, of a firm fibrous texture, which surrounds the anterior extremity of the choroid coat.* To this ligament all the different parts of the eye are attached, except the retina and the crystalline lens. The cornea at its line of junction with the sclerotica, the choroidea, iris, and ciliary processes, are each firmly connected with it. The ciliary ligament, therefore, forms a sort of connecting medium between these parts. The blood, too, which nourishes the iris, humours, and other internal parts of the eye, is sent first to the ciliary ligament and processes.†

The ciliary ligament has the sclerotic coat upon its exterior surface. On the interior surface it is covered by the ciliary plicæ or processes. To its anterior margin the iris is attached; to its posterior margin the choroid coat is connected.

Functions. The ciliary ligament forms a medium of attachment between all the other parts of the eye. The cornea, sclerotica, choroidea, iris, ciliary processes and membranes of the humours, are all attached to the ciliary ligament.

5. *Of the Ciliary Processes.*—The ciliary processes consist of folds or plicæ, about 60 or 70 in number, which line the posterior surface of the

* See Plate III. Figs. 1, 2, 3. † See Blood vessels of Eyeball.

ciliary ligament, having a radiated arrangement towards the iris.* They are firmly attached to the ciliary ligament. Their anterior extremities project upon the anterior part of the vitreous humour, into the posterior chamber of the aqueous humour, and surround the posterior part of the ciliary margin of the iris. They are covered internally with the same pigmentous membrane which lines the inner surface of the iris and choroid coat; here it is called the *ciliary body*. This inner covering or ciliary body is in immediate contact with the investing membrane of the vitreous humour. The membrane of the vitreous humour at this part has indentations and eminences which correspond to the ciliary processes and depressions between them. This indented portion of the vitreous tunic surrounding the lens, is called the *zonula ciliaris* or zone of Zinn. The zonula ciliaris is capable of being raised by inflation, forming a circular cavity around the lens, called the canal of Petit.

The ciliary processes are so extremely vascular, as to be coloured by a successful injection. In the Albino, the pigment upon the choroidea, ciliary processes, and iris, is wanting.

The whole of the arteries of the choroid coat are ramified upon the ciliary processes and ligament, and are called the internal ciliary arteries. They

* See Plate III. Figs. 1, 3 and 4.

innosculate with the external ciliary arteries, and supply the internal parts of the eye with blood.

In birds, fishes, and many of the lower animals, the ciliary processes are wanting.

Function.—The ciliary processes seem only to be useful, in subdividing the blood vessels which supply the transparent parts of the eye.

6. *Of the Iris.*—The iris is a thin circular body, stretching across the anterior part of the eye, immediately within the cornea, so as to form a sort of imperfect partition between the two spherical segments of which the eyeball is composed.* It forms an imperfect partition, because there is a circular aperture nearly in the centre of the iris called the *pupil.* This opening is a little inclined to the nasal side of the iris. The iris, therefore, has two margins; the one its exterior and greater margin, by which it is attached to the ciliary ligament; the other, its lesser or central margin, by which the pupil is formed. The first of these, therefore, is called the ciliary margin of the iris, the other its pupillary margin. The iris is easily torn from its ciliary attachment; and when so torn, it has a denticulated margin.

The iris is the body which possesses the peculiar colour manifest in eyes of different individuals. It is evidently muscular from its functions. Its struc-

* See Plate III. Figs. 1, 2, 3, and 4.

ture also has a fibrous appearance. In many individuals these fibres are more distinct than in others. Some of them seem to surround the pupil like a sphincter; others seem to radiate from the ciliary to the pupillary margin of the iris. Like the choroid coat, the inner surface of the iris is lined by cellular tissue containing black pigment, called the *uvea*. When this is completely separated, the iris resembles a thin transparent membrane in appearance. The black pigment on the posterior surface of the iris, prevents the inconvenience to vision, that would have arisen from its transparency. In the living body the anterior surface of the iris has a blue, green, yellow, or brown colour. But this colour cannot depend on the pigment upon its posterior surface; for, whatever colour the iris may appear to have externally in different subjects, the uvea is always of the same dark brown colour in every individual.

The ciliary margin of the iris is serrated; and it is attached, by its dentations corresponding with the indentations of the margin of the ciliary ligament.

The iris is copiously supplied with blood vessels and nerves. Its arteries are derived from the ciliary ligament; they form two circles upon the iris, a larger and a smaller circle, having numerous communicating branches from the one to the other.

The ciliary nerves can be traced into the iris. This is very distinctly seen in the eye of the whale.

Some anatomists have thought the iris to be covered by a serous membrane, reflected from the inner surface of the cornea and capsule of the lens. The existence of such a covering, though probable, is still a matter of uncertainty. In the fœtus the pupil is occupied by a thin vascular membrane, which disappears at the period of birth.

Functions. The function of the iris, is that of a moveable curtain in front of the eye, to regulate the volume of light admitted into it. This is effected by the involuntary contraction and dilation of its central aperture, the pupil.

The pupil varies in size according to the degree of light to which the eye is exposed. It contracts when the eye is exposed to a strong light, and dilates when the light is more obscure. It therefore acts in sympathy with the retina.*

From the motions of the iris and our knowledge of muscular action, as well as from its structure, we are warranted to conclude that it is a muscular body.

The pupil can be dilated by the application of Belladonna and other narcotics to the eye. When

* See Functions of the Retina, and Adaptation of the eye to different distances.

any of the nerves of the iris are paralized, its form is irregular, from its unequal dilatation.

7. *Of the Retina, Optic Nerve, and its origin.*— The optic nerve contained within its proper sheath proceeds to the posterior part of the eyeball, where it passes through the sclerotic and choroid coats somewhat towards the nasal side of the eye.* The optic nerve then expands upon the inner surface of the choroid coat, into a thin delicate body called the retina. The retina forms what has been termed the third coat of the eye. It is composed of two parts or layers, the one, which is outermost and next to the choroid coat, is thin, transparent, and membranous, the other is more opaque, pulpy, or medullary. The retina, in the living body, and in the eye of an animal quite recently killed, is transparent. By death and exposure, however, it soon becomes opaque. In the recent eye, there is an extremely delicate membrane, covering the exterior surface of the retina, called the membrane of Jacob.† The retina is so loosely connected with the choroid coat that, when the vitreous body is removed, it se-

* See Plate II. Fig. 4., Plate III. Figs. 1 and 5., and Plate V.

† This membrane was first described by a very accurate observer, Mr. Jacob of Dublin. See Medico-Chirur. Trans. of Lond. vol. xii.

parates and collapses. The retina terminates anteriorly at the ciliary processes. The globe or cavity formed by the retina, is completely filled by the vitreous humour; so that the retina may be said to be expanded upon the surface of this body. In the direct axis of the eye, there is a small aperture in the retina, called the central hole or foramen of Soemmerring. This consists of a small round hole at the posterior part of the retina, exactly in the axis of the eye. In the recent eye it is surrounded by a yellow line or disk. When preserved in spirits, a fold of the retina forms at the place, and the yellow spot disappears. Mr. Jacob, of Dublin, is of opinion that there is no foramen at this part of the retina, but that the medullary matter is wanting.*

Where the optic nerve expands to form the retina, the central artery contained within it, divides into two or three large branches, which ramify upon the retina in all directions.

The Optic nerve and its origin, or cerebral part of the visual apparatus, have been already described. See page 39.

Functions.—The retina is the sentient part of the eye,—the ramification of the brain, adapted to receive

* See Medico-Chir. Trans. vol. xii.

those impressions from external objects which produce vision. See Physiology of the Eyeball.

To produce distinct vision, light must fall upon the retina with a certain degree of intensity, neither too weak nor too strong.

The retina is only capable of a certain degree of exertion. It can bear exertion with a medium degree of light for a considerable time; but with a very weak or strong light only for a very short period.

When the retina is fatigued by strong light or intense application, vision becomes indistinct,—the sight becomes dazzled, and a painful feeling is perceptible in the orbit and head.

The retina may be only partially fatigued, as at the place upon which a luminous impression has been continued. The individual will then see a dark spot for a time, at the part which is insensible. By repose, the retina soon returns to its former state.

The retina may also be rendered insensible, only to particular parts of the rays of light. Thus, when the retina has been fatigued by being directed to a red object, upon turning to any thing white, green spots appear upon it. Now we know that when the red part of a ray of light is abstracted, there remains what forms green. In this case, therefore, the retina has only been rendered insensible to the red parts of the luminous rays.

The central part of the retina is the most sensible, probably from being most exerted. That portion at the entrance of the optic nerve is insensible to light. According to Majendie the retina is quite insensible to all other impressions but that of light. This physiologist is also of opinion, that the sensibility of the retina is entirely under the influence of the 5th pair of nerves. This is extremely questionable. For, the experiments regarding it are by no means conclusive, and we cannot trace distinctly any nervous connection between the 2d and 5th nerves. That there is a great sympathy between the functions of these nerves there can be no doubt, as the involuntary contraction of the pupil, closing of the eyelids, and increased flow of tears, upon the sudden application of strong light to the retina, show. But in the present state of our knowledge, I am inclined to think that this takes place through the medium of the brain.

Several Anatomists, as well as myself, have observed nervous filaments, issuing from the ophthalmic ganglion and becoming lost upon the sheath of the optic nerve.* But it is impossible to say decidedly, whether these terminate upon this sheath, or pass through it into the substance of the nerve.

* I have preserved several preparations showing this.

When slit up, the sheath is evidently attached to the optic nerve, by small filaments passing from the one to the other; but whether or not these are the filaments of the nerve from the ophthalmic ganglion, it is impossible to determine.

A direct connection between the ophthalmic ganglion and the optic nerve, would enable us to explain some of the phenomena of the sympathy between the iris and retina, which can otherwise be explained only by their connection through the medium of the *brain.*

It is the opinion of Mr. Travers, that the ophthalmic ganglion is the direct medium of communication between the ciliary nerves and the retina, though he does not say how.*

The field of vision extends over the whole retina, with the exception of the part where the optic nerve enters the coats of the eye. But the particular part and the extent of it that is called into action, is regulated and modified by the direction of the luminous rays, and by the pupil.

The impression made upon the retina by light, is retained for some time after its application has ceased. This is shown by the luminous circle formed by the rapid revolution of an ignited body. The

* See Synopsis, p. 77.

duration of the impression is in proportion to the strength of the impression and the length of its duration.

The light which enters the eye after traversing through the retina, is absorbed by the pigmentum nigrum of the choroid coat.

SECTION III.

OF THE HUMOURS OF THE EYE AND THEIR INVESTING MEMBRANES.

THE humours of the eye are, the transparent bodies which fill its interior. They consist of the aqueous, crystalline, and vitreous humours.

1. *Of the Crystalline Lens and its Capsule.*—The lens is a double convex circular transparent body, situated immediately behind the iris, having only a small space filled with aqueous humour interposed.* From its transparency, the pupil appears, in the living eye, to be a black spot. But when the lens is

* See Plate III. Figs. 1, 3 and 6.

opaque, it is distinctly seen behind the pupil. The lens is solid, soft, of a firm gelatinous consistence, softer in youth, and becoming firmer and harder as age advances. In infancy and childhood the lens is nearly globular, but as age advances it becomes more and more flattened. In youth it is quite transparent, in old age it becomes of a yellow amber colour. By boiling it is coagulated, showing that it consists of albumen. It is then capable of being separated into concentric layers.

The lens is contained in a capsule or proper investing tunic. The posterior half of the capsule of the lens is intimately connected to the capsule, or investing tunic of the vitreous humour. Into this humour, therefore, one half of the lens seems imbeded. The anterior half of the capsule of the lens forms the posterior boundary of the aqueous humour, and is thought to consist of two parts or layers; one the proper capsule of the lens, the other the capsule or membrane of the aqueous humour.

The margin of the lens is not in contact with the anterior extremities of the ciliary processes. A portion of the vitreous humour occupies a small space between the lens and these processes, which may be called the *zonula lucida;* for, in cases where the lens is opaque, the light is admitted into the eye through this ring. Upon the membrane covering this por-

tion of vitreous humour, the vessels for the nourishment of the lens radiate from the ciliary processes to the margin of its capsule.*

The lens occupies a part of the eye between the vitreous and aqueous humours. The space between the lens and cornea, is occupied by the aqueous humour; that between the lens and retina, by the vitreous humour.

2. *Of the Aqueous Humour.*—The aqueous humour occupies the anterior part of the eyeball, and distends the cornea. The space occupied by this fluid, is divided into two compartments by the iris, called the anterior and posterior chambers of the aqueous humour. These communicate with each other by the pupillary aperture.

The quantity of aqueous humour in each eye, weighs from 5 to 6 grains. It consists chiefly of water, with a very small portion of albumen, gelatin, and muriate of soda, dissolved in it. This humour is contained in a proper serous membrane by which it is secreted and absorbed.

* See Edinburgh Medical and Surgical Journal, vol. xxvi. I am glad to find that this space which I have so particularly described is alluded to by several distinguished authors. See Buchorn's Observations on Cataract; Travers Med. Chir. Trans. vol. iv. p. 286; Guthrie's Operative Surgery of the Eye, p. 209; Cloquet's Anatomy, sect. 1911; Majendie, Trans. of Physiology, p. 538.

The investing membrane of the aqueous humour lines the inner surface of the cornea, and covers both the iris, and anterior part of the capsule of the lens. Its existence cannot be satisfactorily demonstrated by dissection, but may reasonably be inferred from analogy and from disease.*

The aqueous humour is constantly undergoing change by absorption and reproduction. When evacuated by a puncture, it is restored in a few hours. It exudes through the cornea and contributes to moisten its external surface. Before death the cornea collapses from this exudation continuing after the faculty of reproduction has ceased.

The aqueous humour has the power of dissolving the crystalline lens, when it is either fluid or broken to pieces and exposed to its action. It also dissolves blood and lymph when effused into it. These are absorbed along with the aqueous humour, and so removed from the eye.

The aqueous humour besides distending the cornea and refracting the light, is useful in permitting the free motion of the iris.

3. *Of the Vitreous Humour.*—This humour is equally fluid with the aqueous; but it is so con-

* See Diseases of this Membrane.

fined in a thin transparent cellular capsule, that it appears to have a gelatinous consistence. These cells communicate with each other. They may be inflated by blowing air into them, which displaces their contained fluid. When any of the cells are ruptured, the vitreous body gradually collapses; the fluid by degrees runs out, and leaves the investing tunic, which may then be inflated. This tunic is called the *hyaloid membrane of the vitreous humour.*

The anterior part of the vitreous humour is occupied by the crystalline lens, for the reception of which, it forms a sort of cup. This excavation is lined by the posterior part of the capsule of the lens, intimately united to the hyaloid membrane of the vitreous humour. That part of its tunic or hyaloid membrane which surrounds the margin of the lens, and to which the ciliary processes are attached, is called the ciliary zone, or zone of Zinn.* This zone consists of small foldings or plicæ corresponding in length to the ciliary processes. This part of the vitreous capsule, is capable of being inflated and raised from the parts beneath, like a circular canal around the lens, called the canal of Petit. At the ciliary zone the retina terminates.

* See Plate III. Fig. 6.

A narrow portion of the vitreous humour, projects forward around the lens, forming the margin of the cup which contains it. This portion of vitreous humour occupies the space between the anterior extremities of the ciliary processes, and the capsule of the lens; and upon it, the vessels proceed in a radiating manner to the lens.*

In the fœtus an artery proceeds from the posterior part of the vitreous body, through the centre of it to the lens. This vessel disappears after birth.

The vitreous body is firmly attached anteriorly to the ciliary processes and capsule of the lens. From the vessels of the ciliary processes it probably derives its nourishment.

Functions of the Humours.—The humours of the eye keep the globe distended, by which its spherical form is preserved. By the retina being expanded on the surface of the vitreous humour, it is placed in the most favourable circumstances for receiving impressions of light from external objects. The humours not only offer no obstacle to the admission of light from their transparency, but by their form and density, they perform an important office in refracting the light admitted into the eye. See physiology of the eyeball.

* See Plate III. Fig. 3.

SECTION IV.

OF THE BLOOD VESSELS AND NERVES OF THE EYE-BALL.*

THE eyeball is supplied with blood chiefly by the ophthalmic artery, a branch of the internal carotid. Several branches from the ophthalmic artery of a considerable size, enter the posterior part of the sclerotic coat. These subdivide and proceed along the choroid coat to the ciliary circle, forming the posterior ciliary arteries. A few smaller branches of the ophthalmic artery proceed forwards and enter the globe near the cornea. These are called the anterior ciliary arteries; they supply the cornea; they inosculate freely with the arteries of the ciliary ligament; and can be seen through the conjunctiva, when the cornea or iris is inflamed. The artery of the retina passes along the centre of the optic nerve.

That the lens and other transparent parts of the eye, are supplied and nourished by vessels carrying the colourless part of the blood, there can be no doubt.† Before arriving at these transparent parts,

* The blood vessels of the external parts of the eye, have been already described. See page 37.

† This I have shown in the paper before referred to in the Edinburgh Medical and Surgical Journal. That Essay has since been

the vessels are very much subdivided, particularly upon the choroid coat and ciliary processes.

The vessels, which I have pointed out, as proceeding from the ciliary processes to the capsule of the lens, may be injected with colouring matter in the eye of the bullock.

That vascular connexions really exist between the lens and its capsule, though they could not be seen, might reasonably be inferred from the consideration of several facts. 1st, That no part of the animal frame is nourished in any other way, than by vascular connexions. 2dly, The regular form and beautiful organization of the lens in concentric layers. 3dly, The death of the lens when sufficiently moved within its capsule to tear it from its supposed vascular connexions. 4thly, When the lens is wounded, opacity is caused probably by the enlargement of its vessels, for adhesive matter is poured out, in the same manner, as when other parts of the body are wounded and inflamed.

That the vessels of the lens are extremely minute, is *a priori* to be expected, on account of the state of extreme subdivision in which its arteries must be. The arteries entering the globe of the eye are much subdivided upon the choroid coat—

translated into several of the foreign Journals, and also reprinted in that at Philadelphia.

very much subdivided on the ciliary processes—still further subdivided on the capsule of the lens; so that when they arrive at the lens itself, they must be in a state of extreme tenuity.

The crystalline lens of the eye is not an uniform mass of unorganized matter, like the contents of a morbid cyst. It is a transparent body, of nearly the same shape and size in all the individuals of the same species; organized in distinct and uniform strata; is always of greater density at its centre than at its circumference; and is subject to the same changes that occur in other organized parts, inflammation, and loss of vitality. How then can this be a part nourishing itself by imbibition?

Veins corresponding to the arteries may be traced.

The nerves of the eyeball are, the optic and the ciliary nerves.* The optic, passes directly from the brain to the posterior part of the sclerotic coat, where it enters the globe to be expanded on the inner surface of the choroid coat. The ciliary nerves take their origin from the ophthalmic ganglion, which is formed by branches of the 3d and 5th pairs of cerebral nerves. They enter the posterior part of sclerotic coat, and proceed forwards between it and the choroid to the ciliary circle to supply the iris and other parts.

* See Plate V.

CHAPTER III.

OF THE PHYSIOLOGY OF THE EYE.

SECTION I.

OF VISION.

HAVING now described the structure and functions of each of the different parts which compose the apparatus of vision, separately, I shall now, as shortly as possible, give a general account of Vision, or that faculty which is exerted by the combined functions of all these parts.

The impressions by which sensations are produced, are received by the extremities of certain nerves in the organs of the senses.

The nerves of the senses are to be considered as ramifications from the brain; each of these nerves being respectively distributed upon its own organ, in such a manner as fits it for receiving the peculiar impressions, which it is intended to convey to the sensorium.

Like the organs of the other senses, the eye serves only to protect and adapt the nerve of sight for receiving its peculiar impressions. For this purpose, the optic nerve is expanded upon the internal surface of a globe, which contains only transparent bodies between the expanded nerve of sight and external objects ; so that it is exposed to the immediate influence of light, its proper stimulus. The parts surrounding the eyeball, called its appendages, which convey to it its nourishment, and serve to protect, move, and lubricate it, are not further necessary to vision, than in moving this organ and preserving it in a fit condition for exerting its functions.

The eye, physiologically considered, consists, *first* of a series of refracting media, by which the rays of light that enter it, are disposed in a certain order. *Second*, of an expansion of the optic nerve so placed as to receive the impressions of light in the most favourable manner for vision. *Third*, of parts which provide for the equable introduction of light into the eye, and for its absorption after it has traversed the retina ; and, *fourthly*, of a spherical incasement, in which the preceding parts are preserved.

It has been shown, that the spherical body or globe, called the eyeball, contains, nourishes and preserves the sentient part or expansion of the optic nerve. This nerve is extended or expanded upon

certain transparent parts called humours, occupying the concave or internal surface of the coats, by which it is most favourably adapted for receiving the impressions of light. The coats of the eye are also admirably constructed, not only for protecting the optic nerve, but also for regulating the proper quantity of light admitted into the eye. The transparent parts, at the same time, concentrate the light into a proper focus in its passage to the retina; this being necessary for producing distinct vision.

Vision, or the sense of sight is the faculty by which we observe and distinguish external objects. This faculty is produced or excited by certain impressions from external objects being received by the eye and conveyed by the optic nerve to the sensorium. It therefore requires the combined functions of all these parts for its exertion.

As it is therefore a sensation produced by a certain stimulus acting upon the eye, the impressions of which are conveyed to the sensorium, vision is properly a function of the brain; and considered as a mental function, we cannot explain how this faculty is ultimately produced, any more than other mental phenomena. But the impressions which excite this function are obtained through the medium of the eye. Of what these impressions consist, and the manner in which they are made upon

the retina, we shall now endeavour to explain. These are cognisable to our senses, and can be explained upon physiological and physical principles, connected with observations upon their phenomena.

Light is the agent or stimulus by which sight is produced. The eye is the proper organ of light—sensibility to light being its own peculiar province; just as the ear is the organ of sound, and the nose of odours.

The impressions made upon the eye by which vision is produced, are occasioned by light emitted or reflected from external objects, entering the eyeball and falling upon the retina, after being modified in its passage through the pupil and humours of the eye. A certain degree of light is absolutely necessary therefore to distinct vision; or light may be said to be the substance—the stimulus—or exciting cause by which sight is produced. Hence, light is the quality which produces vision; the eye, the optic nerve and the brain, are the organs or the apparatus by which this function is exerted.

From what has now been said, it will be obvious that the production of perfect vision depends upon the concurrence of three conditions; first, the emanation of light from the object viewed, and its impingement upon the retina; second, the perfect state of the eye and other parts accessary to vision;

and, third, a certain mental effort which is required for the perception of the object.

As vision, therefore, is only excited by the action of light upon the retina, it will be necessary, before proceeding further, to make a few remarks in explanation of the nature and properties of light; confining these observations, simply to a statement of the facts regarding light, which are connected with the physiology of the eye, and necessary to its being understood.

SECTION II.

OF THE NATURE AND PROPERTIES OF LIGHT.

Regarding the nature of light, different opinions have been entertained by philosophers; and its true cause and nature, may still be considered uncertain. It possesses, however, certain general properties which have been established by experiment and observation. These are the following.

1. Light is sent forth in all directions from every visible point of luminous bodies—such as the sun or bodies in a state of ignition or phosphorescence.

2. All bodies, whether natural or artificial, which are not luminous of themselves, are rendered visible by light which originally comes from a body luminous of itself, such as the sun, or common artificial lights.

3. All visible bodies, whether natural or artificial, throw off light in all directions of the same colour as themselves, although the light from the sun which falls upon them and renders them visible, is white. This is called *reflection* of light.

4. Light consists of separate parts or atoms independent of each other.

5. The separate parts or atoms of light move in straight lines; the smallest of these lines is called a ray of light. These lines or rays of light, when transmitted from one object to another, can cross without interrupting each other, in their course. In their progress, they expand, or diverge from each other.

6. Rays of light can be stopt in their course by the interposition of opaque bodies. And their course can be altered, by the interposition of certain transparent bodies. By opaque bodies, it is either absorbed or reflected.

7. When light moves through transparent bodies such as the air, water, glass, and the like; these are called, the media through which it passes.

8. Light is not a simple substance. It can be

decomposed into three distinct parts or rays of different colours, red, blue and yellow. These are called primitive colours, which, when combined, form white. Besides those enumerated, some have added violet, indigo, green, and orange, as primary colours composing light. But these are mixed colours, each being composed of some two of the three above mentioned.

9. Light moves with prodigious velocity, travelling at the rate of 195,000 miles in a second of time.

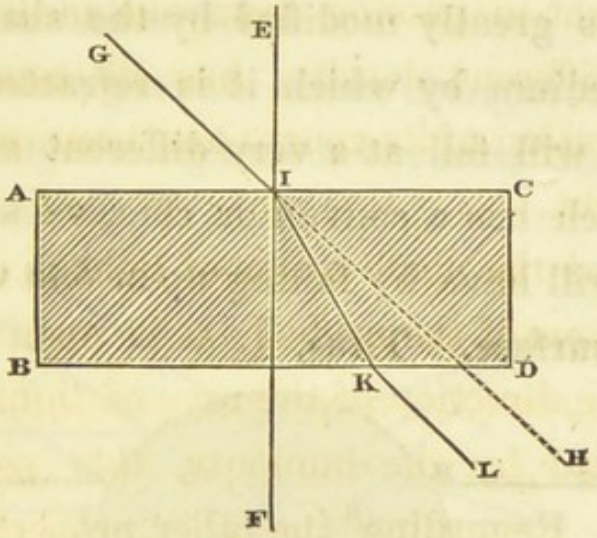
10. Light in passing from one medium to another of different density, has its course altered. This alteration of its course has been called *refraction* of light.

So far as the modification of light is concerned in the functions of the eyeball, it is upon this alteration in the direction of the rays of light, or *refraction*, caused by the humours, that perfect vision depends. Regarding the other properties of light therefore, (viz. its decomposition, reflection, &c.) it will be necessary here, to make only a very few remarks.

1. *Of Refraction of Light.*

1. When a ray of light moves uninterruptedly through the same medium, its course is that of a straight line. But if its course is interrupted by

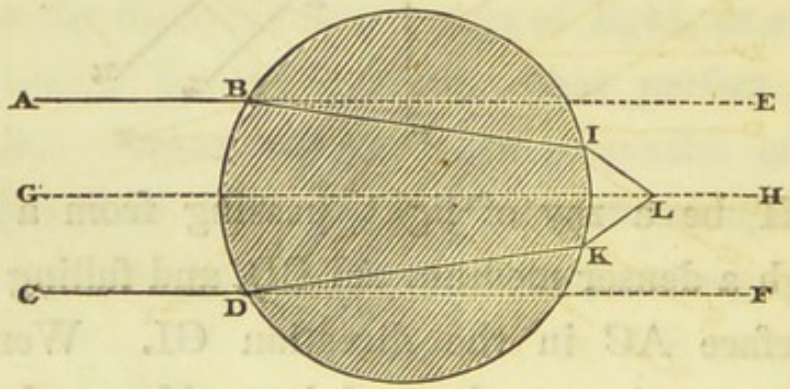
the interposition of a transparent medium of a different density, the direction of its course becomes altered. The change of course which takes place, has a uniform and fixed law. When light passes from a rarer into a denser medium, its course is altered nearer to the perpendicular, drawn through the surface of the denser medium at the point where the ray of light enters it. And the degree of refraction depends on the density of the medium upon which the ray of light falls. Thus,



let GH be a ray of light passing from a rarer through a denser medium ABCD, and falling upon its surface AC in the direction GI. Were its course to continue unchanged, it would pass through in the direction GIH. But in passing through the denser medium, its course is altered from the direction IH to that of IK, being refracted towards the perpendicular EF to the surface AC. Upon its exit

from the denser into a rarer medium, its course is again changed in the contrary direction. It is therefore refracted from the perpendicular, in the direction KL, parallel to GI, AC being parallel to BD. Hence, when light passes in its course from a rarer through a denser medium it is refracted *toward* the perpendicular; and when it passes from a denser into a rarer medium, it is refracted *from* the perpendicular.

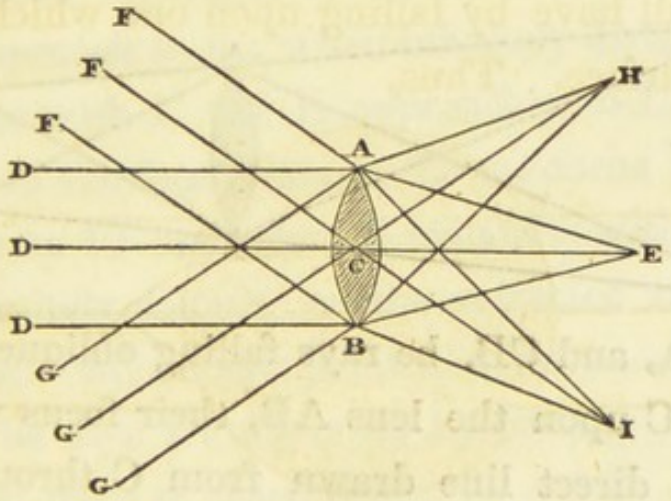
2. It is important to observe, that the refraction of light is greatly modified by the shape or form of the medium by which it is refracted. For the same ray will fall at a very different angle upon a body which has a convex or concave surface from what it will have by falling upon one which has a straight surface. Thus,



let AB and CD be parallel rays falling upon a globular body DBIK. In passing through it, instead of their course being continued in a straight direction to E and F, these rays are refracted towards the perpendiculars to the tangents to the sphe-

rical surface drawn upon the points B and D. The rays AB and CD will therefore be refracted in the direction BI and DK. When these rays pass from the denser medium into one more rare, their course is again refracted from the perpendiculars drawn upon I and K. Their course will then be directed to the point L where they meet, and form a focus. The point L is therefore called the focal point. Hence, convex bodies have the effect of concentrating rays of light, which pass from a rarer medium through them, into a focus.

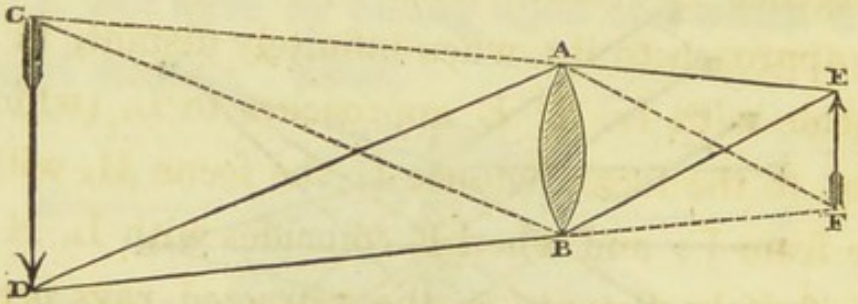
3. Light undergoes the same changes by refraction, in passing through a convex lens, that it does through a sphere. Thus,



let AB be a double convex lens, whose axis is DCE, and C its middle point. The parallel rays DA, DB, will be so refracted in passing through the lens, that they will converge and meet at the point E, which is called the principal *focus* of the lens.

In like manner, parallel rays falling obliquely upon the lens, as FA, FB, and GA, GB, will have their focal points, H and I, at the same distance behind the lens as the point E. In these and all other cases, the rays DC, FC, GC, passing through the centre C, proceed to their focal point without changing their direction. The distance CE, is called the *focal distance* of the lens AB; the length of which depends on the direction of the incident rays, the density and degree of convexity of the lens.

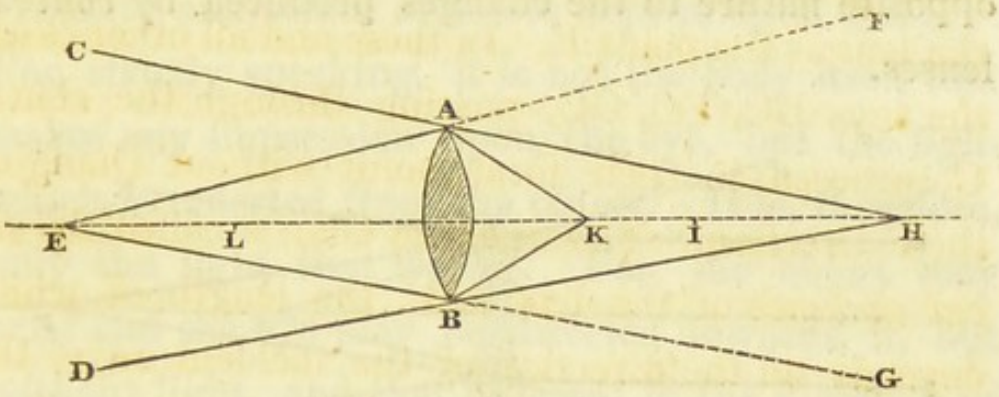
4. In consequence of the centre rays from any point, proceeding directly through the centre of the lens to the focal point, images are inverted by the interposition of a lens. Thus,



Let CA, and CB, be rays falling obliquely from the point C upon the lens AB, their focus will fall at F in a direct line drawn from C through the centre of the lens; and the focus of the rays DA, DB, will fall in a similar manner at E. Hence, it is plain, that the image EF, of the object CD, will be inverted by the interposition of the lens AB.

5. When diverging rays fall upon a convex lens,

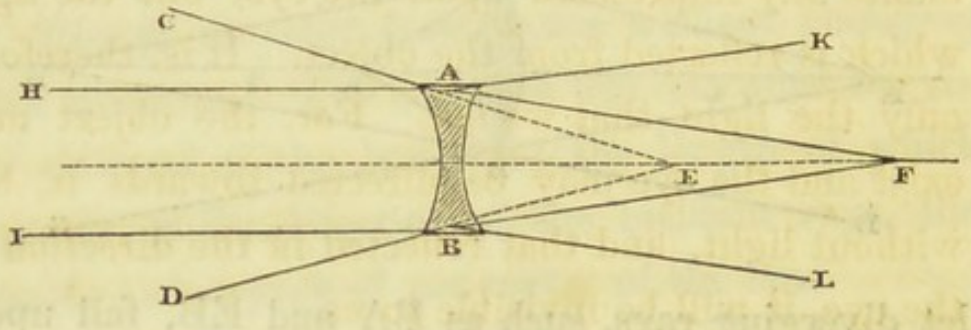
they are refracted to a point beyond the focal point of the lens. Thus,



let diverging rays, such as EA and EB, fall upon the covex lens AB, whose principal focus is I, their divergence will make the focal point recede to a point beyond I, such as H. And further, as the point of divergence E recedes from the lens, the focus H will approach to it; when infinitely distant, H will coincide with I. If E approaches to L, (which is equal to the focal distance I) the focus H, will recede from I; and when E coincides with L, H will be infinitely distant, or the refracted rays become parallel. When the point E is between L and the lens, the rays will *diverge*, by passing through the lens, in place of converging.

6. When converging rays, such as CA and DB, (Fig. 5.) fall upon a lens, in place of meeting at H, their convergence is hastened, so that they come to a focus at K, a point nearer to the lens than I, the focal distance of the lens for parallel rays.

7. By the same laws, light, when refracted through *concave* lenses, undergoes changes of an opposite nature to the changes produced by *convex* lenses.



Hence parallel rays, such as HA and IB, by passing through the concave lens AB is made to diverge towards the points K, L. The focal point E of converging rays, such as CA, DB, is made to recede to a point, such as F. And in the same manner, diverging rays, by passing through a concave lens, would have their divergence increased.

2. *Of the Decomposition, Reflection, and Absorption of Light.*

It has been already stated, that light is not a simple substance, but is composed of three distinct parts of different colours, blue, yellow, and red, which are combined in such proportions as to form, what is called, white or colourless light.

It has also been mentioned, that light is either reflected or absorbed from all opaque bodies. The visibility and colour of bodies depend upon this law. For, strictly speaking, it is not the body itself that makes any impression upon the eye, but the light which is reflected from the object. It is, therefore, only the light that we see. For, the object may exist and the eye may be directed towards it, but without light, and that reflected in the direction of the eye, it will be invisible to us.

When light, or any part of it, is not absorbed by opaque bodies, it is reflected from them. Objects, which *reflect* the whole of the light that falls upon them, appear to us white; those which *absorb* the whole light, appear to be black, as if no light fell upon them. Bodies which appear to us to have different colours, absorb only some of the component parts of the light which falls upon them, and reflect the rest. Thus, objects which seem to be red, absorb the blue and yellow rays, and reflect the red rays, which alone reach the eye;—green objects absorb the red, and reflect the blue and yellow which form green;—blue objects absorb the red and yellow rays, and reflect the blue rays;—orange bodies absorb the blue, and reflect the red and yellow rays; and, in the same manner, every variety of shade of colour which we see, is formed by the rays being

absorbed and reflected in different proportions. Hence the colour which any body seems to possess, depends on the decomposition, absorption, and reflection of light; the colour being that part of the light which is reflected, the rest being absorbed.

The retina is less easily fatigued by some colours than by others. The red rays seem to make the greatest impression upon it, and to wear out its excitability soonest; so that when the red rays have been absorbed, as by objects which seem green, great relief is given to the eye. Hence, how wisely arranged it seems to be, that the foliage of all the herbs which cover the earth, absorb the red rays of light, and reflect those which are least offensive or noxious to the eye.

The above facts are all that it is at present necessary to explain regarding the nature and properties of light. For further information on this subject, the reader is therefore referred to treatises on Optics.

SECTION III.

OF THE FUNCTIONS OF THE EYE IN VISION.

THE eye, as has been already mentioned, is the organ of *light*. By light alone, is its sensibility called into action. But in order that the impressions of light may be felt, they must fall upon the retina. Light must therefore enter the eye, by passing through the cornea, aqueous humour, the pupil, crystalline lens, vitreous humour, and their membranes, all of which are transparent parts, before reaching the retina.

From what has been said regarding the nature and properties of light, the great influence in the modification of it, produced by the humours, and by the convex or spherical form of the eye, as well as, by the contraction and dilatation of the pupil, will at once be obvious.

The functions of the transparent parts of the eye, with regard to light, are precisely those of an optical instrument. The transparent parts through which the light passes to the retina, alter the direction of its course. This refraction of the light, takes place in consequence of the greater *density*

of the transparent parts of the eye, than that of the air—the medium through which light is generally transmitted to this organ. The *convex* or spherical form of the transparent parts, also causes a convergence of the rays of light. This convergence, together with the refraction of the rays, concentrates the light into a focus. The influence of the pupil in the formation of this focus must be very considerable; for, the convergence or divergence of the rays of light, may be increased or diminished by the variation of the size of this aperture. This power of the pupil and transparent parts of the eye, to concentrate the light which enters it, is very important. It increases the field of vision, and renders objects visible at different distances from the eye.

The focus, formed in ordinary eyes, by light from ordinary distances, falls exactly upon the retina, and produces distinct vision. In some individuals, from a peculiarity in the form of the eyeball, the focus falls upon a point nearer to the lens, before arriving at the retina. Such persons, are therefore obliged to hold objects nearer to the eye than is commonly necessary, in order to lengthen the focal distance behind the lens. This, therefore, is termed *short-sightedness*, and is remedied by the use of convex glasses, of such a degree of strength as

counteracts the defect. The opposite of this state, or *long-sightedness*, occurs in all elderly persons. As age advances the convexity of the lens becomes diminished; it loses its power of producing the focal point at the proper distance. The rays which pass into the eye, therefore, have a less degree of convergence in such cases, and the focal point falls somewhere beyond the distance of the retina. Elderly persons, therefore, are obliged to hold minute objects at a greater distance from the eye than they were used to do, in order to cause the focal point to fall nearer to the lens, till the distance corresponds with that of the retina. This state can be remedied by the use of convex glasses, which make up the defect which the diminished convexity, or entire want of the lens, (as after operations for cataract) has produced. Such glasses, therefore, are generally worn, to obviate the inconvenience which arises from the necessity of holding minute objects, at too great a distance from the eye, for seeing them distinctly.

From this change which takes place in the eyes of elderly persons, those who had been short-sighted in their youth, become less so as they advance in life; to such persons glasses are unnecessary, and their sight is said to improve as they grow old.

As the image of an object, is inverted by the in-

terposition of a lens, and is therefore actually inverted upon the retina of the eye, philosophers have puzzled themselves to explain the cause of our not seeing objects inverted. Without entering into any of the explanations of this which have been given, I shall merely observe that, though the rays of light are inverted in the eye, objects do not appear inverted. For, it matters not, whether the lower part of an object is seen by the upper, lower, or lateral part of the retina—still it is the lower part of the object we behold. As we view objects in relation to ourselves and other surrounding objects, if an impression be made upon the retina, it does not signify upon what part of this membrane the impression is received, because the object is seen in relation to the objects around it. Hence, it does not make any difference, that we see the lower part of an object, with the upper part of the retina ; and the upper, with the lower part ; because we see the objects in their relative positions.

SECTION IV.

OF VISION AS A MENTAL FUNCTION.

THE function of vision, requires not only the impingement of light upon the retina, and the perfect condition of the eye, but a certain mental exertion or effort of attention for the perception of an object.

It has been already stated, that the sense of sight is a mental perception, or function of the mind; and that the visual organs having their seat or origin in the brain, the eye, is therefore to be considered only a subordinate, though necessary, part of the apparatus of vision. It is a necessary component part of the apparatus, but not that upon which vision alone depends; being only that part, which is adapted for receiving the external impressions to be conveyed to the mind.

Without a mental exertion, or effort of attention, nothing visible is perceived; and we overlook much that is before us, on account of our attention being limited to one object.

It is only by this mental effort, that we can distinguish one object from another—that we accom-

modate to distance, and have an accurate perception of visible objects.

This mental effort, which is so necessary a part of the faculty of vision, can likewise be traced in the lower animals, from man to the meanest reptile or insect which shrinks at the sight of danger. For this perception of danger alone, demonstrates a certain sensibility or mental exertion, by which the animal fears and shuns it.

When we look at objects and direct the mind to something else, the objects looked at, are not perceived; and when we direct the mind to distant objects that may be in view, those which are nearer are unnoticed. Thus, objects viewed without the mind being directed towards them are not perceived; for, they have made no impression upon the mind. When the axis of the two eyes is different, as in those who *squint*, an object would be seen double, or two impressions would be made upon the sensorium, were the attention of the individual not exclusively confined to one. This attention to one object in such cases, is acquired by custom.

Single vision, or one impression in the mind from an object viewed with both eyes, is easily accounted for by the union, of the optic nerves at the optic commissure in the sella tursica, as also, of the tractus optici at the corpora quadrigemina.

This proves, that it is by the brain or sensorium as one organ, that the faculty of sight is exerted; though it is capable of observing, that two impressions are received upon the eyes, in certain circumstances.

When the eyes are both directed to one object only, the attention is fixed upon that object alone; so that only one impression is made upon the mind. But if the eyes are directed to different objects, unless the individual can fix his attention only upon one, he will either see double, or indistinctly.

In order that only one impression be made upon the sensorium, it is necessary that the axis of both eyes be directed to the same object, on account of the peculiar arrangement of the nervous filaments anterior to the optic commissure. When the axis of both eyes are not directed to the same object, two impressions are made upon the retina.

SECTION V.

OF SINGLE VISION WITH BOTH EYES.

SINGLE vision when both eyes are exerted, is to be accounted for by the union of the optic nerves in

the optic commissure at the sella tursica.* For it is more than probable that the nervous filaments issuing from the right side of the brain, are so disposed at the optic commissure, that they afterwards form the right side of each of the optic nerves and of the retina; those of the left being disposed in a similar manner. By this structure, when both eyes are directed to the same object, the luminous impression falls upon a similar part of the retina of each eye; which two parts issuing from the same side of the brain, one impression only is made upon the mind. This is proved by both eyes being directed to the same object; if one of them is then displaced with the finger in another direction, vision will appear to be double. It is also proved in cases of squinting, where paralysis or loss of power of some of the muscles, prevents the proper motion of one of the eyeballs. In this case, the individual loses the power of directing the axes of both eyes to the same object, and double vision is produced. Hence, persons whose eyes are in this state, become accustomed to view objects with one eye only, by directing their attention to one object, or by closing the affected eye.

For some purposes, however, it is more conve-

* See Page 39, also Plate V.

nient to employ only one eye, as in placing objects in a direct line, or in ascertaining their relative situation with ourselves.

The crossing and exchange of the nervous filaments, which have been described to take place at the optic commissure, though probable, is not necessary to single vision. For, we have only one sense of smell, or of hearing, though the impression is made on both nostrils or both ears, which are each supplied by distinct nerves, and have no other connection but through the medium of the brain.

We direct the axes of both eyes to the same objects for two reasons ; 1*st*, Because the transmission of the light is more perfect and distinct when transmitted directly through the axis of the eye, than when the rays enter it obliquely. In those cases where the direct rays are obstructed from entering the eye, as by a central opacity of the cornea, the individual sees, but not perfectly. 2*d*, Because the central part of the retina is most used, it is therefore most sensible and energetic.

SECTION VI.

OF THE ADAPTATION OF THE EYES TO DIFFERENT DISTANCES.

THE accommodation of the eye to different distances, or rather the power of the eye to see distinctly, distant as well as near objects, is one of the most remarkable, as well as one of the most valuable functions it possesses.

Regarding the manner in which the eye has been conceived to be adapted to receive exact impressions upon the retina, of objects to which it is directed at different distances, much has been written, and much discussion has taken place. Many different changes in the eye to produce this effect have been conjectured, but one of these only is known absolutely to take place.

The different modes worthy of remark, by which the adaptation of the eye to distances has been conceived to take place, are,

1*st*, By the compression of the eyeball by means of its muscles, producing alterations in the form of the eye. But as the whole of the muscles must be continually on the stretch to keep the eye steady, it

seems quite impossible, that the pressure produced by them upon a globular body quite distended with its contents, could materially change the focus of vision. Nor could the pressure be so varied, and so equally distributed on its different parts, and in different positions of the eye, as to produce the changes of form required. Their action would rather draw the eye backwards into the socket.

2d. A muscular power in the ciliary processes, which, when exerted, draws backwards and forwards the crystalline lens. There is nothing muscular in the ciliary processes. They are not attached to the lens, and their extremities are even at some distance from its margin, and they float loose in the aqueous humour. How then can such processes have any effect in moving a body to which they are not attached? Besides, in some animals, particularly in birds and fishes, that are remarkable for the excellence of their vision, the ciliary processes are entirely wanting. And, lastly, the power of adaptation being retained, at least with the assistance of a glass, by those individuals from whose eyes the lens has been removed by operation,* shows, that

* After the removal of the lens, the individual sometimes has his former complete state of vision; in others with the assistance of a common convex glass, the accommodation of the eye to distances is equally perfect as before.

if any change takes place in the eye, it is not connected with the crystalline lens.

3d. That a change is produced in the eye, by a muscular power in the ciliary ligament. A muscular function in the ciliary ligament would by its action contract the circular space which it surrounds, and cause a diminution in the circumference of the eyeball where it is situated. But, as the ciliary ligament is firmly attached to the sclerotic coat, a firm and inelastic texture, and as also to the iris, it is impossible to conceive, how such a contraction of the ciliary ligament can take place without producing some visible change upon the sclerotic coat or iris; or in what way it can affect the crystalline lens. In many of the lower animals that part of the sclerotic coat which covers the ciliary ligament is covered by a bony ring, which, from its unyielding nature, would effectually prevent the contraction of the ciliary ligament, if it did possess such a power. But, even though it were granted, that the ciliary ligament did possess a muscular power, what alteration in the eye could it produce to effect the adaptation supposed?

4th. A late physiologist* has exercised his ingenuity in supposing, that it is by means of the

* M. Jacobson.

canal of Petit, the eye is accommodated to objects at different distances. By this theory it is supposed, that at certain times, the canal of Petit becomes filled by aqueous humour, and emptied according to the distance of objects viewed. The small openings, at which he supposes the aqueous humour to enter and escape, have not been found by others. Besides, the zonula and circle of Petit are wanting in most of the lower animals; and the whole explanation, being quite imaginary, is unworthy of comment.

5*th*. It has been shown by others, that no change in the eye is necessary to adapt it to different distances. In this view it has been compared to a *camera obscura;* which, without any adjustment, displays near and distant objects equally distinctly, though their images, in these cases, are not equally luminous. This has also been proved by a mathematical computation.*

6*th*. It is more than probable that the variation in the size of the pupil contributes in a material manner to the adaptation of the eye for different distances. And this is the only change or alteration in the eye, which is positively known to take

* Martin, Ph. Br. ii. p. 255.

place, in varying the direction of the eye from near to distant objects.

When the eye is directed to a minute object near to it, such as to a book in reading, the pupil is much contracted. If the eye be then directed to objects at some miles distant, the pupil may be observed to become considerably dilated, and *vice versa*. Hence, those persons, whose iris moves with activity, have been supposed to possess a voluntary power in moving the pupil, an effect which I have observed to take place from their directing the eyes from near to distant objects alternately. The same remarks apply to the eyes of many animals.

That the size of the pupil has a very material effect, in accommodating the eye to the different distances of objects, is proved by the following facts. 1st, When the pupil is dilated artificially by belladonna, the individual loses the power of being able to distinguish near objects, though he can see distinctly those which are at a distance from him. In this case vision is so confused, when the eye is directed to near objects, that they cannot be discovered.* 2d, In those cases, in which there

* In a patient under my care, the pupil of the right eye has, during the whole of his life, been observed to be about twice the diameter of that of the left. When the left eye is closed, he can only see to

is a permanent contraction of the pupil, the individual loses completely the power of seeing distant objects; but is able to distinguish objects when they are held very near to the eye.

The change in the size of the pupil, in viewing near and distant objects, may perhaps be said to be owing, in some degree, if not altogether, to the comparative difference in the intensity of light to which the eye is exposed; that from distant objects, being much less intense, than that from objects which are near, because light from distant objects is less luminous by being more diffused, than that from objects which are nearer.

But the angle at which the light falls upon the eye, from distant objects, is different from the angle at which it falls from near objects; hence, the functions of the pupil are required to adjust its quantity, in order that a pencil of rays of the proper magnitude and direction for causing the focus to fall upon the retina, may enter the eye. The pupil varies in size according to the comparative light to which the eye is exposed, and the proper intensity

read with the right, when the book is held at twice the distance from the eye at which he can read with the left.

Engravers and watchmakers, who have their eyes much directed to very minute objects, have much contracted pupils. They also become short-sighted by the eye being so much accustomed to near objects.

of its impression depends upon the focus falling exactly upon the retina, so that the pupil opens to admit light till the focus is produced. As the pupil adjusts and regulates the volume of light which enters the eye, it must have complete influence in adjusting the focus so as to render it perfect for vision. It is also the opinion of Mr. Travers upon this subject, that, "where the iris is from any cause motionless, the power of adapting the eye to distances is lost. I conclude, therefore," he adds, "that the adaptation of the eye to light co-operates with its adaptation to distance."

If the eye required those changes which have been supposed necessary for its accommodation to different distances, and if it really had such a power of adaptation within itself at the command of the will, we would be able to produce this change in the organ without directing the eye to distant and near objects. For, it is impossible to conceive that merely directing the eye to a distance, and this only, could produce such a change. But, when looking at a near object, we cannot alter the eye at pleasure so as to adapt it to distant objects, and render the near ones invisible.

That the power of accommodation, if it possesses this at all, is both very slight and in small degree, and is produced by some very slight change in the

eye, is obvious from the circumstances connected with the vision of those persons who are naturally short or long sighted. In these, the defect is easily obviated by means of glasses of comparatively small degrees of power. But if the eye possessed the faculty alluded to, in accommodating itself to different distances, in any considerable degree, the organ would be sufficient of itself to obviate either of these defects; for it could easily make up sufficient power to compensate for the glasses worn to obviate these states.

The accommodation of the eye to different distances, appears to me to depend entirely on the attention being directed to them, and the proper regulation of the light by means of the pupil. When an object is interposed between the eye and another that is more distant, and to which the attention is fixed, the nearest object will not be perceived, till the mind is directed to it by leaving the more distant object. The near object is then instantly perceived, and the more distant object becomes invisible. When the object from which the light emanates recedes or becomes more distant, the focus is brought nearer to the lens than the retina; but this is compensated by the divergence of the rays being increased by the enlargement of the pupil, by which it admits more divergent rays. The

reverse of this takes place, when the eye is directed from distant to near objects. The focus would then be formed at a point beyond the retina; but the contraction of the pupil, by diminishing the divergence of the rays which enter the eye, causes the focal point to fall upon the retina.

SECTION VII.

OF OUR KNOWLEDGE OF THE SIZE, DISTANCE, &C. OF OBJECTS IN VISION, AND THE EFFECTS OF HABIT.

NOTWITHSTANDING what has been already said, regarding the laws and properties of light, and the production of vision, many of the *perfections* of this function depend on what has been termed custom and habit. Particularly as relates to our estimation of the size, distance, form, and motion of bodies. Our knowledge of them is to be attributed to the result of experience, by which we may be said to have constantly been obtaining information from our earliest years. This, has been obviously demonstrated, in the cases of those persons who have

only obtained sight at an advanced period of life ;* and also in those who have lost one of their eyes at an advanced age. By time and use, the inconveniences experienced, in such cases, gradually become obviated.

None of the properties of objects affect the eye to produce vision, except the emission or reflection of light. It is therefore not the object we see ; it is, strictly speaking, only the rays of light from the object, varying in brightness and in colour. This forms an image upon the retina, which, together with the association of our ideas, and our knowledge of objects derived from experience, combine to produce vision, or to excite in us our perception of the existence and nature of objects, and their relative situation.

SECTION VIII.

CONCLUDING REMARKS.

FROM the account which has now been given of the anatomy and physiology of the human eye, the

* See cases by Cheselden and Wardrop.

delicacy of its structure and the admirable adaptation of its parts to their different uses, must be obvious. These, however, may now be shortly recapitulated.

We have seen, 1st, That the eyes of man are not situated laterally as in many of the lower animals, but in the fore-head; for he possesses a free rotatory motion of the head by which the eyes can be turned to enable him to see in any direction. 2d, That the bony socket in which the eyeball is contained, is well adapted to protect the eye and admit of its free motion. 3d, The importance of being provided with two eyes, which are so constructed, that should one be destroyed, the other is capable of performing the functions of both. 4th, The provision made to increase the usefulness of the eye, by the muscles which surround and move it; and which serve also, for keeping it steadily directed to any one object. 5th, The moveable coverings, formed by the eyelids for the protection of the eye from too much light, and from exposure, as during sleep, as well as, for keeping it clear of extraneous matter, and diffusing moisture over its surface. 6th, The constant lubrication afforded to the eye, by fluids secreted by its appendages, by which its clearness and facility of motion are preserved. 7th, The transparency of that part of the eye which is ex-

posed to the light, to allow its admission into the interior of the organ. 8th, The provision made for the regulation of the quantity of light admitted into the eye by means of the pupil,—its concentration into a focus upon the retina by passing through the humours,—and its absorption by the black lining of the choroid coat. 9th, The expansion of the optic nerve in the retina, by which its sphere of perception is extended; and the admirable construction of the parts surrounding it, both for its preservation, and for producing vision at different distances.

All these combine to render the eye as perfect an organ of vision, as seems to be required, for all the purposes of life. Not indeed so perfect an organ as we are able to conceive, or as even appears to be possessed by many of the lower animals. Still in its very imperfection there is wisdom; for, though it is perfect for every purpose of life, it is defective only to hide from our view what would be offensive; so that well may we conclude with the words of the poet, that the eyes

> "Take in at once the landscape of the world,
> At a small inlet, which a grain might close,
> And half create the wondrous world they see.
> But for the magic organ's powerful charm,
> Earth were a rude, uncoloured chaos still."*

* Young.

From what has been said above, the numerous causes of blindness and imperfections of sight, will also be easily understood. These may be comprehended under the three following heads :—

1*st*, Those cases of blindness or imperfection of sight, arising from those causes which obstruct or prevent the admission of light to the retina; viz. Inability to open the eyelids—central opacity of any of the layers of the cornea—opaque matter, such as lymph or blood, effused into the aqueous humour—opacity of the crystalline lens, of the vitreous humour, or of any of their investing membranes,—contraction or closure of the pupil.

2*d*, Those arising from alterations in the form of the eye, by which light is not properly refracted; viz. a conical form of the cornea—diminution in the size of the eye—absence of the crystalline lens or enlargement of the eyes.

3*d*, Those arising from insensibility of the retina to light, either from disease of itself, of the optic nerve, or of the brain; viz. the different forms of amaurosis.

"O why was sight
To such a tender ball as the eye confined,
So obvious and so easy to be quenched."*

* Milton.

PART SECOND.

DISEASES OF THE EYELIDS

AND OTHER

APPENDAGES OF THE EYE.

PRELIMINARY REMARKS.

Besides wounds, many diseases affect the eyelids and lacrymal organs. These are various in their nature, consisting not only of those diseases which affect other similar textures of the body, but of many which are peculiar to these parts.

The eyeball depends so much on the protection and lubrication afforded it by the eyelids and its other appendages, that many of the diseases of these parts, either produce blindness, or render the eye useless.

In treating of the diseases of the eyelids and other appendages of the eye, those which affect the eyelids and the parts within the orbit surrounding the eyeball, shall be first enumerated; reserving those peculiar diseases, which affect the lacrymal organs, to be treated of in a separate chapter.

CHAPTER I.

DISEASES OF THE EYELIDS.

SECTION I.

OF INJURIES OF THE EYELIDS, AND OTHER APPENDAGES OF THE EYE.

THE most common injuries of the eyelids, are wounds of various kinds. Portions, or the whole of one or both of the eyelids, may be detached; and the wound may divide one or both of the lateral lacrymal canals, or it may penetrate into the orbit.

Wounds of the eyelids require to be carefully treated upon the general principles of practice; great care being taken to place the divided edges of the wound in exact apposition, that permanent contraction or eversion of the eyelid may be prevented. For this purpose, stitches are generally required; these must be carefully introduced, without penetrating through the whole thickness of the eyelid, or into the tarsal cartilage.

When one of the lateral lacrymal canals is divid-

ed, much attention is required to prevent its obliteration. This is to be accomplished by passing a small probe through it, and there retaining it till the wound is healed. The obliteration of the canal, particularly when allowed to take place in the lower, often causes a permanent flow of tears from the eye over the cheek. When both canals become obliterated, this weeping state of the eye is always occasioned.

Foreign bodies are frequently lodged within the eyelids, and sometimes in the orbit. These require to be removed by means of forceps and a probe, or by injecting warm water from a syringe between the eyelids. See injuries of the eyeball.

SECTION II.

OF INFLAMMATIONS OF THE EYELIDS, AND OTHER APPENDAGES OF THE EYE.

INFLAMMATION affecting the eyelids may be of different kinds—such as, simple inflammation of the integuments or cellular tissue—erysipelatous inflammation—chronic inflammation with excoriation and ulceration of the ciliary edges of the eyelids, &c.

Inflammation may affect both the eyelids and other parts within the orbit surrounding the eyeball, or it may be confined to one of these parts; and it may terminate, as in other parts of the body, by resolution, suppuration, ulceration, or sloughing.

1. *Of Simple Inflammation and Abscess of the Eyelids.*—When the eyelids are inflamed, the affection is attended with the usual symptoms of external inflammation—pain, redness, heat, and tension, accompanied with so much swelling of the eyelids as to prevent the patient from being able to uncover the eyeball by opening them. When the degree of inflammation is great, the conjunctiva or mucous membrane lining the eyelids becomes inflamed, which greatly aggravates the case.

This inflammation of the eyelids generally terminates by resolution. In some cases, however, it proceeds to suppuration, and an abscess forms under the integuments. The cicatrization of the sore left by an abscess of the eyelids, sometimes causes a permanent eversion of one or both lids.

Treatment.—This affection of the eyelids is to be treated upon general principles; those remedies which promote resolution, consisting of the application of leeches, and cooling lotions, along with

the administration of purgative medicines, being employed so long as there is any prospect of resolution being produced. When it cannot be terminated by resolution, or, when there is any tendency to suppuration, warm fomentations and emollient poultices are to be applied. By these the inflammation abates, and the suppuration of the tumour is promoted. When matter has formed, the puncture of a lancet is generally necessary; as it both permits more readily the exit of pus or sloughing cellular membrane, and cures the disease with a smaller cicatrix.

2. *Of Inflammation and Abscess within the Orbit.*—Sometimes inflammation affects the cellular tissue and other parts within the orbit which surround the eyeball, without either the eyeball or eyelids partaking of the disease. In such cases, the swelling of the inflamed parts causes them, as also the globe of the eye, to protrude from the socket. This produces an alarming appearance, and great distress to the patient, from the stretching and compression of the optic and the other nerves. The inflammation, in the cases now alluded to, often terminates in the formation of an abscess within the orbit; so that, even when the inflammation declines, the eyeball continues to protrude from the presence

of the matter, till this is evacuated. Inflammation of the parts within the orbit, is generally accompanied with a very considerable degree of constitutional disturbance and inflammatory fever, which is sometimes attended with delirium.

Treatment.—Acute inflammation of the contents of the orbit, requires active antiphlogistic treatment, consisting of depletion to a considerable extent, along with purgatives and diaphoretic medicines. Cooling or warm applications, are to be made to the eye, whichever is most agreeable to the feelings of the patient. When the tumour is circumscribed, and appears to be forming into an abscess, warm emollient poultices are the best applications and give most relief. Whenever the formation of matter can be detected, an opening should be made for its evacuation. The tumefaction of the eye then subsides, and the case requires to be treated upon general principles.

3. *Of Erysipelas of the Eyelids.*—Erysipelatous inflammation of the eyelids is not uncommon; the eyelids may be affected alone; or they may partake of erysipelas of the face and scalp.

When the eyelids are affected with erysipelas, they become greatly swollen, tense, red, and painful, which cause complete inability to open the eye.

The eyelids often become œdematous. The conjunctiva becomes affected with the inflammation, which terminates in a copious effusion of purulent matter from its surface. This inflammation, by spreading to other parts of the eyeball, sometimes causes the disorganization of some of its parts. Like erysipelas of other parts of the body, this is often attended with violent inflammatory fever. This inflammation often terminates by the formation of an abscess, sloughing and ulceration of the eyelids.

An inflammation of the eyelids and eyeball, of a somewhat similar description, takes place in cases of small-pox, measles, and other exanthematous diseases, as also in the other puriform inflammations of the conjunctiva.

Treatment.—Erysipelas of the eyelids requires to be treated upon general principles, by antiphlogistic and other means; care being taken, at the same time, to treat the inflammation of the conjunctiva and eyeball, by the application of the remedies recommended for Purulent Ophthalmia.

SECTION III.

OF CHRONIC INFLAMMATION OF THE EDGES OF THE EYELIDS—LIPPITUDO VEL OPHTHALMIA TARSI.

THE ciliary margins of the eyelids are very often affected with chronic inflammation. The edges of the eyelids are red and excoriated, attended with an exudation of an acrid irritating sanies fluid, which tends to aggravate and keep up the disease. In the course of this affection the eyelashes fall out; but while they remain, they are generally matted together, by the matter which exudes becoming encrusted at their roots. In the morning when the patient awakes, he finds his eyelids adhering together by the drying of the discharge, so that it is with some difficulty they can be opened. It is attended with an itching uneasy sensation, which causes the patient to rub the eyelids.

In many of the most aggravated cases of this disease, minute pustules and ulcerations may be observed upon the edges of the eyelids, involving the roots of the eyelashes; and this, therefore, is probably the cause of their spontaneous detachment.

The orifices of the Meibomian ducts are often

much affected in this disease by excoriation and ulceration; and it is not easy to estimate how far the excretion from these orifices tends to cause and aggravate this affection. When the Meibomian secretion is vitiated, and is of an acrid, irritating quality, it may no doubt produce this affection, or aggravate the disease when it already exists.

This affection is most common among the lower ranks; generally affecting young subjects, but is also frequently observed in elderly persons. It is often kept up and much aggravated by want of cleanliness and neglect.

Treatment.—The cure of this chronic inflammation of the edges of the eyelids, is to be effected by the application of gentle stimulants. Those found to answer best, are those applied in the form of ointment; the unctuous part preventing the encrustation of the matter which exudes. Ointments of the red oxide, or nitrate of mercury, are, in general, very efficacious, and are those generally used. Solution of sulphate of copper and nitrate of silver answer the same purpose, but require to be followed by the application of some unctuous substance, to relieve the itching uneasy sensation in the lids, and incrustation of the matter.

Before any application can be effectually made to the affected parts, the encrusted matter upon the

edges of the eyelids must be completely removed by bathing with warm water; the ointment which is then applied and repeated every night, or night and morning, prevents the encrustation of the matter from returning. After the washing, and before the application of the ointment, bathing the eyes with a weak solution of sulphate of zinc is very beneficial. As eyelashes retain the matter which incrusts upon them, and as they sometimes do not grow again, when they fall out by ulcerations at their roots, the extraction of them before applying remedies, has been recommended. I have not, however, seen cases where this was required. By attention and cleanliness, the inconveniences caused by the collecting and drying of the matter may be prevented.

SECTION IV.

OF ULCERATIONS OF THE EYELIDS.

THE eyelids are often affected with different kinds of ulceration. That connected with chronic inflammation of the edges of the eyelids has been already mentioned in the preceding Section.

Abscesses of the eyelids very often leave a troublesome ulceration, which in particular constitutions degenerates into a strumous or syphilitic ulcer. The cicatrization of these ulcers often causes a permanent contraction and adhesion of the eyelid to the bony margin of the orbit, in many cases, occasioning an eversion of the eyelid.

Treatment.—Ulcers of the eyelids require the application of the common treatment for ulcerations in other parts of the body; great attention being paid, to prevent the contraction and eversion of the lid from their cicatrization.

Strumous and syphilitic ulcers require, in addition, constitutional remedies suited to the state and circumstances of the patient.—Cancerous ulceration of eyelids. See Sect. IX. of this Chapter.

SECTION V.

OF TUMOURS OF THE EYELIDS AND ORBIT.

THE eyelids and other appendages of the eye within the orbit, like other similar textures of the body, are often affected with tumours of various kinds;

such as, ecchymosis, œdematous, inflammatory, warty, encysted, sarcomatous, cancerous, and aneurismal tumours.

1. *Of Ecchymosis of the Eyelids.*—Ecchymosis of the eyelids is a very frequent consequence of blows upon the eye, arising from the looseness and delicacy of the cellular tissue, and the great quantity of blood which circulates in these parts. The effusion of blood into the cellular tissue, causes more or less tumefaction of the eyelids,—is seldom attended with pain, and in a few hours acquires a bluish purple colour. These symptoms go off gradually as the effused blood becomes absorbed. This absorption is effected sooner or later, according to the quantity of blood effused, and the vigour of the system in carrying on this process. The application of gentle stimulants to the skin, such as solutions of the muriate of ammonia or acetate of lead, with the addition of a proportion of vinegar and spirits, may promote the absorption. These may be applied by a wetted compress kept constantly upon the tumour. Such applications also tend to allay and prevent inflammation, which may take place from the same cause that occasioned the ecchymosis.

2. *Of Inflammatory Tumours.*—Inflammatory tumours affecting the eyelids and appendages of the eye are of various kinds. The simple inflammatory tumours which terminate either in resolution or suppuration have been already described.

Hordeolum or Stye.—The only inflammatory tumour to be mentioned now, therefore, is the common affection known by the name of *hordeolum or stye.* This consists of one or more small inflammatory tumours, attended with very considerable pain, which occur upon the margin of the eyelids, at the roots of the eyelashes, and orifices of the Meibomian ducts. The inflammation in these tumours commonly goes on to suppuration, terminating in a small pustule or boil. When suppuration commences, a small whitish point appears at the apex of the tumour; in a day or two this bursts, and sometimes a portion of the cellular tissue within the tumour sloughs and comes away. The tumour, therefore, has all the characters of a common boil upon a small scale. During the first stage of the disease, when the tumour is of a considerable size, the affected eyelid becomes tumified and affected with erysipelatous inflammation. In some cases, even the conjunctiva partakes of the inflammation. This disease most commonly affects young subjects. In many cases there is such a disposition to it, that

it often recurs by a succession of tumours taking place. This depends on some peculiar state of the constitution. Those of scrofulous constitutions are most subject to it.

Treatment.—The treatment of stye in its commencement, consists in endeavouring to remove the inflammation by resolution, by cooling saline lotions, and purgatives. If these cannot remove it by resolution, suppuration of the swelling is to be promoted by means of emolient poultices. It is often slow in suppurating, and seldom requires to be punctured by a lancet, except when it is large and contains a slough. An incision is then required to promote its evacuation and hasten the cure. The treatment now mentioned, along with some purgative medicine, are generally sufficient in removing the disease.

The disposition to the recurrence of this affection, is to be prevented, by attention to the state of the constitution. Sea-bathing, warm clothing, and the application of gentle stimulants to the eyelids, such as, weak citrine ointment, and a solution of sulphate of zinc, &c.

3. *Of Œdematous Tumours of the Eyelids.*—Œdema of the eyelids, as a local affection, takes place most commonly after inflammation of the

eyelids; particularly that of an erysipelatous character. The skin covering the upper and lower eyelids, retaining its natural colour, appears tumified and prominent, giving the eyes a sunk appearance in the sockets. The tumour feels elastic to the touch. It is not attended with any pain or inconvenience, except from its bulk and the deformity it occasions. In the same state it continues for years.

Treatment.—The removal of this affection is attended with great difficulty. Stimulating frictions, blisters, and the introduction of setons, afford the best chance of relief. By these, however, the cure is often only partial.

4. *Of Warty Tumours.*—The eyelids are frequently affected with warts. These, in young subjects, admit of removal by escharotics. In others, they may be removed by escharotics, by incision, or, when pendulous with narrow necks, by ligature. In elderly persons, they sometimes degenerate into cancerous sores; so that they are often the beginning of what has been denominated cancer of the eye. See Section IX. of this Chapter.

5. *Of Chronic, Encysted, and Sarcomatous Tumours.*—Encysted and sarcomatous tumours,

very frequently have their seat in the eyelids, and in the orbits. They are to be distinguished from inflammatory tumours by their being more completely circumscribed, by being very small at their commencement, afterwards enlarging slowly and gradually, and being unattended with symptoms of inflammation.

Tumours of this description, are generally very moveable, when they are not deeply seated within the orbit, or adhering to the bone. When encysted, they are often attended with a slight redness of the skin from chronic inflammation, which seldom affects sarcomatous tumours. Encysted tumours are of a regular form, while the sarcomatous are frequently nobulated. Encysted tumours often convey a sense of fluctuation, which is not perceptible in those which are sarcomatous.

Small tumours of the above description, are frequently situated immediately under the orbicularis muscle of the eyelids, sometimes under the integuments, and sometimes immediately under the conjunctiva, as seen by everting the eyelids.

Tumours of a larger size than those now described, are often situated within the orbit. These, in some cases, are confined to one side of the orbit, in others, they surround nearly the whole of the eyeball. Tumours of the orbit commonly cause a

protrusion of the eyeball to a greater or less extent, according to their size and situation. When the tumour is situated near to the margin of the orbit, its protrusion forwards, is prevented by the ligamentous process of the periosteum which proceeds towards the anterior of the eyeball; so that when it increases in size, by projecting backwards and filling up the orbit, the eyeball is made to protrude. But if the ligament at the interior part of the orbit gives way, the anterior part of the tumour escapes from the orbit, and by protruding, gives place to the eyeball, which again recedes into the orbit.

Tumours of the orbit very often consist of *fungus hæmatodes*. These appear to commence, in some cases, in the optic nerve or coats of the eye; in others, from the periosteum of the orbit.

The sight of the eye, is seldom destroyed by tumours of the orbit. They are hurtful chiefly by their bulk, and only disturb vision by their displacing the eye. When they are of the nature of fungus hæmatodes, however, the eyeball soon becomes affected, vision becomes destroyed, and they generally proceed to a fatal termination.

Tumours of the eyelids, are commonly easily removed by excision. The tumour, being exposed by an incision, should be laid hold of by a hook and carefully dissected out; after which, the edges of

the wound are to be brought together by ligatures, and the usual dressings. When the tumour is situated immediately beneath the conjunctiva, it should be removed by everting the eyelid, and making the incision through that membrane. The tumour being exposed, is then to be dissected out; and nothing further is necessary than to replace the eyelid.

The removal of tumours from the orbit, is attended with considerable difficulty, particularly when they penetrate deeply into its cavity; for they require to be carefully dissected out, without the other parts being injured. This is often not easily accomplished, as there is so little space, between the eyeball and orbit, for manipulation.

If the tumour be situated at the upper part of the orbit, it is necessary, before making the first incision, to ascertain its relation to the levator palpebræ superioris muscle. If the tumour is situated above it, the first incision to expose the tumour should be immediately under the eyebrow, in order that this muscle may be saved. If the tumour be situated below the muscle, the tumour should be exposed, by first detaching the eyelids from each other at their temporal extremity; the upper eyelid should then be everted, and detached through its whole length from the eyeball, by dividing the con-

junctiva. In completing the excision of the tumour, great care is necessary to avoid injuring the parts with which it is surrounded, namely, the ophthalmic branch of the fifth pair of nerves,—the ophthalmic ganglion and its nerves,—the lacrymal gland and its ducts,—the eyeball and optic nerve, together with its muscles. The injury of any of which parts with the knife, would cause more or less injury to vision.

In many cases, where the tumour surrounds the eyeball, its removal cannot be accomplished, without removing the eyeball and other contents of the orbit along with it.

The operation of the extirpation of the eyeball and other contents of the orbit, is not attended with immediate danger to the patient, so far as the operation itself is concerned. It is neither a dangerous nor a difficult operation. When the eyelids are to be left, the first step of this operation is to lengthen the opening between the lids at their temporal angle, by a transverse incision towards the temple. If they are to be removed, they must be included in an external incision upon the margin of the orbit. A hook or ligature should be passed through the eyeball to pull it gently forwards. The eyeball and its surrounding parts are then to be carefully dissected out, by keeping the edge of the knife directed towards the surface of the bone, and leaving

nothing to remain but the periosteum. When the tumour is connected with the periosteum, however, this is also to be removed. The optic nerve and parts around it at the apex of the orbit, are most readily divided by a pair of curved probe-pointed scissors.

Though in this operation several considerable arteries are divided, the bleeding is not dangerous. The orbit, emptied of its contents, is to be filled with *Sharpee*, which stops the bleeding; the edges of the external incision at the angle of the eye, being brought together by ligature, a compress and bandage are to be applied, and the patient then put into bed. The case is afterwards to be treated according to circumstances, as after other similar surgical operations. In three or four days, the dressings are to be removed, by previously applying a poultice over them for some hours. The orbit is then to be washed by injecting warm water into it, and dressings replaced similar to those removed.

6. *Of Aneurismal Tumours.* A case of aneurismal tumour of the orbit, is detailed in the second volume of the Medico Chirurgical Transactions by Mr. Travers, which occurred in a middle aged woman.

In this case there was a fulness in the orbit and protusion of the eye. There were in the orbit two

tumours; one above the eyeball, and the other below it. These were elastic, compressible, and communicated a distinct sense of pulsation. This affection was accompanied with symptoms of fulness of blood in the head—pain—tinnitus aurium; and upon compressing the common carotid artery of the same side, the symptoms and pulsation altogether ceased.

This disease had come on gradually, and had existed for nearly four years. It was cured by tying a ligature around the carotid artery; but the throbbing of the tumours and the pain did not entirely leave the patient for several months after. The accidental loss of a considerable quantity of blood served to facilitate the cure, and to render it more rapid.

There is another case almost similar to the above, which occurred in a delicate middle aged woman, and which was treated in the same manner with perfect success by Mr. Dalrymple, as mentioned by him in the Med. Chir. Trans. Vol. VI. The cure, in this case, was accomplished in a much shorter period than in that of Mr. Travers, owing, in some measure, to this patient not having been so plethoric, and also owing to her having been bled a few days after the operation; which is a practice that should perhaps be taken advantage of after all similar operations, to facilitate and hasten the cure.

SECTION VI.

OF EVERSION OF THE EYELIDS.

WHEN either of the eyelids has any part of its inner surface permanently turned out, the affection is termed *eversion* of the eyelid.* A part or the whole of either eyelid, or both eyelids of the same eye, may be completely everted.† But the lower is most commonly the seat of this affection.

When any of the eyelids are affected with eversion, the eyeball is imperfectly covered, and is therefore not properly lubricated by the diffusion of the tears over its surface, the act of winking being interrupted or prevented.

When the mucous membrane of the eyelid is exposed to the air by a permanent eversion, it becomes affected with chronic inflammation, by which it becomes red and thickened from increased vascularity. The surface of the eyeball too, by the want of its natural covering and protection from external agents, being permanently exposed, also becomes inflamed. In consequence of this inflammation of

* See Plate VI. Fig. 1. † See Plate VI. Fig. 2.

the eyeball, the cornea becomes opaque and vascular; so that vision becomes much impaired, and is, in some cases, ultimately destroyed.

Eversion of the eyelid arises from several different causes; but most commonly from a thickened fungous state of the conjunctiva,—relaxation of the eyelids,—or the formation of a cicatrix of the skin. Cases of this disease may therefore be simple; or the eversion may be complicated with a cicatrix, binding down the eyelids to the bony margin of the orbit. In some of those cases, where the upper eyelid has become everted by the cicatrization of an ulcer, a portion of the skin and orbicularis muscle are wanting from the lid; these having been removed by ulceration or sloughing.

Treatment.—The treatment of this affection must be suited to the nature of the case, and the cause which occasions it. When eversion arises from a fungous state of the conjunctiva, the excision of the fungous part, or the application of escharotics to it, cures the eversion, by allowing the eyelid to resume its proper place.

In simple cases of eversion of the eyelid caused by its relaxation, if the affection is not very considerable or of long standing, a cure may be effected by the application of escharotics to the conjunctiva. For this purpose, the nitrate of silver, sulphate of

copper, and the mineral acids, are usually employed. These may be employed in their concentrated forms, by gently rubbing the inner surface of the eyelid over with them. The eyelid is then to be bathed by directing a stream of water over it from a syringe. The application of the escharotic may be repeated in a few days, when the irritation produced by it has subsided. It is not intended, in all cases, that an eschar should be caused by the application of these substances; though this, in some cases, and in a slight degree, along with their astringent effects, tends to promote the cure.

In more aggravated cases, where there is much relaxation of the eyelid, the excision of a portion from it of the form of the letter V,* and the approximation of the cut surfaces, will restore the eyelid to its natural position. This is to be accomplished by means of scissors or a knife; the portion removed being in proportion to the degree of the relaxation and of the eversion. In addition to the removal of a portion of the eyelid, the excision of a portion of the thickened conjunctiva from the inner surface of the eyelid, permits it to resume its place with more facility. The cut edges of the eyelid may be brought together for cicatrization by means of stitches or by small pins and a twisted

* See Plate XVII. Fig. 1.

suture.* The case is then to be treated as a simple wound, by withdrawing the stitches or pins in a few days and applying the usual dressings.

Those cases of eversion of the eyelid caused by a cicatrix, whether of a wound, abscess, or ulcer, are much less favourable for operation than those already mentioned. The operation above described, requires to be performed, after having divided the cicatrix; the eyelid is then allowed to resume its proper position, and must be retained in a closed state, by a bandage round the head and proper dressings, till the wound is healed.

When along with a cicatrix, the eversion is complicated with an adhesion of the eyelid to the margin of the orbit, or when both eyelids are everted, the case presents a still more unfavourable prospect of advantage from the efforts of the surgeon; as, in some of these, a cure, or even amelioration, is attended with the greatest difficulty, in consequence of the want of integument, and the mobility of the eyelid, by which the edges of the cicatrix become again approximated in the process of cicatrization, when not prevented by the greatest attention in dressing it. The above operation may, in some cases, be performed with advantage after the separation of the adhesion from the bone.

* See Plate XVII. Fig. 2.

In cases of eversion of the upper eyelid, where there is much deficiency of soft parts, very little advantage can be gained by operation, unless in the progress of the cure, the elevating force of the levator palpebræ superioris is counteracted by some means of keeping the eyelid closed; for, in the process of cicatrization, a portion of the orbicular muscle being wanting, the lid resumes its former everted position.

SECTION VII.

OF INVERSION OF THE EYELIDS.

WHEN any part of the ciliary margin of either eyelid is turned inwards, so as to project the eyelashes upon the eyeball, the affection is termed, *inversion of the eyelid.** The inversion may be partial, or may extend throughout the whole length of the eyelid. In some cases, only a few of the eyelashes become directed inwards upon the eyeball; in others, an extra number of eyelashes grow out and project towards the eyeball. In each of these cases, the affection causes great uneasiness to the patient, by

* See Plate VI. Fig. 3.

the inverted eyelashes being a constant source of irritation to the eye, upon the slightest motion, either of the eyeball or eyelids. By this means, inflammation of the eye is excited and kept up, which, by its consequences, becomes fatal to vision.

Different causes have been assigned for the inversion of the eyelid. It has been conceived to arise from the relaxation of the skin of the eyelid ;* from a contraction or cicatrix of the conjunctival membrane lining it ;† from thickening of the conjunctiva along with relaxation of the integuments ;‡ from an altered form, or wrong curve in the cartilage of the eyelid ;§ from a morbid contraction of the orbicularis palpebrarum muscle ;‖ and it has also been conceived to arise from a shortening of the aperture between the eyelids.¶

It is not easy to say whether or not any of these causes ever occasions inversion of the eyelid ; or whether several, or all of them, may not, in some cases, have a share in the production of the disease.

When any degree of inversion has taken place, the existence of it produces such a state of the eye, as tends to increase the extent of the disease. The

* Scarpa, Beer, Ware.
† Crampton.
‡ Guthrie, Saunders.
§ Crampton, Saunders.
‖ Crampton, Guthrie.
¶ Guthrie.

state alluded to, is the inflammation of the eye which it occasions, accompanied with a strong contraction of the orbicularis muscle to prevent the admission of light, and the rubbing of the eyelashes upon the inflamed eyeball. The upper eyelid is that most commonly affected with inversion.

Treatment.—When some of the eyelashes have only taken a wrong direction, without any inversion of the margin of the eyelid, their extraction may be sufficient to relieve the patient; for, when they are reproduced they will most probably take their natural direction outwards.

When inversion is caused by a thickened or fungous state of the conjunctiva, the removal of this state by the excision of the diseased portion of the membrane, is first to be performed. If this fails in curing the inversion, it must be treated as the cases about to be described.

In those cases where there is a double row of eyelashes, or an inversion of the margin of the eyelid, the extraction of the hairs can only be a palliative measure, by giving temporary relief. An operation is therefore required, to cause the permanent eversion of the inverted eyelid, to such a degree as will cause a projection of the eyelashes outwards from the eyeball. For, it is only by such an oper-

ation, that the re-inversion of the eyelashes on the eyeball, can be prevented.

To effect this object, different modes of operation have been practised. Among these the application of the actual cautery, the excision of the whole margin of the eyelid, and various other severe operations have been employed. But the simple removal of a sufficient portion of the skin of the affected eyelid, is, in most cases, sufficient for accomplishing the object in view.

It has been shown, in treating of eversion of the eyelids, that a cicatrix, formed by the removal of a portion of the integument, often causes a complete eversion of the eyelid. It is, therefore, easy to conceive, how a lesser degree of eversion to counteract an inversion of the eyelid, may be produced artificially, by regulating properly the quantity of integument removed either by excision or by caustic.

The removal of an elliptical portion of the skin, may be accomplished by pinching it up, and cutting it off by means of scissors,* care being taken not to include any of the muscles. The quantity of integument to be removed is of great importance; for, on the one hand, if too large a portion is cut away, the patient will not be able to close the eyelids af-

* See Plate XVII. Fig. 3.

terwards ; and, on the other, if too small a portion is removed, the inversion of the eyelashes will continue.

When the whole margin of the eyelid is inverted, the portion of the skin removed, is not to be taken from the middle of the eyelid merely, but equally from its whole length, and close to the roots of the eyelashes. The portion to be removed should be laid hold of by forceps, the extremities of which are equal in length to that of the eyelid, and apply to it equally by having a concave form.* By raising the skin with the forceps, and desiring the patient to open and close his eye, the proper quantity to be removed may be ascertained. The portion is then to be removed by means of curved scissors, applying their concave surface toward the eyeball. Three or four stitches are then to be introduced, by which the cut edges are to be drawn together, and small intermediate portions of plaster then applied.† The extremities of the ligatures may be attached to the forehead to assist in keeping the eyelid everted.

When only a small portion of the eyelid is inverted, so that only a small portion of the skin requires to be removed, it may be laid hold of by a pair of common dissecting forceps. The wound is

* See Plate XVII. Fig. 5. † Ibid. Fig. 4.

afterwards to be treated as a common simple incision.

The removal of such a portion of the skin as above described by means of actual cautery, or caustic substances, is a very old practice, and has lately been again revived. But such a method is much more painful and tedious than excision; and it also is less effectual, and leaves a much greater scar upon the part.

When the removal of a proper portion of the integument from the eyelid fails in giving relief, the excision of the roots of the eyelashes that continue inverted, without cutting either the tarsal cartilage or the conjunctiva, as recommended by Mr. Lawrence, should be adopted.*

SECTION VIII.

OF PARALYSIS AND SPASMODIC AFFECTIONS OF THE MUSCLES OF THE EYELIDS AND EYEBALL.

PARALYSIS of the muscles of the eyelids or eyeball, occurs either as a distinct affection, or symptomatic

* See Lancet, Vol. x. Lecture xix.

of disease of the brain. In some cases, it is accompanied with amaurosis, or other disease of the optic nerve or eyeball.

The levator palpebræ superioris, is a muscle that we frequently see affected with paralysis. In this case the patient has a falling down of the upper eyelid, which he can only partially raise by the relaxation of the orbicularis muscle; so that vision is prevented by the eyelid covering the central part of the cornea. This affection has been denominated *ptosis.*

When any of the straight muscles are in a paralytic state, the eyeball is no longer capable of being drawn to the side to which the affected muscle is attached. The patient, therefore, appears to *squint,* as it has been called. This paralysis of the muscle may be partial, the patient being capable of moving the eye to a certain extent; or it may be complete, the patient being unable to exert it. Paralysis of one of the straight muscles, prevents the axis of the affected eye, from being made to correspond with that of the other in vision, as the patient has not the power of directing to the object viewed. This causes the patient to see double when both eyes are exerted, if the axis of the sound eye is not made to correspond with that of the eye affected. If all the recti muscles are paralysed, the eye remains motionless.

Paralysis of the muscles of the eye may be a functional affection, or it may arise from some organic cause.

It often takes place in delicate children from affections of their bowels, and inflammations of the eye. In adults, it is often connected with cerebral disease.

In some cases of paralysis of the parts supplied by the fifth pair of nerves, the iris and other internal parts of the eye become inflamed, the cornea becomes opaque, and the eye wastes.

When paralysis is a local affection—stimulating lotions and embrocations, consisting of camphor, hartshorn and cantharides, with blisters to the vicinity of the eye, should be employed ;—when from disordered bowels, purgatives and other such remedies. Blisters and issues also behind the ear have been of use in some cases.

In the case of ptosis, unconnected with any other disease, the excision of a portion of the skin of the upper eyelid, as in cases of inversion of the eyelid, affords essential relief.

In a case where one of the straight muscles (the abductor) had become paralysed in the course of an acute cerebral affection, and where it continued many months after various means of treatment had been applied, I was agreeably surprised to find some time

afterwards, that the patient had recovered from the affection completely, without any further remedies having been applied.

SECTION IX.

OF CANCER OF THE EYELIDS.

CANCEROUS ulcerations of the eyelids are not uncommon. They begin like a wart, or scirrhus tubercle, which ulcerates and spreads to the surrounding parts. In the course of time, continuing perhaps for years, the ulceration completely removes the eyelids and other soft parts around the eyeball, leaving the coats of the eye denuded and collapsed in some part of the orbit. * In ten cases of this disease, of which I have delineations, this has happened; the coats of the eye appearing to resist the diseased action, but becoming shrivelled and collapsed from a deficiency of the humours. In several cases, the ulceration of the skin extended over a considerable part of the face before death; in one case, excavating the orbit and laying bare

* See Plate VI. Fig. 6.

the nose, the forehead, and spreading downwards to the upper lip. *

For this affection, the complete and early removal of the diseased parts affords the only chance of a cure.

When a part of the eyeball is laid bare, by the removal of a portion of the eyelids, and of the other parts surrounding it, by cancerous ulceration, the excision of the eyeball and other contents of the orbit is rendered necessary. For, although the eyeball continues unaffected with the disease, and continues still capable of performing its functions, its being left in the orbit after the removal of one or both of the eyelids, would not only be a hideous deformity, but it would become a source of great inconvenience to the patient, from the want of its protecting covering.

* See Plate XVI. Fig. 2.

CHAPTER II.

DISEASES OF THE LACRYMAL ORGANS.

SECTION I.

OF INFLAMMATION OF THE LACRYMAL GLAND.

THE lacrymal gland, though often inflamed along with the other contents of the orbit, is seldom affected with inflammation alone.

Inflammation of the lacrymal gland, however, has been observed in scrofulous subjects. In these cases, the gland enlarged and protruded from between the temporal extremity of the eyelids. In some the inflammation has terminated in suppuration, by which a fistulous opening formed, in consequence of the exudation of the tears along with the matter discharged.

SECTION II.

OF SCIRRHUS AND CANCER OF THE LACRYMAL GLAND.

Cases of scirrhus and cancer of the lacrymal gland are not unfrequent. In some cases, this gland alone is affected with these diseases ; in others, it partakes of the disease along with the other appendages of the eye.

This disease is characterized by a chronic enlargement and induration of the gland, accompanied with occasional severe lancinating pain and burning heat in the part. In some cases, an ulceration takes place in the skin covering it, showing a distinctly carcinomatous character, by having an elevated, indurated, and tuberculated margin,—much pain at times,—a foul appearance, and giving out a thin fetid discharge. By slow degrees this ulceration affects the surrounding parts,—the eyelids and other appendages of the eye becoming involved in the disease.*

The lacrymal gland has frequently been removed on account of this disease. Its early removal ap-

* See Plate VI. Fig. 5.

pearing to be the only chance of a cure, and the only means of preventing the neighbouring parts from becoming affected.

The extirpation of the lacrymal gland is not a difficult operation. It is to be performed, by dividing the external angle of the eyelids, by an incision of about half an inch in length towards the temple. The tumour then becomes exposed, and is to be laid hold of with a hook and dissected out. The integuments are then to be brought together by a stitch, compress and bandage; and the cure is afterwards to be conducted as in other similar surgical operations.

SECTION III.

OF OBSTRUCTIONS OF THE LATERAL LACRYMAL CANALS.

THE absorption and passage of the tears to the lacrymal sac, is sometimes prevented by relaxation or obstruction of the lacrymal puncta; or the passage of the tears to the lacrymal sac may be prevented by an obstruction or obliteration of one or both of the lateral lacrymal canals. In either of these cases,

the eye is overflowed by the tears, which pour over the cheek, constituting the disease known by the names of Weeping eye, Epiphora, vel Stillicidium lacrymarum, &c. The obstruction is known to exist in the lateral canals by the sac being empty.

When relaxation of the puncta or of the eyelids, as in elderly persons, prevents their absorbing the tears, the introduction of gentle stimuli and astringents into the eye has a beneficial effect. These may consist of drops of Vinum opii, solution of sulphate of zinc, or of nitrate of silver, made with two or three grains to an ounce of water. These may be dropt into the eye night and morning, and the eyelids may be bathed two or three times a-day with a weak solution of acetate of lead, or sulphate of zinc. When there is any excoriation of the edges of the eyelids, a weak ointment of the red oxide or nitrate of mercury should also be applied.

When the lacrymal puncta are closed, the point of a pin or very small probe may, in general, be introduced into them. When the punctum is rendered pervious, a small probe can then, in most cases, be introduced through the lacrymal canal to the sac. In effecting this, however, the direction of the canal, which is by no means straight, must be humoured. See Plate II. Fig. 2.

These canals only become imperforate from the

healing of wounds, in which cases I am not aware that the passage can be restored; one of the puncta, however, is capable of performing the functions of both.

SECTION IV.

OF ACUTE INFLAMMATION OF THE LACRYMAL SAC AND DUCT.

THE lacrymal sac and duct, are often affected with acute inflammation, from injuries and other accidental causes. In the situation of the lacrymal sac, immediately below the insertion of the tendon of the orbicularis palpebrarum muscle, a circumscribed, hard, and painful swelling arises.* This tumour is commonly of a round or oblong form, tender to the touch, and acquires a redish colour from the integuments over it becoming inflamed. In consequence of the inflammation and swelling of the ducts connected with the lacrymal sac, the tears are prevented from passing to the nose, so that they overflow

* See Plate VI. Fig. 4.

the eye and run over the cheek. Sometimes inflammation of an erysipelatous character affects the integuments around the eye. When the degree of inflammation is great, the patient is affected with symptomatic inflammatory fever.

When this inflammation of the lacrymal sac has continued for a few days, and does not terminate by resolution, a copious secretion of muco-purulent matter takes place from the internal surface of the sac. By this morbid secretion the sac is distended, in consequence of its evacuation being prevented by the swelling of the lacrymal ducts. The sac, therefore, becomes distended to a considerable size, being unconfined by the bone at this part. The tumour enlarges, and proceeds progressively to burst externally through the integuments. The skin becomes more red, tense, and painful, along with a sense of fluctuation in the tumour, after which a yellow spot appears at its apex and the skin gives way;—thus giving passage to the contents of the tumour, through an ulcerated opening formed through the sac, the fibres of the orbicularis muscle, and the skin. By the application of emollient and soothing remedies, the inflammation now declines,—the discharge from the sac becomes diminished, consisting at last only of mucus,—the external opening cicatrizes,—the tears are absorbed by the lacrymal puncta, and

are conveyed through their natural course to the nose.

Acute inflammation of the lacrymal sac may arise from injuries or other accidental causes,—it may take place spontaneously,—or from obstruction of the nasal duct.

Inflammation of the lacrymal sac and duct may terminate either by resolution—effusion of lymph—or by suppuration; the last of which is, in some cases, accompanied with sloughing of the integuments covering the sac.

In some cases, where the patient is of an unhealthy constitution, after the bursting of the tumour, the inflammation continues, assumes a chronic form, and often terminates in a permanent obstruction of the nasal duct; so that the tears and mucus continue to flow out through the ulcerated opening, and the affection degenerates into the disease termed fistula lacrymalis, to be afterwards described.

In some cases of inflammatory tumour in the situation of the lacrymal sac, it is not easy to determine whether the inflammation affects the sac, or is confined to the parts covering it. But this is not of much importance, for whether the abscess forms in the sac, or affects only the skin, the mode of treatment in this state of the disease is the same. This consists in the application of antiphlogistic and

soothing emollient applications, and the evacuation of the matter by the puncture of lancet, when the tumour begins to point. Whether the opening communicates with the sac or not, the introduction of probes and all other causes of irritation are, in this affection, carefully to be avoided, as they would only prove hurtful.

In the early stage of the affection, general and local blood-letting with purgatives, and the application of cooling lotions, consisting either of a solution of the acetate of lead, or the acetate of ammonia should be employed, to promote the termination of the inflammation by resolution. When the termination of the complaint by resolution is no longer to be expected, warm emollient poultices are to be applied to promote suppuration.

Whenever the tumour points externally an opening should be made with a lancet. An opening made in this way, heals more readily,—leaves a less cicatrix,—removes the pain,—and prevents the increase of the tumour and sloughing of the integuments.

The poultices are to be continued after the opening of the tumour, until the pain and inflammation have abated ; after which the application of simple dressings are sufficient to complete the cure.

When a permanent obstruction of the nasal duct takes place, and the opening into the sac becomes

fistulous, the case requires to be treated in the manner afterwards recommended for this affection. See Section V.

SECTION V.

OF OBSTRUCTIONS OF THE NASAL DUCT, ENLARGEMENT OF THE LACRYMAL SAC, AND FISTULA LACRYMALIS.

OBSTRUCTIONS of the nasal duct from inflammation, either acute or chronic, are not of unfrequent occurrence. Such obstructions take place from thickening of the coats of the duct, contracting its diameter, and, in some cases, proceeding to complete obliteration of its canal. The enlargement and inflammation followed by the bursting of the lacrymal sac, generally follows the obstruction of the nasal duct. When an external opening takes place in the sac, the tears mixed with muco-purulent matter are evacuated from it, and this constitutes the disease which is termed *fistula lacrymalis*.

Inflammation and suppuration of the skin covering the sac, is liable to be mistaken for inflammation and suppuration of the sac itself. When the

sac is affected, the tears and matter flow out at the puncta when the tumour is pressed upon, which is not the case when the skin only is affected. Sometimes, however, an abscess of the skin bursts into the sac, as well as externally.

This disease, which is known by the name of fistula lacrymalis, has been divided into four stages or degrees of the complaint.

First Stage, or Chronic Enlargement of the Sac without inflammation.—An enlargement, or preternatural distension of the lacrymal sac, forms a distinctly circumscribed tumour at the inner or nasal angle of the eye, immediately below the insertion of the orbicularis muscle.* When this tumour is not attended with pain or inflammation, it can be completely emptied by pressure with the point of the finger ; the contents of the sac, which consist of tears mixed with mucus, being evacuated either upwards through the puncta lacrymalia, or downwards through the nasal duct into the nose. This pressure, which is necessary for evacuating the contents of the sac, the patient is generally in the habit of employing himself, from time to time, to obtain temporary relief. Pressure being required to empty the sac, shows that

* See Plate IV. Fig. 4.

there is some obstruction of the nasal duct. The distension of the sac indicates the obstruction, while the contents passing down to the nose by pressure, shows that the passage is still pervious. The distended sac often attains a considerable size from its readily yielding at this part, where it is not confined by the bones. The tears, by their passage into the nose being obstructed, after the sac is distended, pass over the cheek, which constitutes a form of the "weeping eye." This state is very inconvenient to the patient, particularly when the flow of tears is increased by exposure to cold air, &c.

This stage of the disease does not constitute a true fistula lacrymalis, for there is no external fistulous opening into the sac. The affection may remain stationary in this state, and advance no further than the first stage; the sac being relieved, from time to time, by the evacuation of its contents by external pressure.

This first stage of the complaint has been described as a distinct disease, and from some has obtained the appellation of hernia, relaxation, and dropsy of the sac.

When the tumour in this first stage of the disease inflames, it passes into or becomes the second stage.

Second Stage.—When the enlarged and distended lacrymal sac inflames, this constitutes the second stage of fistula lacrymalis. The tumour becomes painful and has acquired a red colour, which is often not confined to the circumscribed tumour only, but is diffused over a considerable portion of the surrounding skin; and the surface of the inflamed parts, from the swelling and tension, attains a clear shining appearance.

In this, the second stage of the disease, suppuration very soon takes place; so that purulent matter is effused into the interior of the sac, from the inflamed surface of its mucous membrane. When the contents of the sac therefore are evacuated, either by the puncta lacrymalia, or by an opening made through the skin into the sac, tears mixed with pus and mucus flow out.

When the inflammation of the sac is considerable and has continued for some days, the accumulation of matter within it, makes it point externally like a common abscess; the pain and tension subside, and a sense of fluctuation may be felt in it; after which, it bursts below the angle of the eye and allows its contents to escape, when it is not previously opened by the lancet.

When an opening into the sac has been thus established, the disease has past into its third stage,

which then becomes or constitutes a true *lacrymal fistula.* The tears, instead of passing over the cheek, as in the preceding stages of the disease, are now absorbed by the puncta, carried into the sac, and pass out at the external opening along with the muco-purulent secretion; being prevented from passing down into the nose by the obstruction of the nasal duct.

This affection of the lacrymal sac, which has now been described as the second stage of fistula lacrymalis, may occur without having been preceded by the first stage. See Acute Inflammation of the Lacrymal Sac and Duct.

The second stage of the disease or inflammatory tumour of the sac, is liable to be confounded with Erysipelas, or a simple inflammatory tumour of the skin at that part; for, the pressure, caused by the inflamed skin upon the sac, causes the tears to flow over the cheek. But when, by pressure with the point of the finger, the contents of the tumour can be evacuated through the lacrymal puncta, there can be little doubt of the disease being situated in the lacrymal sac. Because this evacuation of the tumour could not take place, were the tumour distinct and unconnected with the sac, unless a communication existed between the abscess and the sac, in which case, the matter would find its

way more readily into the nose by the nasal duct, than through the lacrymal puncta. In the case of an abscess of the skin opening into the lacrymal sac, the tumour can never again become distended, even though the external opening should close, as the matter will afterwards find its way into the nose. By attention to these circumstances, therefore, an accurate diagnosis may be formed.

Third Stage.—When the tumour of the lacrymal sac has inflamed, suppurated, and been opened or burst externally, the third stage or true lacrymal fistula is formed. The tears and contents of the inflamed sac flow out by the external opening, and its edges become callous, not having any disposition to heal; the cicatrization of the opening being prevented by the continual discharge, unless the passage through the nose is restored. If, upon the inflammation of the parts subsiding, the obstruction of the nasal duct is removed, giving passage to the tears and secretion from the sac, the external opening heals, and the patient gradually gets well. In some cases, the sac fills again, and becomes distended as before. In others, a small part of the opening remains ununited, and allows the fluid from the sac to oose constantly through it. In these last cases, if nothing be applied to the sore, the matter

dries as it exudes, and forms a crust or scab on the opening. The disease is very often in this state when the patient first applies to the surgeon for relief.

When the tumour has burst spontaneously, the opening through the skin is, in many cases, not exactly opposite to that in the sac. This arises from the matter having escaped from the sac, and extravasated into the cellular tissue, before the skin gave way.

When the nasal duct is examined, by introducing a probe through the opening into the lacrymal sac, an obstruction is found to exist. This obstruction varies in degree, from that caused by a slight contraction of the passage by the thickening of its lining membrane, to a complete obliteration of it. The complete obliteration of the nasal duct, constitutes one form of the fourth stage of the disease.

Fourth Stage.—By the long continuance of the second and third stages of fistula lacrymalis, a complete disorganization of the lacrymal sac and duct is produced. The continued inflammation causes the complete closure and obliteration of the passage. When the external opening has continued for some time, the sac ulcerates; a fungous growth issues from interior, and, in many cases, this is accompanied

with a copious discharge of tears and matter, which is often followed by a diseased and caries state of the os unguis.

Chronic inflammation of the conjunctiva and edges of the eyelids, frequently accompanies the different stages of fistula lacrymalis.

From the description of the different stages of fistula lacrymalis which has now been given, it will be evident that they should not be considered as distinct diseases; but as different stages of the same disease, which pass into each other. Each depending on the same cause, the obstruction of the nasal duct.

Cause of Fistula Lacrymalis.—The cause of each of the degrees or stages of Fistula lacrymalis is an obstruction to the passage of the tears, in the nasal duct. The most common cause of this obstruction is inflammation of the lining or mucous membrane of the duct. The inflammation produces a thickening of this membrane; and, as it is confined within a bony canal, the interior of this duct becomes completely filled or occupied, by the thickening of its texture and effusion of lymph; and consequently, it becomes partially or completely obstructed. So that the tears cannot pass down to the nose.

The inflammation causing obstruction of the nasal duct, may be either of an acute or a chronic character. By its continuance, a stricture, or complete obliteration of the passage, takes place.

SECTION VI.

TREATMENT OF OBSTRUCTIONS OF THE LACRYMAL DUCT AND FISTULA LACRYMALIS.

In describing this disease, it has been stated, that by far the most common cause of it, is the obstruction of the nasal duct, occasioned either by contraction, or obliteration of the canal of which it is composed. It is only by directing our efforts, therefore, to remove this obstruction, that the removal of the disease can be obtained. Various modes have, at different times, been recommended and employed for the accomplishment of this object. And not until a very late period, was its true nature and proper treatment distinctly understood.

The treatment of this disease requires to be varied and adapted according to the stage of the affection.

Treatment of the First Stage.—In the first stage of the disease, when there is enlargement without any inflammation of the sac, or complete obstruction of the nasal duct, the patient is frequently contented with the palliative remedy, consisting of the periodical evacuation of the sac by pressure with the finger. This state of the disease may continue for years, without giving to the patient any further inconvenience. He therefore prefers the temporary relief, to any more active treatment for its cure.

The treatment of this stage of the disease by injections, in the manner employed and recommended in 1712 by M. Anel, together with the introduction of small probes into the nasal duct, through one of the lateral lacrymal canals, continues to be employed in the present day. The instruments for this purpose are delineated in Plate XVII.

The injections to be employed should at first consist of water simply, and afterwards of a weak solution of acetate of lead, or sulphate of zinc. But as fluids are absorbed by the lacrymal puncta, these solutions may be introduced into the sac, by dropping them into the inner angle of the eye, having previously emptied the sac by pressure with the finger. When these have been employed for some days without passing into the nose, a small probe is to be introduced through one of the lateral lacrymal canals.

When the point of this probe has been passed so far as the lacrymal sac, its direction requires to be changed, along with that of the lateral canal, from the horizontal to the perpendicular direction. In this position, the probe is to be passed downwards, and a little outwards towards the wing of the nose of the same side. In accomplishing this introduction of the probe, care must be taken not to penetrate through the mucous membrane of the canal with its point, which is necessarily small. This is to be avoided by pulling the probe a little back and changing its direction, when it meets with any resistance before arriving at the seat of the obstruction. When resistance is felt at the obstructed part of the duct, it may, in general, be overcome by gently increased pressure upon the instrument. The introduction of the probe requires to be repeated at intervals of a day or two, and the size of the probe may be gradually increased.

When the obstruction of the nasal duct is slight and inconsiderable, by the repeated introduction of these probes and injections, by the removal of obstruction, the complaint may be cured.

A probe of a larger size than those above described, when bent in a peculiar form, admits of being introduced upwards from the nostril into the nasal duct, when its lower orifice can be obtained with the

point of the probe. To introduce the point of the probe into this orifice, is attended with some difficulty. The point of the probe is to be passed gently backwards upon the mucous membrane at the external side of the nostril, at the fossa between it and the inferior spongy bone, when it will, in many cases, pass into the orifice of the duct. When this can be accomplished, the obstruction may be removed by a few repetitions of the introduction of the probe, along with the injections introduced through one of the lateral lacrymal canals.

When the cure of the first stage of the complaint cannot be accomplished by the methods above described, an incision requires to be made into the lacrymal sac. By this, the case is converted into the third stage of the disease, and is to be treated in the manner afterwards mentioned.

Treatment of the Second Stage.—When the enlarged sac and duct have become inflamed, the case requires to be treated, in the manner already recommended, for acute inflammation of these parts.

If the tumour proceeds to suppuration, and if, instead of getting well, a fistulous opening becomes established, from obstruction and chronic inflammation of the nasal duct, the treatment required, is as follows :

Treatment of the Third Stage.—The disease having become a true lacrymal fistula, requires the restoration of the natural passage of the tears into the nose. This is to be done, by removing the obstruction of the nasal duct. When the acute inflammation has been removed, in most cases, by perseverance, a probe can be introduced downwards from the sac into the nose. When this has been done, all that is necessary, is the introduction of some means of keeping the duct pervious. For this purpose several instruments have been employed. These consist either of a small tube* introduced down into the nose, and left there to convey the tears down; or the introduction of a solid body called a style,† by the sides of which, the tears find a passage downwards.

The introduction of the tube, is an old method lately revived and recommended by M. Dupuytren. The introduction of the style, is that which is almost universally adopted in this country. When the tube is introduced, the skin is allowed to heal over it; when the style is employed, its head remains uncovered, by which it is occasionally withdrawn.

The tube employed, may consist either of lead or silver, made considerably broader at its upper

* See Plate XVII. Fig. 11. † Ibid. Fig. 7.

than at its lower part, to prevent its passing too far down, or shifting its position. By this tube, the cure is complete at first, but its use has been found to be followed, after some time, by inconvenience, from the tube changing its position, and becoming obstructed, so that the disease returns.

The bougie or style may be made of whalebone, catgut, silver or lead, with a head to prevent its passing altogether into the sac. When this instrument is introduced, the sac contracts,—the opening into it diminishes,—the overflowing of the tears is no longer troublesome,—they pass down into the nose, and the patient is restored to comparative comfort and ease. So that, upon the whole, this method of cure is found to be least troublesome and most complete. The style requires to be worn for a considerable length of time, being removed only at times to wash the parts, which is to be done, by means of a small syringe and warm water. Some patients are completely cured by wearing the style for a few months; while others, require to wear it for years. From the little inconvenience it produces, it is better to continue it too long, than to run the risk of a relapse.

Treatment of the Fourth Stage.—When there is a complete obliteration of the nasal duct, prevent-

ing the introduction of a probe into the nose, a sharp penetrating instrument requires to be forced down through the bony canal. By this an opening is formed in the natural course of the duct, which is to be kept open by the introduction of a metallic style. By the use of the style, the duct continues pervious, and the tears are conducted to the nose; the case is then to be treated precisely as one of the third stage of the disease.

When the disease is accompanied with a fungous state of the lacrymal sac, the application of escharotics is required to remove it. When there is also a caries state of the os unguis, as soon as the diseased bone exfoliates, the case is to be treated, in the manner above mentioned, according to the degree of the disease.

SECTION VII.

OF DISEASES OF THE LACRYMAL CARUNCLE.

Several diseases of the lacrymal caruncle have been enumerated, such as tumours and cancer of

this body. Of such diseases I have observed only a few. These consisted apparently of tumours or diseased states of the mucous membrane, of which this body is composed, which were successfully removed by excision.

PART THIRD.

DISEASES

OF THE

EYEBALL.

THE great number and variety of the diseases which affect the eyeball, have been already alluded to. (See page 2.) These for the most part, consist of organic changes in the different parts of the organ, and are most commonly the consequences of inflammation.

In treating of these diseases, therefore, a full account of *inflammation of the eye* will be premised. The various diseases, including inflammation of the different parts of the eyeball, will then be described individually.

CHAPTER I.

OF OPHTHALMIA OR INFLAMMATION OF THE EYE.

SECTION I.

PRELIMINARY REMARKS.

INFLAMMATION may affect the whole eyeball, or it may affect one or more of its component parts. When it affects only one part, the inflammation, in the progress of the case, frequently extends to the parts adjacent to that first affected.

Inflammation of the eye occurs in two distinct states, *active* and *passive*, which are distinguished from each other by a difference in their symptoms.

When the active or acute inflammation is confined to one particular part of the eye, as to the conjunctiva, iris, retina, &c. the disease in each of these parts, is marked by some peculiarity or characteristic symptoms.

Passive or chronic inflammation is, in like manner, commonly confined to some particular part of

the eye; and the chronic inflammation of each part is attended with peculiar distinguishing symptoms.

Inflammation is by far the most frequent disease that affects the eye. And most of the other affections of this organ are the consequences of inflammation, arising either from its violence or improper treatment. This disease, therefore, cannot fail to be considered as one of the greatest importance.

Certain symptoms occur in all cases of active or acute inflammation of the eye, whether it affects the whole eyeball, or only some of its component parts. Certain remedies too, are applicable to each of these cases. The same may be said of the symptoms and treatment of passive inflammation.

It will prevent repetition, therefore, to detail these symptoms and remedies applicable to ophthalmia generally, before describing the inflammations of the particular parts of the eye individually. These general symptoms and modes of treatment are to be kept in view, as applicable to the inflammations of each of the different parts of the eye. By this, when treating of the inflammations of the different parts separately, it will only be necessary, to describe the peculiar or characteristic appearances presented in each, and to mention the special treatment that may be requisite for their alleviation or cure.

SECTION II.

OF ACTIVE OR ACUTE INFLAMMATION OF THE EYE.

1. *Symptoms.*—Acute inflammation of the eye, is characterized by pain in the eye or in some part of the head,—an increased flow of tears,—intolerance of light,—and redness of the eye. Along with these, there is commonly a sense of fulness and increased heat in the organ. One or more of these symptoms may be wanting, and yet the disease may be sufficiently well marked.

Acute inflammation of the eye, particularly when violent or to any considerable degree, is attended with the usual symptoms of inflammatory fever—headach, lassitude, nausea, increased circulation and heat of skin.

Swelling, the common attendant of inflammation, only takes place when the eyelids or parts surrounding the eyeball are inflamed. In these cases swelling sometimes takes place to a great degree.

Redness is not a constant symptom. The internal parts of the eye may be inflamed to a very violent degree without any external redness. The same may be said of intolerance of light, which, at

the commencement of the disease, seldom occurs in proportion to the degree of the inflammation, but depends rather on the nature of the parts affected.

When there is redness of the eye from acute inflammation, the increased blood-vessels, upon minute examination, will appear to be distinct, chiefly small and numerous, having a bright red colour, and not having a tortuous course.

Pain, though a very common symptom of acute inflammation of the eye, is not always present. The pain may be very violent, darting through the head, —it may intermit,—it may amount only to increased heat and uneasiness in the organ,—or it may be wanting altogether, while the inflammation, attended with other symptoms, exists to a considerable degree. The coats of the eye are so unyielding in their nature, that when any of the more internal parts are inflamed the pain is very great.

When the whole eyeball is inflamed, the degree of inflammation is to be estimated chiefly by the degree of pain,—opacity of the transparent parts—intolerance of light, and the presence of inflammatory fever.

In cases where the inflammation is violent, the cornea frequently acquires a dim or turbid appearance, from the increased distension of the eye. This

state makes the patient apprehend that the eye is going to burst.

A dim opaque state of the cornea, may also take place from effusion of lymph or pus into the aqueous humour, or between the layers of the cornea—and it may occur from death and sloughing of the cornea.

2. *Terminations.*—Besides resolution, effusion of lymph or ulceration, acute inflammation of the eye may terminate, as in other parts of the body, in suppuration or sloughing. These last generally destroy the eye by the evacuation of its contents. But organic changes produced by inflammation to a much less extent, may also be fatal to sight. As the most common of these, may be enumerated, opacity, ulceration and staphyloma of the cornea,—staphyloma of the sclerotic coat,—adhesions of the iris to the cornea or lens,—closure of the pupil,—cataract,—diminution or enlargement of the eyeball,—and amaurosis. These consequences of ophthalmia are only to be averted by prompt and vigorous treatment at the commencement of the disease.

3. *Causes.*—Acute ophthalmia may be idiopathic or it may be symptomatic.

The causes of inflammation of the eye may be very various. It may arise spontaneously, or take place from some exciting cause. It is often modified by the cause that has induced it, and other external circumstances, as well as by the nature of the part affected, and the state of the patient's constitution. The cause may be either *local* or *constitutional*.

The most common local causes of ophthalmia, whether idiopathic or symptomatic, are

1. Exposure to excessive heat and light. 2. Cold and moisture. 3. Wounds and other injuries of the eye. 4. The introduction of foreign bodies. 5. The application of acrid substances or acrid vapours to the eye. 6. Intemperance. 7. Contagion, by the application of morbid matter to the eye.

The most common constitutional causes are,

1. The suppression of customary evacuations. 2. General Plethora. 3. Derangements of the alimentary canal.

Acute inflammation of the eye occurs as a symptomatic affection in Small Pox, Measles, Erysipelas, Gonorrhea, Gout, Rheumatism, Scrofula, Cancer, and Syphilis. In many of these cases, it requires to be treated as a local, as well as a constitutional disease. It is also sometimes connected with other Exanthematous eruptions.

SECTION III.

TREATMENT OF ACUTE INFLAMMATION OF THE EYE.

When acute inflammation exists in the eye, the same treatment is generally required, whatever cause may have given rise to the disease. But, when the inflammation has been caused by a foreign substance having got into the eye, this must be entirely removed, before any other means of cure are applied.

If any acrid irritating fluid has got into it, the eye must be immediately washed with tepid water, applied by a syringe or sponge; and a drop or two of almond oil may then be put into it. When the fluid which has got into the eye, is of an *acid* nature, or can be decomposed by lime water, this may be used to wash the eye, if it can be immediately procured.

In the same manner, lime, sand, or other foreign substances, may be washed from the eye. Larger bodies which have got within the eyelids, may be abstracted by means of a probe and forceps, or rubbed off with the point of a hair pencil. Those adhering to the cornea, or imbedded in it, may be

removed by means of the edge or point of a cataract needle; and those which may have got within the eye, when they can be seen, should be abstracted by making an incision in the cornea, and introducing forceps through it.

In all cases of acute inflammation of the eye, the following treatment must be employed, and adapted to the circumstances of individual cases.

The remedy, which is chiefly to be relied upon, is the *General and Local Detraction of Blood*, early resorted to, and repeated according to circumstances; together with strict attention to the other parts of the *Antiphlogistic Regimen*, and to the other *auxiliary remedies* afterwards to be mentioned. On each of these remedies, I shall now make a few remarks in detail, and point out the circumstances by which their application is regulated in practice.

1. *General Blood-letting.*—When the symptoms indicate that the inflammation is violent or deep seated, and particularly when there is increase of pulse and fever along with it, general blood-letting should be employed to an extent proportioned to the severity of the disease, the age, strength, and habits of the patient.

In the case of an adult patient, from *sixteen* to *thirty ounces* of blood may be taken, from the arm,

if he bears the loss of this quantity without fainting; and this bleeding may be several times repeated, at intervals from eight to twenty-four hours, if the violence of the disease continues, and the strength of the patient is sufficient to bear it.*

In the case of an infant affected with ophthalmia, one leech may be applied to each eye, but the bleeding should be immediately stopt by compression, when the leech has separated; and this bleeding may be repeated in twenty-four or thirty-six hours after, according to circumstances.

2. *Local Blood-letting.*—When the patient is weak—when the disease is recent, and not violent—or when it continues after general bleeding has been employed, local bleeding should be resorted to. In this case the blood is to be taken directly from the affected part, or from its immediate neighbourhood.

The *Local* detraction of blood may be effected, by making *Scarifications*, or by applying two or

* In the cure of purulent ophthalmia, it was at one time thought necessary to employ bleedings to the extent of thirty, forty, or even sixty ounces each time: See Edinburgh Medical and Surgical Journal for 1807. But in the generality of cases, from sixteen to thirty ounces is now found to be quite sufficient, more especially since it can be repeated according to circumstances, as often as may be found necessary.

three *Leeches* upon the inner surface of the eyelids, when its vessels are enlarged—by applying six, eight, or more *Leeches* to the forehead,—to the cheek close to the eye, or to the external surface of the eyelids—or it may be done by *Cupping* the temples or nape of the neck.

Scarifications, or the application of leeches upon the inner surface of the eyelids, should not in general be employed, except in cases where the violence of the inflammation has been overcome by other treatment; for, when employed previously to this, they have generally been found to produce hurtful irritation. But they may be highly beneficial in the cases of infants—in slight cases—or where the inflammation has been in some measure subdued, and where some inflammation, with increased vascularity of the conjunctiva, still continues.

The application of leeches to the neighbourhood of the eye, is the most easy and gentle way of abstracting blood, in slight cases of inflammation, where a small quantity may be quite sufficient. They form, likewise, a useful auxiliary to general bleeding, in severe cases. It is preferable therefore, to apply them either to the forehead, immediately above the eyebrow, or to the cheek immediately below the lower eyelid. By apply-

ing them to the forehead, blood is taken directly from the branches of the ophthalmic artery; but the bites do not bleed so freely when the leeches are detached, as they do when they are applied under the lower eyelid, where the skin is more vascular. The application of two or three leeches to the inner surface of the lower eyelid, by everting it with the point of the finger, is attended with much greater benefit than a much larger number applied to the skin. This, therefore, is a mode of abstracting blood very much to be recommended.

The application of the leeches directly upon the external surface of the eyelids, is very liable to excite distressing *Erysipelatous* inflammation of the parts, by which the employment of other remedies is prevented. In some individuals, Erysipelas always follows their application to the skin, but this may often be prevented by applying the leeches to the inner surface of the eyelid.

Cupping the temples is also a very excellent mode of local blood-letting, when a larger quantity is wanted than a convenient number of leeches could abstract, or when leeches cannot be procured.

3. *Antiphlogistic Regimen.*—The other parts of the antiphlogistic regimen, which, in all cases of violent active inflammation must necessarily be at-

tended to, consist in avoiding all *stimulants* to the body, both external and internal—general and local; and in employing artificial means to lessen phlogistic diathesis in the system.

The general and local *external* stimulants to be avoided, are :—

1. External heat, or the accumulation of the internal heat around the body, and particularly that about the eyes.

2. The motion or exercise of the voluntary muscles. And,

3. Light, which acts as a powerful stimulant to the eye.

The general and local *internal* stimulants to be avoided, are :—

1. All kinds of mental exertion.

2. The use of nutritious aliments, and spirituous liquors.

3. Thirst.

4. The accumulation of alimentary matter in the bowels; and,

5. The pain of the local inflammation, which, being in general a source of irritation, and stimulus to the system, is to be moderated by the employment of general and local remedies.

In employing the antiphlogistic regimen, it is not by attention to one or two of the particulars

above mentioned that any beneficial effects will be obtained, but by the observance of them all. And, it is surprising how very slight an irregularity on the part of the patient, is sufficient, in many cases, to retard his cure—to cause a relapse—or an aggravation of the inflammatory affection.

4. *Local Applications.*—The local applications which are useful in acute inflammations of the eye, may be employed either warm or cold, whichever is most agreeable to the feelings of the patient, or gives him most relief.

In the most violent inflammations of the eye, *Warm Applications*, when used at the commencement, and during the first or acute stage of the disease, are generally found to be most useful, and to give most temporary, as well as permanent relief. This is effected by the heat causing relaxation of the over distended and unyielding parts. They consist in fomenting the eye, either with a warm decoction of popy heads—of equal parts of these, and the leaves of hyoscyamus—of camomile flowers,* or merely with warm water alone, by means of a piece of soft sponge or lint. In cases of puriform

* These decoctions are made by boiling *one ounce* of the dried herbs in *three pounds* of water for ten minutes, and then straining the liquor.

ophthalmia, these applications must be frequently injected between the eyelids, by means of a syringe, having a small ivory pipe attached to it. Warm emollient poultices, are also of great use, in many cases of severe ophthalmia.

Warm applications are employed with most benefit after local blood-letting, as they have then a double effect; by promoting the bleeding, as well as tending, of themselves, to allay the inflammation.

Warm applications in the form of *Vapour*, have also been sometimes found to answer very well, in removing the inflammation, pain, and irritability of the eye, when other applications had failed. The vapour employed, may consist of that arising from any of the above fomentations, or from boiling water poured upon a small quantity of camphor and tincture of opium;* and the vapour is applied, merely by holding the eye open, over the vessel in which the hot fluid is contained.

When warm applications are employed, they should be discontinued, whenever a remission of the inflammation takes place, and tepid or cold

* A pint or *pound* of boiling water, may be poured into a vessel containing *one drachm* of camphorated spirit of wine, and one of tincture of opium.

ones should then be substituted; for, when warm applications are continued longer than this, they are apt to cause too much relaxation of the blood-vessels, and thereby to induce passive inflammation.

Cold Applications are highly useful in slight cases of acute ophthalmia; and also in more severe cases, if the patient experiences most relief from them. They are also to be used, after warm applications, as above mentioned.

The cold applications may consist either of a weak solution of acetite of lead—of acetite of zinc, or of sulphate of zinc.* These solutions are best applied, by keeping a small compress of lint, or of linen, wet with them, constantly upon the eye; the wetting of the compress being renewed, whenever it gets the least dry or warm. In some cases, it may be necessary to have the patient's head shaved, and the cold applied over the whole head.

To render these applications more effectual, Ice may be either put into the solution, or applied to the eye.

* The solutions of acetite of lead and sulphate of zinc, are to be made in the proportion of *one grain of the salt to an ounce of water;* and the solution of the acetite of zinc of the Edinburgh Pharmacopæia, diluted with an equal quantity of water. The strength of these should be gradually increased.

Any of the above solutions, or one made with alum,* should be injected between the eyelids, in cases of puriform ophthalmia, after the matter has been washed from the eye with water; and in these cases the solutions may be used either cold or tepid.

It is of much consequence, also, to keep patients affected with acute inflammation of the eye, in a cool, well-aired apartment, from which light is excluded.

5. *Evacuating Remedies.*—There are several evacuating medicines, the administration of which, is often of great importance, in the cure of inflammation of the eye. These are purgatives, emetics, diaphoretics, and blisters.

a. Purgative Medicines.—The frequent administration of purgatives, particularly those of the *saline class*,† is of very considerable importance, both in preventing and diminishing, a phlogistic state of the system, as well as, in lessening the flow of blood to the head.

b. Emetics.—The operation of an emetic, frequently cuts short acute inflammation of the eye, when

* From one to six grains of alum to an ounce of water.

† Sulphate of magnesia, sulphate of soda, tartrate of potass and soda are those usually employed; to any of which a small quantity of the tartrate of antimony and potass may be added.

employed in slight cases, at the commencement of the disease, or in other cases after the employment of blood-letting.

The tartrate of antimony and potass, is most frequently used for this purpose, as it causes much nausea and relaxation of the system, as well as having a purgative effect. Of this, two or three grains may be given dissolved in three or four ounces of water; and half of this dose may be repeated in twenty minutes after, if necessary.

Nauseating doses of the tartrate of antimony, may also frequently be used with advantage, to lessen the force of the circulation of the blood, in violent and obstinate cases of ophthalmia, after the employment of other remedies has been ineffectual.*

c. Diaphoretics.—In acute inflammation of the eye, when there is any febrile affection of the system; when the disease has arisen from cold, and is attended with rheumatic pains; or when it is accompanied with catarrh, the administration of diaphoretic medicines is attended with much benefit.†

* The tartrate of antimony to produce nausea, is usually given in the dose of a fourth of a grain dissolved in water, and repeated every half hour, till the effect is produced.

† The Diaphoretics should be selected chiefly from those of the antimonial preparations. Frequent doses of the powder of antimony, either alone, or combined with calomel, is perhaps the best.

d. Blisters.—When the inflammation continues obstinate after the employment of the above remedies, the application of blisters may be used with benefit. They may be applied either to the forehead and temples, or, which is preferable, either to the nape of the neck, or behind the ears ; for, when applied to the forehead and temples, they might prevent, for some time, the local detraction of blood which may afterwards become necessary.

6. *Puncture of the Cornea.*—The evacuation of the aqueous humour, by a puncture of the cornea, was first proposed by Mr. Wardrop,† from whose observations it appears, that it may be performed with very great benefit in all cases of violent acute inflammation of the eyeball, and particularly when they resist other treatment. This operation is indicated when the pain is very intense, accompanied with a sense of fulness in the eye, or a feeling as if the eye was going to burst ; and also, when the eye, either from its prominence, or from a whitish turbid appearance of the cornea, appears to be very much distended.

† See original papers upon the subject by Mr. James Wardrop, in the Edinburgh Medical and Surgical Journal for 1807. And Medico-Chirurgical Transactions, vol. iv.

This operation is easily performed by introducing the point of a common lancet, or cornea knife, through the cornea into the anterior chamber, at a small distance from its margin; the instrument is then to be turned round a little upon its own axis, so as to allow the fluid to escape more readily by the sides of it. A cataract needle may also be used for the same purpose.

Other circumstances, besides those mentioned, may demand the puncture of the cornea; as when effusion of blood or purulent matter takes place into the aqueous humour. By this operation the pain from distension may be removed, and bursting of the eyeball prevented.

When the inflammation is only slight, or when it has so far abated, as not to require the constant application of any of the above local applications, and when the eye can, with impunity, bear some degree of light, a dark green or black shade may be used. It should be constantly worn over both eyes for some length of time, care being taken not to keep the eyes too warm, by its being worn close upon them, which would be very prejudicial.

When the inflammation is confined entirely or chiefly to one particular part of the eye, as to the conjunctiva, cornea, iris, &c. in addition to the

above, the treatment afterwards mentioned for inflammation of these parts individually, is also to be employed.

When the inflammation has been removed, the strength of the eye should be restored by the frequent application of the cold astringent solutions formerly mentioned, or of cold water simply. And when necessary, the strength of the system must be restored upon general medical principles, not forgetting the use of the shower bath.

When acute ophthalmia terminates in passive inflammation, ulceration of the cornea, or any of the other affections of the eye, the appropriate remedies are to be employed for these states.

SECTION III.

OF PASSIVE OR CHRONIC INFLAMMATION OF THE EYE.

PASSIVE or chronic inflammation of the eye is not attended with acute pain, nor with any considerable degree of intolerance of light or increased lacrymation. The patient either has no pain, or complains of it only at times, as consisting of a dull soreness or uneasiness in the eye. The disease generally be-

comes chronic, and continues for a long time nearly stationary; or it proceeds by slow and almost insensible degrees to disorganize the parts affected, or to produce other important changes in them. The patient in some cases, when the internal parts are affected, being sensible of the complaint only from his sight becoming gradually more and more impaired. The disease in many cases has frequent states of excitement, or increased action amounting to acute inflammation; these attacks, however, are generally not of long duration.

Inflammatory fever does not attend this affection, though in young and irritable subjects periodical feverish attacks are not unfrequent. It is very often attended by symptoms showing a deranged state of the digestive organs, consisting of foul tongue, loss of appetite, irregularity of bowels, &c.

The morbid appearances in passive or chronic inflammation of the eye are quite peculiar. When the exterior of the eye is affected, the increased vascularity appears to be greater and of a deeper red colour than in cases of acute inflammation. When it follows acute inflammation, the redness becomes much increased, in consequence of the enlargement and turgescence of the vessels from relaxation. The vessels being in a state of relaxation and turgescence, also makes them become tortuous in their course.

That the vessels are in an atonic or relaxed state is proved, by remedies restoring them to their natural state, which always aggravate acute inflammation, as well as by the other symptoms. These remedies are quite of an opposite nature to those which are useful in acute ophthalmia, for they consist of stimulants, nourishing diet, &c.

When the more internal parts of the organ are affected, pain, impaired vision, along with opacity of the cornea, or humours of the eye—adhesions of the iris to the lens—closure of the pupil or opacity of the retina, mark the progressive and destructive effects of chronic inflammation going on in the eye.

Chronic inflammation commonly takes place in some particular part of the eye, without the rest of the organ being affected.

Chronic ophthalmia frequently takes place without any evident cause; and it is modified by the peculiar circumstances in the constitution of the patient, either natural or acquired. It is also very often symptomatic of some constitutional affection; or it may be the consequence of acute inflammation. It occurs as a sympton of rheumatism, gout, scrofula, cancer, and syphylis. And, it is always aggravated, as well as sometimes produced, by derangement of the digestive organs.

SECTION IV.

TREATMENT OF PASSIVE OR CHRONIC INFLAMMATION OF THE EYE.

CHRONIC inflammation of the eye, commonly arises from, or depends upon, some particular state or affection of the constitution. The constitutional treatment of it, therefore, requires particular attention. Local remedies are also to be applied, according to the form of the disease and particular part of the eye that is affected. These shall be afterwards mentioned, when treating of chronic inflammation of particular parts of the eye separately.

The treatment required, when chronic ophthalmia has taken place from impaired general health, delicacy of constitution, or from derangement of the digestive organs, is chiefly to be directed to the removal of this state. Hence, the regimen and remedies recommended by Mr. Abernethy for this purpose, are most commonly employed, and in many cases with complete success. These consist in a moderate nourishing diet, taken at proper intervals; carefully avoiding high seasoned food and spirituous liquors. Particular attention to proper exercise, is also of great importance. Along with these, tonic,

and the milder purgative, medicines ought to be used. Small doses of calomel, or blue pill, along with a few grains of rhubarb, so as gently to affect the bowels, are of particular use. Their beneficial effects are peculiarly manifest in young subjects. By their use, in a few days, a very favourable change may be observed in bad and obstinate cases of chronic ophthalmia. By this treatment, such cases, in general, soon become wonderfully changed to the better, and go on progressively to recover. In some cases, the blue pill with compound extract of colocynth or neutral salts, may be substituted with advantage, for the remedies above mentioned.

To prevent the mercury in the above medicines from affecting the mouth, when continued for any length of time, the compound rhubarb pill, or magnesia and rhubarb, may be substituted.

The use of diaphoretics—the warm or cold bath —the application of blisters or issues to the temples or nape of the neck, may also be used with advantage, particularly in cases where there is great irritability either of the organ, or of the constitution.

When chronic ophthalmia is symptomatic of another disease, as of rheumatism, gout, scrofula, or syphylis, the treatment must of course be directed to the affection of which it is a symptom, as well as, to the state of the eye.*

* See Iritis, and Strumous Ophthalmia.

When the states of excitement, that are so apt to occur, take place to a violent degree, the application of leeches, or the division of some of the enlarged vessels, and other antiphlogistic remedies, may be required.

In many cases of chronic ophthalmia, when the more external parts of the eye are affected, much benefit is derived from the use of local applications. These, however, it is unnecessary at present to particularise, as they will be fully pointed out, when the affections of the different parts to which they are applicable, are treated of individually.

CHAPTER II.

DISEASES OF THE TUNICA CONJUNCTIVA.

PRELIMINARY REMARKS.

THE tunica conjunctiva, or mucous membrane which covers the anterior part of the eyeball and inner surface of the eyelids, is subject to the same diseases which affect the mucous membranes in other parts of the body. Of these, inflammation is by far the most common, and it is also the most important, on account of the greater number of the other affections of this membrane, being the consequences of inflammation.

SECTION I.

ACUTE INFLAMMATION OF THE TUNICA CONJUNCTIVA.

ACUTE inflammation of the conjunctiva is of two distinct kinds. The one consisting of a simple in-

flammation of the membrane; the other is, in addition, attended with a copious effusion of purulent, or muco-purulent matter from the inflamed surface. Hence, the one is called *simple*, the other *purulent* inflammation of the conjunctiva.

When acute inflammation affects that part of the conjunctiva which covers the *Cornea*, peculiar symptoms and effects are also produced.

Each of these three different forms of acute inflammation of the conjunctiva therefore, will be treated of separately.

1. *Of Simple Acute Inflammation of the Conjunctiva.*—Simple acute inflammation of the conjunctiva generally takes place either spontaneously or from some exciting cause, such as injuries upon the eye, the introduction of foreign substances, intemperance, and the like.

The simple acute inflammation of the conjunctiva is attended with the usual symptoms of acute ophthalmia, viz. pain, redness, increased heat, lacrymation, and intolerance of light, to a greater or less degree. The pain and fever, are not so great as in the inflammation of the deeper-seated parts of the eye, or when the disease is of the purulent kind. It is not attended with swelling of the eyelids; and although there is usually a muco-purulent discharge

from the eye along with the tears, the quantity effused is very inconsiderable.

In simple acute inflammation of the conjunctiva, the enlarged vessels, which then carry red blood, seem to come from the fossa palpebrarum, or that part, where the conjunctiva is reflected from the eyeball upon the eyelids;* they are superficial, and therefore appear larger and more distinct, than when they belong to a more deeply seated part; and they may be easily moved by moving or stretching the membrane. All these enlarged red vessels, appear to run towards the cornea, some of them taking a course nearly in straight lines,—some are more winding and tortuous,—while others run in a slightly zig-zag or angulated course; and they generally send off numerous branches, at acute angles, in different directions, as they proceed. Their smaller and more numerous branches may be often seen to cross over, and at other times to inosculate freely with each other, upon the conjunctiva, producing an appearance of fine net-work. But, when they are very small and numerous, they present a uniform red appearance.†

* See Plate VII. Fig. 1.

† These vessels were at one time considered to be new productions; but this is impossible. For, we can occasion them to appear, by the application of stimulants, in a few seconds. By blood-letting or syncope they disappear as readily as they can be produced.

The largest of these conjunctival red vessels proceed towards the cornea, dividing into smaller and more numerous branches as they advance, till their minute extremities at last disappear at the margin of the cornea; and, unless that part of the conjunctiva which covers the cornea, be the chief seat of the disease, or partake in the general inflammation of the conjunctiva, they never extend over the cornea. The cornea, however, assumes a dim or muddy appearance, which produces more or less indistinctness of vision.

2. *Of Purulent Inflammation of the Conjunctiva.*—The purulent or puriform ophthalmia takes place only from some specific cause; as, when it occurs *symptomatic* of small-pox, measles, or erysipelas,—or when *idiopathic*, from infection, as in purulent or Egyptian ophthalmia, gonorrheal, and infantile purulent ophthalmia. These last, probably take place, only by the application of morbid virus to the eye. The infantile purulent ophthalmia, has been considered to arise from the contact of the matter of *fluor albus*, imparted from the mother at the time of birth.*

* It is deemed quite unnecessary here, to enter into those controversies which have been agitated, regarding different points of secondary importance, connected with these purulent inflammations of the eye. How Egyptian, may be distinguished from Gonorrheal ophthalmia,—and whether they are of a contagious nature, or arise from other

Those affections of the eye, which are called Purulent Ophthalmiæ, of the different kinds already mentioned, are affections almost entirely of the tunica conjunctiva, from which the pus is copiously secreted. The degree of inflammation which takes place in these puriform affections, is, in general, very great; and the inflammation often spreads to the adjacent parts, so as to occasion abscess or sloughing of the eyelids,—disorganization of the internal parts of the eye,—opacities, ulceration, sloughing, or staphyloma of the cornea,—and suppuration of the eyeball; so that the ravages by these diseases have been truly dreadful, the humours being evacuated, in many cases, by the bursting of the eye, which then collapses and becomes quite destroyed.

When the inflammation of the conjunctiva is of the purulent kind, the eyelids are so much swollen in the first stage of the disease, that it is often impossible to see the eyeball in a satisfactory manner, even by using a speculum, and tearing the eyelids open. This practice, though recommended by some, may occasion much harm by the irritation that is thereby excited.

causes, and the latter from *metastisis*, have been keenly disputed. These points, I conceive, have been long ago completely settled. I have said, they are points only of *secondary importance*, because, the phenomena and consequences of the inflammation, are the same in each, and they require the same mode of treatment.

Minute inspection of the eyeball, however, is not of much consequence, as the continuance and the degree of violence of the inflammation can be well enough estimated from other circumstances—by the degree of swelling, tension, and brightness of the red colour which are visible upon the external surface of the eyelids—by the pain and heat in the organ —and, by the discharge from the eyelids, which, in the first stage of the disease, consists chiefly of tears. When the violence of the inflammation is over, the disease passes into the second or suppurative stage; the eye discharges purulent matter; the above symptoms diminish; and, when the degree of inflammation has been great, and has not been cut short by the remedies employed, the eyeball, which can then be examined, very frequently exhibits the appearance called *Chemosis.**

The effect of the inflammation upon the cornea, and internal parts of the eye, if it has produced any bad consequences, will then be seen, and will require the attention of the surgeon according to circumstances.

When purulent inflammation of the conjunctiva does not terminate by resolution, the most common consequences of it are, chronic inflammation, opacity, ulcer, and sloughing of the cornea, with adhe-

* See Plate VIII. Fig. 1 and 2.

sion, prolapsus of the iris, styphyloma, or suppuration of the interior of the eye. These, however, are each to be considered as distinct diseases, and treated accordingly.

3. *Of Acute Inflammation of Conjunctiva of the Cornea.*—When the conjunctiva covering the cornea is the seat of acute inflammation, the affected part becomes opaque, and enlarged red vessels are seen passing from the white part of the eye directly to the opacity.* These run nearly in a straight direction to the cornea, and then divide into numerous minute branches upon the opaque part. This vascular opacity begins at the margin, proceeds gradually towards the centre of the cornea, and sometimes extends even beyond this.

The cornea becomes thickened, and the disease often passes into a chronic state. The enlarged vessels are quite superficial, so that they can be easily raised from the sclerotic coat, along with the conjunctival membrane.

* See Plate XI. Fig. 1.

SECTION II.

TREATMENT OF ACUTE INFLAMMATION OF THE TUNICA CONJUNCTIVA.

SIMPLE acute inflammation of the conjunctiva generally terminates in resolution. The consequences of it however may be more serious, as by continuing, or spreading to other parts, it may materially impair or destroy vision. It, therefore, requires the vigilant and attentive application of the antiphlogistic treatment and other remedies, consisting of bleeding, purgatives, low diet, &c. as recommended for acute ophthalmia at page 174. But great care must be taken to substitute the cold for the warm applications, whenever the violence of the disease is subdued; for, when this is not done, the inflammation is very apt to assume the passive or chronic state, which is generally more difficult to be removed than the active state.

When the inflammation is of the *purulent* kind, particular care must be taken, frequently to inject the fluids formerly mentioned, at page 180, between the eyelids, and to change the warm for cold applications. In addition to this, it is in general necessary, after washing them, to besmear the edges of

the eyelids with some mild ointment,* to prevent their adhering together, in consequence of the evaporation of the matter which exudes.

In cases of purulent ophthalmia, where the conjunctiva is much swollen and protruding from between the eyelids, it has been the practice in the army, to remove considerable portions of it with scissors. The relief thus produced is very great. And, though the portions removed, appear to be considerable in their swollen state, very little of the natural membrane is cut off. Leeches may also be applied to the tumified conjunctiva, with great benefit. When the conjunctiva of the cornea is particularly affected, the division of the enlarged blood-vessels going to the inflamed part, is of great importance.

SECTION III.

OF PASSIVE OR CHRONIC INFLAMMATION OF THE CONJUNCTIVA.

THE inflammation of the conjunctiva may be of a passive or chronic character from its commencement,

* Unguentum Oxidi *Zinci* Albi, is the one most commonly employed.

or it may follow acute inflammation by gradually passing from the active into the passive state. It varies in degree from a few enlarged vessels upon the eyeball or inner surface of the eylids, to the distressing states about to be described.

1. *Of Passive Inflammation of the Conjunctiva, consisting simply of increased Vascularity of the Conjunctiva.*—Passive inflammation of the conjunctiva, may consist of increased vascularity of the sclerotic part of this membrane, and that which lines the eyelids, without that of the cornea being affected. The inflamed vessels have then a deep red colour, inclining to purple, are often tortuous in their course, and have a turgid appearance, without symptoms of acute inflammation being present. In some cases, a rupture of some of these vessels, appears to take place, blood being effused beneath the conjunctiva. The conjunctiva has a relaxed appearance, and forms into folds. The patient experiences the sensation of dust or sand existing in the eye, and a feeling of weakness in it.

2. *Consisting of increased Vascularity, accompanied with Pustules, or Opacity of Cornea.—Strumous Ophthalmia.*—When passive inflammation of the conjunctiva, is not the consequence of acute ophthalmia, it is generally of a pustular character,

taking place commonly in subjects of a delicate or irritable constitution. This form of the disease has been denominated *Strumous Ophthalmia.* It is most common in young subjects; and is frequently confined, only to a small part of the conjunctival membrane.

Several distinct and important affections of the eye, have been included under the term of Strumous or Scrofulous Ophthalmia, from each of them being either caused, or kept up, by that peculiar state or disposition of the constitution termed *scrofulous.* The disease, in each of the different forms alluded to, is no doubt modified by the same cause, but it is necessary to distinguish them from each other, in order that the proper treatment may be adopted.

The different forms in which scrofulous ophthalmia appear are,—Chronic inflammation of the conjunctiva simply.—Inflammation of the eye, the same as that last mentioned, attended with opacity, pustule, or ulceration upon the cornea, and in some cases, with adhesions and prolapsus of iris.—And, excoriation, pustule, and ulceration of the edges of the eyelids.*

Each of these forms of ophthalmia, are primarily affections of the conjunctival membrane. They may

* This last has been already treated of as an affection of the eyelids. See page 115.

either exist separately,—two of them may be conjoined,—they may each occur in succession, or they may all exist at once in the same subject. They take place most commonly in young subjects. They may occur without any evident cause; or they may supervene to an attack of inflammation of the eye of another description, as that from an injury, small-pox, measles, &c., which is the most common case; the inflammation with which the eye has been affected, passing insensibly into the scrofulous ophthalmia, or becoming modified by this state of the constitution.

Strumous ophthalmia most commonly depends upon a debilitated or relaxed and irritable state of the constitution; and consequently, in its progress, it undergoes many sudden changes upon the slightest cause, either of excitation or depression, arising from variation or irregularity of diet, of weather, or of any other external circumstances which affect the constitution. It is in this respect, that strumous chiefly differs from simple inflammations of the eye; the morbid appearances presented, in many cases, being nearly the same in each. This is further obvious, by the circumstance of a constant recurrence of the strumous ophthalmia taking place, when it has been cured by the same remedies which are employed for simple inflammation of the eye,

unless the peculiar state of the system is, in some degree, obviated.

Each of the forms of scrofulous ophthalmia, that have now been mentioned, has an acute stage, which, though sometimes of very short duration, differs in no respect from acute inflammation of the conjunctiva already described.* Or, an attack of acute inflammation from any other cause, may form the first stage of the scrofulous ophthalmia. It is only in the second stage, therefore, when it becomes chronic, of a distressing and untractable nature, along with other circumstances connected with the appearance and constitution of the patient, that its true nature is evident.

The most important and most common form of strumous ophthalmia consists of inflammation of the passive kind; having, at the same time, frequent states of excitement, relapses, or recurrences of acute, which alternate with the passive inflammation. These acute states are seldom very violent, but frequent, taking place every two or three days; and, when it abates, it leaves the vessels of the conjunctiva in an enlarged and relaxed state, accompanied, in many cases, with opacity or ulceration of the cornea.

* See page 193.

The passive inflammation is known, by the eye having a highly vascular appearance, extending either over the whole, or only a part of it. This increased redness of the eye, though sometimes attended with considerable tenderness to the light and lacrymation, is not accompanied with that pain and heat which exists in the organ, when the inflammation is of the acute kind. It also continues for a long time nearly stationary, when proper remedies are not applied.

When the disease is of the pustular kind, small vesicles or pustules, resembling aphthæ, appear most commonly about the margin of the cornea, sometimes upon the white part of the eye, and at other times, although more rarely, upon the cornea itself.* Distinct plexuses of red vessels may, at the same time, be seen upon the conjunctiva, running towards these aphthæ, when there is only one or two; but, when the aphthæ are numerous, and surround the cornea, the increased vascularity upon the white of the eye, is then more general. The inflammation, which accompanies these pustules or aphthæ, is generally of the passive kind; the red vessels then appear to be larger, more tortuous, and of a deeper colour than in acute inflam-

* See Plate VII. Fig. 2.

mation, and there is no intolerance of light. Sometimes the pustules burst externally, but they may, in general, be removed without doing so.

In some cases the cornea is much affected, it becomes opaque, and the pustules upon it, pass into ulcerations.

In children affected with this disease, the intolerance of light is sometimes very considerable; and it is much greater than is easily accounted for by the external appearances.

Strumous ophthalmia frequently occurs in the form of excoriation or ulceration of the edges of the tarsi. The edges of the eyelids have a red excoriated appearance, sometimes small pustules and ulcerations exist, accompanied with an exudation of gummy matter, which, by drying, makes the eyelids adhere to each other. This state frequently accompanies the preceding forms of the disease. When it continues for some time the eyelashes fall out.

3. Consisting of Increased Vascularity, Thickening of the Conjunctiva and other states from Puriform Ophthalmia.—When chronic inflammation of the conjunctiva follows any of the purulent ophthalmiæ, it presents a very different appearance from those already described.

In many cases of purulent ophthalmia, when the acute stage of the inflammation abates, the sclerotic conjunctiva assumes a bright red, granulated, villous, or fungous appearance, termed *Chemosis.** This state is produced by the thickening and vascularity of the conjunctiva and œdema, or serous effusion into its cellular texture, but no distinct enlarged vessels can be readily distinguished upon it. In cases of this description, the conjunctiva lining the eyelids, likewise partakes of the inflammation, and presents the same vascular, villous, or granulated appearance ;† and the conjunctival membrane is sometimes so much increased in thickness, that it protrudes from between the eyelids, in the form of a large fungi. Along with this, the chambers of the eye may be filled with purulent matter, from suppuration within; or the cornea may be opaque and vascular, or in a state of sloughing or ulceration.

By passive or chronic inflammation of the sclerotic and corneal conjunctiva, the cornea is always rendered more or less opaque; generally it has a

* See Plate VIII. Figs. 1 and 2. These granulations in chemosis, however, are not the same as those seen upon ulcerated surfaces, for, in chemosis, there is no ulceration, although there is a secretion of pus. There is, in general, no breach of the mucous membrane.

† See Plate VIII. Fig. 3, in which the upper eyelid is turned inside out.

dim or clouded appearance, which is called *nebula.** In this case the conjunctival covering of the cornea becomes thickened, and loses its polish and transparency. In some cases, this superficial opacity or nebula, is diffused equally over the whole cornea; in others, it is only partial. Those parts of the cornea which are not nebulous, are in some cases transparent, while in others, some of these parts, instead of being transparent, have a greater degree of opacity than the nebulous parts.

In passive inflammation of the conjunctiva of the cornea, vessels of a deep red colour, and of a very considerable size, may in general be seen passing over the sclerotic conjunctiva, and ramified upon the corneal conjunctiva.† These have generally, more or less, a tortuous course, and they send off numerous branches as they proceed, some of which, cross over each other, while others inosculate freely upon the cornea.

In passive inflammation of the sclerotic conjunctiva, the part of this membrane which lines the eyelids, very frequently partakes of the disease; particularly that upon the inner surface of the lower eyelid, which generally appears much thickened,

* Passive inflammation, with nebula of the cornea, is well seen in Plate VII. Fig. 2, and Plate IX. Fig. 1.

† See Plate IX. Fig. 1.

having a deep red villous appearance, from being covered with enlarged turgid red vessels.*

The chronic or passive inflammation of the conjunctiva of the eyeball, is very frequently kept up by the morbid state of that part of the conjunctiva which lines the upper eyelid. In such cases the lining membrane is much thickened from attacks of inflammation, and presents a fungous, or granulated appearance ;† and the granulations or morbid eminences, sometimes assume even a cartilaginous appearance and hardness. The friction of these upon the eyeball, keeps up the diseased state, both in the sclerotic and corneal conjunctiva, sometimes for months, and even years.

The same chronic inflammation is also frequently kept up by inversion of the eyelids, in consequence of which the eyelashes are turned in, and made to rub upon the eyeball, thereby producing constant irritation.

In cases of passive inflammation of the conjunctiva, vision is impaired in proportion as the corneal conjunctiva is affected.

* See Plate IX. Fig. 1. † See Plate VIII. Fig. 3.

SECTION IV.

TREATMENT OF PASSIVE OR CHRONIC INFLAMMATION OF THE CONJUNCTIVA.

THE *Constitutional* treatment required for this, as well as for passive inflammation of other parts of the eye, has been already fully detailed. See page 190. The *Local* treatment necessary for passive or chronic inflammation of the conjunctiva, therefore, shall now be particularly pointed out, as applicable to the different forms of chronic ophthalmia which have now been described.

Passive inflammation of the conjunctiva, requires treatment of a different and even opposite nature, from that of acute inflammation; for the vessels of the part affected, being in a state of relaxation, the application of astringent, stimulant, or escharotic substances, is required to restore them to a healthy state.

1. When passive inflammation is in the form of increased vascularity and *relaxation* of the conjunctiva of the eyeball and eyelids, the removal of it may be effected by dropping into the eye, either

the wine of opium,*—a weak solution of the nitrate of silver,† or sulphate of copper, every night, or both night and morning. These applications frequently require to be varied; for, when their employment is continued for a length of time, they lose their effect, so that others must be substituted. The applications which may be substituted, are, the ointment of the red oxide of mercury—drops, consisting of a solution of the muriate of mercury, either alone, or combined with a small quantity of the wine of opium,‡—or the extract of lead, either pure or diluted.§ Along with these, the use of cooling astringent collyria is highly beneficial. These should consist of a solution either of acetite of lead, sulphate of zinc, or super-sulphate of alumina, in the proportion of one or two grains to an ounce of water.

* When remedies are mentioned without any particular proportions being given for making them, they are to be understood as those of the Edinburgh Pharmacopœia.

† The solution of nitrate of silver to be dropt into the eye, may be made with from *one to six grains* to *an ounce of water*.

‡ For the purpose above mentioned, the solution of muriate of mercury may be made with from one to five grains of the salt, to an ounce of water, with the addition of one or two drachms of the wine of opium.

§ The liquor acet. plumbi answers very well, diluted with two or three parts of water, and having a small quantity of wine of opium added to it.

When the passive inflammation of the conjunctiva is accompanied with profuse discharge of matter, as in the second stage of purulent ophthalmia, the solutions of alum, sulphate of zinc, or sulphate of copper may be also used with advantage. These should be weak when used as injections, and stronger when dropt into the eye.

When the conjunctiva of the lower eyelid is covered with large turgid red vessels, they should be divided, by drawing the point of a scarificator quickly over them. The same may be done upon the eyeball when the disease is confined only to a small part.

2. The management and cure of *Strumous Ophthalmia* is often attended with the utmost difficulty; and even when it is cured, vision is often left more or less impaired; or it leaves the eye in an extremely weak and irritable state. The treatment of it requires the greatest and most constant attention and perseverance—frequent alteration or variation of the remedies employed, according to the changes which take place in the disease, besides attention to the general health of the patient.

The treatment of the first stage of the disease, differs in no respect from that of the acute inflammation already described, with this exception, that

whenever a remission of the acute stage is observed, tonic, astringent, and stimulating remedies must be used to prevent, if possible, the great degree of relaxation and passive inflammation which soon follow, forming the second stage of the disease.

The remedies to be used in the second stage of the disease, are, tonic, astringent, and stimulating applications to the eye; accompanied with such remedies and regimen internally, as will prevent the occurrence of a relapse, which is the most troublesome and distressing circumstance, in such cases, as also the one which it is most difficult to obviate.

The applications to the eye, should, at first, consist of a weak solution of alum or sulphate of zinc, either alone, or having a small quantity of the *vinum opii* added to it. These should be gradually increased in strength from one to eight grains to an ounce of water, and they should be varied with other applications of the same kind. Such as drops of the vinum opii alone, a weak solution of the sulphate of copper, muriate of mercury or nitrate of silver,*—ointment of the red oxide of mercury, white oxide, or nitrate of mercury.

When a relapse or recurrence of the acute inflammation takes place, these remedies must be

* One or two grains of any of these to an ounce of water, either alone or with the addition of a small quantity of vinum opii.

omitted, and either warm fomentations or a simple cold solution applied to the eye. Bleeding, in these relapses, as they are slight, is seldom necessary, and might increase the tendency to relapse in future; so that when the relapse is frequent and severe, a blister should be applied to the back of the neck or between the shoulders. Antimonial diaphoretic medicines, the warm bath, doses of calomel and rhubarb, or blue pill along with rhubarb, or neutral salts, are also highly beneficial.

The patient, in the second stage of the disease should get a moderate allowance of animal food. He should also get some of the above medicines to keep his bowels freely open, and excite gently the alimentary canal. Peruvian bark, or sulphate of quinine, muriate of lime, chalybeate mineral waters, gentian, colombo, sulphuric acid, warm clothing, exercise in the open air, with the use of the cold or shower bath, may also be used with much advantage in curing the disease, and in obviating the tendency to relapse. Scarification or division of the enlarged vessels may be necessary, and attended with benefit.

The eyes should not be confined or tied up, as this tends much to increase the irritability of the organ when exposed to the light or air. A large

shade should therefore be worn, made of thin pasteboard, and covered with green or black silk.

When the cornea is opaque or ulcerated, the same plan of treatment is necessary, touching the ulcer occasionally with a pointed piece either of nitrate of silver or sulphate of copper, when the healing process appears to become languid.

When the edges of the eyelids are affected with an exudation of gummy matter, the ointment of the white oxide of zinc should be frequently rubbed over the edges of the eyelids, after washing them, to prevent their adhesion. When there is excoriation or ulceration of the tarsal edges, the ointment of the red oxide or nitrate of mercury ought to be applied, after washing the parts.

General constitutional treatment, I have always found to be of much more consequence, in curing strumous ophthalmia, than local remedies. The most troublesome circumstance, the tendency to relapse, spontaneously or from very trivial causes, is to be obviated by invigorating the general system, by the treatment above mentioned; and, when the circumstances of the patient admit of it, by residence in a more genial climate during the winter months.

By attention and perseverance in the above treatment—to the diet and digestive organs of the pa-

tient, many severe and unpromising cases of strumous ophthalmia may be cured and vision restored.

3. When the eye is in the state of *Chemosis* following purulent ophthalmia, the remedies to be applied are those recommended at page 211, by the use of which, the conjunctiva gradually assumes its healthy state.

If the conjunctiva has the relaxed and tumified appearance, represented in Plate VIII, Fig. 1, the application either of nitrate of silver or sulphate of copper very speedily removes it. Either of these substances, is to be passed along the surface of the swelling, so as to produce only a very superficial eschar; for, they remove the swelling by acting as stimulants exciting the absorbents; their being made to cause the death of the part, therefore, is not necessary. Immediately after the application of the caustic, the part is to be well washed with tepid water, poured upon it by means of a sponge or elastic gum syringe. The application of the caustic may be repeated every day, or every second day, according to the degree of irritation that it occasions, till the removal of the swelling is accomplished. Along with this, a weak solution of acetite of lead or sulphate of zinc may be used to bathe the eye four or five times a-day.

The excision of portions of the thickened and tumified conjunctiva, has been recommended, but is not, in general, necessary.

The most troublesome and distressing kind of chronic ophthalmia, is that accompanied or kept up by a granular state of the membrane lining the eyelids. When this granular state exists, any active inflammation or tendency to it that is present, must be removed by antiphlogistic treatment, according to the circumstances of the individual case. The application of escharotics must then be employed with diligence and perseverance, to destroy the granulations; for, by the removal of these granulations, a cure of the diseased state of the conjunctiva, covering both the eyeball and cornea, is, in general, obtained. For this purpose the nitrate of silver, the sulphate of copper, and the diluted nitric acid, are most commonly employed. When the granulations are large, the removal of them by means of a knife or scissors has been recommended. But it appears impossible to do so, without at the same time removing along with them a portion of the natural membrane, as these morbid eminences consist of a diseased and thickened state of the conjunctiva. And, the removal of a portion of the conjunctiva, always causes a cicatrix and contraction of it, which might be followed by inversion of the eyelid. The

practice of incision, therefore, seems now to have been in a great measure laid aside.* Besides, the other means are generally found sufficient for their removal, and are even required where excision is practised.

The employment of the above escharotics, must be suited to the nature of each individual case; for the granulations, as was formerly mentioned, occur in a variety of forms, from soft bloody fungous, to that of a cartilaginous appearance and hardness.† The most powerful of these escharotics, the nitrate of silver, has been found best suited to those cases, in which the granulations have a hard *cartilaginous* appearance, as they are with difficulty acted upon by the other remedies. For the cases, in which the granulations have a *fleshy* appearance and consistence, the sulphate of copper has been found to answer best; and in those cases‡ where the granulations are *soft*, *spongy*, and *bloody*, the diluted nitric

* See Dr. Smith's Report of the Treatment of Cases at the Military Hospital, Chatham, in the 17th volume of the Edinburgh Medical and Surgical Journal, by which it appears that this method was not employed there.

† See page 210.

‡ The arrangement which has been here adopted, is the same as that used by Dr. Smith in the report formerly alluded to, as it is both sufficiently simple and distinct. The treatment also here mentioned is very nearly the same as that described by Dr. S.

acid has been found the best, from its easy application, and as it has not only an escharotic, but also an astringent effect.

The application of nitrate of silver, or sulphate of copper, is effected by the eversion of the eyelid, and rubbing a smooth pointed piece of the caustic upon the granulations, till an *eschar* is formed of the extent and depth that may be necessary. Before the eyelid is replaced, the internal surface of it is to be well washed with tepid water, either by pouring it on the eyelid from a sponge, or with an elastic gum syringe; this will remove any superfluous particles which may remain and irritate the eye. For accomplishing this purpose more effectually, *Lime Water* has also been employed, but apparently without any superior efficacy. The application of *Almond Oil* has likewise been employed, immediately after the washing, but also without any additional benefit. The nitric acid, diluted with four parts of water, is applied by means of a camel's hair pencil, and followed by the above ablution. The severe burning pain, which the application of these substances generally causes, is commonly of short duration, and is usually relieved, by bathing the eye with tepid water, for some time after they have been applied. This, therefore, should usually be directed.

The application of the caustic is sometimes followed by an attack of acute inflammation; but this is easily remedied by depletion, &c.

The eschar or slough formed by the caustic, usually separates within five days after it has been applied according to its depth; and the surface left appears to be very red, villous, and slightly ulcerated. The same appearances present themselves after each application, but always in a less degree, until the diseased state is entirely removed. Some simple collyrium of lead or zinc should, at the same time, be frequently applied, to lessen the irritation caused by the caustic, and to assist in removing the disease.

In a few days after its application, the irritation produced by the caustic subsides and the slough separates. The caustic may then be applied in the same manner as formerly; and it must be repeated at similar intervals, until the removal of the diseased state of the eyelid is accomplished, varying the caustic employed, and the extent of its application according to circumstances.

The removal of the granulated state of the inner surface of the eyelids, is, in general, both tedious and difficult; but it is found to cure entirely, or in a great measure, both the chronic inflammation of the eyeball and opacity of the cornea, even though

they have existed for a considerable length of time. When this is not the case, however, the other remedies above mentioned for these states, at page 211, must be applied.

SECTION V.

OF THE DEATH OR SLOUGHING OF THE CONJUNCTIVA.

THE death of a portion of the conjunctiva, is a common occurrence, from the action of stimulating or escharotic substances when applied to it; the size of the dead part, depending on the quantity and quality of the acrid matter, as well as the extent to which it is applied. The formation of a slough or eschar upon the conjunctiva is the first and almost immediate effect of lime, sulphuric acid, and the like, when applied to the eye. The slough forms before inflammation takes place. The eye then inflames; in the course of a few days, the slough gradually separates, and leaves an ulceration more or less deep, according to the thickness of the deadened portion. In the healing of this ulceration, the eyelids frequently contract adhesions to the eyeball.

When a portion of the corneal conjunctiva is deadened, it may exfoliate, or it may separate by the usual sloughing process. When the slough is very superficial, it separates in a day or two, leaving the cornea nearly in its natural transparent state. This process being similar to that of the separation of the cuticle in like circumstances.

The sloughing of the conjunctiva of the cornea, has been shortly and well described by Mr. Travers, in the following sentence: "The gangrenous opacities of the cornea, produced by lime or other substances destroying its texture, are sometimes superficial and defined in extent, and a process somewhat resembling exfoliation ensues. More frequently this disorganization is integral and complete. The cornea, disorganized by acids, is rendered instantly opaque, shrivelled, and of a yellow colour, almost resembling a piece of wash leather."* These appearances, in sloughing and exfoliation of the cornea, are well seen in the cases which are represented in Plate XIII. Figures 3 and 4.

The entire thickness of the conjunctiva covering the whole or part of the cornea may be deadened. When the deadened portion separates, it leaves the *cornea propria* exposed and in a state of ulceration.

* See Travers' Synopsis, page 120.

By the healing process the part affected is rendered opaque, and becomes covered with a new production, somewhat similar to its former tunic.

Violent acute inflammation of the eye, is generally produced by the same cause which occasions sloughing of the conjunctiva. This inflammation is generally the cause of further mischief to the organ, when it is not arrested by the remedies employed.

Treatment.—The remedies to be applied in cases where the conjunctiva loses its vitality, consist in removing the inflammation by the means described at page 175. Foreign substances are to be carefully removed from the eye. When the process, by which the slough is separated, becomes languid, gentle stimulants are to be introduced within the eyelids. For this purpose, a weak solution of the nitrate of silver, muriate of mercury, or wine of opium, may be dropped into the eye.

When an ulcer of the cornea has been produced by the sloughing of its conjunctival covering, the remedies afterwards mentioned for ulcerations of the cornea are to be applied.

SECTION VI.

OF PTERYGIUM, MORBID GROWTHS, AND CANCER OF THE TUNICA CONJUNCTIVA.

Besides the inflammatory affections and their consequences already described, the conjunctiva is often the seat of other diseases of a chronic character. The most common of these are pterygium, and fleshy tumours, or growths upon the conjunctiva. This membrane is also sometimes the seat of cancerous disease.

Pterygium consists, in thickening of the conjunctiva with increased vascularity. It proceeds from the circumference of the eyeball towards the centre of the cornea, becoming narrower at its corneal extremity, till it terminates at a point. This gives the diseased part, the appearance of a triangular portion of new membrane, upon the conjunctiva. See Plate X. Fig. 1.

This disease generally takes place slowly and gradually, without any particular uneasiness to the patient, except the loss of vision, when it covers that part of the cornea which is opposed to the pupil. It is sometimes the consequence of inflam-

mation of the conjunctiva. It may take place at several sides of the eye; but most commonly only at one; or it may extend over one half of the eye, like a thin web which has been termed *pannus*. When the disease spreads over the cornea, it seldom passes beyond the centre of this part.

In some cases of pterygium, so much thickening and increase of the conjunctival membrane take place, that the diseased portion has the appearance of a fleshy tumour of a considerable size. This form of the disease seldom encroaches upon the cornea. It is loosely attached, so that it can be easily moved upon the eyeball.

Small tumours, also of a rounded form, and very similar to those already mentioned, are, at times, met with, upon different parts of the conjunctiva. They seem to be composed almost entirely of red vessels, and present a fleshy appearance. Small fleshy tumours likewise are frequently situated immediately beneath the conjunctiva, particularly of the lower eyelid.

These diseases of the conjunctiva, are commonly not attended with pain and inconvenience, except that arising from their bulk, or being so situated as to obstruct vision.

Excision with the knife or scissors, is the proper mode of curing these affections. Some cases, however, may be cured by the application of caustic, or repeated scarification.

In cases of membranous pterygium, the removal of a small portion from the sclerotic conjunctiva near to the margin of the cornea, and parallel to it, generally cures the eye. The incision may be made with small curved scissors, the conjunctiva being raised with a hook or forceps. The portion removed should include the whole breadth of the disease. In a few days after the operation, some cases require the application of caustic to the cut edges, when they have a disposition to granulate. Should any acute inflammation follow the operation, it is to be treated upon general principles.

Fleshy tumours upon the conjunctiva, have generally a very loose attachment, so that they are easily raised from the subjacent parts, and snipt off with scissors; care being taken, at the same time, to remove as little of the natural membrane as possible, that its contraction may be avoided.

Small tumours situated beneath the conjunctiva are easily removed, by making an incision upon them through the membrane with a small knife, and then dissecting them neatly out.

A chronic fungous state of the conjunctiva, having somewhat the characters of a cancerous affection, is occasionally met with in the eyes of elderly persons. There are at present before me three cases of this affection, in which it was thought proper to remove the whole of the eyeball along with the diseased conjunctiva. Upon dissection, the coats and other parts of the eye, seemed to be quite unaffected, and in their natural state.

Cancerous ulceration sometimes attacks the conjunctiva, but appears to do so, only in common with the skin and other parts surrounding the eyeball. See Cancer of the Eye.

CHAPTER III.

DISEASES OF THE CORNEA.

PRELIMINARY REMARKS.

THE cornea, from its structure, is subject not only to inflammation and its consequences, in common with other parts of the body, but to several diseases peculiar to itself. In consequence of its important functions, too, these diseases are very frequently the cause of blindness.

Inflammation, or other disease of the cornea, may affect the whole, or only part of it. The disease may be confined to one, or several of the layers of the cornea may be affected.

There is no disease of the cornea, in which its natural transparency is not more or less affected, except in some cases of superficial ulcer of it, and those affections in which the form of its curvature only, becomes altered.

Inflammation of the conjunctival or anterior layer of the cornea having been already described, the other diseases of the cornea shall now be enumerated.

SECTION I.

OF ACUTE INFLAMMATION OF THE CORNEA PROPRIA, AND ITS TREATMENT.

In many cases of acute ophthalmia, the cornea propria, or middle layer, appears to be the primary and chief seat of the disease. But the inflammation of other parts, in some cases, extends to the cornea propria, particularly when its conjunctival covering is affected.

The appearances of acute inflammation affecting the cornea propria are quite peculiar. As this disease is deeper seated than inflammation of the corneal conjunctiva, the enlarged red vessels, which are seen upon the white part of the eyeball, appear to be much smaller, more numerous and minute, than when the conjunctiva is affected; and they may be seen running upon the sclerotica into the cornea

propria, beneath the conjunctiva.* These vessels form a red zone, which, in some cases, surrounds the whole cornea, in others, only a part of it; and the redness appears to be greatest, at the place nearest to the affected part; or they run, in clusters, at different parts, according to the situation, extent, and degree of the inflammation. The partial or complete red zone, which is seen at the margin of the cornea, is, in general, only about two lines in breadth. It seems to be formed by the subdivision and expansion of a few large red trunks of the anterior ciliary arteries. By pinching up the conjunctiva with forceps, these vessels may be seen to lie beneath it, and so firmly fixed to the subjacent parts, that they are not raised with the membrane.

The whole cornea has a clouded appearance; but at the part of it which is most affected, a distinct opacity may be observed, and very small red vessels ramified through it, sometimes making it appear quite red; at, or near to this part, also, there is frequently an effusion of pus, and sometimes of blood, evidently between the conjunctiva and the cornea propria, or between the laminæ of the latter.† The quantity of matter effused is in some cases so considerable, that it forms a small projecting abscess

* See Plate XI. Fig. 2. † See Plate XI. Fig. 2.

upon the cornea.* When the abscess bursts externally, an ulcer of the cornea is formed; when it discharges internally into the aqueous humour, the pus falls to the lower part of the anterior chamber, and its situation may be changed with the position of the eye.† The presence of matter in the aqueous humour is termed *hypopium*.‡

The inflammation of the cornea propria, is distinguished from that of the iris, choroid coat, and capsule of the aqueous humour, by the absence of the whitish line round the cornea, which appears in these other three diseases.|| The appearance of the whitish line, is wanting, from the inflamed vessels passing directly into the cornea propria under the conjunctiva, without leaving that part of the sclerotica which surrounds the cornea, of its natural colour.

In most cases of acute inflammation of the cornea, numerous enlarged conjunctival vessels, may also be seen upon the white part of the eye-ball; and the inflammatory symptoms attending it are in general very considerable.

Acute inflammation of the cornea is frequently produced by injuries upon the eye, which act either chemically or mechanically. When the cornea is

* See Plate XIII. Fig. 1.
† See Plate VII. Fig. 3.
‡ See Plate VIII. Fig 2.
|| See Iritis.

simply wounded by a sharp body, opacity and inflammation of the part take place; the wound heals, and the transparency of the cornea is gradually restored, leaving, in many cases, only the vestige of a cicatrix. When the cornea suffers a lacerated wound, the opacity left is much greater.*

When any minute sharp body has become imbedded in the cornea,† unless it be removed an abscess forms, precisely as in other parts of the body.

When, from the nature of the foreign matter applied to the eye, a slough forms upon the cornea to a greater depth than its conjunctival covering, symptoms of violent inflammation take place—the dead part is gradually separated, and an ulcer of the cornea is produced. When a considerable portion of the whole thickness of the cornea, separates in consequence of its vitality being destroyed, the iris is exposed. This gives rise to violent inflammation of the iris. If a small portion of the cornea only has sloughed, forming an opening into the anterior chamber, an ulcer of the cornea, with protrusion of a portion of the iris, usually takes place.‡

* See Plate XII. Fig. 3.

† It is not uncommon for stone cutters, blacksmiths, and those employed in turning brass or steel, to have minute splinters imbedded in the cornea. For removal of these see page 174.

‡ See Plate XII. Figs. 1 and 2. See also next section.

Treatment.—When the cornea is inflamed, the remedies for acute ophthalmia, detailed in chapter first, section third, ought to be vigorously applied.

When a slough upon the cornea, has not separated by the time that the symptoms of acute inflammation have declined, gently stimulating fluids are to be dropt into the eye. These may consist of a weak solution of sulphate of zinc, nitrate of silver, muriate of mercury, or of wine of opium. When ulceration of the cornea, either without or with protrusion of the iris, is produced, the remedies to be mentioned when treating of these affections are to be applied.

When a collection of pus takes place between the layers of the cornea to any considerable extent,* so as to threaten to burst either externally or internally, the matter should be evacuated by a small puncture, made either with the point of a lancet or cataract needle, in order to avoid the destruction of the whole thickness of the cornea. Where the quantity of pus is not great, it becomes gradually absorbed as the inflammatory symptoms abate.

* See Plate XIII. Fig. 1.

SECTION II.

OF SIMPLE ULCERATION OF THE CORNEA, AND THAT COMPLICATED WITH PROLAPSUS OF THE IRIS.

THE conjunctival covering of the cornea is frequently affected with ulceration. When its surface has been abraded by injury; when a superficial slough has separated from it, or a small aphthous vesicle upon it has burst, a superficial ulceration of the cornea is produced. The affected part becomes somewhat opaque, which opacity, though slight, often extends beyond the ulceration. An opening, leading to an ulcer of the cornea propria, is also another form of ulcer of the corneal conjunctiva.

The most common ulcer of the cornea is that in which the middle part or cornea propria is affected, there being an opening externally through its conjunctival covering.

Ulceration of the cornea is commonly produced either by inflammation,—a small pustule, or an abscess of this part, bursting externally. It is also produced by wounds or sloughing of the cornea.

An ulcer of the cornea propria, appears to be

slightly elevated around its circumference, and depressed a little at its centre, the ulcerated part having formed the cyst of an abscess, or been denuded of its conjunctival covering.* The ulcerated part discharges a watery fluid; and it very often retains the usual transparency of the cornea. But when the ulcer is healing, it acquires an opaque or ash-coloured line around its circumference, which marks the size of the ulcer, and shows the healing process to be going on by adhesive inflammation.† And when the ulcer has healed, the opacity, which it generally leaves, is never so large as the part marked by this opaque line.

The size of ulcers upon the cornea, varies from that of a depression made by the point of a pin, to one-third of the size of the cornea.‡ Their depth also is various. They are commonly not deeper than the conjunctival covering; sometimes, however, they penetrate through the whole thickness of the cornea propria, and lay bare the membrane of the aqueous humour, which sometimes gives way and bursts. This allows the aqueous humour, a portion of the iris,§ and sometimes, when the ulcer is large,

* See Plate XIII. Fig. 2. † Scarpa. ‡ Wardrop.

§ This constitutes the disease called Procidentia Iridis. See Plate XII. Fig. 1 and 2.

a part or the whole even of the vitreous humour to escape. When this last mentioned circumstance takes place, it causes irrecoverable blindness by the collapsing of the eye.

When an opening through the cornea, which allows the aqueous humour to escape, is very small, the chambers are gradually evacuated,—the eye becomes soft,—and the iris, along with the crystalline lens, are pressed forward into contact with the cornea. By great care and rest, this opening may heal,—the aqueous humour will re-accumulate,—and the iris and lens will resume their proper situations. In some cases, however, the opening does not close so quickly,—it continues open, and allows the constant escape of the aqueous humour, by which it becomes a *fistulous* opening through the cornea.* The eye in this state, is flaccid and useless as an organ of vision; and it is in imminent risk of becoming completely destroyed. By proper attention it may recover from this state, by the gradual closing of the opening. After the opening has closed, by a thin membrane forming over its surface, the pressure of the aqueous humour from within, causes this thin newly formed part to project in form of a small vesicle.† This vesicle enlarges

* Fistulous openings of this kind is very common, in cases of Staphyloma of the cornea.

† See Plate XIII. Fig. 2.

gradually, and may remain for months without undergoing any other change,—or it may burst and the part again heal as before.

In other cases where the opening in the cornea is larger, the aqueous humour flows out more suddenly, and a portion of the iris falls forward and protrudes. The protruding portion of the iris becomes entangled with the opening and adheres ; by which, as by a natural plug, the breach in the cornea is repaired. A protrusion of the iris, therefore, in such cases, is to be considered as a fortunate occurrence.*

Ulcers of the cornea, are commonly attended with chronic inflammation, and irritability of the eye. These, as well as the ulceration, are generally the consequences of acute inflammation. The chronic inflammation and irritability continue till the ulcer is healed, the cicatrizing process being carried on by inflammatory action.

Ulcers of the cornea heal by cicatrization. This is effected by a process similar to that which takes place in the healing of ulcerations of other parts of the body. Superficial ulcers, or those affecting only the conjunctiva of the cornea, may get well without leaving any opacity. But, when the ulceration af-

* See Essay on this subject in Edinburgh Medical and Surgical Journal for July 1829, by the Author.

fects the cornea propria, cicatrization seldom takes place, without causing a permanently opaque state of the part, * as well as, a pit, or depression, from loss of substance.

When this opacity is situated at the side of the cornea, vision may not be impaired; but, when it is unfortunately situated opposite to the pupil, blindness is produced, by the light being intercepted.

When the ulcer penetrates the whole thickness of the cornea, and a protrusion of the iris takes place, the protruded portion becomes strangulated in the ulcer, and soon adheres to the cornea. The pupil is drawn to one side, and is either contracted or completely obliterated. † By this state of the parts violent inflammation of the iris is produced; and only in the slighter cases, and by great dexterity of management, can the sight of the eye be preserved. In cases of adhesion between the iris and cornea, the anterior chamber is partially or completely obliterated, in consequence of the anterior surface of the iris remaining in contact with the posterior surface of the cornea.

* See Plate XII. Fig. 4, 6, and 8.

† See Plate XII. Figures 1, 6, 7, 8, and 9, in which these different states are represented.

The size of the protrusion of the iris is various, according to the size of the opening in the cornea. Thus, varying in different cases, from that of a small point, to the size nearly of the whole cornea.

When a portion of the whole thickness of the cornea ulcerates or sloughs away, the iris, which is thus exposed, inflames, granulates, and becomes covered with a thin membrane resembling cuticle. See Plate XIII. Fig. 7.

Wounds of the cornea penetrating into the aqueous humour, are, in many cases, followed by protrusion of the iris similar to that above described.

SECTION III.

TREATMENT OF ULCERATION OF THE CORNEA AND PROLAPSUS OF THE IRIS.

ULCERATION of the cornea, like that of other parts of the body, often heals spontaneously. In many cases, however, the healing process becomes languid, and requires to be promoted by remedies.

After acute inflammation has abated, local applications may be employed to promote the healing of ulceration of the cornea.

The most effectual of these, is the *Nitrate of Silver.* This application, allays the inflammation and irritability of the eye, and promotes the healing of the ulcer. The nitrate of silver may be applied to an ulcer of the cornea, either in the solid form, by a pointed piece, or by a solution of it in water. A strong solution, consisting of one drachm to an ounce of water, may be applied by means of a hair pencil; and this application may be repeated in a day or two if necessary. Or a weak solution, containing one or two grains to an ounce of water, may be injected between the eyelids twice a-day. One or two applications of the nitrate of silver, in many cases, puts the ulcer into a healing state, so that no further repetition of it is necessary. In applying nitrate of silver to an ulcer of the cornea, the formation of an eschar with it, is much to be deprecated; for, the repetition of this, would soon make an opening completely through the cornea, by which the loss of the eye would be almost certain. Other stimulating, astringent, and escharotic substances must occasionally be employed, in different forms, and alternated with each other, for the purpose of healing ulcers of the cornea. The applica-

tions of this description which answer best are those which were formerly recommended for removing chronic inflammation of the conjunctiva.

When a portion of the iris protrudes through a *wound* of the cornea, if the protrusion is quite recent, an attempt may be made to replace it. This is to be accomplished, by pushing the protruding part back with a blunt probe, or by the application of belladonna, which makes the iris contract. Puncturing the tumour may also assist the replacement of it. The tumour consists of a small bag or pouch, formed of the iris, containing aqueous humour. The evacuation of this fluid, therefore, by a puncture, causes the tumour to collapse, which allows it more readily to resume its proper situation. But, when the prolapsus has existed for some length of time, so that adhesion has taken place between the cornea and iris, and if the protruding part is large or pendulous, it must be removed by means of scissors. The nitrate of silver is then to be applied to the part, to promote the healing of the cut surface. When the protruding part, however, is not large nor projecting, it may be reduced by the repeated application of the caustic alone, which causes it to contract and cicatrize.

But, if the protrusion of the iris takes place through an *ulcer* of the cornea, the case is very dif-

ferent. No attempt should, in this case, be made to replace it. The protrusion of the iris is rather to be considered as a fortunate circumstance, being the only way that an ulcerated opening through the cornea, when considerable, can be repaired, without the destruction of the eye for vision. In some cases, therefore, of penetrating ulcer, this process of nature to fill up and obviate the impending destruction of the eye, may with propriety be imitated by art; so that a portion of the iris should be pressed out, or pulled out with a small hook, and entangled in the opening.

SECTION IV.

OF SPECKS, OR CHRONIC OPACITIES OF THE CORNEA, UNATTENDED WITH INFLAMMATION.

CHRONIC opacities or specks upon the cornea differ from each other, in different cases, in number, situation, size, and degree of opacity. Most commonly there is only one, situated towards the centre of the cornea;* and the obstruction to vision which

* Wardrop.

is occasioned, depends much more upon the situation of the speck, than on any of the other circumstances. For, by being opposite to the pupil, it prevents the light from getting into the eye.

Specks of the cornea are various in size, from a spot that is with difficulty perceived, to one covering nearly the whole cornea.

Modern authors have arranged specks or opacities of the cornea without inflammation, into three classes, distinguished from each other, chiefly by the degree of opacity which is present. This arrangement, therefore, may be adopted, as it is sufficiently simple and accurate.

In the *first* species of opacity or speck, the cornea may be said only to have lost its transparency, as it is only slightly opaque, having the semi-transparent or clouded appearance, which is termed *nebula.* * This degree of opacity may be confined only to a very small part of the cornea, or diffused over the greater part or even the whole of it. The affected part may be all equally opaque, or some parts of it may be more opaque than the rest; and the iris and figure of the pupil can, in general, be obscurely seen through it. This kind of opacity is

* See Plate VII. Fig. 2, and Plate IX. Fig. 1. In these it is attended with inflammation, but the appearance of the opacity is the same as if the red vessels were wanting.

evidently superficial, and arises from the conjunctiva covering the cornea, having become thickened in consequence of inflammation.

In the *second*, the degree of opacity is much greater, and apparently deeper seated, "giving the cornea a bluish or white milky appearance. It is seldom equally opaque through its whole extent, being generally more so at the centre, and becoming gradually of a lighter shade towards the margin. In some instances, the shade is very unequal in different parts of the speck," but neither the pupil nor iris can be distinguished through it.

In the *third* form of speck, the cornea becomes of the opaque glistening white colour of common pearl. It is in general circumscribed, and situated opposite to the pupil. It has often one or two red vessels passing into it; and there is frequently adhesion between the opaque part and the iris.*

Opacity of the cornea, is, in many cases, accompanied with some increased vascularity, from chronic inflammation.

These two last kinds of speck, are produced by a deposition of opaque matter between the laminæ

* See Plate XII. Figures 4, 5, and 6.

of the cornea, in consequence of inflammation, or the healing of wounds or ulcers.

Circumscribed central opacities of the cornea, have sometimes been mistaken for opacities of the crystalline lens. In the case of opacity of the cornea, upon looking into the eye from the side, the iris and pupil may be distinctly seen behind the opacity.* Whereas, in the case of cataract, the opaque body is posterior to the iris.

In many elderly persons, an opaque ring forms round the margin of the cornea, by a natural process, which is called *arcus senilis*.†

Treatment.—The removal of chronic opacities from the cornea, is always uncertain, and often impossible.

Opacities of the first and second kinds may sometimes be removed or lessened by the use of those remedies by which the absorbents can be excited to remove the deposited opaque matter. For this purpose many different substances have been employed. Those which answer best are the lotions, drops, &c. recommended at page 212, for the removal of chronic inflammation of the conjunctiva. These remedies cause an increased action in the

* See Plate XII. Fig. 5 and 6. † See Plate XII. Fig. 10.

vessels of the parts, by which the absorption of the speck is promoted. They should be applied to the eye every night and morning, and their use persevered in for some length of time. Their strength must be gradually increased, and they should be frequently varied with each other, according to their effects.

When an opacity of the cornea, is attended with chronic inflammation or increased vascularity of the eye, there is much more hope of removing it, than when it is not so accompanied. For, when this increased vascularity is removed, the opacity, in general, either becomes less, or completely vanishes.

When an opacity of the cornea is incurable, and is situated opposite to the pupil, by which vision is obstructed, the case will require the formation of an artificial pupil opposite to a transparent part of the cornea.* In such cases, a temporary cure is obtained by the dilatation of the pupil beyond the margin of the opacity, by Belladonna, when the pupil admits of being so dilated.

* See Artificial Pupil.

SECTION V.

OF CONICAL CORNEA, HYDROPHTHALMIA, AND STAPHYLOMA.

1. *Of Conical Cornea.*—The cornea in some cases, without any evident cause, gradually becomes conical, the centre of the cornea forming the apex of the cone, while its transparency remains unaltered. Patients affected with this change in the form of the cornea, complain that they see objects before them multiplied, the surface of the cornea being irregular; the large cone of which the cornea appears to consist, being made up of several smaller cones. This irregularity upon the surface of the conical cornea, can, in many cases, be seen only by passing a lighted candle backwards and forwards before the eye. The reflected image of the flame diminishes and increases in size, as it ascends and descends over the eminences.*

When the cornea assumes a conical form, it not only retains its transparency, but has a remarkably bright and pellucid appearance. Vision, in these

* This experiment was invented, and first performed by Dr. Brewster.

cases, is so much impaired, from the irregularity of the surface of the cornea, that objects appear to be multiplied, and cannot be distinctly seen.

Conical cornea takes place generally in middle-aged persons, and affects both eyes at the same time, though in different degrees. It appears to take place from a gradual thinning of the cornea, in consequence of the absorption of some of its layers.*

This affection causes great indistinctness of vision, which can only be ameliorated by the use of glasses. The defect is remedied very imperfectly, on account of the irregularity of the surface of the cornea. Some assistance, however, may be rendered to vision, by the use of double concave glasses, and at the same time contracting the sphere of vision, by making the transparent part of the spectacle-eye very small, or by making it of a funnel shape, tapering to a small orifice.

2. *Of Hydrophthalmia.*—When the cornea, retaining its transparency, becomes more prominent than natural, causing an increase in the size of the anterior chamber of the aqueous humour, the disease is termed *Hydrophthalmia.* The cornea retains its spherical shape, but is so much changed, as to form

* Wardrop. Travers.

a larger segment of a globe. In this, as in conical cornea, the focus of vision is changed, and the sight is indistinct. The use of glasses affords the only chance of benefiting the patient.

3. *Of Staphyloma.*—When the cornea becomes opaque, thickened, and prominent, the disease is termed *Staphyloma.* Staphyloma may affect either a part or the whole of the cornea. A partial degree of it may exist, without vision being much impaired, if the eye is otherwise sound; but, in most cases, vision is generally much impaired or quite destroyed.* It is a very frequent and unfortunate consequence of violent acute inflammation of the eye, particularly that of the purulent kind. The affected part of the cornea is generally much thickened and opaque, and the iris frequently adheres to it.

A staphylomatous cornea varies much in its size and shape, in different cases, and at different times in the same case. When the staphyloma is partial, and not of long standing, it only projects a little beyond the natural size of the cornea; but when the whole cornea is affected, and when it has existed for some length of time, it frequently projects to a considerable distance beyond the socket, so that it

* See Plate X. Figures 2 and 3, and Plate VIII. Fig. 4.

cannot be covered by the eyelids. It is in some cases cone-shaped, and in others of a more globular form.

Staphyloma of the cornea often becomes stationary; but it also frequently continues gradually to increase in size, after the inflammation which caused it has subsided. There is frequently a small fistulous aperture at the apex of the tumour, through which the aqueous humour exudes, so as to make the size of the tumour vary at different times.

In several cases of staphyloma, I have seen the cornea give way by ulceration, by which so much of the humours escaped, that the eye became reduced nearly to its natural size. The deformity and inconvenience of the disease, therefore, were removed by a spontaneous natural process. This has been imitated by Bëer, who has recommended the application of caustic, to produce a similar ulceration.

Enlarged blood-vessels, are generally seen running from the angles of the eye, and ramifying upon the staphyloma.

In my collection there are several preparations of eyes affected with partial and complete staphyloma of the cornea. In these, each of the three layers, or parts of which the cornea is composed, are distinctly seen to be increased in size and thickness at the place affected. In one of a large complete sta-

phyloma, the continuation of the conjunctiva over the cornea, as well as the other layers of the cornea, are distinctly seen. (See Plate VIII. Fig. 4.) The iris generally adheres to the cornea in cases of staphyloma, and is drawn forwards. So, when a portion of the cornea is removed in such cases, the iris is also divided.

The appearance of a staphylomatous cornea, the adhesion of the iris, and the previous history of the case, show that the disease had commenced with ulceration of the cornea, attended probably with prolapsus of the iris. The affected part progressively increases by interstitial deposition from diseased action. The diseased cornea yields to the increased accumulation of aqueous fluid, and enlarges to the projecting form it so often assumes.*

Staphyloma does not admit of any cure. But when the diseased cornea projects so far beyond the orbit that it cannot be covered by the eyelids, the size of it must be lessened, as it is not only a great deformity, but it is very liable to inflammation from exposure to injury, and constant irritation from the air, dust, &c. The size of the eye should be lessened, by removing a portion of the diseased cornea,

* Both Professors Scarpa and Beer have given most absurd explanations of the *pathology* of staphyloma of the cornea.

and allowing the aqueous humour and crystalline lens to escape.

This operation is performed by passing a cornea knife through the tumour, transversely across the eye, and by it, dividing the lower part of the cornea completely, so as to form a flap. This flap is to be laid hold of, and removed by means of scissors, care being taken to leave as much of the cornea as will allow the cut edges to unite. If a greater portion than this be removed, the iris, being exposed, inflames, and much distress to the patient is occasioned.* By the operation, now described, the diseased eye is reduced nearly to the same size with the other, which is all that can be done in such unfortunate cases. When inflammation of the eye follows this operation, the common remedies for acute ophthalmia may be required.

* See inflammation of the iris.

CHAPTER IV.

DISEASES OF THE SCLEROTIC COAT.

PRELIMINARY REMARKS.

FEW diseases seem to affect the sclerotic coat. This arises from its structure, neither being very delicate, nor very highly organized. When it is inflamed, the inflammation is generally occasioned, in consequence of the connexion of this coat with other parts. When inflammation takes place in any of the other parts of the eye, the sclerotic coat, often becomes affected, in the progress of the disease. The sclerotica most frequently becomes affected, in cases of acute inflammation of the cornea, choroid coat, and iris.

SECTION I.

ACUTE INFLAMMATION OF THE SCLEROTIC COAT.

WHEN the sclerotic coat is inflamed, its blood-vessels increase in size; they are small and nume-

rous, carry red blood, and run nearly in a straight direction towards the cornea. They are obviously situated upon the sclerotic coat, and are covered by the conjunctiva, which can be moved upon the eyeball without the situation of the enlarged vessels being changed.

The inflammations of most other parts of the eye, are accompanied with more or less inflammation of the sclerotic coat. Inflammation confined to the sclerotic coat alone, very rarely occurs. Inflammation of this coat, will therefore be more properly noticed and described, when treating of inflammations of the other parts of the eye.

The only diseased change in the sclerotic coat to be noticed here, is that which forms the subject of the following section.

SECTION II.

OF STAPHYLOMA OF THE SCLEROTIC COAT.

STAPHYLOMA of the sclerotic coat consists in some part or parts of this coat becoming prominent, and projecting in the form of small tumours upon its

surface.* These tumours or projections have a remarkable appearance, from some parts of them having a bluish colour, and having red vessels copiously ramified upon them.

Eyes affected with this disease often appear to be considerably enlarged, accompanied with disorganization of the humours, and amaurosis. This has been considered to be a dropsical state of the eyeball.

In some cases there is general enlargement of the eyeball, the sclerotica having a blue appearance at different parts, without any circumscribed projection.

These states of the sclerotic coat, are generally accompanied with disorganization of the internal parts, so that the eyeball, in many cases, feels softer than natural; and the lens becoming separated from its attachments, may generally be seen floating in the eye.†

Staphyloma of the sclerotic coat, has commonly been conceived to take place in a slow and gradual manner, from thinning of this coat by an interstitial absorption of its substance. In those cases where I have seen it take place, it has come on in the progress of acute inflammation of the iris and choroid coat, the sclerotica having also become much in-

* See Plate X. Fig. 4. † See Plate XIV. Fig. 9.

flamed. When this has occurred, the projection, or dark coloured tumour of the sclerotica covered with enlarged red vessels, gave to the eye a most alarming appearance, by resembling cases of malignant fungoid disease of the eye, at the time the coats of the eye are about to give way.

In one case where staphyloma of the sclerotic coat occurred in the progress of acute ophthalmia, I was induced to make a small incision into the projecting part, in order to relieve the sufferings of the patient, which were very great. By this incision a quantity of yellow-coloured serous fluid was evacuated from between the sclerotic and choroid coats. The wound healed, the fluid re-accumulated, and was again discharged. The choroid coat remained entire, so that none of the humours of the eye were evacuated. In this case, therefore, a separation had taken place, between the sclerotic and choroid coats, by the interposition of inflammatory effusion at the part affected.

Not unfrequently staphyloma both of the sclerotica and cornea, are conjoined in the same eye, by the same cause (ophthalmia) having produced both.

Staphyloma of the sclerotic coat, may exist in a slight degree, without vision being much impaired by it, if the eye is otherwise sound. But unfortunately its existence is, in general, an indication of

disorganization of other parts of the eye from previous inflammation.

Staphyloma of the sclerotic coat admits of no remedy. And, it is such a frequent concomitant of disorganization of the internal parts of the eye, that its existence generally, either forbids the practice of operations for cataract and artificial pupil, or, at least, renders the prognosis, in such cases, very unfavourable.

CHAPTER V.

DISEASES OF THE CHOROID COAT, IRIS, AND MEMBRANE OF THE AQUEOUS HUMOUR.

PRELIMINARY REMARKS.

From the intimate connexion that exists between the choroid coat, iris, and membrane of the aqueous humour, inflammation seldom affects any one of these parts, without the others becoming inflamed also. By some surgeons, an attempt has been made, to distinguish the inflammations of these parts from each other; and they have pointed out peculiar appearances observable in the inflammations of each of them. But this, I apprehend to be, in many cases, impossible. We can, indeed, in some cases, conjecture as to which of those parts is most affected, by the morbid appearances; but, in general, the inflammation, by affecting each of them simultaneously, causes the symptoms and appearances to be confounded with each other. What has been described as inflammation of the iris, too, is attended

with symptoms of a nature far more severe than can be conceived to occur, from this small part being inflamed alone.

Inflammation of the choroid coat, iris, and membrane of the aqueous humour, therefore, shall be treated of together. And in this description the circumstances shall be pointed out, which lead to the supposition that, in certain cases, the disease affects the choroid coat and membrane of the aqueous humour, in a more particular manner than the iris.

It must be admitted, however, that chronic inflammation of the membrane of the aqueous humour, often occurs as a distinct disease.

SECTION I.

OF ACUTE INFLAMMATION OF THE IRIS, CHOROID COAT, AND MEMBRANE OF THE AQUEOUS HUMOUR.

ACUTE inflammation of the iris gives rise to very violent symptoms. When the disease continues for any length of time, the whole eyeball becomes affected—the symptoms are remarkably severe—the distress of the patient is very great—and the eye

becomes either completely destroyed, or is so much disorganised as to render it useless as an organ of vision.

Acute Inflammation of the iris occurs *idiopathic* both spontaneously and from injuries of the eye; and it occurs *symptomatic* from Syphilis, Gout, and Rheumatism, as also in the disease called Sibbens.

In each of these symptomatic forms of iritis, the morbid phenomena and consequences of the disease, are the same with the idiopathic form of it. So that, were a case of any of them presented, it would be impossible, without reference to other circumstances in the history of the patient, to say to which disease it belonged. The collateral circumstances, by which syphilitic or rheumatic iritis, is to be distinguished from the others, is, by the first being accompanied or preceded, by symptoms of syphilis, the latter by rheumatic complaints. And so with the other symptomatic forms of iritis. Hence, an idiopathic iritis may, from the state of the constitution, become or assume the appearance of any of these symptomatic forms of it. This is exemplified, in cases of iritis from injury, or after operations upon the eye.

The description of iritis about to be given, therefore, is applicable to every form of the disease; for, the same phenomena and consequences occur, both

in idiopathic and symptomatic iritis. The treatment, however, of each of these, requires to be modified according to circumstances, as shall be particularly pointed out.

When the iris is affected with acute inflammation, the disease is attended with the usual symptoms of acute inflammation of the eyeball;* but, the external appearances upon the eye, mark distinctly the seat of the disease.

The first, and most striking of these morbid appearances, is the distribution of the enlarged blood-vessels upon the external parts of the eyeball. A complete zone or circle of red vessels, may be seen upon the white part of the eye, running towards the cornea. This red zone makes its appearance at the distance of three or four lines from the margin of the cornea; and disappears at the distance of about a line before arriving at its margin. The vessels forming this zone, do not, however, terminate there, but pass through to the iris, where it is attached to the sclerotic coat; by which a line of this coat around the cornea, is left nearly of its natural colour.† The zone of red vessels is sometimes incomplete; and at other times, the number of vessels is much greater at some parts of it, than at

* See page 170.

† See Plate IX. Fig.2.

others. It is formed by the subdivision of the anterior ciliary arteries. These run forward upon the facia, covering the anterior of the eyeball and tendinous insertions of its muscles. They are therefore situated beneath the conjunctiva, which can be raised or moved to either side, without either moving or changing the situation of these vessels.*

This red zone, is formed upon the sclerotica, by the inflamed external or anterior ciliary vessels, which proceed forward, in distinct separate trunks till they arrive at the place, where the zone is formed by their subdivision. The red zone is seen through the conjunctiva, upon the sclerotica, occupying that space, between the insertion of the muscles of the eyeball, and the place where the iris is attached to the sclerotic coat. Through the latter part of this coat, these vessels pass to the iris, and other parts about the ciliary ligament; this being the part where the anterior and posterior ciliary arteries innosculate with each other. When examined minutely, the vessels forming the red zone, appear to be small, deep-seated, and to run in straight lines.

In some cases, the sclerotic coat becomes completely red, from increased vascularity.

When these symptoms and appearances exist, without any alteration in the state of the iris from

* See Plate IX. Fig. 3.

its natural appearance, the disease may be considered to affect the choroid coat, in a more particular manner than any of the other parts, or to be chiefly confined to it.

In those cases where its containing membrane is affected, the aqueous humour acquires a turbid milky appearance, arising either from an admixture of lymph effused into it, or from opacity of the membrane of the aqueous humour lining the cornea. This frequently takes place to a remarkable degree when the disease begins to decline. In some cases this humour becomes of a brownish yellow colour, probably from an admixture of blood. When the membrane lining the cornea is affected, it has an opaque mottled appearance.

In most cases where the inflammation, either of the choroid coat, membrane of the aqueous humour, or of the iris, is considerable, another set of enlarged vessels may be seen running upon the conjunctiva, but presenting a very different appearance from those already described. They are large superficial trunks, seeming to arise from the fossa palpebrarum, and in their course, presenting the aborescent appearance, formerly described in inflammation of the conjunctiva.*

These conjunctival vessels run towards the cor-

* See page 194.

nea; and in a few days, if the inflammation increases, their extremities cover that space which is left between the ciliary vessels and margin of the cornea; thus removing the appearance of the whitish line around it. But if the inflammation of the iris abates, the enlarged ciliary vessels disappear, and sometimes leave only the enlarged conjunctival vessels, so that the red circle or zone is no longer visible. If the sclerotic coat becomes much inflamed, its complete redness, also prevents the whitish line around the cornea from being seen. But, if the sclerotic redness diminishes, the whitish line again becomes visible, while the red zone remains.

When the iris is inflamed it loses its proper colour, and requires a dusky hue. This change, arises from the pigment behind it, shining through the reddened vascular iris. The pupil becomes contracted and irregular; and, when the inflammation is in any considerable degree, or has existed for some days, small globules, or masses of coagulable lymph, and sometimes blood, may be seen in the pupil, or upon the surface of the iris, as is shown in the plate already referred to, representing a severe case of this disease.

The effusion of lymph in acute inflammation of the iris, in most cases, causes an adhesion between the pupillar margin of the iris and the capsule of

the lens. Such adhesions are known by irregularity of the form of the pupil, particularly manifest upon the application of belladonna.* In some cases the pigmentous membrane on the posterior surface of the iris, adheres to the capsule of the lens; so that portions of it are sometimes left attached to this capsule, when the capsule is dilated.

Lymph effused from the inflamed iris in many cases becomes organized by red vessels, which may be seen to ramify upon its surface. These vessels sometimes burst, by which blood is effused into the cavities of the aqueous humour. The blood falls to the lower part of these cavities, and in some cases they are completely filled.† A gradual absorption of this effused blood takes place.

When lymph is effused into the posterior chamber of the aqueous humour, the iris is sometimes pushed forwards nearly in contact with the cornea.

It is almost unnecessary, to state the destructive consequences to vision, that are occasioned by inflammation of the iris. In some cases, where the

* See Plate XIV. Fig. 1. and Plate XIII. Fig. 5.

† In a case of iritis, which terminated in a mass of organized lymph, filling up the pupillary aperture, when the inflammation was quite abated, the patient thought fit to indulge in a glass of spirits. On the following morning, the acute inflammation of the eyeball returned, and the cavities of the aqueous humour, were almost completely filled with blood.

retina becomes affected, vision is quickly destroyed. Blindness, from permanent contraction or closure of the pupil, and effusion of lymph, is also a very common consequence of it.* Slighter cases, terminate in resolution or adhesion between the pupillar margin of the iris and capsule of the lens.

When the inflammation continues to increase, the whole of the eyeball becomes affected, the contents of the orbit become swollen and project from the socket, and the conjunctiva gets into the state of chemosis. This general enlargement of the parts surrounding the eye, and thickening of the conjunctiva, make the eyelids appear to be swollen, distended, and cause great pain upon touching the organ.

The coats of the eye, as well as the parts surrounding the eyeball, being over-distended and swollen from the inflammation, the pain becomes very violent and distracting to the patient. In some, it is confined to the eye, and feels like needles darting through it; in others, it shoots from the eye through the head. The pain is to be accounted for by the pressure upon the ciliary nerves, owing to the unyielding nature of the sclerotic coat. Pressure upon these nerves seems also to cause paralysis of the iris. For, in many cases, when the cho-

* See Plate XV. Fig. 10, and Plate XIV. Figures 2 and 3, also Plate XIII. Fig. 6.

roid coat is inflamed, and where the iris does not seem particularly affected, the pupil is quite motionless, and often irregular. In other cases, the pain is more connected, with affection of the retina and optic nerve. In cases of arthritic and rheumatic iritis, the violent deep seated pain,—the semi-opaque green appearance of the pupil,*—and the complete loss of sight, show that the retina partakes of the disease.

Inflammatory fever takes place in the severer forms of iritis to a considerable degree.

The cases of most violent inflammation of the eye, that are met with, are aggravated cases of iritis, where the neighbouring parts, have in its progress become affected. When it takes place from exposure of the iris, by a wound or destruction of the cornea, the inflammation becomes very violent—the pain becomes so severe, that the patient, from continued suffering and want of sleep, becomes almost distracted—and the appearance of the eye becomes alarming. The exposed and inflamed iris pours out lymph. † This soon becomes organized,

* See Plate XIII. Fig. 5.

† There is in my possession, a preparation where both sides of the iris are covered with yellow lymph. Two weeks previous to the death of the patient from whom this eye was taken, the cornea had been destroyed by sulphuric acid. The cornea sloughed off, and left the iris exposed.

vascular, and forms granulations. The existence of these granulations at the anterior of the eye upon the exposed iris, surrounded by an opaque, and perhaps a sloughing cornea, together with chemosis and general enlargement of the eye, sometimes so much alarm the surgeon, that he fears the existence of a malignant disease. And this opinion is strengthened, by the circumstance of the granulations bleeding, in consequence of the slightest touch in washing the eye, or even by the friction occasioned by raising the upper eyelid to examine the organ. These granulations upon the exposed iris, gradually form into a thin cuticle upon its surface. *

In some of the most aggravated cases, there is not much chemosis; but some part of the sclerotica, projects like a staphyloma of this coat, attended with high vascularity, pain, and other symptoms of inflammation to a great degree.† These appearances give the diseased eye a most formidable aspect; for, in some cases of malignant disease, the eye presents the same appearances, just before a fungus bursts

* See Plate XIII. Fig. 7.

† In the cases mentioned at page 257, where a considerable quantity of dark-coloured serous fluid was evacuated from between the sclerotic and choroid coats; the choroid coat appeared to be the part chiefly affected.

forth. The diagnosis, therefore, between such cases as has just been described, and cases of malignant fungus of the eye, sometimes becomes a matter of considerable difficulty. A few remarks on the subject are therefore necessary.

Malignant fungus of the eye, is generally a chronic affection, and is not attended with acute inflammation. When a fungus from the eye, takes place in the course of acute inflammation after destruction of the cornea, more particularly if any obvious cause can be assigned for the inflammation, a malignant disease is not much to be feared. At all events, this case only admits of soothing treatment, under which the case will either get well, or if malignant, its true nature will become manifest.

SECTION II.

TREATMENT OF ACUTE INFLAMMATION OF THE IRIS.

ACUTE inflammation of the iris, whether idiopathic, or symptomatic of some other disease, requires nearly the same treatment in all cases.

The employment of the antiphlogistic and other remedies formerly mentioned, (see page 174) are, in many cases, quite sufficient to remove the acute inflammation of the iris. The exhibition of *mercury* along with these, however, has been very commonly employed, on account of the disease generally declining whenever this mineral affects the system, even in cases where it has been used before the iris became affected.

It is the practice of many of the most experienced ophthalmic surgeons of the present day, to recommend mercury, in most cases, for the cure of iritis; as it has been found, when used along with the other remedies, to cure the disease more speedily and perfectly, than when these other remedies are used alone; and as it has appeared to be prejudicial in a very small proportion of cases. Some, have an aversion to the use of mercury, in cases of iritis. But, as the affected parts are so delicate, that the continuance of inflammation in them, destroys irreparably their functions, so the sooner the inflammation is removed, it must be the more advantageous for the patient. For, the abatement or continuance of the inflammation, even for a few hours, may be of the greatest importance; as on this may depend either the restoration of his sight, or his being doomed to future blindness.

The most powerful means, therefore, should be employed for this purpose, until the general use of them is proved to be hurtful. By the use of mercury, I have seen many eyes saved, which otherwise, in all probability would have been lost; and many lost, where this mineral was not used, that might possibly have been saved, by the progress of the disease having been arrested by this remedy; for, a remission of the disease generally takes place, whenever the system becomes affected by the mercury. This last circumstance, I have often seen exemplified, in cases which had resisted all other treatment, though employed in the most judicious manner and for a very considerable length of time.

When mercury is given for acute inflammation of the iris, it should be given by doses frequently repeated, so as to affect the system as soon as possible. For this purpose, calomel, or the mercurial pill, with a little opium, answer best, a dose being given every six hours.

The greatest dangers to be apprehended in the disease now under consideration are, effusion of lymph, filling up the pupil,—closure of the pupil,—or adhesion either between the iris and cornea, or capsule of the lens, taking place. These adhesions may, in some measure be prevented, and, when they have taken place in a slight degree, removed, by the

introduction of Belladonna into the eye, so as to keep the pupil in a state of temporary dilatation. Belladonna may be applied every day, by introducing between the eyelids, a small quantity of the inspissated juice of the plant, either alone or dissolved in water;* or, it may be mixed with fomentations applied to the eye. Slight cases of iritis are sometimes destructive to vision, by the permanent contraction of the pupil; an event, which might probably have been prevented, by the timely use of this substance.

When Iritis is connected with Rheumatism, Gout, or Syphilis, it requires, in addition to the remedies above mentioned, the application of the general medical treatment, which the circumstances of the patient, on account of the state of these diseases, may require.

When iritis is connected with Rheumatism or Gout, vision is in great danger, from affection of the retina;† and the removal of the inflammation is very difficult, on account of the intractable nature of these diseases in many constitutions. In such cases, mercury is sometimes, not only ineffectual, but hurtful. Colchicum and opium, I have often found very beneficial.

* One drachm of the extract of Belladonna may be dissolved in an ounce of water.

† See Page 268.

When the eye affected with iritis, is in the state described at pages 268 and 269, warm fomentations and poultices give most relief. As the inflammation declines, the granulations upon the exposed iris, form into a thin cuticle upon its surface. They require occasionally to be touched with caustic when too luxuriant, or when the action in them becomes languid; but this must not be applied, till acute inflammation has entirely ceased.

SECTION III.

OF PASSIVE OR CHRONIC INFLAMMATION OF THE IRIS AND MEMBRANE OF THE AQUEOUS HUMOUR.

INFLAMMATION of the iris and membrane of the aqueous humour, sometimes occur in a passive or chronic form. Acute inflammation of these parts may terminate in this state; or this chronic affection may take place spontaneously, without any acute inflammation.

When chronic inflammation of the iris and membrane of the aqueous humour, takes place spontaneously, its progress may be considerable before it at-

tracts the notice of the patient; the first intimation that he gets of the disease, being an impaired state of his vision. In some cases, the disease is confined chiefly to those parts of the membrane connected with the iris and lens; in others, it affects the lining membrane of the cornea, or of the aqueous humour generally.

When the eye is examined, an irregularity of the pupil, and in some cases a contraction of it, may be observed: The iris loses its proper colour; the pupillar margin of the iris may be seen to adhere, at one or more points, to the capsule of the crystalline lens.* By these adhesions which it has contracted, the pupillar margin of the iris is drawn backwards to the lens, particularly at the adherent parts; the motions of the pupil, at the same time, become impeded, in proportion to the number and extent of the adhesions. Small masses of lymph, may be seen to form the connecting medium, between the iris and the lens. The effusion of lymph, may be confined to one or more points of the circumference of the pupil, which, in the progress of the affection, by extending, cause the complete adhesion of the pupil to the capsule of the lens. If the deposition of the lymph is recent, and the iris can

* See Plate XIV. Figs. 5 and 6.

be detached from its adhesions, by the dilatation of the pupil, the lymph, which remains upon the capsule of the lens, is more distinctly seen. The capsule of the lens, in the progress of the disease, generally becomes opaque, from its either partaking of the inflammation, or acquiring a coating of effused lymph. This effused lymph, in many cases, fills up the pupillary aperture. The inner surface of the cornea too, occasionally acquires a dimness and opacity from similar causes. In chronic inflammation of the iris, I have neither seen lymph effused in such quantity, nor so dense, as in cases of acute inflammation of the iris. Neither have I ever seen the lymph organised by red vessels. It has generally a flaky or downy appearance; in some cases, mixing with the aqueous humour, and rendering it opaque.*

The progress of the disease is various in different cases. Commonly it is remarkably slow and insidious, and seems to continue for several years gradually destroying the sight; and that too, notwithstanding the employment of various remedies to arrest its progress. Vision gradually becoming impaired as the disease advances, till it is quite destroyed. And this last symptom (impaired vi-

* See Plate XI. Fig. 3.

sion) is commonly the only one, by which the patient is conscious, that mischief is going on in the eye.

Chronic inflammation of the iris and membrane of the aqueous humour, is not in general attended with pain, intolerance of light, or external redness, unless occasionally in a slight degree. In several cases, I have observed the cornea to have become more prominent than natural, approaching to the state called *hydrophthalmia*, by which the focus of vision was so altered, that sight became confused and indistinct.

In the essay which I had the honour to present to the Medico-Chirurgical Society of Edinburgh upon this subject,* I pointed out a complete analogy, between this affection and chronic inflammation of serous membranes in other parts of the body. I therefore suggested, that the disease now under consideration, might rather be considered, as an affection of the serous membrane lining the cavities which contain the aqueous humour, than a disease affecting the iris itself. I adopted the title, there-

* See Edin. Med. Chir. Trans. vol. ii. The account of this, though new, the author was glad to find confirmed by the observations of several eminent members of the society.

I find that Mr. Lawrence also mentions this disease in his lectures. See the Lancet, vol. x. p. 257.

fore, under which I have now considered it, because the organic changes affect both the iris, and the serous membrane containing the aqueous humour.

Treatment.—This disease has been found to be very intractable, so that the treatment of it has proved extremely unsatisfactory. In many cases, of this disease, the medical and surgical treatment, employed to arrest its progress, has not been attended with success. This has consisted chiefly of courses of mercury, in addition to the remedies formerly recommended, when treating generally of chronic inflammation of the eye.* The use of Belladona, where the iris can be affected by it, is of peculiar utility in this affection, by separating and preventing the further progress of adhesions. Attention to the general health, with small doses of mercury, is chiefly to be relied on, for arresting the progress of the disease. Should symptoms of excitement and acute inflammation come on, the application of a few leeches, with attention to the other remedies, formerly recommended, for acute inflammation of the eye, should be had recourse to.

* See page 190.

SECTION IV.

OF CONTRACTIONS—DILATATIONS OF THE PUPIL, AND OTHER DISEASES OF THE IRIS.

ALL the diseased states of the iris, except inflammation, are dependent upon some of the diseases of the other parts of the eye. Thus, *contraction* of the pupil, may be the result of inflammation, or it may arise from adhesions to the cornea or lens—prolapsus of the iris through an opening in the cornea,—or from morbid sensibility of the retina. And *dilatation* of the pupil, with or without irregularity of its form, depends generally upon some affection either of the brain, optic nerve, retina, or ciliary nerves.

The various functional and organic affections of the iris, are therefore enumerated, when treating of the diseases of the other parts of the eye with which they are connected, and of the operations for artificial pupil.

CHAPTER VI.

DISEASES OF THE OPTIC NERVE AND RETINA.

PRELIMINARY REMARKS.

In this chapter will be included, an account of the diseases of the cerebral and nervous parts of the visual apparatus.

The cerebral and nervous parts of the visual apparatus, are of such delicate structure, that their functions are very easily impaired, and their texture disorganized by disease. As these parts perform so important functions also, their diseases are of the greatest importance. And although the diseased changes in these parts, are, for the most part, from their situation, hid from our view, in consequence of their peculiar functions and great sensibility, a complete knowledge of these diseases, is obtained from the state of vision, along with the other symptoms.

SECTION I.

OF ACUTE INFLAMMATION OF THE RETINA.

ACUTE inflammation of the retina, is fortunately a disease of rare occurrence, both on account of the violent and distressing symptoms with which it is accompanied, and the complete loss of sight which it often occasions.

It is attended with the common symptoms of acute ophthalmia, generally to a considerable degree of severity. The symptomatic fever is great. Violent and distracting pain, darting from the bottom of the eyeball through the head, is in general the first and most prominent symptom of it. The pain comes on suddenly, accompanied with great intolerance of light; the admission of which is compared to a dart passing through the head. In some there is a diminished sensibility to light, which proceeds to blindness. The pain is much increased by moving the eyeball; and is sometimes followed in the course of a few hours with total blindness. In some cases, the pain is confined chiefly to the eyeball, and is compared to the piercing of a sharp body. The patient complains of occa-

sional sparks, vivid flashes of light, and other luminous bodies appearing before his eyes, both by night and day. Upon inspection, little or no redness is perceived upon the eyeball. The pupil, appears, in some cases, contracted, in others, dilated and motionless, the humours to be turbid and muddy, presenting a semi-opaque appearance.*

In many cases, other parts of the eyeball are affected with inflammation, at the same time with the retina. Along with this disease, therefore, symptoms of inflammation of the conjunctiva, iris, choroid coat, or of some of the other parts, may be present.

It frequently happens, that the symptoms and pain attending inflammation of the retina, are so violent, that it resembles inflammation of the brain; the patient being affected to such a degree, with pain, confusion of intellect, delirium and want of sleep.

It need scarcely be remarked, that this is a highly dangerous disease to the organ of vision. It generally terminates with vision being more or less impaired. By the continuance of it, the internal parts of the eye become disorganized, so that sight is quite destroyed, and from the agony which the patients experience, they are often thankful to arrive

* See Plate XIII. Fig. 5.

at a termination to their sufferings, even with the loss of sight.

This disease is not always fatal to sight. When the proper remedies are applied early, or the disease is only in a slight degree, a perfect recovery may take place. In those cases which I have seen terminate favourably, the eye was long of recovering its wonted vigour. In one case, paralysis of the abductor muscle was the only bad consequence: it continued for some time after the eye recovered. Amaurosis, however, from paralysis of the retina, or its disorganization, frequently takes place, and is always to be dreaded.

Treatment.—Acute inflammation of the retina demands the employment of the most active remedies. The antiphlogistic treatment should be carried to its greatest extent, to arrest the progress of this violent and destructive disease. See Treatment of Acute Ophthalmia, page 174.

The violence of the symptoms, and of the affection of the brain, in this disease, require particular attention. When these are considerable, the head should be shaved, and cold applied over it, or blisters to the scalp and temple. Light must be carefully excluded from the patient; and, upon recovery, the exertion of the eye, requires to be very gradually and cautiously attempted.

SECTION II.

OF CHRONIC INFLAMMATION OF THE RETINA.

SOME forms of Amaurosis, and that particular state of the eye, called Glaucoma,* appear to consist in chronic disorganizing inflammation, either of the retina, or parts immediately connected with it.

In the affection termed *Glaucoma*, the pupil is dilated, irregular, and motionless. A deep-seated opacity is generally to be observed, arising either from an opaque state of the vitreous humour—the retina, or both. The opacity, at the same time, does not appear to be at all adequate, to account for the degree of blindness. This state of the eye takes place slowly and gradually, generally with pain in some part of the head or in the eyeball, vision gradually becoming more and more impaired, till the eye becomes altogether blind. After this stage of the disease, a softening of the eyeball very often takes place, from a gradual absorption of its humours.

* See Plate XV. Fig. 8.

This proceeds till the eyeball is quite shrivelled and contracted, leaving only its tunics sunk in the orbit.

From the state of the pupil, it is evident, that other parts besides the retina, are affected. For, its dilatation and irregular form, could not arise from the state of the retina alone. In cases where the same symptoms occur, without the natural size and shape of the pupil being altered, the eye does not contract and shrivel. Such are therefore to be considered as cases of amaurosis.

In some cases, a degree of this disease certainly exists, where there is slight opacity of the humours,—where the patient can distinguish light, and where the pupil is quite natural, though its motion is sluggish, and wasting of the eye does not take place.

When this disease takes place spontaneously, it commonly affects persons above the meridian of life. It seems often connected with rheumatism and gout. As a consequence of acute inflammation—of operations or injuries of the eye, it may take place at any age.

I am uncertain, whether the affection termed morbid sensibility of the retina, is referable to chronic inflammation, or is to be considered as a species of amaurosis.

In children there is sometimes a degree of intolerance of light, for which it is impossible to account by the external appearance of the eye. It is free from external inflammation or disease of the cornea, yet the intolerance of light is so great, that it is with much difficulty and pain to the patient, a view of the eye can be obtained. This is a state which often follows chronic ophthalmia, and is removed by attention to the state of the bowels.

Some of the affections of the eye, which are commonly considered cases of amaurosis, certainly consist of chronic inflammation of the retina. In such cases there is pain, heat in the eye, dislike to light, and aversion to use the eye, along with *muscæ volitantes* and an opaque appearance of the retina.

The retina and vitreous humour seem to have some peculiar dependance on each other; for, in most cases, both of the disorganized fluid state,—of the enlargement and diminished size of the vitreous humour, the retina is, either in, or acquires, a diseased state, causing insensibility to light.

Chronic inflammation of the retina, diseased vitreous humour, glaucoma, and amaurosis, are frequently combined or run into one another.

Treatment.—There is little to be said with regard to the treatment of this disease. I have known patients afflicted with it, teased and tortured with repeated topical bleeding, blisters, courses of mercury, with other remedies and local applications, but have never seen any benefit derived from them. So that, in many cases, the patient sooner or later, required the application of an artificial eye, to obviate the deformity arising from the contraction of the eyeball.

SECTION III.

OF AMAUROSIS.

UNDER the title of *Amaurosis*, are usually comprehended, all imperfections of sight, arising from disease, or disordered function of the sentient parts, or those which I have termed, the *cerebral and nervous parts* of the apparatus of vision; even although such imperfections of sight, arise from a great many different diseased states, both functional and organic, not of these parts merely, but of other parts of the body at a distance from them.

The term amaurosis, therefore, is commonly given to all imperfections of vision, which arise from any disease which affects the functions of the *retina.*

Amaurosis may affect one eye or both; and the derangement of function, may extend over the whole of the retina, or only a small part of it may be affected.

The functions of the retina may be affected by many diseased states, not of itself merely and those parts with which it is connected, but of parts also which are remote from it.

Whether the seat of the disease which occasions amaurosis is in the brain—in the optic nerve—in the circulating system—in the digestive organs—in the retina itself, or other parts of the eye, the effects of the diseased state are indicated *by the increased or diminished sensibility of the retina to light;* and the true nature of the disease is to be inferred from this, in connection with other symptoms.

Amaurosis may be *functional* or *organic,* and each of these forms of it, may be again divided into that which is *idiopathic,* and that which is *symptomatic* of some other disease.

Amaurosis is attended with a certain combination of symptoms, from whatever cause it may arise. In treating of this disease, therefore, these symptoms shall be first detailed, mentioning, at the

same time, the circumstances attending them, which tend to point out the nature and cause of the amaurosis.

Symptoms of Amaurosis.—The most common symptoms of amaurosis are imperfect vision, consisting of partial or complete loss of sight, either permanent or temporary—pain in the eye or some other part of the head—dark spots, sparks, and flashes of light, or other imaginary objects appearing before the eye, called *muscæ volitantes* or ocular spectra,—accompanied with an irregular, dilated, and commonly immoveable pupil; which aperture has, in many cases, also lost its jet black appearance.*

In different cases these symptoms are modified by the nature of the *cause* of the amaurosis, which may occasion them to assume a considerable variety of appearances. This circumstance frequently renders the diagnosis a matter of difficulty, more especially from several other diseases of the eye being attended with symptoms somewhat similar. With these diseases, also, amaurosis is frequently complicated. It is, therefore, of importance to be acquainted with the variety of appearances which the symptoms of amaurosis present, in different cases, according to the cause of the disease.

* See Plate XV. Figure 8.

1*st, Impaired Vision.*—According as vision is imperfect or entirely lost, amaurosis is called perfect or imperfect, partial or complete. The imperfect vision is in some cases temporary and periodical, in others it is permanent, which is the more common occurrence.

When the blindness or imperfection of sight is temporary and periodical, it frequently takes place at regular intervals, as at a particular time every day, or every month; or, as sometimes happens in females, it takes place at a particular time during each pregnancy, and again goes off at the period of delivery. When the imperfection of vision is more permanent, it often varies at different times of the day; in some cases, the sight of the patient habitually becomes worse in the afternoon, and is rather better again next morning; others see worse for an hour or two after rising. The degree of light at different times of the day, in some cases, has an effect on the sight; some seeing best in a full bright light, others in a weak light, as after sunset. Some see well in candle light, others do not. Some persons see only during the bright light of day, and become blind in the evening; this is called Hœmeralopia, seeing by day, or night-blindness. Seeing in the dark or by night, is called Nyctalopia, which is a much more rare occurrence.

The eye having been for some time in a state of rest, as during sleep, in many cases, enables persons to see better upon rising in the morning than at other times of the day. This shows, that the disease is produced, or aggravated by exerting the eyes. The state of the stomach too, has a temporary effect upon the sight of some persons. When empty, along with faintness, there is dimness and indistinct vision, or muscæ volitantes, in those who do not otherwise complain, which goes off after taking food. Amaurotic persons, are easily affect- from this cause. Dyspeptics, delicate persons, and those subject to sick headach, often complain of dimness of sight.

These varieties in the state of vision in amaurotic persons are referable to the susceptibility of the retina to light,—the degree of it necessary for vision, the adaptation of the pupil, and the quantity of light that is either absorbed or reflected within the eye.

Impaired vision from amaurosis varies in different individuals, and in some cases at different times in the same individual, from a slight dimness or muddiness, as if every thing was seen through a mist, to the state of perfect blindness. Some patients affected with amaurosis, and in whom

vision is only impaired, see objects, particularly small ones, very indistinctly, as if they were envelloped in a cloud, so that they do not see their proper shape; others see objects imperfectly by seeing only a part of them, there being a partial insensibility of the retina. Some describe a horizontal, others a vertical screen, rendering one half of the object viewed invisible, when the axis of the eye is directed to the object; so that they are obliged to move either the head or the eye, in the direction necessary to cause the light admitted into the eye, to be directed to the sensible part of the retina. For the light, in such cases, is most commonly required to enter the eye in an oblique direction. In some cases, however, the lateral vision is impaired or lost, so that the patient sees only in the direct line of the axis of vision. Other persons affected with this disease, can discern the shape of objects, but cannot distinguish their proper colours; while to others, colours appear different from what they really are. This arises from the retina being insensible to part of the rays of which light is composed. Some persons affected with this disease see objects multiplied, being doubled or tripled, a circumstance which is not easily accounted for. In some, objects appear distorted, as bent, lengthened, or shortened.

In those persons who can discern only a part of an object, there is reason to believe that only a part of the retina is sound. In others, to whom a part only of an object is invisible, only a part of the retina is diseased. When the portion of the retina with which the patient sees, is not opposite to the axis of vision, he seems to squint in looking at an object. For vision depends on the situation, as well as the extent, of the part of the retina which is affected.

2. *Pain.*—Amaurosis very often begins with pain in the eye or some part of the head. This, is a very frequent symptom attending the disease, in all its stages and degrees. It is generally situated in the forehead or in the eye. In some cases, however, there is no pain, but great heat is felt in the eyes.

Pain, at the commencement of amaurosis, affecting the forehead, temples, or eyeballs, often diminishes in proportion as the sight becomes impaired; and, when the vision has become extinct and the amaurosis perfect, the pain usually ceases altogether, when the disease is seated in the eyeball. The pain is, in many cases, not constant, but comes and goes, and is various in its degree at different times. In some cases, it assumes an intermitting character, increasing and becoming more severe towards the evening, every day, or every second day, and con-

tinuing for several hours. In many cases, instead of pain, there are only disagreeable and painful sensations felt about the eyeball, or there is a sense of fulness in the forehead and eyes, along with increased heat and flushing of the face.

The pain accompanying amaurosis is not always an indication of inflammatory action going on; nor can it always be referred, to a plethoric state or fulness of blood in the parts; for, it sometimes occurs when the amaurosis neither seems to depend on inflammation nor plethora in the head or eye, and even when there are symptoms of an opposite state.

When the pain and vision, are worst soon after taking food, this is obviously hurtful by the stimulus and excitation it produces, which shows that the disease, either arises from plethora or is of an organic nature. When, on the other hand, the disease is worst before taking food, a state of debility or languid action is probably the cause of it.

The pain is sometimes referred to the situation of the supra-orbitar, infra-orbitar, or other nerves about the eye, and, in some of these cases, the affection resembles the disease, called Tic douloureux affecting the fifth pair of nerves.

By the situation, extent of the pain, and its association with other symptoms, an accurate opinion may be formed, with some degree of accuracy, as to

whether the disease is organic, or only functional. In the most common forms of functional amaurosis, the pain is at times inconsiderable, and declines as the dimness of sight increases. In the organic amaurosis, the pain is usually severe, constant, without any complete intermission, and is commonly increased by any cause of excitement.

The existence of organic disease, is rendered more certain, when accompanying amaurosis, there exist other symptoms of cerebral disease, such as stupor, paralysis, or torpor of the system.

3. *Muscæ Volitantes* or ocular spectra.

Persons affected with amaurosis generally think that they see objects before them, which, in reality, have no existence. These phenomena, have been termed ocular spectra or muscæ volitantes. They present different and varied appearances in different persons, and also at different times in the same person. They have commonly the appearance of certain known objects at rest or in motion; in some they all seem to be black, in others to have different bright colours. Sometimes they have the appearance of black motes, streaks or net work. Very often, bright, shining, or luminous objects are seen, which present different appearances, as balls of fire, flames, bright flashes of light, sparks, rays of light, or falling stars. In some a luminous spot appears,

which forms a circle that gradually expands till it vanishes altogether. In some cases there is a black spot of this kind.

In many cases, these appearances are very transitory; in some, they come on only at regular intervals; in others, they are fixed and permanent.

When ocular spectra are transitory, they generally vary in their appearance at different times, and seem to float about before the eye, forming into fantastic shapes. Sometimes, this symptom appears in form of a single black mote, resembling an insect moving before the eye; sometimes two or three appear, at other times an immense number seem to be present.

In many cases the muscæ volitantes are the only symptom of amaurosis that exists.

When this symptom is constant, and when the spectrum remains the same, without changing its form or situation, unless to increase, there is reason to think that it is a symptom of organic disease; the floating or moving spectra being commonly a symptom of the functional amaurosis. The fixed spectrum, pointing out the part of the retina which is insensible or diseased; the floating muscæ volitantes, disordered circulation.

In functional amaurosis muscæ volitantes occur

in two distinct and opposite states; the one of increased excitement, the other of collapse.

4. *State of the Pupil.*—The state of the pupil, which indicates the mobility and activity of the iris, is one of the most sure indications of the healthy and diseased states of the retina, when taken along with other circumstances.

In an eye affected with amaurosis, the pupil is in general more dilated than natural, and frequently has an irregular shape, not having its completely circular form. Its contraction, upon the sudden admission of light, is either slow, incomplete, or both. In some, it moves more quickly than natural, from increased susceptibility of the retina to light; and in some it is more contracted than natural. The state of the pupil will often point out at once which of the two eyes is affected, even although the disease is very slight.

When the retina is quite insensible the pupil is generally dilated, motionless, and often also irregular. In some cases, however, of perfect amaurosis, the iris retains its mobility. These states of the pupil may arise from the state of the iris and ciliary nerves, independent of disease of the optic nerve or retina.

The colour of the pupil is frequently changed in cases of amaurosis. Instead of its natural black or

dark green colour, in some cases it has a clouded, a muddy amber, or yellowish green colour. Some of these particular states are called Glaucoma.

In some cases, when the pupil is dilated, a yellowish white or green colour is observable in the bottom of the eye, having also red vessels ramified upon it. This may be caused, by the retina having become opaque—a deposition of lymph upon it, from previous inflammation, or by a morbid growth or tumour.

The pupil, presenting an opaque appearance, occasionally give rise to some difficulty in distinguishing amaurosis from opacity of the humours of the eye, particularly that of the crystalline lens or cataract. How a correct diagnosis may be formed between these two diseases will be pointed out when treating of cataract.

Causes.—Amaurosis, whether idiopathic or symptomatic, arises from many different causes. It affects persons of all ages and circumstances, and it is also sometimes a congenital affection. It may take place in one eye, or both may be affected, according to the nature of the cause, by which it is produced. It may come on suddenly, or it may take place slowly and gradually; affecting one eye at first, and the other afterwards, or affecting both

at the same time. It affects only one, when it arises from a local cause ; but, when from a constitutional cause, both are generally affected.

Amaurosis varies in degree in the progress of different cases. It may gradually diminish till the patient recovers. But, when it continues, or gets worse, imperfect amaurosis may become perfect—and that which was at first functional, may become organic.

In some cases, amaurosis is accompanied with inflammatory symptoms ; such as increased force in the circulation, indicated by quick full pulse, pain in head or eye, increased determination of blood to these parts, giving rise to flushing of face, increased heat, lethargy, and tinnitis aurium. In others, it is accompanied with symptoms of dyspepsia, or derangement of the digestive functions, indicated by sickness, loss of appetite, headach, foulness of tongue, and irregularity of the bowels. These states are very frequent causes of functional amaurosis.

When amaurosis is accompanied with derangement either of the circulating or digestive systems, and is not occasioned by organic disease, this derangement is generally the cause of it. Removing or curing the disorder of the circulating or digestive systems, therefore, very frequently cures the

disease. But great attention is necessary to prevent its recurrence.

Functional amaurosis, is likewise frequently caused by over-exertion or excitement of the eye, and goes off when the organ is allowed to rest. A plethoric state of the system—debility from great and sudden evacuations—narcotic and other deleterious substances,—pressure upon the brain, either from depression of a portion of skull, or from extravasation of fluid, often produce this affection. Pressure upon the optic nerve or retina, as by a tumour within the orbit or cranium, also produces functional amaurosis.

Organic amaurosis is frequently occasioned by external injury, when either the optic nerve or retina is wounded and detached from its connections. The retina may also be pressed upon or detached from the other coats of the eye by effusion of blood. Change in the texture of the retina from inflammation of it—enlargement or wasting of the eye,—and tumours or suppuration connected with the optic nerve or retina, are also frequent causes of organic amaurosis.

Amaurosis may also arise from organic affections of the brain, such as, apoplexy from congestion or extravasation of blood,—hydrocephalus,—abscesses

or tumours of the brain. In these cases it is a symptomatic affection.

In consequence of the peculiar connection that exists between the fifth pair and visual nerves, amaurosis has often been observed to arise, from injury or disease of the branches of the fifth pair. Some of these cases have been cured, by the division of the nerve, or the removal of the source of irritation.*

Diagnosis.—From what has been said, in the full account which has been given, of the symptoms of Amaurosis, and the allusions that have been made, regarding the connection between these and the causes which give rise to the disease, very little now remains to be said upon the subject of diagnosis.

In organic amaurosis, the state of vision seldom varies, but continues much in the same state. In functional amaurosis, it varies considerably at different times, and in particular states of the system.

Organic amaurosis is often known to exist, from particular combinations of the symptoms attending it, as well as from the cause by which it has been occasioned. When marks of disorganization of the globe exist, such as general enlargement of the eye-

* See Wardrop and Travers.

ball,—staphyloma of the sclerotic coat,—atrophy from absorption or evacuation of the humours,—opacity of the vitreous humour,—pupil much dilated, contracting little or remaining stationary,—insensibility of the eye to light,—superficial varicose vessels upon the sclerotic coat,—or an opaque appearance in the situation of the retina, along with muscæ volitantes, whether stationary or permanent, the amaurosis is generally organic.

Complications.—Cases of amaurosis are often complicated with different diseases of the eye, such as cataract, permanent contraction or closure of the pupil, disorganization of the vitreous humour, &c.

SECTION IV.

TREATMENT OF AMAUROSIS.

THE proper treatment of amaurosis is only to be applied, by employing remedies suited to the nature of the disease, and to the removal of the cause from which it arises.

It is functional amaurosis alone, whether idiopathic or symptomatic, that offers encouragement

for medical treatment. When early applied, the disease may in general be cured; but when it has existed for any considerable length of time, it may have become organic and incurable.

The remedies, which are beneficial in cases of amaurosis, are few in number, chiefly consisting of the antiphlogistic regimen, and those medicines which correct functional derangement in the digestive organs; and, in the more rare cases, when the disease arises from debility, remedies of a tonic and stimulating quality.

When amaurosis arises from inflammation, determination of blood to the head, or suppression of an habitual evacuation, the treatment consists in diminishing the quantity of blood sent to the head and to the eye. The same remedies, therefore, apply to this, that are recommended for acute inflammation of the eye. These, consist of bleeding, blisters, nauseating, and purgative medicines, as in cases of ophthalmia, applied according to circumstances, along with a spare diet, and the restoration of any suppressed evacuation. Removing the hair, and the frequent application of cold water to the head, or shower bath, are also of great importance.

When amaurosis arises from dyspepsia or derangement of the digestive organs, these states

being corrected, cures the amaurotic affection. Such cases are to be treated upon general medical principles, and the treatment persevered in for a considerable length of time. I have usually found that magnesia and rhubarb, with aloetic or compound colocynth pill alone, or combined with either a small quantity of calomel or blue pill, are highly beneficial, and sufficient to accomplish the desired effect. In some cases, the blue pill, at night, with small doses of neutral salts next morning, are also useful.

When it arises from a state of general debility, tonics and nourishing diet, with an allowance of wine, are requisite. Stimulants, as the vapour of ammonia applied to the eye, are also of use. In such cases, and when the disease arises from the eye having been over-excited from two strong light or too much exertion, bleeding is to be avoided as hurtful. Complete rest and tranquillity, both of mind and body, as well as of the eye, are of most consequence.

I had occasion, when treating of chronic inflammation of the retina and its adjacent parts, to allude to a species of amaurosis, which takes place from some chronic disorganizing process in these parts.

The application of blisters and issues upon the temples or back of the neck, along with mercurial and purgative medicines, are best suited to arrest the progress of this form of the disease. By perseverance in the use of these for some length of time, I have seen the most unpromising, and, at first, obstinate cases, yield and get well.

When amaurosis takes place, in consequence of excessive determination of blood to the head or eyes, from too great excitement, along with the remedies above mentioned, keeping the mind and the eyes, as much as possible, in a state of tranquillity and rest, are of the utmost importance, in removing and preventing the further progress of the disease. The patient should neither read, write, nor work at any kind of employment which requires much exertion of sight.

Moderation in diet, and temperance, along with the daily use of the shower bath, or cold otherwise applied to the head, ought strictly to be enjoined, together with exercise in the open air.

The occasional detraction of blood, particularly by cupping the temples, behind the ears, or between the shoulders, is also of great use.

Cases. Cases of most of the diseases of the eye, are given in the descriptions of the plates illustrating this

volume; but as there are no cases of amaurosis given there, it may be useful here, to detail some cases of this affection, to illustrate the effects of remedies.

Case I. A. B. from the country, Æt. 13. September 20th, 1826. Complains of dimness and indistinctness of sight, particularly when he attempts to read or write, by continuing at any of which, even for a very short time, he loses his sight almost completely. Red spots and specks of fire often appear before him. Has pain across the forehead occasionally, upon using his eyes; pupils natural. Affection of eyes has existed for between two and three years, and is ascribed to an acute febrile affection.

Recommended him to take a pill of compound extract of colocynth with a small quantity of calomel every night, or every second night, according to its effects upon the bowels. To take exercise in the open air—not to exert his eyes, either in reading or writing, &c.

To bathe the head with cold water morning and evening.

Moderate diet.

Nov. 14. Has experienced much benefit from the medicines, &c. Finds his sight much better when taking the pills and going about in the open air. He can now read for a greater length of time, though his eyes still fail to see the letters when it is continued.

To continue the same treatment.

30. Is much better—finds his sight greatly improved, and he has less pain in his head and eyes.

Jan. 10, 1827. Though he is much better, he is still far from being well. He can only write a few lines, before his sight almost entirely fails him.

To have his head shaved, and a blister applied to back of neck.

To continue the other treatment.

I did not hear much of him again till May, 1828, when I was informed he had persevered in the treatment recommended during most of the preceding year, that he had got gradually better, and that he was now attending school and felt himself quite well.

Case II. C. D. Æt. 12. from the country, February 23, 1827. Complains of being unable to see to read. Of this she began to complain 6 months ago, and became gradually worse till she could neither distinguish the letters nor even the lines of a book. When she tried to read large print, she could see the letters best at first, but soon lost her sight altogether. The left eye is worse than the right. Can see to go about—but imperfectly. Tongue white—complains of pains in the stomach and bowels at times, as also of sickness and headach. Eyes quite natural in appearance. Occasionally she sees sparks of fire before her eyes.

To take a small dose of magnesia and rhubarb twice a day; and a pill of compound extract of colocynth, every night.

27. Is still much the same—medicines taken as directed. Bowels moved two or three times daily. Tongue not so much loaded. Has still pains in the bowels and sickness at times.

To take a mercurial pill every morning in addition to the other medicines.

March 7. The sight began to improve very much some days ago, and she can now see to read perfectly even the smallest print. Symptoms and general health greatly better. To continue the medicines but in less quantity.

Case III. E. F. Æt. 68. August 23, 1828. In left eye—pupil contracts freely by light. When dilated by Belladona, there is considerable deep-seated opacity of a yellowish green colour. Pupil somewhat irregular. Sight of this eye is almost entirely gone. There is like a piece of dark crape before the eye, with numerous dark motes floating about before it. This eye became affected 12 months ago, since which time it has been gradually getting worse.

In right eye—Appearances much the same as in the left—vision not so much impaired—pupil not so irregular. The same black motes are seen before it, but to a less extent. Could see to read with this eye two weeks ago, which she cannot now do, nor even distinguish the largest letters. Has no headach or stomach complaint.

To apply blisters to her temples.

To take a compound colocynth pill, with calomel, every night.

Sep. 19. Left eye continues the same. Right eye has been improving for the last week. She has had a blister on her neck which is kept discharging. She can now see to read large printed books, which she could not do before. Sight better at some times than others.

To continue the medicine, and take exercise in the open air.

Oct. 6. Both eyes have become much better. She can now see to read the newspapers, and can employ herself in sewing, &c. General health improved.

Remarks on the preceding cases.

These three cases, are selected, as illustrating three different forms of functional amaurosis. The

first, being amaurosis from local plethora, or determination of blood to the eyes, the sequel of acute fever. The *second*, amaurosis from derangement of the stomach and bowels; and the *third*, amaurosis from chronic inflammation of the retina. Each of these cases, had been unsuccessfully treated by others; probably from the treatment not having been suited to the particular nature of the cases. Indeed one of them, (case 3.) was sent to me as a case of cataract. It will be observed also, that the treatment not only requires to be suited to the nature of the case, but also to be persevered in for a considerable length of time. And having commenced the proper treatment, it should be persevered in, even though under unpromising circumstances at first, as affording the best chance of being followed by the favourable result, which attended it in these cases. These measures being necessary, in many cases, to prevent the recurrence of the amaurosis, as well as to cure it.

In cases where there is a deficiency of pigmentum nigrum upon the choroid coat, the glare and reflection of the light, are to be obviated in some measure, by the interposition of a screen, or the use of coloured glasses.

CHAPTER VII.

DISEASES OF THE CRYSTALLINE LENS AND ITS CAPSULE.

PRELIMINARY REMARKS.

From their very delicate structure and high degree of organization, the crystalline lens and its capsule, are easily destroyed by injuries upon the eye—by inflammation—or disease in the parts adjacent to them. From the transparency of these parts, being absolutely necessary to vision, opacity of either of them, or *cataract*, forms one of the most important diseases of the eye.

The diseases of the crystalline lens and its capsule to be described, are, inflammation—the effects of injuries,—and cataract.

SECTION I.

OF INFLAMMATION AND THE EFFECTS OF INJURIES UPON THE LENS AND ITS CAPSULE.

THE anterior part of the capsule of the lens constitutes a large portion of the membrane of the aqueous humour. The preceding observations, therefore, regarding inflammation of the membrane of the aqueous humour, are to be considered as applicable to inflammation of the anterior part of the lenticular capsule; this part of the membrane of the aqueous humour being often affected.

The undoubted existence of acute inflammation of the lens itself, I have only observed in cases, where it was the consequence of injuries. In many cases of cataract, however, there is ample evidence of the lens and its capsule being affected with chronic inflammation.

1. *Inflammation of the Crystalline Lens from Injury.*—When the lens is injured, and its capsule ruptured or torn by a sharp instrument, without any of these parts being detached from their vas-

cular connections,* they inflame, the neighbouring parts become affected, semitransparent albuminous matter is poured out from the opening into the chambers of the aqueous humour, and the lens becomes opaque.† The injury, when slight, seems to be repaired by a process of nature, of which the effusion of lymph is a part; but an opaque state of the injured part remains. In case of cataract, when the lens is neither in a dead nor fluid state, precisely the same effects result from the laceration of the capsule and lens with a needle, without displacing them from the vascular attachments. Hence such an operation is quite unavailing.‡

2. *Death and Solution of Lens from Injury, the Capsule retaining its Vitality.*—If the lens receives such an injury as detaches it from its vascular connections within the capsule, the death of the lens appears to be the consequence. The capsule, though injured, if not torn from its vascular attachments,

* The vessels radiating from the ciliary processes to the circumference of the capsule of the lens, and those of the lens itself, I have demonstrated in an Essay upon the subject in the Edinburgh Medical and Surgical Journal, vol. xxvi. and also in the Anatomical description of the Eye. See page 62, and Plate III. Figure 3.

† See Plate XIV. Fig. 4.

‡ Numerous cases, illustrating these and the following observations are given in the essay above alluded to.

retains its vitality and transparency. The lens, however, becomes opaque, and, when its capsule has been opened, is exposed to the action of the aqueous humour. In such circumstances, the lens is dissolved and absorbed with the aqueous humour —rapidly and completely in young subjects, more slowly, and generally imperfectly, in elderly persons.* These changes could not take place unless the lens had previously lost its vitality ; for the solvent power of the aqueous humour cannot be conceived to be so great as to enable it to act chemically upon a living part.

After the removal of the lens from its situation by an operation or injury, the capsule retains its transparency ; but the wounded edges of it contract, from elasticity, towards its circumference, when the vessels connecting it with the ciliary processes have not been injured.

These changes are frequently induced, by the operation to remove the lens when opaque—more especially in young subjects. In such cases, therefore, as well as in cases of accidental injury, the changes described may be observed. The transparent state which the capsule retains, is amply illustrated by the cases in which an opaque lens has been

* See Plate XV. Fig. 9.

successfully removed from this membrane, whether by solution, depression, or extraction.

Probably few cases occur, except in operations for cataract, where the lens is detached from its union with the capsule by an injury, without the capsule being, at the same time, either wounded or detached.

3. *Death of the Lens and its Capsule from Injury and from Disease.*—When an injury inflicted on the eye, has been of such a nature that the crystalline lens and its capsule have been detached from their connections, they lose their vitality—they become opaque, and are quite in the state of a foreign body in the eye.* Though by such injuries, these parts are sometimes quite removed from their natural situation, the vessels by which they are nourished may be torn asunder, the lens and its capsule become dead, and yet they often remain *in situ* from the attachment of the posterior part of the capsule to the hyaloid membrane; a very slight movement being sufficient to rupture the slender vessels surrounding the capsule of the lens.

In many cases, where the lens and anterior part of its capsule evidently become dead, the posterior part of the capsule seems to retain its vitality

* See Plate XIV. Fig. 7.

and transparency; showing that this latter part is probably nourished by a different set of vessels, from which it is not so very easily detached as the anterior part, owing to its close connection with the hyaloid membrane. The well known fact, that the lens and anterior part of its capsule, are frequently in a diseased state, while the posterior part remains sound, strengthens the probability of this conclusion. That the nourishment of the lens depends on its capsule, is also evident from the circumstance, of the lens, in cases of cataract, being many years opaque, without its capsule becoming affected; but the capsule is never long in a diseased state, without the lens also becoming opaque, and often fluid.

When the capsule of the lens has been ruptured or opened, by the injury which has detached these parts from their vascular connections, the lens is subjected to the action of the aqueous humour, and may undergo the changes of solution and absorption, mentioned in the preceding pages. The dead capsule, however, not being so easily acted upon by the aqueous humour, remains, becomes opaque, shrivelled, and contracted.* In the course of time, the more soluble parts of it, in some cases, seem to be removed by the aqueous humour; while those

* See Plate XV. Fig. 5.

parts, which seem to be insoluble in that fluid, remain in the form of detached shreds.* When subjected to the action of the aqueous humour, the lens does not always dissolve; in elderly persons, when hard and firm in its texture, it seldom becomes completely dissolved.

Precisely similar changes to those just described, are produced by operations for cataract, when, in the performance of them, the capsule, as well as the lens, has been torn from its vascular connections; the opaque and shrivelled capsule which remains having attachments so slight, that, in many cases, it has a tremulous motion in the eye.†

When the lens and its capsule have been detached and deprived of their vitality, without the capsule being opened, as by a blow upon the eye, or by disorganizing inflammation of the globe, they have, in some of the cases which I have seen, rolled about in the eye for some time, of a semitransparent appearance, and otherwise unchanged; in others, they have become quite opaque.‡

In many instances that have come under my notice, the lens and capsule had apparently become dead after an attack of inflammation. In some

* See Plate XIII. Fig. 9. † See Plate XV. Fig. 6.

‡ See Plate XIII. Fig. 8. and XIV. Fig. 9.

cases, the same changes have taken place without any evident cause, after which, these parts remained *in situ* and became of a yellowish white colour.* In one of these cases, I opened the capsule with a needle introduced into the eye, nine years after the patient had lost her sight, when I found the capsule adhering to the iris, tough, opaque, and filled with a milky fluid.

When the lens inclosed in its capsule, becomes dead, probably by the lapse of time, it also becomes fluid from decomposition.† After this has taken place, the capsule appears, in some cases, to have given way, and discharged its contents into the aqueous humour; after which the fluid lens becomes sorbed, leaving the opaque dead capsule.‡

The death of the lens, whether spontaneously, or by purulent ophthalmia at the period of birth, is probably, in many cases, the cause of what has been termed, *congenital cataract;* the capsule having burst into the aqueous humour, by which the lens had been dissolved, leaving an opaque capsule;

* See Plate XIV. Fig. 7. and Plate XV Fig. 2.

† In making dissections, upon opening the capsule, after the parts have lain some time, I have found the lens converted into a milky fluid.

‡ See Plate XIV. Fig. 10.

or, where the lens has remained within its entire capsule, till operated on, it has been generally found to be in a fluid state.*

SECTION II.

OF CATARACT.

THE disease termed cataract consists of an opaque state of the whole, or a part, either of the crystalline lens, its capsule, or of both these. The opacity of these naturally transparent parts produces indistinctness of sight or blindness, by preventing the rays of light from passing to the retina.

The opacity is most commonly situated in the lens itself, in which case the disease is called *lenticular cataract.* When it is the capsule of the lens that is opaque, *capsular or membranous cataract.* When both are opaque, *capsulo-lenticular cataract;* and when the opacity consists of lymph deposited upon the capsule of the lens, or in the posterior

* What has been termed *congenital* Staphyloma, may generally be traced, to have been caused by Ophthalmia after birth.

chamber of the aqueous humour, filling up the pupillary opening, *adventitious cataract.*

Cataract may take place spontaneously, from inflammation or injury of the eye at any age; but that form of it which exists in infants is called *congenital cataract.*

The chief, and in most cases, the only symptom, which attends the existence of cataract, is *impaired vision.* The indistinctness of sight varies in degree, from being only like a mist before the eye, to that of complete blindness, according to the degree of the opacity.

This partial or complete loss of distinct vision, in cases of cataract, is of a peculiar kind. The sight of the eye is not lost; the light being only intercepted, from getting directly to the retina by the opaque body, the patient can generally distinguish light from darkness. Some light is admitted to the retina in most cases, either in consequence of the cataract not being completely opaque, or by the sides of the lens, through the transparent space, between it and the ciliary processes occupied by the vitreous humour. This transparent space, which I have called the *zonula lucida,* manifests itself by the black ring which generally surrounds cataracts, when the pupil is fully dilated. (See Anatomy of the Eye, p. 62.) There are cases, however, in which

light is not admitted, owing to the complete opacity and increased size of the lens, or its adhesion to the iris. When the lens is neither completely opaque, increased in size, nor adhering to the iris, and yet the patient cannot distinguish light, the cataract is generally complicated with some other disease of the eye, as shall be afterwards pointed out.

As light is admitted into the eye in cases of cataract, in the manner mentioned, these patients frequently complain of the distressing glare of light which is constantly before them. The rays of light being admitted at the circumference of the lens, are refracted in all directions, cross each other within the eye, and so cause this troublesome sensation.

In cataractous eyes, the quantity of light admitted, depends also on the size of the pupil. On account of the pupil dilating in a dull obscure light, patients then see more light, or distinguish objects better, than they can do otherwise. When the pupil is dilated by Belladonna, the patient, who was previously blind, sometimes sees so much better, while the effects of this substance continue, as to be able to distinguish objects, and even to read. The dilation of the pupil, by this medicine, is of great use in examining cases of cataract. It enables the examiner to see the disease more thoroughly, the state of the iris, and elucidates doubtful cases.

When indistinctness of vision, arises from cataract alone, it depends so much on the degree of the opacity that it can be pretty accurately judged of by the surgeon. The opacity varies, from that of a slight semi-opaque appearance to complete whiteness. It is of great consequence to observe, that a slight degree of opacity in the lens, frequently exists in elderly persons, from the lens becoming of an amber colour, without vision being impaired. When a patient who complains of blindness, therefore, has only this degree of opacity of the lens, the loss of sight must depend on some other cause. In many cases of amaurosis, a similar degree of opacity often exists, which, though it is seated in the retina, is not very easily distinguished from opacity of the lens. An accurate diagnosis is to be found, by the degree of opacity not being sufficient to account for the degree of blindness, and the existence of other symptoms of amaurosis.

A cataractous lens appears to be much more opaque when in the eye, than it does when removed from it. Though it may seem perfectly opaque in the eye, it appears to be semi-transparent when extracted. So that the opacity of a cataract, may appear to be very considerable, and yet may not materially impair vision.

Along with impaired vision, in many cases of cataract, there are other symptoms connected with the disease. These are symptoms of chronic inflammation, indicated by tenderness of the eye to light—a sense of heat in the eyes—and increased vascularity. These symptoms, vary in degree at different times, but take place frequently, particularly upon any cause of excitement. By many, this has been considered as the cause of spontaneous cataracts. M. Petit observed that, in 300 cases of cataract, two-thirds of them occurred in persons, who had exerted their eyes much in a strong light.

The appearances presented by cataractous eyes are different, in different cases, according to the nature of the disease,—the extent and degree of the opacity.

Of Lenticular Cataract.—Lenticular cataracts vary in colour, consistence, and size, in different cases. In colour they are generally white, yellowish white, greenish, or bluish grey, striated, radiated, or speckled, and sometimes, though rarely, brown; in which case it has been called, black cataract. In consistence, they vary from fluid, to a firm caseous consistence, or even bony hardness. Pure white cataracts are generally either fluid or

bony. Grey, striated, radiated, and speckled cataracts are generally firm, and of the consistence that the healthy lens should be, at the age of the patient.

Lenticular cataracts, when solid, are generally about the size of the natural lens; when fluid, larger; and when hard, smaller. Lenticular cataracts, when not perfectly opaque, commonly appear to be most opaque at the centre, and less so towards their circumference, from the greater thickness of the lens at its centre than at its circumference. See Plate XIII, Fig. 8. and Plate XV, Figs. 1, and 4. In some cases, only the central part of the lens is opaque, particularly at the commencement of the disease, so that vision is not materially impaired. Opaque lines frequently radiate from an opaque centre. In one case, I found the central part converted into bone.

Of Capsulo-Lenticular Cataract.—Capsulo-lenticular cataracts are not uncommon. When the opaque lens, is either fluid or softer than natural, the caspule is generally opaque also. A semi-opaque lens, having some parts quite white, like spots or specks upon it, is a common form of this kind of cataract. Those parts appearing more opaque than the rest, where both capsule and lens are affected. See Plate XV, Figs. 2 and 3. In fluid cataracts, opaque

spots, consisting of portions of opaque lens, may sometimes be observed to change their position, when the capsule is sufficiently transparent.

Of Capsular Cataract.—Opacity may affect only the anterior part of the capsule, the posterior part, or both, the lens remaining transparent. The opacity may be general, or it may be only partial. Opacity of the posterior part of the capsule, is, in some cases, with difficulty distinguished from an opacity of the vitreous humour, or of the lens itself.*

In many cases of capsular cataract, the lens is wanting, either by having been absorbed, or removed by an operation. The absorption of the lens generally takes place by a rupture of the capsule. The lens, if fluid, then flows out, and is absorbed along with the aqueous humour; or if solid, it is acted on by this humour till it has been completely removed; a contracted opaque capsule then remains.† See Plate XIV. Fig. 10.

When the capsule becomes opaque, after the removal of the lens by an operation, it is called

* See Plate XIV. Fig. 8.

† The following statement shows the proportions in which the different kinds of cataract occur. Of 306 cases of cataract operated on by M. Dupuytren at the Hotel Dieu, 279 were lenticular, 22 membraneous, and 5 fluid cataracts.—Sebatier, tom. iv. Edit. 1824.

secondary cataract. This is generally caused by the capsule having been detached from its vascular connections. In consequence of which, its death is occasioned ; it becomes opaque, shrivelled, and contracted. See Plate XV. Figs. 5 and 6.

The capsule of the lens is rarely dissolved by the aqueous humour. In young subjects, however, it is frequently, in the course of time, acted upon and partially dissolved by that fluid. In some cases, secondary cataract appears to consist merely of shreds of the posterior part of the capsule. See Plate XIII. Fig. 9.

Of Adventitious Cataract.—Adventitious cataracts, or those consisting of matter effused into the posterior chamber of the aqueous humour, generally adhere to the pupillar margin of the iris, and form a connecting medium between it and the lens. They are commonly of a whitish-yellow colour, are always the consequence of inflammation, and the lymph in some cases becomes organized, so that red vessels appear upon it. See Plate XIV. Fig. 6, and Plate XV. Fig. 10.

Sometimes, adventitious cataract is accompanied with a much contracted pupil; both these states being the result of the same cause. See Plate XIV. Fig. 3.

Of the Progress and Causes of Cataract.—Cataract is a disease which takes place from various causes. It may be a congenital affection,—it may take place from an injury,—or it may come on spontaneously. In the latter cases, it takes place generally after the meridian of life, first affecting one eye, then shortly afterwards the other. It is commonly slow in its progress, gradually becoming worse, but requiring several months or even years before it is quite opaque; when vision, having been gradually more and more impaired, is at last destroyed.

Cataract is frequently caused by injuries done to the eye, such as the displacement of the lens, or the bursting of its capsule by a blow upon the eye, or by the puncture of a sharp body. Inflammation of the internal parts of the eye also frequently occasions the common forms of the disease, as well as that species of it termed adventitious cataract. When it has been occasioned by any of these causes, it is generally complicated with some other derangement of structure in the eye.

Of the Affections with which Cataract is often complicated.—Cataract is frequently complicated with other affections of the eye, which always renders the case more unfavourable and more difficult

to cure. The most common and the most important of these are,—adhesion between the iris and lens,—adhesion between the iris and cornea,—contracted pupil,—chronic inflammation of the iris or of the retina,—amaurosis,—and opacity or disorganization of the vitreous humour.

By dilating the pupil, either by closing the eyelids for a short time, or the application of Belladonna, adhesions between the pupillar margin of the iris and the capsule of the lens, are easily distinguished. That part of the iris which adheres, not dilating, produces an irregularity in the form of the pupil.* When there are many adherent points, or when the adhesion is complete, the pupil is contracted, immovable on the application of light or Belladonna, and is often irregular.† In such cases, the patient may not distinguish light from darkness, and yet the more internal parts of the eye may be sound.

When the cataract consists of adventitious membrane or masses of lymph, it generally adheres to the iris, in which case, light is completely excluded from the retina.

In chronic inflammation of the iris and membrane of the aqueous humour, when the lens and

* See Plate XIV. Fig. 1. and XV. Fig 7.

† See Plate XIV. Fig. 3, and Plate IX. Figs. 2 and 7.

capsule lose their transparency, the case is considered by superficial observers, to be a common case of cataract. In such cases, strictly speaking, there is cataract, but it appears to be of a very peculiar kind, the eye being affected, both with opacity of the lens and capsule, as also an effusion of lymph, with adhesions to the iris.* Such chronic inflammatory action in the membrane of the aqueous humour and parts about the lens, in a less degree and without effusion of lymph, has been frequently said to accompany spontaneous cataract. In such cases, this seems to be the cause of the opacity. It also causes the adhesions to the iris, that so frequently exist in cases of cataract; and in the present state of our knowledge, it may be questioned, whether this is not the common cause of, what have been usually considered, spontaneous cataracts.

The worst affection with which cases of cataract can be complicated is amaurosis. When this exists, the pupil is generally dilated, and is of an irregular form. The patient, either does not distinguish light from darkness, or does so very imperfectly; in many cases, the degree of opacity does not account for the defect in vision; and he often sees sparks and flashes of fire, black spots, and the like,

* See Edinburgh Medical Chirurgical Trans. vol. ii. See also Plate XIV. Fig. 6.

before him. Very often, amaurotic patients complain of frequent and severe headach. The history of the case too, deserves attention. Eyes that have previously suffered much from inflammation, very often have their delicate internal parts disorganized, which is accompanied, in most cases, with amaurosis. Cataract seldom takes place suddenly—amaurosis frequently. In amaurosis too, the blindness in some cases intermits, which in cataract does not.

Along with amaurosis, inflammation of the eye very often produces disorganization, or an opaque state of the vitreous humour. This state of the eye, frequently accompanies cataract. It is known by the insensibility of the eye to light,—immobility of the iris—irregularity of the pupil,—softness of the eyeball, and the previous history of the case.

Diagnosis of Cataract.—Several other diseases of the eye are apt to be mistaken for cataract. These are central opacity of the cornea—chronic inflammation of the retina—and amaurosis. The manner, in which a correct diagnosis may be formed, in any of these cases, has already been explained, in treating of each of these diseases, as well as, in the observations made upon cataract. An accurate diagnosis can only be formed, by one who is familiar with the appearances, which each of these states pre-

sent. In all doubtful cases, considerable assistance is obtained by the application of Belladonna to the eye. The state of the iris, as well as, the degree and situation of the opacity, are more distinctly investigated. Some assistance is also derived, from a concentrated focus of light being directed into the eye, by means of a double convex lens. The state of vision,—its relation to the state of the pupil, and degree of opacity—together with the presence or absence of symptoms of amaurosis, are also circumstances of essential consequence, in the formation of a correct diagnosis.

SECTION III.

TREATMENT OF CATARACT.

CATARACT has been found quite incurable by medicines, applied either externally or internally. Cataract causes blindness by intercepting the light from the retina, the other parts of the eye being entire. But the lens and its capsule, being parts of the eye not essential to vision, their removal from the axis of the eye, becomes desirable when they are

opaque. Accordingly, several surgical operations, are practised for the removal of the opaque body, by which vision may be restored.

A spontaneous cure of cataract, takes place in those cases, where an injury, which has caused the cataract, has also so ruptured the lens and its capsule, that its solution and absorption take place by the agency of the aqueous humour.* In other more rare cases, where the lens has become detached from its connections, in consequence of disorganization of the vitreous humour, and fallen from the axis of vision, a spontaneous cure has also happened.† M. Boyer mentions an interesting case of a gentleman, who, after 25 years blindness, his eye having been considered unfit for an operation, suddenly had his sight restored when walking along the street; the detachment of the lens above described, having taken place at its upper half, by which it waved to and fro in the eye.‡

The crystalline lens, may be removed from the axis of the eye, in three different ways.—1. It may be depressed or removed from its situation into the vitreous humour, which is the operation called *Couching*.—2. The lens may be broken up, in order to accomplish its solution and final absorption

* See page 312. † See page 316. ‡ Malad. Chirurg. vol. v. p. 509.

along with the aqueous humour. This is called the operation by *Absorption*.—3. The lens may be extracted or completely removed from the eye, which is called the operation of *Extraction*.

Each of these operations may be performed in several different ways; and each of them have at different times had their advocates and opponents. When properly performed, they may be equally successful in effecting a cure. But they are not equally well suited to every case. The operation best adapted to one class of cases, may be quite inadmissible in another. The operation by absorption, for example, is the best suited to cases of soft or fluid cataract; while, in such cases, the operations of couching and extraction are quite inadmissible. Hard cataracts may be removed either by depression or extraction; but there may be circumstances attending individual cases, which may make one of these operations inapplicable, and cause the other to be preferred.

Cataracts can be properly treated, therefore, only by the judicious and proper selection of that operation, which is known to be best adapted to the nature and circumstances of each individual case. Thus a complete knowledge of the different operations for cataract, and the adaptation of them to in-

dividual cases, becomes indispensable to every one, who would practise properly this branch of surgery.

Before performing an operation in any case of cataract, there are several preliminary questions to be considered. 1st, The nature of the cataract. 2d, Whether or not the cataract is complicated with other diseases of the eye. 3d, The propriety of operating, if only one eye is affected. 4th, The time at which it is proper to operate. 5th, Which operation is best suited to the individual case under consideration. 6th, When both eyes are affected, whether one or both, should be operated on at once.

The answer to the two first of these questions is contained in the preceding description of cataract. As to the 3d, If the patient wishes it, there can be no objection, in ordinary circumstances, to the performance of an operation. In cases of cataract of both eyes, we might as well object to operate upon the other, after one eye has been cured, as refuse to operate when only one eye is affected. Besides, the retina loses its vigour, by continued exclusion from light. And, in many cases, the presence of an opaque lens in the eye has proved hurtful. *

4th, Whenever useful vision is destroyed, it is time to operate; but it would be improper previous-

* See Saunders, Travers, &c.

ly to this, as the patient might be deprived of the vision he had, by the operation being unsuccessful. For, any degree of useful vision, however little, is better than the risk of an unsuccessful operation; more especially, if the other eye is irrecoverably blind. Infants, may be operated on at any age, after they are a few months old.

No operation for cataract should be performed, when there is inflammatory diathesis present, as an impending fit of the gout, dentition, &c.

Previously to discussing the 5th of these questions, the different modes of performing each of the operations will be described.

As to the 6th and last of these preliminary questions, it is certainly safest when there is any doubt, to operate on one eye only at once, reserving the other for a future time. Operating on both at once, has these advantages, however, that it saves time and anxiety to the patients, and prevents the necessity of further weakening the constitution, by a second application of antiphlogistic remedies.

It is to be kept in view, that in all cases of cataract, the removal or destruction, both of the lens and the anterior part of its capsule, is required. For, when the capsule is left entire, it often becomes opaque, forming a secondary cataract.

In performing operations on the eye, the patient

may be placed either in a recumbent or sitting posture, according to the inclination, either of the operator or the patient. An assistant is then to hold one of the eyelids open, by pressing it with two of his fingers or a speculum * against the edge of the orbit, carefully avoiding to make pressure upon the eyeball. The operator keeps the other eyelid open, while, at the same time, he makes any pressure upon the eyeball, that may be necessary to keep it steady. Some operators require no assistance. It is always an advantage, to have the pupil dilated by Belladonna, previous to an operation for cataract.

1st, *Of Couching or Displacement of Lens.* The operation of couching, as well as that of breaking up the lens for absorption, is performed by means of a needle introduced into the eye. Needles of various shapes and sizes have been used for this purpose. Of these, two only require to be noticed, as they combine all the properties requisite. These are, the curved, and the straight needles, which may be made to answer every purpose required. The curved needle in common use, is that of Professor Scarpa.† Some preferring a greater or less degree of curvature at its point, according to the

* See Plate XVIII. Fig. 7. † See Plate XVIII. Fig. 11.

operation for which it is to be used. The straight needle, which seems best, is the lance-pointed needle of Professor Bëer.* These needles are represented in the plate of the ordinary size for using upon adults. When they are to be used in the cases of children, they should be of a smaller size.

Some Surgeons, have recommended needles of a much smaller size, and Mr. Jacob, of Dublin, has recommended a small common sewing needle. By using very fine needles, no advantage is gained, and sufficient power, cannot be exerted with them, to tear up or depress the lens.

There are two modes of couching—the *partial* and the *complete* displacement of the lens. The former is called, *reclination* of the lens, the latter, the *depression* of it. These, may both be performed by introducing the needle, either anteriorly to the iris, through the cornea, or posteriorly through the sclerotica. But in both, the laceration of the vitreous humour, where it is to receive the lens, being essential to the permanent displacement of this body, can be much better effected by the needle, when introduced posteriorly, than anteriorly.

The first part or stage of the operation of couching or displacement of the lens, is the introduction

* See Plate XVIII. Fig. 12.

of the needle through the coats of the eye. Some introduce the needle anterior to the iris, through the cornea and pupil, at the distance of one or two lines from the margin of the sclerotic coat; others, posterior to the iris, through the sclerotic coat and ciliary circle, at the distance of a line and a half from the margin of the cornea.* To avoid wounding the lateral ciliary artery, when the needle is introduced through the sclerotic coat, it should be made to penetrate, either a little above, or below the transverse diameter of the eye. The injury of the iris, is also carefully to be avoided.

The needle, being held like a writing pen, is to be gently and steadily introduced into the eye, till its point reaches the centre of the posterior surface of the lens. The posterior part of the capsule of the lens and a portion of the vitreous humour, are then to be cut and torn in different directions; in order to form a breach in the capsule, for the escape of the lens, and in the vitreous humour for its reception, when depressed. After the laceration of these parts with the needle, its point is to be carried over the upper edge of the lens, carefully avoiding the injury of the ciliary processes. The anterior part of the capsule, is then to be torn with the point of the needle, and the lens depressed, either vertically

* See Plate XVIII. Fig. 1.

or horizontally, into the vitreous humour, below the axis of the eye and margin of the pupil. * The lacerations required, are accomplished by moving the handle of the needle in different directions, and giving it a slight rotation upon its axis. The depression of the lens, is accomplished by raising the handle of the needle upwards and forwards, by which, its point is depressed, downwards and backwards.

The operation of depression, as described by Scarpa and his followers, may be performed without any laceration, either of the posterior part of the capsule of the lens, or of the vitreous humour. But, when these remain entire, the lens will be merely pressed down upon the vitreous humour, pulling along with it, a portion of the hyaloid membrane and of the retina, from the ciliary processes and choroid coat. See Plate XVIII. Fig. 20. The consequence of this, is, that the lens will rise again into its place, from the elasticity of the vitreous humour, and much inflammation of the eye will be occasioned.

When the operation, as described by Scarpa, therefore, is successful, it is by the accidental or forcible rupture of the posterior part of the capsule and of the vitreous humour, by means of the lens, in depressing it.

* See Plate XVIII. Fig. 19.

The laceration of the vitreous humour in operations for the depression of the lens, the neglect of which is the common cause of the lens rising to its place and rendering the operation unsuccessful, has not been sufficiently insisted upon, by authors who have written upon this subject. It has been noticed, indeed, by Mr. Travers, but has not been alluded to by others.

It is necessary for me to remark here, that the operations of *reclination* and *depression*, as described by practical authors, who have not alluded either to the *laceration* of the posterior part of the capsule for the escape of the lens, or to the formation of a *breach* or cavity in the vitreous humour for its reception, cannot fail to mislead and disappoint the surgeon; for, both of these, as well as the laceration of the anterior part of the capsule, are essentially necessary to the success of this operation. If these are omitted, the rising of the lens, and secondary cataract must result. By following implicitly the directions of such authors, the lens would merely be pressed down upon the vitreous humour, in the manner represented in Fig. 20. of Plate XVIII, and soon resume its former situation. Or, if only the anterior part of the capsule is opened, the lens easily leaves it, and, when depressed, passes down between the vitreous humour, iris, and ciliary processes; from

which situation it either rises again to its place, or remains to produce destructive inflammation of the internal parts of the eye. Nor, is the rising of the lens into its former place, the only inconvenience which arises, from its not being depressed into a breach of the vitreous humour. When the lens is depressed, while all the other parts remain entire, the hyaloid membrane and the retina, are forcibly detached from the ciliary processes and choroid coat, which may give rise to violent inflammation and destruction of the eye.

My own experience leads to remark, that in order to depress the lens effectually, and prevent its resuming its former place, it must be depressed into a breach of the vitreous humour. For, in the cases upon which I have operated, the lens never again rose to its place, when it was depressed into a laceration of the vitreous humour. This then, being an indispensable part of the operation, renders it impossible to perform depression of the lens properly, by the needle introduced through the cornea.

When a reclined or depressed lens makes injurious pressure either upon the iris or retina, it may afterwards be necessary, to introduce a needle again to remove it from its situation, that blindness may be prevented.

When the lens gets into the anterior chamber of the aqueous humour, either spontaneously or after an operation, a needle should be introduced through

the sclerotica,—brought forward through pupil into the anterior chamber,—and placed upon, or pushed into the anterior surface of the lens. By the point of the needle, the lens is then to be pushed backwards through the pupil, and depressed into the vitreous humour.* The reasons, for preferring this operation to extraction in such cases, are, the difficulty of making the incision of the cornea, on account of the eye being generally in a state of inflammation, and the presence of the lens in the anterior chamber—the fluid state of the vitreous humour—and the lens being apt to be pushed backwards by the knife.

In performing the operations of depression and reclination, the introduction of the needle through the cornea, would be preferable to introducing it through the sclerotic coat, as, in general, less inflammation follows the puncture of the cornea. But, when the needle is introduced through the sclerotica, the operator has more command of the needle in depressing the lens, and in accomplishing the other necessary steps of the operation.

After the lens has been depressed into the vitreous humour, it has been found, in some cases, slowly and gradually to undergo solution and absorption, by the aqueous fluids that surround it.

Operations for cataract, by the depression of the

* See Plate XIII. Fig. 8.

lens into the vitreous humour, are performed by the native Indians in Hindostan, who have no pretensions to knowledge either of anatomy or surgery. Their mode of operating, is by introducing a blunt pointed needle of a triangular form into the eye, through an opening previously made through its coats with a lancet. By the point of this needle, they depress the lens, into a breach formed in the vitreous humour, with success equal to that of the most experienced surgeons.*

2. *Of breaking up the Lens, that it may be removed by absorption.*—This operation, is founded on the circumstance of the lens being dissolved by the aqueous humour, and absorbed along with it, when it is wounded and denuded of its capsule.

The anterior part of the capsule, may be torn and the lens broken up, to be acted upon by the aqueous humour, by any of the couching needles above described. The needle is to be introduced, and the anterior part of the capsule lacerated, in the same manner as in the operation of couching. But the third stage of the operation, instead of the depression of the lens, consists, in cutting and tearing it into fragments, in order that it may be more readily dissolved by the aqueous humour.

* See Transactions of Medical and Physical Society of Calcutta, V. II.

In performing this operation, it is not sufficient merely to open the capsule. The lens requires to be displaced from its vascular connections, to be divided as much as possible, and some of its fragments placed in the anterior chamber, to facilitate its solution. In the case of fluid cataract, however, the capsule, which is generally opaque, requires to be freely opened and detached from its connection. In this case, the fluid cataract, and portions of capsule mix with the aqueous humour, and are gradually absorbed along with it. If there is a solid hard nucleus, it should be depressed. Cases of fluid cataract, very often require a second operation, for the removal of the capsule.

When the needle is introduced behind the iris in operating for cataract, it is called the *posterior* operation, by depression or solution; when introduced through the cornea, the *anterior* operation, or *keratonyxis*.

There is very little difficulty or danger in performing these operations; and, in general, they are not followed by any great degree of inflammation. Sometimes, indeed, there is no inflammation whatever. After operating upon young subjects, in particular, inflammation seldom takes place; even when both eyes have been operated on at the same time.

3. *Of Extraction of the Lens.*—The extraction of the lens is a much more complicated operation than either of the preceding. Consequently it is attended with more difficulty in its execution, and with more danger to the eye.

Extraction of the lens consists in making an opening in the cornea, dividing the capsule, and extracting the lens through these openings and the pupil.

The opening in the cornea, is the most important part of this operation. It may be made in several ways. In order to be large enough, to permit the escape of the lens, its length requires to be nearly the whole breadth of the cornea. The incision may be made upwards, including the upper half of the cornea, or downwards, including the lower portion.

The most common and elegant mode of making the incision of the cornea, is by means of the knife of Professor Bëer,* which is of such a form, as to complete the incision at once by a single stroke, and to prevent the escape of the aqueous humour, before the incision is completed.

This knife being held as a writing pen, is to be passed through the cornea, at the distance of about a line from its margin, and a little above its horizontal diameter, having a direction to the centre of

* See Plate XVIII. Fig. 2.

the eye. In penetrating the cornea, this direction of the knife is necessary, to prevent its point from passing between the layers of the cornea. The point of the knife having penetrated into the anterior chamber, is to have its direction altered. It is then to be passed across the eye, with its side parallel to the iris, till it has reached the point at the opposite side of the cornea, corresponding to that at which it entered. By continuing to pass the knife steadily on, it cuts itself out by dividing the cornea. This incision, when completed, includes a segment of nearly half the cornea, being divided at the distance of a line from its circumference. See Plate XVIII. Figure 2.

A similar incision of the cornea, may be formed by first making a puncture with a sharp-pointed knife* at the side of the cornea. The incision may then be completed, by introducing through this puncture, either a small bistoury,† or the blade of a pair of small curved scissars. By any of these instruments, the incision, commencing at the puncture, may be prolonged so as to form a flap, similar to that made by the cornea knife as above described.

Upon completing the incision of the cornea, the aqueous humour flows out. All pressure is to be

* See Plate XVIII. Figs. 2 and 16. † See Plate X. Fig. 17.

removed from the eye, and the eyelids may be closed for a short time. The anterior part of the capsule of the lens is then to be divided, by introducing a sharp-pointed needle through the opening in the cornea and the pupil. By this needle the capsule is to be divided upon the lens in different directions. By gentle pressure then applied to the eye, the lens is made to escape. The iris, when it has been disturbed, and the flap of the cornea, are to be carefully placed in their proper situations; after which the eyelids are to be closed, and a cold wet compress applied over them.

After this operation, the cut edges of the cornea unite, and in 24 hours the aqueous humour is regenerated. From its elasticity, the divided portions of the capsule contract towards its circumference. Very considerable inflammation generally follows the operation, for which the proper remedies are to be applied.

The greater difficulty and danger to the eye, in the operation of extraction, than there is, either in couching or absorption, independently of the greater degree of inflammation that generally follows it, arise from the following circumstances.

1. The mobility of the eye—involuntary motions of the eye, and the difficulty of fixing it in making the incision. These are to be overcome, by drawing the back of the knife over the cornea

before introducing it, by gentle counter-pressure with the fingers at the time of passing the knife through the eye, and by steadiness and deliberation on the part both of the operator and patient. When the knife has pierced the opposite side of the cornea, the operator has complete command of the eye.

2. The danger of cutting the iris from its getting under the edge of the knife. When the iris gets under the knife, so that it would be divided by completing the incision of the cornea, the knife should be withdrawn, and the incision either completed by means of the small bistoury or scissars, or the operation delayed. In some cases, by gently rubbing the eyeball, the iris contracts and gets out of the way of the knife.

To obviate this difficulty, many very dexterous operators have been in the practice of withdrawing the knife, after making a puncture through the side of the cornea, and then, of either completing the incision with a knife of another form, or of introducing a cornea knife concealed upon a blunt blade of the same shape, which prevents the sharp blade from cutting, till it is moved forwards upon the guard, after arriving at the opposite side of the cornea. It is then made to 'puncture the cornea, and complete the incision.

3. The difficulty of pressing out the lens from too great contraction of the pupil. Even although

the pupil is fully dilated by Belladonna, it contracts upon dividing the cornea. There is, therefore, frequently some little difficulty in pressing out the lens without tearing the iris. This, is only to be obviated, by steady and gentle pressure applied upon the eyeball, at a short distance from the middle of the cut flap, by which the edge and afterwards the body of the lens, gradually make their escape. Care must be taken not to press the lens into the vitreous humour. The existence of permanent contraction of the pupil, or adhesions of the iris, should be known previously to an operation, as they render such cases improper for extraction.

4. Another difficulty in getting out the lens, arises from the incision of the cornea being too small. This is to be obviated, by never operating in cases where the cornea is of a very small size, and by making the incision as large as the cornea will permit. Care must be taken, however, not to cut too near to the margin of the cornea, by which the iris loses its support and falls out.

5. Prolapsus of the iris and vitreous humour. When any part of the iris, protrudes through the cornea, it is to be carefully replaced by means of a probe. If a portion of the vitreous humour protrudes, it should be cut off with scissars, and the remainder replaced into the eye. Care must be taken, not to allow any portion of the vitreous hu-

mour to remain between the cut edges of the cornea; for the membranous capsule of the vitreous humour, acting as a foreign body interposed, prevents the re-union of the lips of the wound.

6. The escape of the vitreous humour along with the lens. A very considerable portion of the vitreous humour may escape, without the complete destruction of the eye. When the whole of it escapes, along with its secreting incumbrance, the eye permanently collapses. Some have thought that the evacuation of a portion of the vitreous humour was rather an advantage, by preventing the too great distension of the eye when inflammation comes on.* The removal of such a portion, however, is not attended with any particular danger.

7. The vitreous humour being in a fluid state from disorganization of its capsule. This cannot always be known before an operation. It may be suspected when the eye has a soft flaccid feel, and when there is an undulatory motion of the iris or lens. In these cases extraction is an improper operation. In many such cases, the capsule of the lens becomes detached from its connections, and, with the lens enclosed, it floats about loose in the eye.†

* Beer, Richter. † See Plate XIV. Fig. 9. and XIII. Fig. 8.

8. The cataract breaking to pieces. In cases where the lens is soft, or chalky and friable, it breaks to pieces in the eye. When this happens, the largest of the fragments are to be scooped out, and the smaller pieces left for absorption.

9. Considerable, or even violent inflammation, so commonly follows the operation of extraction, that, when there is any tendency or disposition to inflammatory action in the system, one of the other operations, where there is less risk of this, should be preferred. This disposition to inflammation in the system, we can, in many cases, ascertain by the previous history, state of constitution, and former experience of the patient.

10. In many elderly persons, the cornea becomes so tough, that there is considerable difficulty and danger to the eye in completing the necessary incision of it. In such elderly persons too, the union of the incision, does not take place so quickly as in others.

We shall now consider the question, as to the choice of an operation.

The operations by couching and absorption may be employed with perfect success, in all cases of cataract admitting of cure by operation. The operation of extraction is a more perfect operation than

these, for the removal of hard cataracts; but it requires both a more steady patient, and a more experienced and dexterous operator for its proper accomplishment; and, there are many cases, wherein one of the other operations may be employed, in which extraction would be improper.

As general rules, all simple cases of hard cataracts may be operated upon, either by depression or extraction. Soft, fluid, and membranous cataracts, particularly those of young subjects, by breaking up and absorption.

Complicated cases, with the exception of some cases of amaurosis, where the humours or other parts of the eye are entire, require to be operated on by the needle. Extraction may be said to be improper in all complicated cases. In complicated cases, too, the prognosis should be very guarded, as the success of operations in these, is very uncertain.

The diseased states of the eye complicated with cataract, requiring the operation to be performed with the needle, are,

1. When the eye is small, soft, and very moveable.

2. When there is chronic inflammation of the conjunctiva and edges of the eyelids.

3. When the iris adheres to the cornea.

4. When the iris adheres to the capsule of the lens.

5. When the cornea is disorganized or opaque.

6. When the vitreous humour is disorganized.

7. When there is any tendency to inflammation of the eye, either of a simple or specific character, or to amaurosis.

An operation with the needle has been thought impracticable, in cases of fluid vitreous humour, in consequence of its flowing out at the sides of the needle. But this cannot happen when the needle is properly made. The point should not make a larger opening, than is filled up by the body of the needle.

I have shown that the most common cause of capsular cataracts, is the detachment of the capsule from its ciliary connection, by which its death is occasioned.* The greatest care, therefore, is necessary in performing operations for the removal of the lens, not to perform them so rudely as to tear the capsule from its ciliary attachment. For, if this is done, the capsule, after the removal of the lens, contracts into the centre of the pupil, forming a secondary capsular cataract, and will require another operation for its removal.

* See p. 314, also Edin. Med. and Surgical Journal, vol. xxvi.

4. *Of Operations for Secondary or Membranous Cataracts.*—These are generally in the form of shreds of capsule, adhering to the hyaloid membrane of the vitreous humour; by introducing a needle behind the iris they can be readily scraped off, detached from the vitreous body, and depressed out of the sphere of vision. Sometimes they adhere also to the iris, from which they must likewise be detached.

5. *Treatment after Operations, &c.*—After operations for cataract, the case requires to be treated as one of inflammation of the eye upon general principles; taking care to prevent the contraction or closure of the pupil, by the use of Belladonna. The patient should not be allowed to use his eye too soon, and when well, he will require to be furnished with a proper glass. The lens being removed, the focus of vision is so altered, that a magnifying glass of two or two and a half inches focus, is generally required, in order that the patient may see to read. A glass of six or seven inches focus is generally sufficient for seeing more distant objects.

Operations for cataract, even though well and perfectly performed, are not always followed with success in restoring sight. Various unforeseen circumstances, may occur after the operation, to frustrate its success. The most common cause of this

failure, is the supervention of violent inflammation, by which the internal parts of the eye become disorganized,—the pupil closed,—or amaurosis is occasioned. The inflammation may be of some specific kind, as connected with gout, rheumatism, or syphilis, which had been previously in the constitution. In many of these cases, the progress of the inflammation cannot be arrested.*

By the operations of couching or absorption, the removal of the cataract may be imperfect; so that, in order to complete the cure, a second or even several repetitions of the operation may be necessary. The inflammation following a second operation, is generally slighter than after the first.

The various circumstances already mentioned, as difficulties in performing the operation of extraction, are often the causes of its being unsuccessful. See page 346.

The arguments, for and against the different operations for cataract, have certainly been much exaggerated by those who have entered into a discussion of their merits. The following results of the operations of several highly eminent surgeons, show the comparative success of the different oper-

* In two cases, I have also seen the eye destroyed by Erysipelas taking place, after the introduction of a needle into the eye to remove cataract. And in many, from Rheumatic Iritis.

ations, as well as the success attending operations for cataract generally.

By extraction, Daviel is said to have operated on $7\frac{1}{19}$ cases successfully to 1 unsuccessfully; but this is doubted. Richter and Sharp $2\frac{1}{3}$ to 1. In 306 cases operated on by M. Roux at la Charité by *extraction*, the proportion of successful to the unsuccessful cases, was $2\frac{1}{3}$ to 1. In 306 cases, operated on by M. Dupuytren at l'Hôtel Dieu, chiefly by *depression*, the proportion of successful to unsuccessful cases, was $5\frac{5}{26}$ to 1.*

By the native Indians, who perform couching in their own peculiar mode, the success in 77 cases was $2\frac{1}{2}$ to 1.†

The varied success of these operations is not to be wondered at, when we consider, that the nature of the cataract, is different, in different cases, and that it is frequently complicated with other diseases.

Besides the particular kind of operation, employed for the cure of cataract, the success depends also, both on the selection made of the cases, and the dexterity of the operator.

* Medicine Operatoire par Sabatier, tom. iv. Edit. 1824.

† See Trans. of Med. and Phys. Society of Calcutta, vol. ii.

CHAPTER VIII.

DISEASES OF THE VITREOUS HUMOUR.

THE only diseases of the vitreous humour that require to be mentioned are, the fluid and opaque states of this body.

A fluid state of the vitreous humour, or rather a disorganized state of the cellular texture containing it, is a common consequence of inflammation of the eye. This state is known by preternatural softness of the globe, and a vacillating or waving motion of the iris. In many of the cases, where disorganization of the vitreous humour has taken place, the coats and other parts of the eye, have also undergone an alteration of structure; such as general enlargement of the eyeball, staphyloma of the sclerotic or cornea, adhesions of the iris, or displacement of the crystalline lens, which may sometimes be seen to float loose in the eye.*

* See Plate XIV. Fig. 9. and XIII. Fig. 8.

When a disorganized state of the vitreous humour is even suspected, operations upon the eye for cataract, or artificial pupil, require to be performed with caution, and with a very guarded prognosis.

In those cases, where there seems to be an opacity behind the crystalline lens, either the vitreous humour, the retina, or both may be opaque. See Glaucoma, page 284.

CHAPTER IX.

OF ARTIFICIAL PUPIL.

SECTION I.

OF THE CASES REQUIRING THE FORMATION OF AN ARTIFICIAL PUPIL.

CERTAIN affections of the eye, requiring the formation of an artificial pupil to restore sight, are of frequent occurrence. This operation is necessary, when the light is prevented from passing into the interior of the eye, by permanent contraction or closure of the pupil, or by a partial opacity of the cornea. In such cases, sight can frequently be restored, by the formation of a new pupil or opening in the iris.

The cases requiring the operation may be included in two divisions.

1. *Simple Cases,* or those, in which there is either a contracted or closed pupil; and those

cases, in which there is a central opacity of the cornea, preventing the admission of light to the retina. In both these cases, the other parts of the eye being entire.

2. *Complicated Cases*, in which the simple cases above described are complicated, or conjoined with some other diseases of the eye.

The most common affections, with which the cases, capable of being cured by the formation of an artificial pupil, are complicated, are—Adhesion between the iris and capsule of the crystalline lens—Adhesion between the iris and the side of the cornea—Adhesion between the iris and centre of the cornea, with obliteration of the anterior chamber of the aqueous humour—Cataract and partial staphyloma of the cornea.

When there is reason to think that the simple cases above mentioned, are complicated with either amaurosis,—opacity of the vitreous humour,—general enlargement of the eyeball,—a staphyloma of the sclerotic coat,—or atrophy of the eyeball, from previous disorganizing inflammation of the eye, the case is generally quite hopeless.

The patient being able to distinguish light from darkness, in cases requiring the formation of artificial pupil, is always a favourable symptom. The absence of it, however, should not be a reason for

withholding an operation. For, many cases occur, where, from the nature of the affection of the iris or cornea, light is prevented from entering to the interior of an eye, which may be otherwise sound.

On the other hand, there are cases, where no reason can be assigned for the patient being unable to distinguish light. There may be a sufficient opening in the pupil, where, only the direct rays of light are prevented from passing to the retina, by a central opacity of the cornea; so that, the patient should be able to see the light, by the rays passing to the retina indirectly, at the side of the opacity. The patient should always be able to distinguish light, where the pupil is not entirely closed, though it may be so contracted from adhesion to the lens or cornea, as to be unfit for distinct sight. In such cases, when the patient does not distinguish light, the prospect of a cure is very uncertain. The case, in all probability, being complicated with amaurosis, or disorganization of the internal parts of the eye: so, an operation though successfully performed, may not restore sight.

Having premised these general remarks, the cases requiring an operation for artificial pupil, will now be more fully described.

1. *Of the Simple Cases requiring the Formation of an Artificial Pupil.*

a. Contraction or Closure of the Pupil.—A complete closure of the pupil, or such a permanent contraction of it as prevents distinct vision, frequently occurs, as a consequence of inflammation of the iris. The same states frequently result from operations for cataract; as also from wounds, ulceration or sloughing of the cornea, through which the iris has protruded, or to which it has adhered.* In some cases too, when the pupil, though nearly of an ordinary size, is closed by an effusion of lymph into it, by which it is obliterated and rendered immovable, an artificial pupil is required to restore sight.†

In some rare cases, the pupil has been found occupied, by the fœtal pupillary membrane, which had not disappeared at birth.

b. Central Opacity of the Cornea.—A central opacity of the cornea, obstructs the passage of light through the pupil. It is a frequent consequence of inflammation, ulceration, or sloughing of the cornea, while the more internal parts of the eye retain their

* See Plate XII. Figs. 6, 7, and 8.

† See Plate XIV. Figs. 2 and 3, and XIII. Fig. 6.

natural state.* Light is admitted to the retina, though not directly, the opacity being situated opposite to the pupil. The patient can therefore distinguish light from darkness, and even see objects, when the pupil is dilated beyond the limits of the opacity of the cornea. This has given rise to deceit in such cases. The patient, by the use of Belladonna, has conceived his blindness cured, till he found that the effects of this medicine, were only temporary and evanescent.

In the cases just described, a part of the cornea is supposed to be transparent, opposite to which, the new pupil must be formed.

2. *Of the Complicated Cases requiring the Formation of an Artificial Pupil.*

a. Contracted or Closed Pupil, with Adhesion between the Iris and Capsule of the Crystalline Lens, and Cataract.—The inflammation which causes a permanent contraction or closure of the pupil, very frequently, causes also a partial or complete adhesion of the pupillar margin of the iris to the capsule of the lens, which is generally opaque.† Such an adhesion renders the case more

* See Plate XII. Figs. 4, 5 and 6.

† See Plate XII. Figs. 9, and 10, also Plate XIV. Figs. 2 and 3.

difficult to cure. An operation for the removal of the lens as well as the formation of an artificial pupil being, in most cases, necessary. For the lens, or its capsule, is generally either opaque, or is rendered so by an attempt to form the artificial pupil. Cases of this description, therefore, may be termed either contraction of the pupil with adherent cataract; or cataract with adherent and contracted pupil.

In some cases, the pupil may be contracted, and adhering to an opaque lens;* in others, the existence of a cataract, cannot be known till a new pupil has been formed. When cataract is then found to exist, an operation for the removal of it must be had recourse to, either at the time of making the artificial pupil or at an after period.

Cases requiring an artificial pupil, may also be accompanied with adventitious cataract.†

In some cases, the affection which renders the formation of an artificial pupil necessary has been occasioned by the operation for the removal of a cataract, so that the lens may be wanting.

b. Contracted or Closed Pupil with Adhesion between the Iris and Cornea.—An adhesion between the iris and cornea, in consequence of a

* See Plate XII. Figs. 9 and 10. † Plate XIV. Figs. 2 and 3.

wound, ulceration, or sloughing of the cornea, has always the effect of altering the form of the pupil. When the adhesion takes place at one side of the cornea, the pupillar margin of the iris adheres only at one point. This renders the pupil immovable, draws it to the side where it adheres, and occasions a permanent contraction or closure of it.*

When a sufficient part of the cornea is transparent, this forms one of the most common cases, as also one of the most favourable for the formation of an artificial pupil. The patient can generally distinguish light, if the eye is otherwise sound. And, the adhesion to the cornea, is rather an advantage than an objection, in performing some of the operations for artificial pupil.

c. Central Opacity of Cornea with Pupil adhering to it.—When there has been a lesion in the centre of the cornea, the whole pupillar margin of the iris generally adheres to it; and the iris is drawn forwards, so as nearly to obliterate the anterior chamber of the aqueous humour, by its contact with the cornea.† These circumstances render such cases very difficult to operate upon, and much more unfavourable than those last described.

* See Plate XII. Figs. 6, 7, 8, and 9.

† See Plate XII. Figs. 6 and 8.

d. Contraction or Closure of the Pupil, with partial Staphyloma of the Cornea.—In cases of this description, there is commonly a complete adhesion of the iris to the cornea, bringing the surface of the iris in contact with the cornea.* A small part of the cornea is generally transparent, behind which, the formation of an opening in the iris may be attempted, but the prospect of a cure is not great in such unfortunate cases.

The simple and complicated cases requiring an artificial pupil, are, unfortunately, often complicated with each other. Such combinations of affections of the eye are, with great difficulty, if at all, to be cured.

An operation for artificial pupil should not, in general be attempted, when the patient has the vision of one eye. For, if the new-formed pupil is not in the centre of the iris, sight will be confused or double, in consequence of the axes of vision of the eyes, not corresponding with each other.

* See Plate X. Fig. 2.

SECTION II.

OF THE OPERATIONS FOR THE FORMATION OF AN ARTIFICIAL PUPIL.

In consequence of the great variety of cases, requiring the formation of an artificial pupil, it may be easily conceived how an operation that is applicable to one case, may be very unsuitable to another. Hence, the operations for artificial pupil are very numerous, and different modes of performing these operations are required, according to the nature of each particular case.

The object of each of these operations is the same, being the formation of a new opening in the iris; but this opening may be required either in the centre, or at the circumference of the iris;—it may be required where the pupil is closed, or where the pupil is in its natural state;—and it may be required when the iris adheres either to the cornea, or to the capsule of the lens. Some of these operations, are performed by simply dividing the iris; others, by the excision of a portion of it; while by others, a portion of the iris is detached from its ciliary con-

nection. By one set of operations, the new opening or pupil is made in the centre of the iris; by another, near to its circumference; so, the operator must adapt the operation to each individual case that may come under his care, by selecting the one best suited to its peculiar circumstances.

Whatever may be the nature of the case, the nearer to the centre of the eye the new pupil can be formed, it will be the more useful to vision. A new pupil has also been found to be most useful, when made at the lower part of the eye. In many cases, however, we have not this in our choice, a small part only of the cornea being transparent, behind which the new pupil must be formed.

The different modes of performing operations for artificial pupil, have been very numerous. The instruments employed too, have been very various and complicated.

The operations for artificial pupil may be included under three different heads; namely, those operations—1. By the simple division of the iris. 2. By the excision of a portion of the iris; and 3. By the separation of a portion of the iris, from its ciliary attachment, either alone, or conjoined with the excision of a portion of the iris, or the strangulation of it in an opening made in the cornea.

1. *Of the Simple Division of the Iris.*—By two different operations, consisting simply of the division of the iris, an artificial pupil may be formed.

a. An artificial pupil may be formed, by a transverse incision through the centre of the iris.* This is accomplished by means of a small knife† introduced through the sclerotic coat, which is the operation of Cheselden, and the first that was practised. The eye is to be held as in the operations for cataract; the knife being held as a writing pen, with its cutting edge turned backwards, is then to be introduced through the sclerotic coat, at the distance of about a line from the margin of the cornea. When the point of a knife has reached the posterior chamber of the aqueous humour, it is to be directed forwards, and made to pass through the iris into the anterior chamber, at the distance of about a line from its ciliary margin. The point of the knife, is then to be directed and pushed forwards, to the opposite side of the anterior chamber of the aqueous humour. The iris is then to be divided, by pressing the edge of the knife backwards, and giving it a sawing motion.

In order to divide the iris to a sufficient extent, the repetition of several similar incisions may be

* See Plate XVIII. Fig. 3. † Ibid. Fig. 15.

necessary before the knife is withdrawn from the eye. By the late Dr. Monteith of Glasgow, this operation has been performed by making an opening in the cornea, and then dividing the iris with scissars.

By this operation, the new pupil is made in the centre of the eye. It is therefore applicable to cases of closed pupil, when the centre of the cornea is transparent, whether simple, or accompanied with adhesion of the iris to the cornea or capsule of the lens.

The chief difficulty in performing this operation, arises from the iris yielding to the pressure of the knife, without being cut. So that, an adhesion of the iris to the cornea, is rather an advantage than a disadvantage. Such an adhesion, not only keeps the iris upon the stretch, before being divided by the knife; but it tends to keep the edges of the incision asunder, thus obviating another circumstance, which has been found to prevent the success of this operation.

When cataract exists in the eye, along with closed pupil, the opaque lens may be divided and removed from the axis of the eye, at the same time that the incision is made through the iris.

b. By a double division of the iris, or operation of Professor Maunoir of Geneva, an artificial pupil may be formed. This double division of the iris is ef-

fected by making a puncture in the side of the cornea, two or three lines in length, by means of a lance-shaped knife.* Through this puncture of the cornea, small scissars† are introduced to divide the iris at the opposite side of the eye. When the scissars have entered the anterior chamber, one blade is to be passed through the centre of the iris into the posterior chamber of the aqueous humour, the other between the iris and cornea. The iris is then to be divided at two different parts, near to each other, so as to include a portion having the form of the letter V.‡ The portion included between these two incisions shrinks and contracts towards its ciliary margin, and thus leaves an open space or artificial pupil sufficient for vision.

Both of the blades of the scissars used in this operation, should be probe-pointed, when the pupil is not entirely closed, that they may be introduced without injuring the other parts. When the pupil is closed, the blade, to be passed posterior to the iris, must be sharp-pointed.

The artificial pupil formed by this operation being at the side of the iris, it is applicable both to cases of closed pupil, and of central opacity of the cornea. One advantage of this operation is, that the new

* See Plate XVIII. Figs. 2 and 16. † Ibid. Fig. 8. ‡ Ibid. Fig. 6.

pupil is not made opposite to the incision of the cornea, the cicatrix of which very often causes a permanent opacity.

2. *Of the Operations for Artificial Pupil, by the separation of the Iris from the Ciliary Ligament.*— This operation may be performed in several different ways.

a. An artificial pupil may be formed, by the simple separation of a portion of the iris from its ciliary attachment.* This operation was proposed and performed both by Bëer and Scarpa; and was suggested to them, in consequence of having seen similar openings formed accidentally by injuries.

The mode of forming the separation of the iris from its attachment is, by introducing a cataract needle or small-hook † into the eye, and with it tearing a portion of the iris from the ciliary ligament. Scarpa introduced his curved needle for this purpose, through the coats of the eye behind the iris; Bëer introduced the needle through the cornea. By this operation a sufficient pupil could be formed, provided the opening remained permanent.

The opening made in this way, however, was soon found not to be permanent, as it generally

* See Plate XVIII. Fig. 5. † Ibid. Fig. 13.

closed up again, by the iris resuming its former situation, so the operation was abandoned.

This last operation having often proved unsuccessful, led other surgeons to adopt the following modes of operating.

b. To render the pupil, formed by the separation of a part of the iris from the ciliary ligament, permanent, the excision, or strangulation of the separated portion in an opening through the cornea, is practised. This operation, is accomplished by making a small opening in the cornea, at the distance of three lines from that part of the margin of the iris, where the separation is to be made. Through this opening, a small single or double hook is introduced, for the purpose of laying hold of the iris, and tearing it from the ciliary ligament to a sufficient extent. For the same purpose, a small hook, to be introduced concealed upon the blade of a needle, has been recommended, by which the previous puncture of the cornea is superseded. * To perform the same operation, I have used an instrument, which both penetrates through the cornea and serves as a hook. This I have called a hook-needle. †

* See Plate XVIII. Fig. 14.

† See Plate XVII. Fig. 18. The same instrument, (only of a larger size) I was much surprised to find, since the publication of the last edition of this work, delineated in a tract by Bëer, published in 1799, which he used, to extract the lens from its capsule, in cases of cataract.

When the iris has been torn from its ciliary attachment, it is to be pulled a little out through the opening in the cornea. The protruding portion may then be either removed by means of scissars, or left in the wound, that it may adhere to the cornea. *

By this operation a permanent opening or new pupil is effectually made. It forms a mode of operating, that is applicable to most cases, requiring the formation of an artificial pupil. In performing this operation, care should be taken, to make the new pupil of a sufficient size to prevent the possibility of the *arcus senilis* † from obstructing the sight.

One of the greatest objections to this operation is, that whenever the iris is torn from its attachment, blood is effused into the aqueous humour, which prevents the operator from seeing the further movements of the instrument.

3. *Of the Operations for Artificial Pupil by the Excision of a portion of the Iris.*—Like the other operations for artificial pupil, the excision of a portion of the iris, may be performed in different ways.

a. When the pupil is closed, a portion may be removed from the centre of the iris by the opera-

* See Plate XVIII. Fig. 5. † Plate XII. Fig. 10.

tion of Wenzel. This is accomplished by making an incision of the cornea, similar to that for the extraction of the lens.* In making this incision, Wenzel made an incision and flap of the iris, similar to that of the cornea, though of a smaller size, as he passed the knife across the eye. The flap of the iris, was then removed by means of scissars, introduced through the opening in the cornea.

b. Another method, by which a portion may be removed by excision from the iris, is, by causing a portion of it to protrude through an opening in the cornea, and then cutting it off by means of scissars. This is the operation of Professor Bëer, of Vienna, improved by the late Mr. Gibson of Manchester.†

The first part of this operation, consists in making a puncture in the cornea, about three lines in length, by means of a knife, opposite to that part of the iris, at which the new pupil is to be formed. All pressure is then to be removed from the eye, and the knife carefully withdrawn, to prevent as much as possible the escape of the aqueous humour. The iris, then comes in contact with the opening in the cornea, closes it like a valve, and

* See Plate XVIII. Fig. 2.

† The different operations of Mr. Gibson are improvements on the operations of Wenzel and Bëer.

prevents the further escape of the aqueous humour. By the application of gentle pressure upon the eyeball, a portion of the iris is made to protrude. This protruding portion is then to be snipt off by means of scissars, by which an artificial pupil will be formed. After this operation, the iris having a new formed aperture through it, resumes its place, and the wound of the cornea heals.*

When, in performing this operation, a portion of the iris cannot be made to protrude, or where the protrusion is too small, a part of the iris is to be pulled gently out by means of a small hook,† or hook-pointed forceps.‡

c. A portion of the iris may also be removed by introducing scissars through an opening in the cornea. The knife employed to puncture the cornea, is, at the same time, to make a corresponding opening in the iris. Through this incision in the iris, one blade of the scissars is to be introduced; the other blade between the iris and cornea. A triangular portion of the iris, is then to be removed, by making two incisions with the scissars.

These operations, by the excision of a portion of the iris, are applicable only in cases where the iris does not adhere either to the lens or cornea. They

* See Plate XVIII. Fig. 4. † See Plate XVIII. Fig. 13.
‡ See Plate XVIII. Fig. 9.

are attended with this disadvantage, that the opening in the iris, is formed opposite to the cut part of the cornea, which is often rendered permanently opaque, by the cicatrization of the incision.

Treatment after operations for Artificial Pupil, &c.—The inflammation following operations for artificial pupil is often considerable. Antiphlogistic treatment is therefore necessary; and it is to be employed, in proportion to the degree, and continuance of the inflammation. This inflammation often frustrates the success of these operations.

After operations for artificial pupil, the application of Belladonna is often useful in dilating the aperture in the iris.

Several other unfavourable circumstances, very often attend cases requiring artificial pupil. The eye, has generally suffered much from previous inflammation, and is affected with a complication of several diseases, so that we are frequently induced to attempt an operation, in cases, where there is not much hope of success.

When a case requiring an artificial pupil is complicated with cataract, it may be removed either at the time of forming the artificial pupil, or at a subsequent period by a second operation.

CHAPTER X.

OF INJURIES OF THE EYEBALL, AND THEIR TREATMENT.

THE eyeball is much exposed to injuries from various causes. From the delicate structure of its parts, the eye is easily affected by external injury, and is often altogether destroyed.

The effects of injuries of the eye, may be either primary, or secondary. The effects of the injury may be primary or immediate, as the disorganization of a portion of the brain, the retina, or of the texture of some other part of the eye. Or, they may be secondary, being the consequences of the inflammation which follows.

Injuries of the eyeball, like those of other parts of the body, are followed by inflammation, and also by changes peculiar to the structure of this organ.

Injuries of the eyeball, may be considered under two divisions, or those which are occasioned by mechanical violence, and those which are produced by chemical agency.

1. *Of Injuries from Mechanical Violence.*—The most common injuries of the eye from mechanical injury, are, those which arise from incised, punctured, and lacerated wounds, contusions, and the introduction of foreign substances, either within the eyelids or into the eyeball.

An effusion of blood into the interior of the eyeball, or under the conjunctiva, is often the immediate consequence of a wound. This blood becomes gradually absorbed.

When the cornea or sclerotic coat is penetrated by a wound, a protrusion either of the iris, choroid coat, retina, or humours of the eye, usually takes place. In some cases, a portion of the iris, is detached from its ciliary attachment. Violent inflammation of the whole eyeball, generally ensues upon the infliction of the injury. The internal parts are deranged, and often become disorganized; so that loss of sight, is often produced, either by opacity of the cornea, closure of the pupil, opacity of the lens or the vitreous humour, disorganization of the retina, or evacuation of the eyeball.

The peculiar effects arising from the iris becoming involved with injuries of the cornea, as well as those of injury of the crystalline lens and its capsule, have been already explained.*

Acute ophthalmia to a considerable degree, is often produced by hard rough bodies, when introduced and lodged within the eyelids. When any hard sharp-pointed body, becomes lodged within the coats of the eyeball, violent and distressing inflammation, particularly of the parts with which it is in immediate contact, generally takes place, by which the eye becomes disorganized.

2. *Of Injuries from Chemical Agency.*—The accidental application of substances which act chemically upon the eye, is not unfrequent. The injurious effects of these upon the eye, are in proportion to their stimulant and escharotic powers, and the extent of their application. The eye is often burnt by explosions of gunpowder, inflammable gas, boiling water or steam, and melted lead. When the injury from any of these cases is severe, inflammation, followed by sloughing and even bursting of the eye, are the consequences.

Inflammation and sloughing of the external parts

* See prolapsus of the iris, and effects of injuries upon the lens.

of the eye, are often produced, by the application of lime, sulphuric acid, alcohol, turpentine, and the like.

3. *Treatment.*—To obviate the destructive effects of injuries upon the eyeball, the strict application of the antiphlogistic treatment recommended for acute ophthalmia, is required. In many cases, this affords the only chance to the patient, of saving his eye. The preservation and recovery of the eye, from very serious injuries, by proper perseverance in this treatment, is often surprising.

The manner, by which foreign matter is to be removed from the eye, has been already described.* The remedies for protrusion of the iris, have also been already mentioned.† When a portion of the choroid coat protrudes, it is to be treated in a similar manner with protrusion of the iris. If a portion either of the retina or vitreous humour protrudes, it should be cut off with scissars.

Sloughing, ulceration of the cornea, and chemosis of the conjunctiva, when produced by the inflammation succeeding an injury, are to be treated by the remedies recommended in the preceding chapters.

* See page 174. † See page 242.

CHAPTER XI.

OF FUNGUS HÆMATODES AND CANCER OF THE EYE.

FUNGUS Hæmatodes and Cancer, frequently attack the eye or parts surrounding it. When any of these diseases affect the eye or its appendages, they present the same characteristic appearances that distinguish them in other parts of the body.

1. *Of Fungus Hæmatodes of the Eye.*—Fungus hæmatodes most commonly affects young subjects. It begins generally within the orbit, affecting the posterior part of the eye. A whitish tumour, with red vessels upon it, appears at the bottom of the eye, accompanied with blindness and a dilated immovable pupil.* The eyeball becomes filled with a solid tumour. The optic nerve, retina and coats of the eye, as also the parts surrounding

* See Plate XIII. Fig. 10.

them, all become involved in the disease. As the disease increases, the tumour enlarges, fills the orbit, and projects from the eye.* In some cases, the disease commences in the periosteum of the orbit, in others, it appears to spring from the bone itself. The tumour varies in texture; it is in general solid—of a cerebriform character—and in many cases, even of children, it has been found to consist of osteo-sarcoma. Tumours of this nature are usually rapid in their growth.

Fungus hæmatodes is generally a constitutional, and also a fatal disease. In its most early stages, the whole contents of the orbit, have been thoroughly removed, but the disease has, almost invariably, soon returned and proved fatal.

2. *Cancer of the Eye.*—Cancer of the eye generally occurs in persons above the meridian of life. It usually commences exterior to the orbit, or in the external parts of the eye.† It attacks first the eyelids or conjunctiva, by ulceration, having the peculiar cancerous appearance. This gradually extends, till the whole parts within the orbit surrounding the eyeball, become removed by the cancerous ulceration.‡ Becoming gradually worse, this disease

* See Plate XVII. Fig. 1. † See Plate VI. Figs. 5 and 6.
‡ See Plate XVII. Fig. 2.

may last for years. When the eyeball is denuded, the humours of the eye become lessened,—the coats of the eye collapsed,—and the sight becomes destroyed. I have seen a very considerable number of cases of cancer of the orbit, but have never seen any of the coats of the eye, affected with the peculiar cancerous ulceration, except the conjunctiva. The eyeball, therefore, often remains in the orbit, after all the other parts around it, have disappeared.

In cancer of the eyelids, the early and complete removal of the diseased part, may effect a cure.

For the farther illustration of these diseases, I beg to refer the reader, to the works of Mr. Saunders and Mr. Travers.

FIG. I.

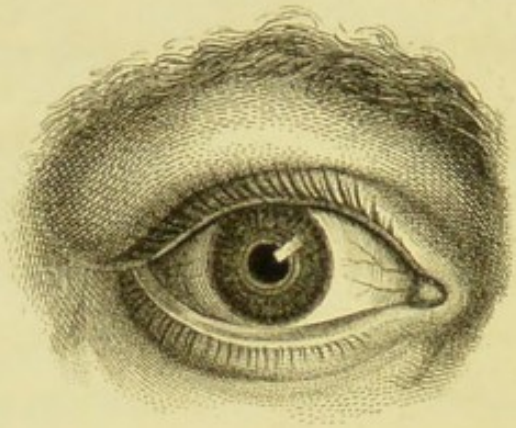


FIG. III.

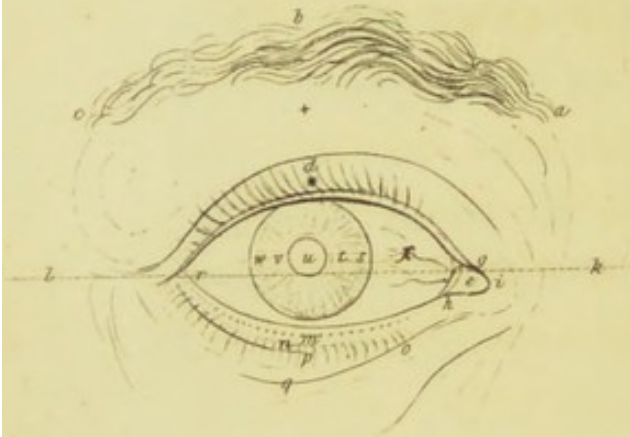


FIG. IV.

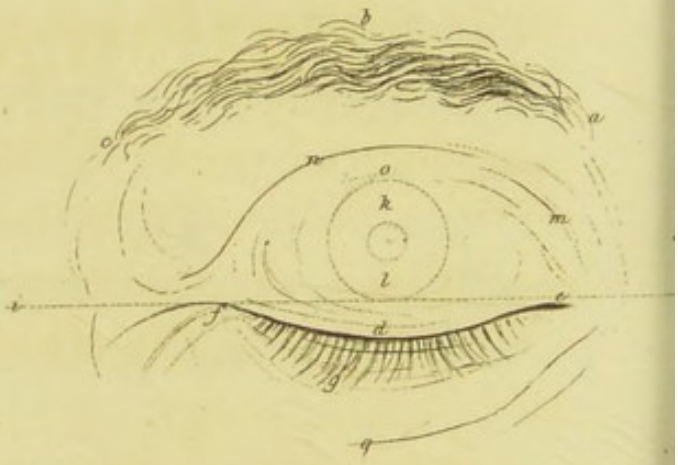
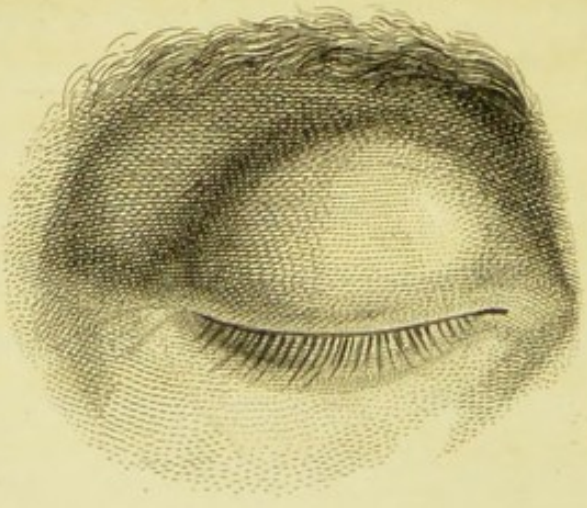


FIG. II.



EXPLANATION

OF

THE PLATES.

PLATE I.

THE Figures of this plate, are intended to show the external parts of the eye, in its open and closed states.

Figure I. represents the natural appearance of the right eye when open. To this Figure, the letters upon Figure III. refer.

a. b. c. The eyebrow. *a.* The nasal extremity. *b.* The middle. *c.* The temporal extremity.

†. *d.* *. The superior or upper eyelid. † The more fixed part. * The more moveable part. *d.* The fold of the integument produced when the eyelids are open, by the action of muscle of the

upper eyelid, which draws its superior edge backwards into the orbit.

e. * *r. m.* The aperture of the eyelids.

* The margin of the superior eyelid, beset with the ciliæ or eyelashes.

e. f. g. h. i. The internal, nasal, or greater canthus of the eye.

e. The lacrymal caruncle.

f. A fold of the conjunctiva—better developed in the lower animals, and called the *membrana nictitans.*

g. h. The orifices of the lateral lacrymal canals, called the lacrymal *puncta.*

i. The tendon of the orbicularis palpebrarum muscle, which passes over the lacrymal sac.

l. k. a. Horizontal line, drawn to show, that the inner canthus, is lower than the external canthus.

m. n. p. q. The inferior or lower eyelid.

m. n. The margin of the lower eyelid. At the internal edge of the margin, the dotted line marks the orifices of the sebaceous ducts. *n.* The external edge of it, into which the eyelashes are inserted, *p.*

o. q. The fold of the inferior eyelid when open.

r. The external, temporal, or lesser canthus of the eye.

s. t. u. v. w. The iris and pupil, as seen through the transparent cornea.

u. The pupil, or pupillary aperture of the iris.

t. v. The internal, lesser, or pupillary margin of the iris.

s. w. The external, greater, or ciliary margin of the iris.

v. x. The white part of the eyeball, covered by a mucous membrane called the conjunctiva. *x.* Red blood vessels ramified upon this membrane.

Figures II. and IV. Represent the right eye closed, as in sleep or in winking.

a. b. c. The eyebrows.—*a.* The internal or nasal extremity—*b.* its middle—*c.* its temporal extremity.

c. d. e. f. The upper eyelid expanded over the eyeball.

e. f. The aperture of the eyelids closed.

e. The inner or greater angle, or canthus of the eye.

f. The anterior or lesser angle or canthus of the eye.

g. The ciliæ or eyelashes of both eyelids.

h. i. The horizontal line, showing the inner angle to be situated lower than the temporal angle.

k. l. The situation of the iris, or rather of the cornea, when the eyelids are closed.

m. n. q. The depressions at the margin of the eyeball—the folds of the eyelids having disappeared by the extension of the eyelids over the globe.

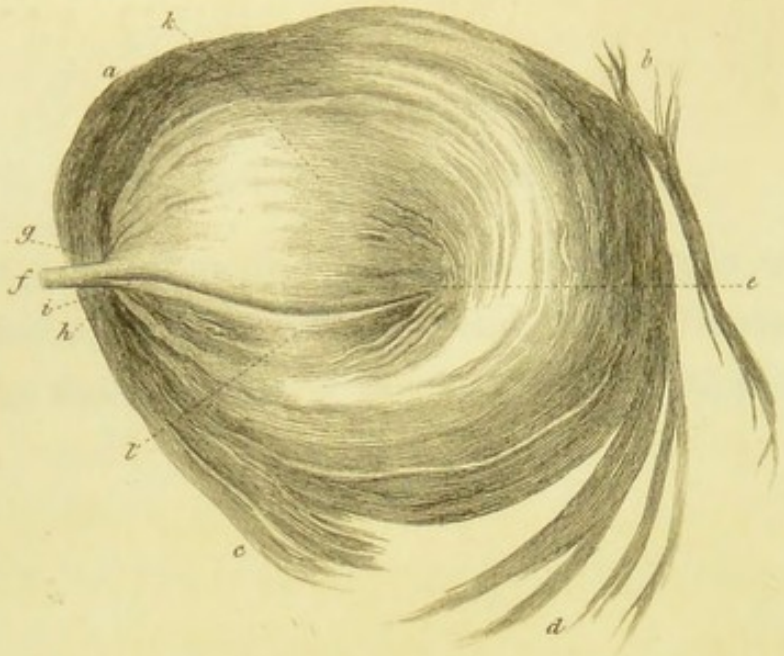


FIG. II.

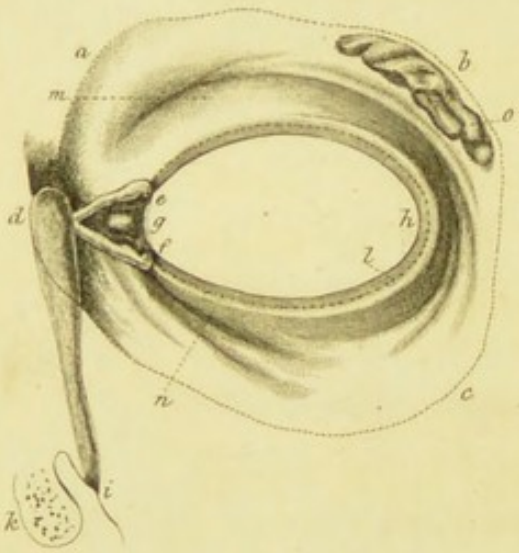


FIG. III.

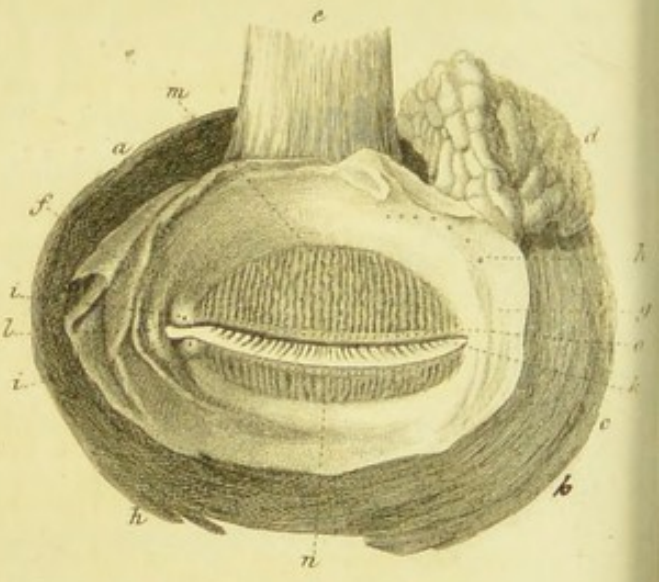


FIG. IV.

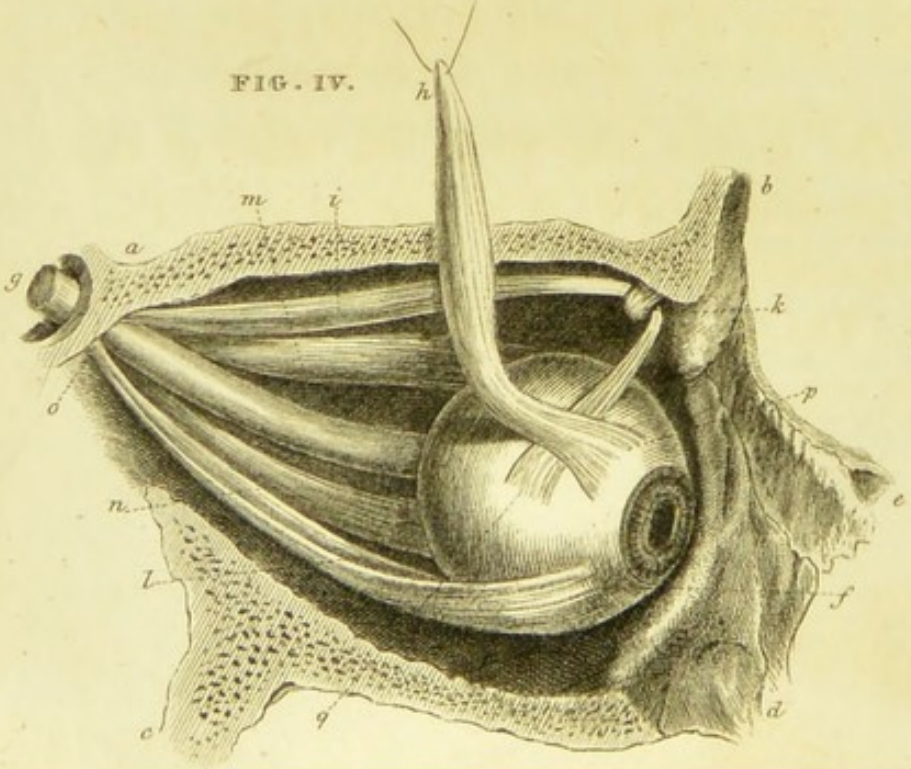


PLATE II.

The Figures of this Plate are intended to illustrate the anatomy of the appendages of the eye—namely the eyelids, muscles of the eye, and lacrymal organs. They are taken partly from nature, and partly from the Plates of Soëmmering.

Figure I. Shows the exterior muscle of the eyelids of the left eye.

a. b. d. e. The orbicularis palpebrarum muscle.

a. b. The origin of its fibres from the frontal bone—*c. d.* from the superior maxillary and malar bones.

e. i. The aperture of the eyelids closed.

k. The fibres of the orbicularis muscle which cover the upper eyelid.

l. The fibres of the same which cover the lower eyelid.

f. The tendon into which the fibres of the muscle are concentrated, to be inserted into the superior maxillary bone.

g. h. The fibres of the muscle which cover the lacrymal sac.

Figure II. Shows the anatomy of the eyelids, after the removal of the integuments and orbicularis muscle.

a. b. c. d. Marks the situation of the bony margin of the orbit by a dotted line.

e. g. f. h. The aperture of the eyelids open.

g. The inner or greater angle of the eye.

h. The external or lesser angle.

e. f. The puncta lacrymalia, or orifices of the lateral lacrymal canals, which lead to the lacrymal sac *d.*

d. i. The lacrymal sac and nasal duct. The part above the margin of the orbit *n. d.* is called the lacrymal sac; that below, or confined within the bony canal which leads to the nose, the nasal duct.

i. The lower orifice of the nasal duct, entering the lower and lateral part of the nose, at the fossa formed by the inferior spongy *(k)* and superior, maxillary *(i)* bones.

l. The orifices of the sebaceous ducts leading from the Meibomian glands, shown by a dotted line round the inner margin of the eyelids.

m. The cartilage of the upper eyelid.

n. The cartilage of the lower eyelid.

o. The lacrymal gland.

Figure III. Shows the inner surface of the eyelids of the right eye.

a. b. c. The external margin of the orbicularis muscle.

d. The lacrymal gland.

e. The tendon of the levator muscle of the upper eyelid.

f. g. The mucous membrane which lines the inner surface of the eyelids, and covers the anterior surface of the eyeball, called the *tunica conjunctiva.*

h. Seven points representing the orifices of the ducts leading from the lacrymal gland, by which the tears are conveyed to the inner surface of the eyelids.

i. i. The orifices of the puncta lacrymalia.

k. l. The aperture of the eyelids, a little open, by which the ciliæ or eyelashes of the upper lid are partly seen; *k.* the external angle, *l.* the inner angle of the eye.

l. Shows the fold at the inner angle, called the lacrymal caruncle.

m. n. The cartilages of the eyelids seen through the mucous membrane. The lines across these cartilages, represent the sebaceous follicles, or glands, called the glands of Meibomeus. These glands are situated, between the mucous membrane lining the eyelids and the tarsal cartilages.

o. A dotted line, showing the orifices of the

ducts of these glands along the margin of the eyelid.

Figure IV. Shows about one half of the bony orbit, in which the eyeball and its appendages are contained. The part of the orbit here seen, is that next the nose. The eyeball and its muscles, are seen *in situ*.

a. b. c. d. Part of the orbit, formed by the bones of the cranium and face.—*a.* part of the sphenoid bone—*b.* part of the frontal bone—*c.* the sphenoidal; and *d.* the superior maxillary bone.

e. The nasal bones.

f. The eyeball, or globe of the eye.

g. The extremity of the optic nerve, where it passes from the cranium to the orbit.

h. The levator oculi muscle, raised from its situation at its origin, to show the parts beneath, —its insertion into the eyeball remaining at *p.*

i. The superior oblique muscle, having its origin at the foramen opticum, *g.*—the pulley through which it passes at *k.* and its insertion into the eyeball at *q.*

l. The abductor oculi muscle.

m. The abductor oculi.

n. The depressor oculi.

o. The bony ring of the sphenoid bone, from which all these muscles take their origin.

FIG. I.

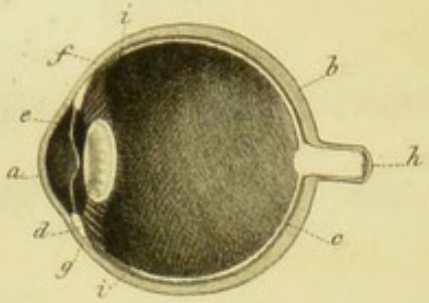
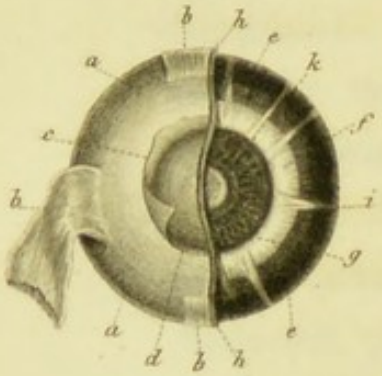


FIG. II.



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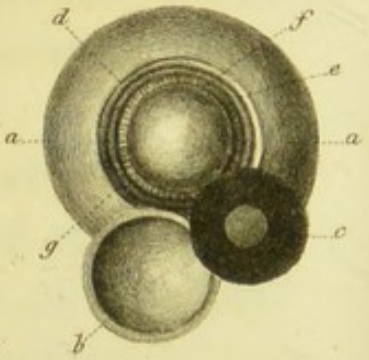


FIG. VI.

FIG. IV.

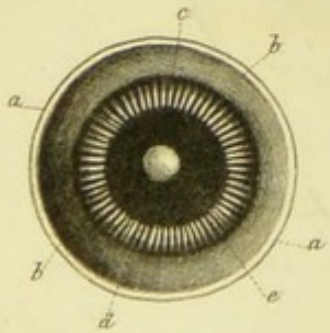


FIG. V.

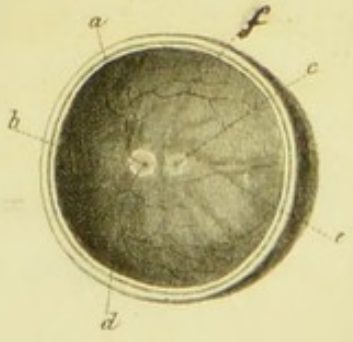


PLATE III.

Represents different sections of the eyeball, to show its internal structure. The drawings were made from preparations, which are still in my possession, except that of Figure 6.

Figure I. One half of the eye divided perpendicularly, giving a lateral view of its internal structure.

a. The cornea.

b. The sclerotica.

c. The choroidea.

d. The ciliary ligament.

e. The iris.

f. The ciliary processes.

g. The crystalline lens.

h. The optic nerve, expanding into the retina within the choroid coat.

i. i. The anterior termination of the retina.

The Aqueous Humour occupies the space between the crystalline lens, *g*, and the cornea, *a*. The Vitreous Humour, that between the lens and the Retina.

Figure II. Gives a view of the anterior parts of the eyeball. Upon the right side of the eye,

the internal tunics are seen; on the left these have been removed, to show the parts situated immediately beneath them.

a. a. The sclerotic coat. *h. h.* its cut edge.

b. b. b. The extremities of three of the straight muscles of the eyeball.

c. A portion of the tunica conjunctiva, left at margin of the cornea.

d. The transparent cornea, but represented here as opaque from maceration in spirits.

e. e. The choroid coat.

f. The ciliary ligament.

g. The iris.

i. One of the ciliary nerves going to the iris.

k. The pupil, through which, the crystalline lens is seen in an opaque state, from maceration in spirits.

Figure III. Another view of the anterior parts of the eyeball.

a. a. The sclerotic coat.

b. The cornea, removed from its connection with sclerotic coat and turned downwards, by which its inner surface is seen.

c. The iris detached from its connection with the ciliary ligament and turned down, by which its inner surface is also exposed.

d. The anterior margin of the sclerotic coat, from which the cornea has been detached.

e. The anterior margin of the ciliary ligament and anterior extremities of the ciliary processes.

f. The space occupied by the vitreous humour, between the anterior extremities of the ciliary processes and the crystalline lens.

g. The crystalline lens.

Figure IV. The inner surface of the anterior half of the coats of the eyeball, the humours being removed.

a. a. The cut edge of the sclerotic coat.

b. b. The choroid coat immediately within it.

c. The ciliary plicæ or processes.

d. The posterior surface of the iris.

e. The pupillary aperture of the iris, through which the cornea is seen.

Figure V. The inner surface of the posterior half of the coats of the eyeball, the humours having been removed.

a. The sclerotic and choroid coats.

b. The entrance of the optic nerve through the coats of the eye, where it expands to form the retina.

c. The foramen centrale of Soëmmering, or central hole in the retina.

d. The retina.

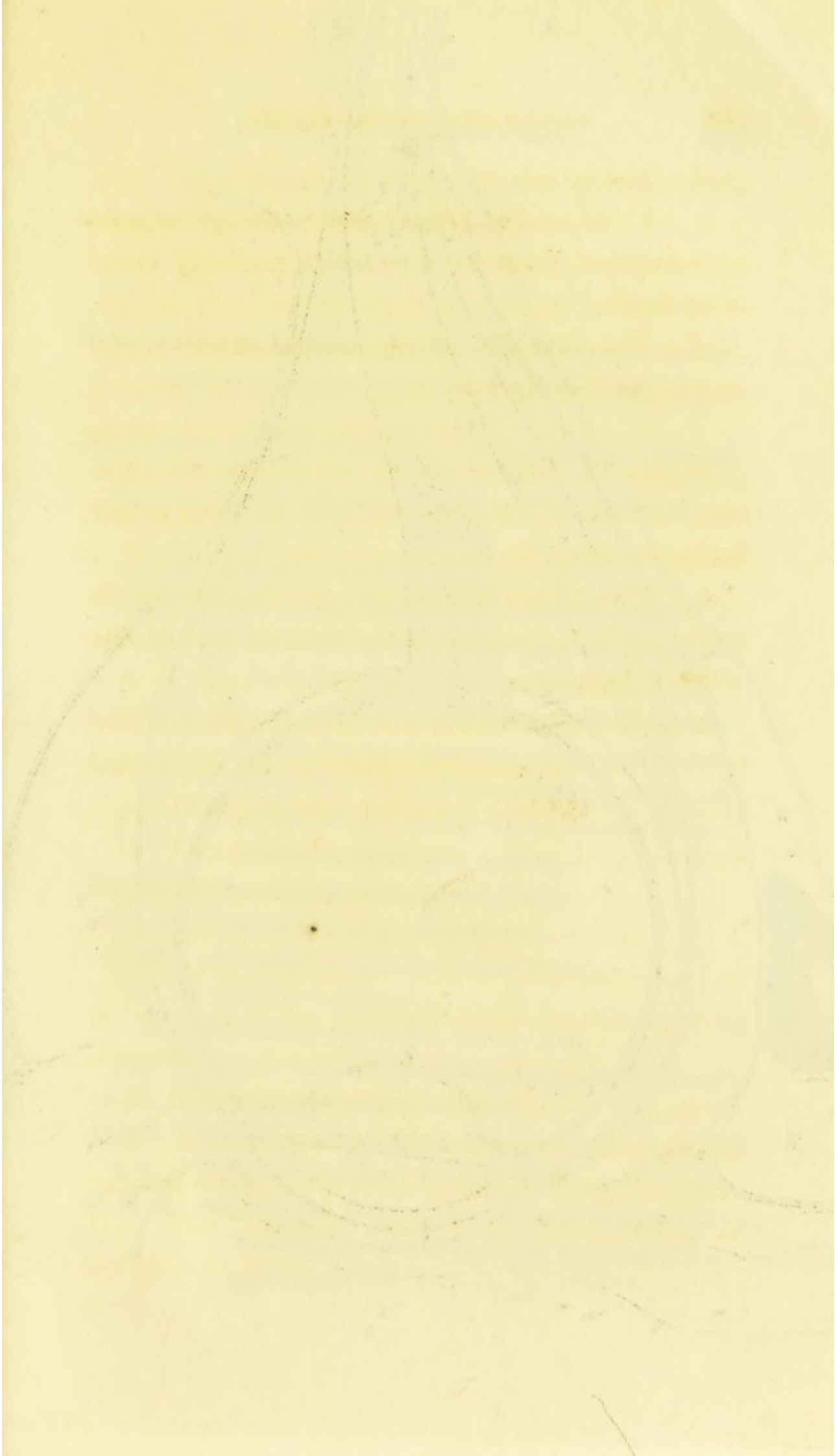
e. A fold of the retina, which always appears at the central foramen, but which probably forms after death.

f. The branches of the central artery of the retina, ramified through it.

Figure VI. Represents the crystalline and vitreous humours of the eye, inclosed in their proper tunics or capsules.

a. The crystalline humour or lens, having its posterior half, imbeded in the anterior part of the vitreous humour.

b. c. The vitreous humour ;—*b* the plicæ of the hyaloid membrane, corresponding to the ciliary processes, and which form the canal of Petit.



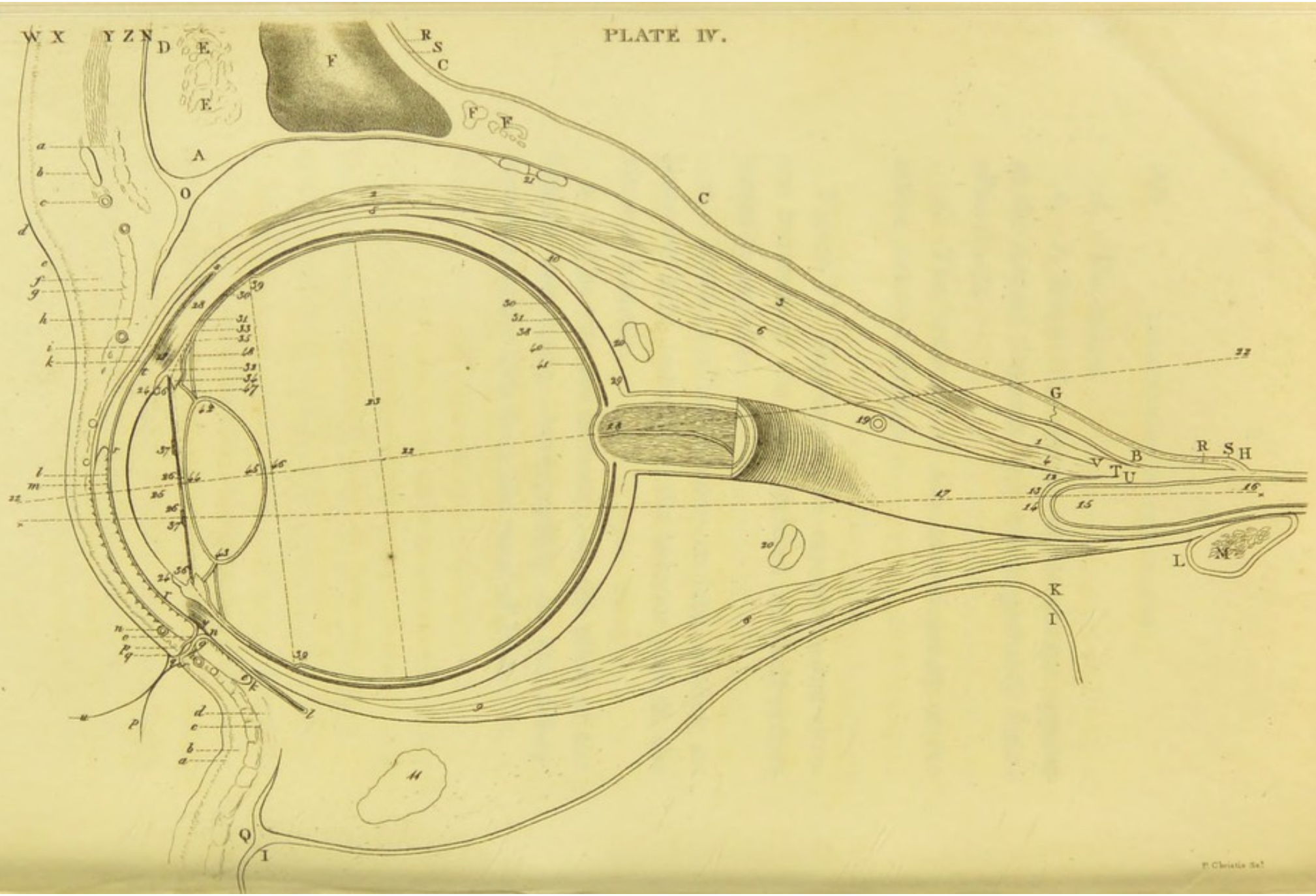


PLATE IV.
W X Y Z N
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PLATE IV.

Perpendicular Section of the Apparatus of Vision upon a magnified scale, seen from the side, the eyelids closed.

(Copied and Translated from Soëmmering on the Eye, with some additions.)

This gives a more full and minute description of Fig. 1. Plate II.

A.—II. *The Bony Orbit.*

A. H. The superior boundary or roof of the orbit.

A. B. The smooth surface of this boundary turned towards the orbit.

C. C. G. H. The uneven surface turned towards the brain, and having the depressions and eminences, corresponding to the depressions and eminences of the inferior surface of the anterior lobe of the brain, which rests upon it.

A. D. E. F. Frontal part of the frontal bone.

C. C. G. Orbitar part of the same bone.

F. E. Medullary cells of the frontal bone.

E. Left frontal sinus.

E. F. Medullary cells of the orbitary part.

G. Suture between the frontal bone and the great wing of the sphenoid bone.

Q. M. Lower boundary of the orbit.

I. I. Superior Maxillary bone.

G. B. H. Part of the body of the sphenoid bone, which forms the superior boundary of the canal of the optic nerve.

II. M.	Inferior boundary of the orbit.
K. L.	Orbitral slit filled up by tendinous fibres, cellular tissue, blood-vessels and nerves.
M.	Part of the sphenoid bone which forms the inferior boundary of the canal of the optic nerve.
L.	The periosteum.
B. H. M.	Canal in the sphenoid bone for the optic nerve.
N.	Periosteum of the frontal bone.
O.	Continuation of the periosteum, toward the superior eyelid in the form of an arch nearly tendinous.
P. Q.	Periosteum of superior maxillary bone continued towards lower eyelid.
× · × ·	Axis of the cone of the orbit.
R. S. V.	Dura mater of the brain which covers the frontal and sphenoidal bones.
R.	The external surface of the dura mater.
S.	Its internal surface.
T. U. V.	Point where the dura mater adheres.
T.	Part of the orbital periosteum.
U.	Part of the sheath of the optic nerve.
V.	Part of the cellular tissue between the tendon of the levator muscle of the superior eyelid (*i.*) and the strait superior muscle of the eye (4.)

W.—Z.	*The Forehead.*
W.	Thickness of the skin of the forehead.
X.	Cellular tissue between the skin and the frontal muscle.
Y.	Frontal muscle.
Z.	Cellular tissue situated between the frontal muscle and the periosteum of the frontal bone.

a.—d. *The Eyebrow.*

a. Corrugator muscle of the eyebrow.

b. Section of the frontal vein.

c. Section of the frontal artery.

d. Hairs of the eyebrow.

e.—g. *Superior Eyelid.*

e. Thin skin of the eyebrow.

f. The cellular tissue on the outside of the sphincter muscle of the eyelids, which disappears in the skin towards the edge of the lid.

g. The sphincter muscle of the eyelids.

h. Cellular tissue on the innerside of the sphincter muscle of the eyelids, which is insensibly lost towards the edge of the lid.

i. Tendon of the muscle which raises the upper eyelid.

k. Very fine cellular tissue between this tendon and the conjunctiva.

l. Cartilage of the superior eyelid.

m. Marks or indentation of the sebaceous folicles upon the inner side of the eyelid.

r. r. s. t. Conjunctival lining of the upper eyelid.

r. v. Part where it covers the cartilage and sebaceous glands.

r. s. Place where it is attached to the tendon by thin cellular tissue.

r. k. s. t. Where it is reflected upon itself.

s. t. Portion which covers the anterior part of the sclerotic of the eyeball.

y. r. 24. s. Superior pouch or cavity of the conjunctiva; or the space between its two layers, formed by

the one which lines the superior eyelid, and the other which covers the superior parts of the eyeball. This space, is here represented by a black line *a*, *t*,—the place where the layers are in contact, *s. t. r.*

o. p. q. Margin of the upper eyelid.

o. The internal edge of this margin the most thin.

p. Its thicker external edge.

q. Place where the cuticle of the eyelid becomes changed, or passes into the conjunctiva of the superior eyelid.

u. Cilia of superior eyelid.

n. The orifice of coronary artery of the superior eyelid.

u.—q. *Inferior eyelid.*

q. Place where the skin of the cheek becomes the skin of the inferior eyelid.

b. Cellular tissue between the skin and sphincter palpebrarum.

c. The sphincter palpebrarum.

d. Cellular tissue beneath the sphincter palpebrarum.

e. g. Cartilage of the inferior eyelid. The indented line marks the section of the sebaceous glands.

f. g. Margin of inferior eyelid.

f. Its exterior edge.

g. Its interior edge.

h. The groove between the two edges.

f. Place where the cuticle of the face passes into the conjunctiva of the inferior eyelid.

y. Triangular space between the edges of the eyelid, and the conjunctiva of the eyeball.

k. l. m. n. Conjunctiva of inferior eyelid.

g. k. Cartilage and sebaceous glands of this eyelid.

k. l. Conjunctiva connected to the sphincter palpebrarum by interposed cellular tissue.

l. Conjunctiva reflected upon itself.

m. n. Where it covers the sclerotica.

y. l. Inferior cavity of the conjunctiva, or space formed by its two layers, the one lining the inferior eyelid, the other covering the eyeball. This space is marked by the black line where the layers are in contact, *l. y. r.*

p. Cilia of inferior eyelid.

q. Space between the cilia and margins of the eyelids.

1.—11. *Muscles of the Eye.*

1. 2. 3. Levator of superior eyelid.

1. 1. Its posterior fixed, and tendinous extremity, which is attached to the periosteum of the orbit.

2. Its anterior, moveable, and tendinous extremity, which passes over the cartilage of the superior eyelid, and is lost at its margin.

3. Its fleshy fibrous portion.

4. 5. 6. Superior straight muscle of the eyeball.

4. Its fixed, tendinous and posterior extremity, which is attached to the sheath of the optic nerve, a little anterior to the extremity of the inferior straight muscle.

5. Its anterior, moveable and tendinous extremity, which terminates in the sclerotica at 28.

6. Its fleshy fibrous portion.

7. 8. 9. Inferior straight muscle of the eyeball.

7. Its posterior fixed, and tendinous extremity, which is attached to the sheath of the optic nerve, a little posterior to the extremity of the superior straight muscle.

8. Fleshy portion of the muscle.

9. Its anterior moveable and tendinous extremity, which terminates in the sclerotica at *m*.

10. Tendon of the superior oblique muscle.

11. Section of inferior oblique muscle.

12—18. *The optic nerve*—somewhat in the form of the letter S, and covered with cellular tissue.

12—13. Sheath of the optic nerve formed by the dura matter.

12. The interior layer of this sheath.

13. Its exterior layer.

14. The inner sheath of optic nerve.

15. Section of the fibrous substance of the optic nerve.

16. Part of the optic nerve which passes through the long canal at the point where it appears flattened from the top to the bottom.

17. Cylindrical part of the optic nerve.

18. Extremity of the optic nerve penetrating and strangulated in the sclerotic coat. In the figure the fibrous structure of the optic nerve, the passage of the central artery, and the mode of adhesion between the membranes of the nerve with the coats of the globe, are delineated.

19. 20. Blood vessels and nerves of the eye.

19. The principal trunk of the ophthalmic artery.

20. The principal trunk of the ophthalmic vein which winds round the eyeball.

21. Twigs of the first branch of the fifth pair of nerves.

22—46. *The globe of the eye, or the eyeball.*

22. 22. Axis of the globe.

23. Great transverse diameter of the globe.

24. 25. 26. The cornea. 24. 24. Section of the cornea, which shows its thickness, its convexity, and the mode of junction with the sclerotica. 25. 26. 26. Space between the cornea and lens, which is divided into the anterior chamber 25. and posterior 26. 26.

24. *t.* and 24. *v.* Double furrow between the cornea and the sclerotica.

27. 28. 29. The sclerotica 27. Its anterior extremity, which appears to pass into the cornea, and which internally presents a double furrow upon which is firmly placed the ciliary ring (32.) of the choroid coat 28. The thinest part of the sclerotica covered by the tendons of the strait muscles.

30. Pigmentum nigrum, or black substance of the choroid coat.

31. 31. The choroid coat. 32. 33. Ciliary ring of the choroid or ciliary ligament, by which it adheres firmly to the sclerotica. 32. Anterior edge, or thickest part of the ring which terminates in becoming thinner towards the concavity of the cornea. 33. Posterior edge of the ring. 34. 35. Ciliary process or fold. 34. Anterior extremity or thickest part of each

process. 35. Posterior extremity of the same fold, which terminates in a delicate point.

34. 39. 39. Part of the choroid which does not cover the retina, and which is seen through the vitreous humour.

39. 46. 39. Part of the choroid which in ordinary is more dark in the globes of adults.

36. 37. Iris. 36. 36. Margin to which the iris is attached, and which resembles a prolongation of the ciliary ring and processes.

37. 26. 26. 27. Pupillary margin of the iris forming the half of the pupil.

38. Black substance between the choroid and the retina.

39. 40. 41. Retina. 39. 39. Its anterior extremity indicated by the line. 39. 46.—39. 40. Medullary substance of the retina.

41. The choroid upon which the nervous matter is extended.

39. 41. 23. 22. 46. 39. Internal surface of the retina seen through the vitreous humour.

42. 43. The crystalline lens. 43. 42. Its length ; 44. 45. its thickness; 42, 44. 43. its anterior convexity; 42. 44. 43. its posterior convexity.

46. 26. Capsule of the lens. 34. 42. Distance of the lens from ciliary body.

47. The part of the vitreous humour, which occupies the space between the ciliary processes and the margin of the lens, covered by its hyaloid membrane, upon which the vessels proceed to the capsule of the lens.

47. 48. The part of the hyaloid tunic which forms the canal of Petit.

PLATE V.

Lizars Sculpt

PLATE V.

This plate gives a view of the base of the brain and the eye, *in situ*, to show the origin, connection and relative situation, of the optic nerves.

a. a. The anterior lobes of the cerebrum.

b. The eyeball.

b. g. d. l. The parts belonging to the eye which are contained in the orbit.

c. One of the first pair or olfactory nerves.

d. The second pair or optic nerves at the place when they make their exit from the craneum. One of these nerves is here seen passing to the eyeball, imbeded in adipose and cellular tissue.

e. The third pair of nerves.

f. That part of the third nerve which is situated in the orbit. The portion between *e.* and *f.* having been removed.

g. The adductor muscle into which a large branch of the third nerve is sent.

h. The ophthalmic or lenticular ganglion formed by portions of the 3d and 5th pairs of nerves, and from which numerous branches are sent to the posterior part of the sclerotic coat, where they enter the eye. These nervous branches are imbeded in adipose substance.

i. i. The tractus opticus of each side, arising from the corpora quadragemina and thalami nervorum opticorum, which parts, cannot here be shown.

k. The corpora geniculata, anterior, and posterior.

l. The margin of the abductor muscle of the eye.

m. One of the crura of the cerebrum.

n. One of the crura of the cerebellum, which, joining with its fellow, forms the Pons Varolii or tuber annulare.

o. o. The lobes of the cerebellum.

p. The medulla oblongata.

PLATE VI.

FIG. I.

FIG. II.

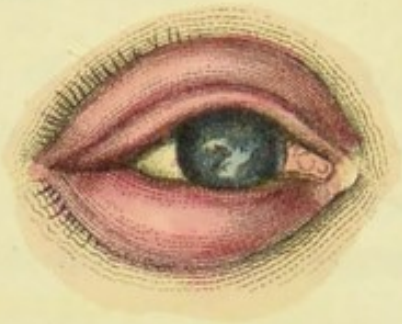


FIG. III.

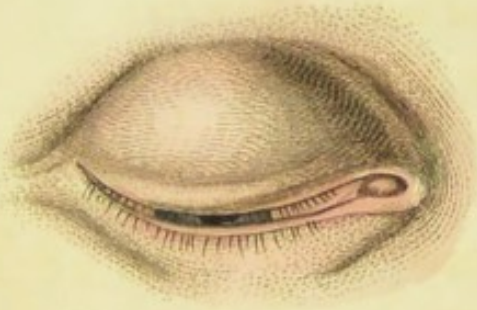


FIG. IV.

FIG. V.

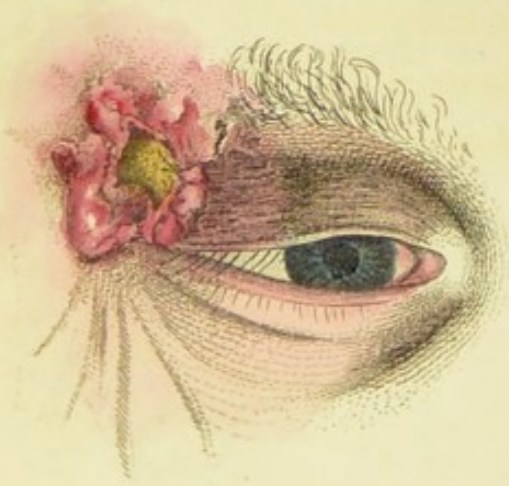
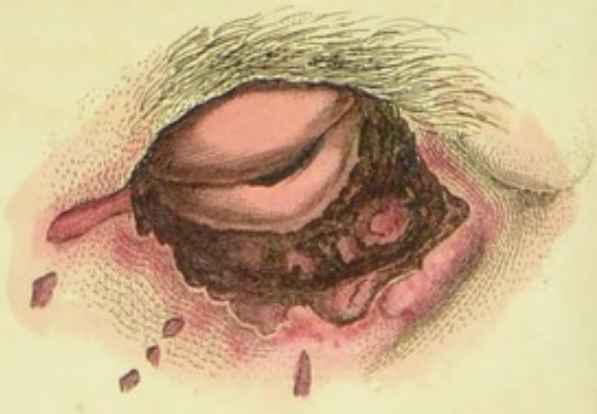


FIG. VI.



A.W. delin.

W.H. Lizars sculp.

PLATE VI.

Figure I. represents a case of eversion of the lower eyelid, with a cicatrix below its external angle. This case was cured by the excision of a triangular portion of the lid, along with a portion of the thickened conjunctiva from its inner surface.

Figure II. Case of eversion of both eyelids in a young man, caused by an attack of inflammation. The cornea had become opaque.

Figure III. Inversion of upper eyelid, copied from one of the plates of Demours.

Figure IV. Tumour at the inner angle of the eye, from enlargement of the lacrymal sac, from a woman of 30, as seen in the second stage of *Fistula lacrymalis.*

Figure V. Case of cancer of the lacrymal gland in a man of 65. The disease commenced 17 years previously. The delineation represents it in a state of painful ulceration.

Figure VI. Case of cancer of the eye from a man of 60. The parts contained in the orbit around the eyeball have been removed by cancerous ulceration; leaving the eyeball and cartilage of the upper eyelid in front of it, contracted and shrivelled.

PLATE VII.

FIG. I.

FIG. II.

FIG. III.

PLATE VII.

Figure I. represents a case of simple acute inflammation of the tunica conjunctiva, in a middle aged man, which was removed, in a few days, by the employment of the usual remedies.

Figure II. represents pustular, or more properly aphthous, inflammation, in a boy of six years old. Clusters of enlarged red vessels of the conjunctiva, are here seen running to the aphthous vesicles. The cornea is somewhat opaque. These, are common appearances, in strumous ophthalmia.

Figure III. represents an abscess, situated at the margin of the cornea, which has burst internally. In consequence of this, some pus has got into the anterior chamber of the aqueous humour, which, from its greater specific gravity, has fallen to the lower part of it.

PLATE VIII.

Figure I. represents an eye affected with chemosis, from thickening, relaxation, and œdema of the conjunctiva, following puriform ophthalmia. Portions of this membrane, are here seen to form pendulous tumours, which project from between the eyelids.

Figure II. represents the conjunctiva affected with another form of chemosis. This occurred in a patient who had an attack of purulent ophthalmia, of which, this is the second or suppurative stage. There is also an effusion of lymph or pus into the anterior chamber. The tumefaction here, is only to a small degree, as the thickened conjunctiva, in this case, only overlaps the edge of the cornea. Sometimes it covers the cornea completely, and projects beyond the eyelids, as in the preceding figure.

Figure III. represents the inner surface of the upper eyelid turned out, which is easily done by means of a probe, to show what is termed, the *granular state* of the conjunctiva lining it. This is

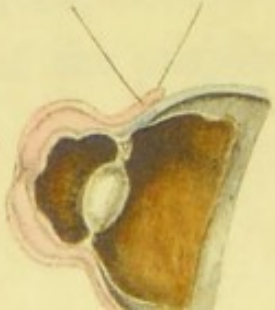
PLATE VIII.

FIG. I.

FIG. II.

FIG. III.

FIG. IV.



very frequently a sequel, or last stage, of violent inflammation of this membrane, especially when it has been puriform.

Fig. IV. Section of staphylomatous eye. This represents one half of an eye affected with staphyloma of the cornea, from a preparation in my collection. The cornea is much increased in size, so as to project much beyond its natual situation. Its thickness is very much increased, and it had become more soft and fleshy than its natural state. The different layers of which the cornea is composed, can be traced with considerable precision, in consequence of the changes they have undergone in their structure. The iris adheres to the inner surface of the cornea, and is drawn forwards. The crystalline lens and other parts, are in their natural state. This figure represents the case described at page 82.

PLATE IX.

Figure I. represents a case, from an elderly man, of chronic or passive inflammation of the conjunctiva, both in that part of it covering the eyeball and cornea; in consequence of which, the cornea, at different parts, appears to be opaque and vascular.

Figure II. represents a case of violent acute syphilitic inflammation of the iris, a few days after its invasion. The zone of enlarged ciliary vessels is seen at a little distance from the cornea, where these vessels run to the iris. The iris, is almost wholly covered with lymph, effused upon its surface, filling up part of the pupil and anterior chamber, which has altogether a turbid or muddy appearance.

Figure III. In this figure, which is another view of the same eye as the last, the course of the enlarged ciliary vessels, and of the enlarged conjunctival vessels, in inflammation of the iris, is more distinctly seen.

FIG. I.

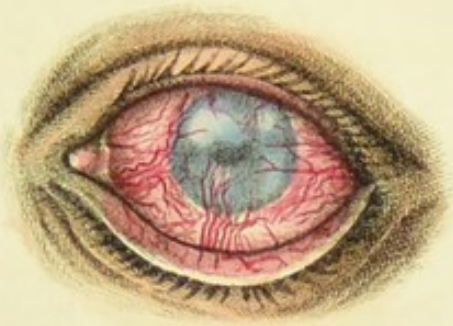


FIG. II.

FIG. III.

A.M.C. delin.

W. Lizars Sculp.

PLATE X.

FIG. I.

FIG. II.

FIG. III.

FIG. IV.

A.W. delin.

W.H. Lizars sculp.

PLATE X.

Figure I. represents a case of pterygium, copied from the work of Professor Bëer of Vienna.

Figure II. represents partial staphyloma of the cornea.

Figure III. represents complete staphyloma of the cornea, which had been produced by infantile purulent ophthalmia.

Figure IV. represents a case of staphyloma of the sclerotic coat, at the upper side, near to the margin of the cornea. The patient was made to turn his eye towards the nose, that a more distinct view of the disease might be obtained. A projection of the sclerotica, is here seen of a bluish colour, upon which, there are several smaller projections, surrounding the cornea.

PLATE XI.

Figure I. This and the two following figures represent the different appearances of the acute inflammation of each of the three component parts of what is commonly called *the cornea.* This figure is copied from Mr. Wardrop's Morbid Anatomy of the Eye, and of which he gives the following description:—" This figure," he says, " represents the inflammation of a small portion of the conjunctiva covering the cornea. The diseased portion is of an opaque, white colour, a little elevated above the natural surface of the cornea, and extending from the sclerotic coat to beyond the centre of the cornea. It has an oblong form, except near its extremity, where it becomes broader, and two large vascular trunks pass to the cornea, and are ramified into a number of minute branches when they reach the extremity of the opaque spot. The whole cornea is a little clouded. The eyelids are turgid with blood."*

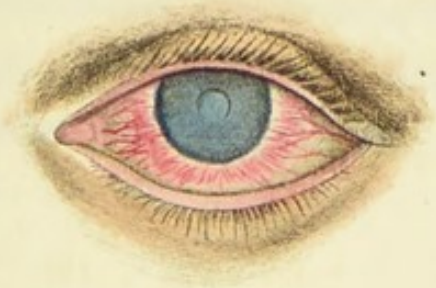
Figure II. represents a case of acute inflamma-

* See Vol. I. p. 147.

FIG.I.

FIG.II.

FIG.III.



A.W.delin.

W.H.Lizars Sculp.

tion of the cornea propria of a young man, in which enlarged red vessels upon the sclerotica, are seen around the margin of the cornea, passing into its proper substance. As these vessels are under the conjunctiva, they appear to be smaller, more minute, and of lighter colour than if they had been superficial. There is also some inflammation of the conjunctiva, both of the sclerotica and cornea, as is marked by the enlargement of its vessels. Some of these conjunctival vessels, are ramified upon the cornea, where there is a part of it opaque. A small globule or drop of pus, is also seen under the conjunctiva of the cornea, situated nearly opposite to the pupil. The whole of the cornea has a dim or turbid appearance.

Figure III. represents a case of inflammation of the membrane of the aqueous humour. A zone of enlarged ciliary vessels, is seen half-way round the cornea at its lower part, and a considerable quantity of albumen has been effused into the aqueous humour of the anterior chamber, giving it an opaque turbid appearance, and almost filling up the pupillary opening. In this case there was very little pain, and no intolerance of light.

PLATE XII.

Figures I. and II. represent a case of prolapsus of the iris, through an ulcerated opening of the cornea, Fig. II. being a profile view, shows the projection of the tumour of the iris. These are copied from the plates of Demours.

Figure III. represents an opacity of the cornea, being the cicatrix of a wound, copied from Bëer.

Figure IV. Central opacity of the cornea having a red vessel running over it.

Figure V. Another case of central opacity of the cornea; the eye being turned a little to one side, a part of the pupil, which is seen behind the opacity, comes into view.

Figure VI. Case in which two-thirds of the cornea is opaque. Iris adhering to opaque part,—pupil contracted, and drawn to a side under the opacity. This patient, therefore, could only see, when the eye was turned to the side, and that very imperfectly.

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P.T. Christie Sculp.t Edin.r

Figure VII. Pupil much contracted and drawn to the side, so that it consists merely of a chink. This took place, in consequence of the protrusion of a portion of the iris, through a wound in the cornea. To the cicatrix of the cornea, the pupillar margin of the iris adheres. *Synechia anterior* of the Germans.

Figure VIII. Opacity of the cornea, to the inner surface of which, the pupillar margin of the iris adheres. In consequence of this, the anterior chamber of the aqueous humour is obliterated, the anterior surface of the iris, being in contact with the posterior surface of the cornea.

Figure IX. Pupil drawn to one side from adhesion to the cornea, being the result of a wound of the cornea, to the cicatrix of which the iris adheres. The capsule of the crystalline lens is also opaque, and adheres to the iris.

Figure X. Contracted immoveable pupil, with adherent cataract, the consequences of a wound through the cornea, the cicatrix of which is seen at its centre. The white line around the margin of the cornea, represents an opaque state that frequently takes place in elderly persons, and is therefore called the *arcus senilis*.

PLATE XIII.

Figure I. An abscess of a considerable size between the layers of the cornea, which projected considerably forwards.

Figure II. Shows two diseased states of the cornea.—The uppermost an ulcer of the cornea.—The lower a small vesicle after ulceration.

Figure III. represents a circumscribed slough or dead portion of the cornea, from a man who had accidentally got a drop of an acrid stimulating fluid into his eye, eight days before this drawing was made. It was accompanied with much acute inflammation of the eye.

Figure IV. represents the eye of a middle-aged man, in which the death and exfoliation of the conjunctiva of a part of the cornea had taken place, in consequence of some lime having got into the eye six months previously. The eye was free from inflammation, and the opaque part had the appearance of chalky matter pealing off. At the centre of the affected part, where some of the dead parts

PLATE XIII.

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have already separated, the cornea has regained its former natural transparency.

Figure V. Case of rheumatic iritis in an elderly lady. The iris had become of a dark brown colour—pupil somewhat opaque and of a greenish colour—lymph effused at lower part of iris causing adhesion to the capsule of the lens—vision had become completely lo

Figure VI. Case where the eye had become wasted and much diminished in size after iritis—pupil much contracted and closed with a portion of opaque lymph.

Figure VII. represents the eye of a young woman, whose cornea sloughed off in the progress of a gonorrhœal opthalmia. When the inflammation abated, a thin membrane, resembling cuticle, formed over the surface of the iris, after the effusion of lymph; strong bands of it intersect the iris. This is the state of the eye described at pages 268 and 269.

Figure VIII. Eye of an old man where the lens had spontaneously got into the anterior chamber of the aqueous humour, and where I depressed the

lens into the vitreous humour, with a needle introduced through the coats of the eye, posterior to the iris.

Figure IX. Case of secondary membranous cataract after repeated operations with the needle. The white shreds here seen, could not be observed when the pupil was contracted to the ordinary size. This cataract, therefore, could not have interrupted vision. They consist, of portions of the posterior part of the capsule of the lens, stil adhering to the hyaloid membranes. As this eye was nearly blind, there must also have existed amaurosis. This drawing was made after the pupil had been dilated with Belladonna.

Figure X. Case of Fungus Hæmatodes in its early stage, in which a tumour is seen at the bottom of the eye, copied from one of the plates of Mr. Saunders. The pupil was of an irregular form, and somewhat dilated—vision gone—a yellowish tumour covered by a plexus of red vessels was seen in the posterior part of the eye. The eye was removed by an operation. And the globe was found nearly filled by a cerebriform tumour.

PLATE XIV.

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PLATE XIV.

Figure I. Shows two points of adhesion between the iris and capsule of the lens, being the result of inflammation. Belladonna having been applied to the eye, the pupil has dilated where no adhesion existed. The adhesions being situated opposite to each other, the dilated pupil, from its figure, has the appearance of a double pupil.

Figure II. Pupillar margin of iris adhering to capsule of lens. A circle of lymph, is seen to form the connecting medium, and nearly to fill up the pupil. This is *Synechia posterior*.

Figure III. Effusion of lymph filling up the pupillary aperture, and causing the adhesion of the iris to the lens, the consequence of iritis.

Figure IV. Effusion of lymph in consequence of a wound in the capsule of the lens.

Figure V. The lower part of the pupillar margin of the iris, adhering to capsule of lens, in conse-

quence of lymph being poured out, from chronic inflammation of the membrane of the aqueous humour. The patient from whom this was taken was a man of fifty-six years of age. He had been gradually losing the sight of his eye for three years, without any other symptom of disease in it.

Figure VI. Another case of chronic inflammation of the membrane of the aqueous humour, from a young woman whose eye had been affected for twelve years. The sight of this eye left her gradually. Had always a feeling of uneasiness in it. The pupillar margin of the iris, is adhering to the opaque capsule of the lens. A line of yellow lymph, is seen to connect these parts all round. A line of lymph, appeared also to be deposited, upon the anterior surface of the iris near to its ciliary margin. This forms a case of adventitious cataract.

Figure VII. Crystalline lens and its capsule opaque, and of a yellowish white colour, caused by inflammation during small-pox. They seem to have lost their vitality, presenting precisely similar appearances to those which took place in the eye of a young man from a blow with a snow-ball.

Figure VIII. Opacity of the posterior part of capsule of the lens. Part of its margin is brought into view by the eye being turned a little to the side. These two last figures are the eyes of an old man.

Figure IX. Crystalline lens and its capsule which have become detached from their connections, and float loose in the eye, in consequence of disorganization of the vitreous humour. This was occasioned by long-continued inflammation of the internal parts, which also caused general enlargement of the eyeball.

Figure X. Congenital cataract from a young man, consisting of an opaque capsule, which has contracted into the centre of the pupil. Its contents, consisting probably of opaque fluid, having been discharged into the aqueous humour, and absorbed.

PLATE XV.

Figure I. represents the common appearance of a firm spontaneous lenticular cataract, from an elderly man.

Figure II. An opaque adherent capsular cataract, which contained opaque fluid, caused by an attack of inflammation nine years previously.

Figure III. Capsulo-lenticular cataract from a patient of fifty. The parts which are more opaque than the rest, show the parts where the capsule is opaque.

Figure IV. A firm lenticular cataract, from an elderly lady having a striated appearance, the stria radiating towards the centre.

Figure V. Opaque shrivelled capsule, the lens having become dissolved in consequence of a wound several years previously. The pupil is dilated by Belladonna.

Figure VI. Capsular cataract projecting from a contracted pupil, the result of an operation for

PLATE XV.

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Pl. Christie Sc.

cataract by extraction. The opaque part of the cornea marks the place of incision.

Figure VII. Adherent capsular cataract with pupil of a very irregular form.

Figure VIII. Eye of an elderly woman affected with amaurosis, in consequence of an attack of inflammation. Pupil much dilated and irregular, with an opaque appearance in the interior of the eye. This state of the eye is called *Glaucoma.*

Figure IX. Crystalline lens opaque and becoming dissolved by the aqueous humour, in consequence of a sharp body having penetrated it, through the cornea. The cicatrix of the wound is seen at the side of the cornea.

Figure X. Effusion of dense lymph filling up the pupillary aperture, organized by red vessels which are seen upon its surface, the consequence of iritis. This constitutes one form of adventitious cataract.

PLATE XVI.

Figure I. Case of Fungus Hæmatodes of a child of between two and three years old, taken a few days before death. The fungous tumour, projected to a great extent beyond the orbit, upon the face and side of the head.

Figure II. Case of Cancer of the orbit, in a woman of 71 years of age. The disease began by a sore on the side of the nose. Four years previously to the time when the disease had assumed the appearance here represented, the sore upon the nose was about the size of a half crown piece. Caustic had been then applied—the ulceration spread—and disease proceeded to excavate the orbit, by removing the parts around the eyeball. The eyeball is here seen in the upper and temporal side of the orbit in a contracted state, its coats having resisted the cancerous ulceration. The patient lived about a year after this drawing was taken.

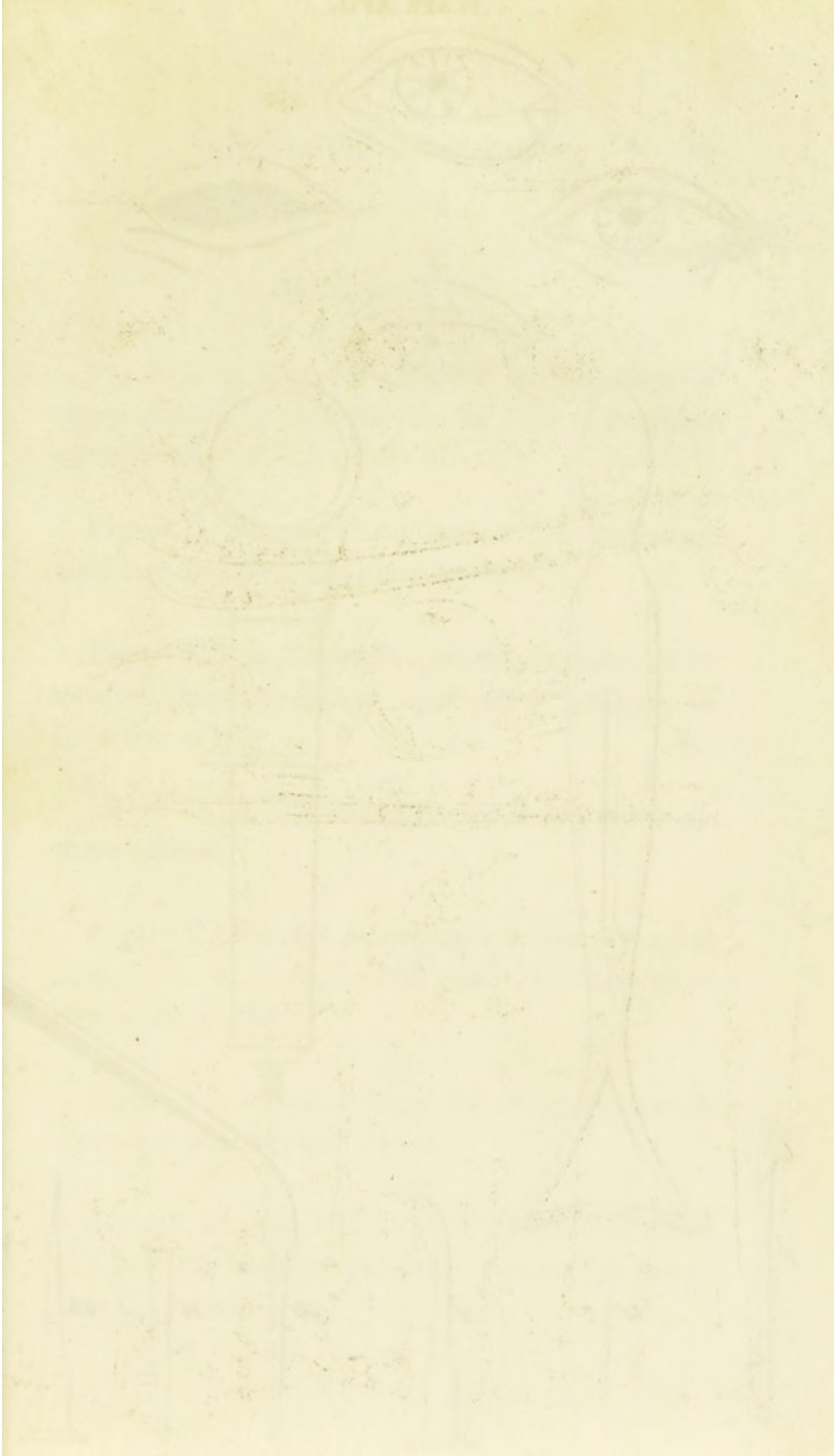


PLATE XVII.

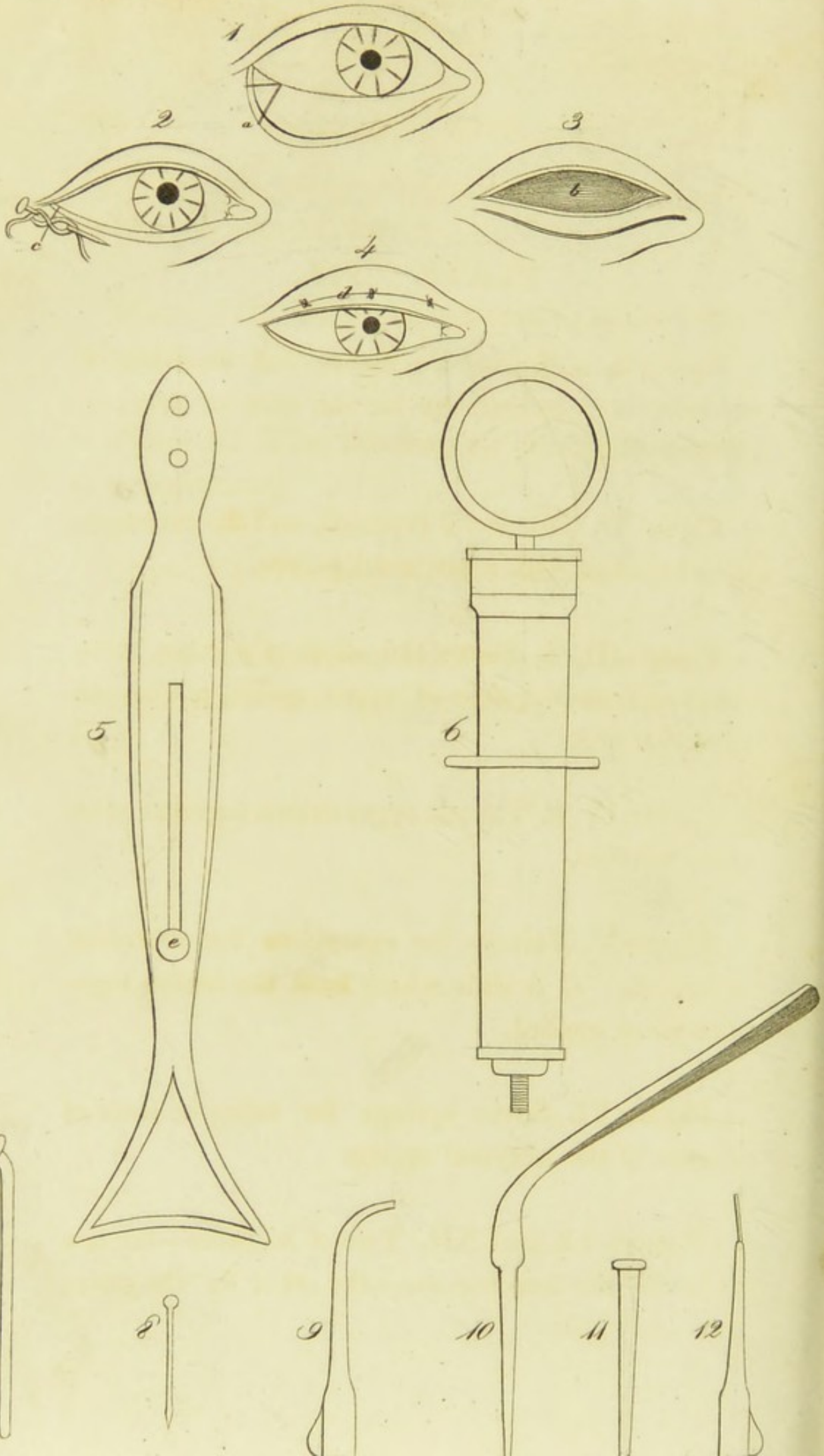


PLATE XVII.

Figure I. *a.* Shows the figure and situation of the portion to be removed for the cure of eversion of the eyelid.

Figure II. The eyelid replaced, and the cut edges held together with a pin and ligature.

Figure III. *b.* Shows the eliptical portion, to be removed from the skin of upper eyelid, to cure an inversion of it.

Figure IV. *d.* The cut edges drawn together with three stitches.

Figure V. Forceps for operations for inversion of eyelids. *e.* A slide which hold the blades together when applied.

Figure VI. Silver syringe for using in cases of disease of the lacrymal organs.

Figures IX. and XII. Two of its tubes—the one (IX.) for the lacrymal sac—the other for the punctum lacrymale.

Figure VII. A style for passing down to the nose in cases of lacrymal fistula.

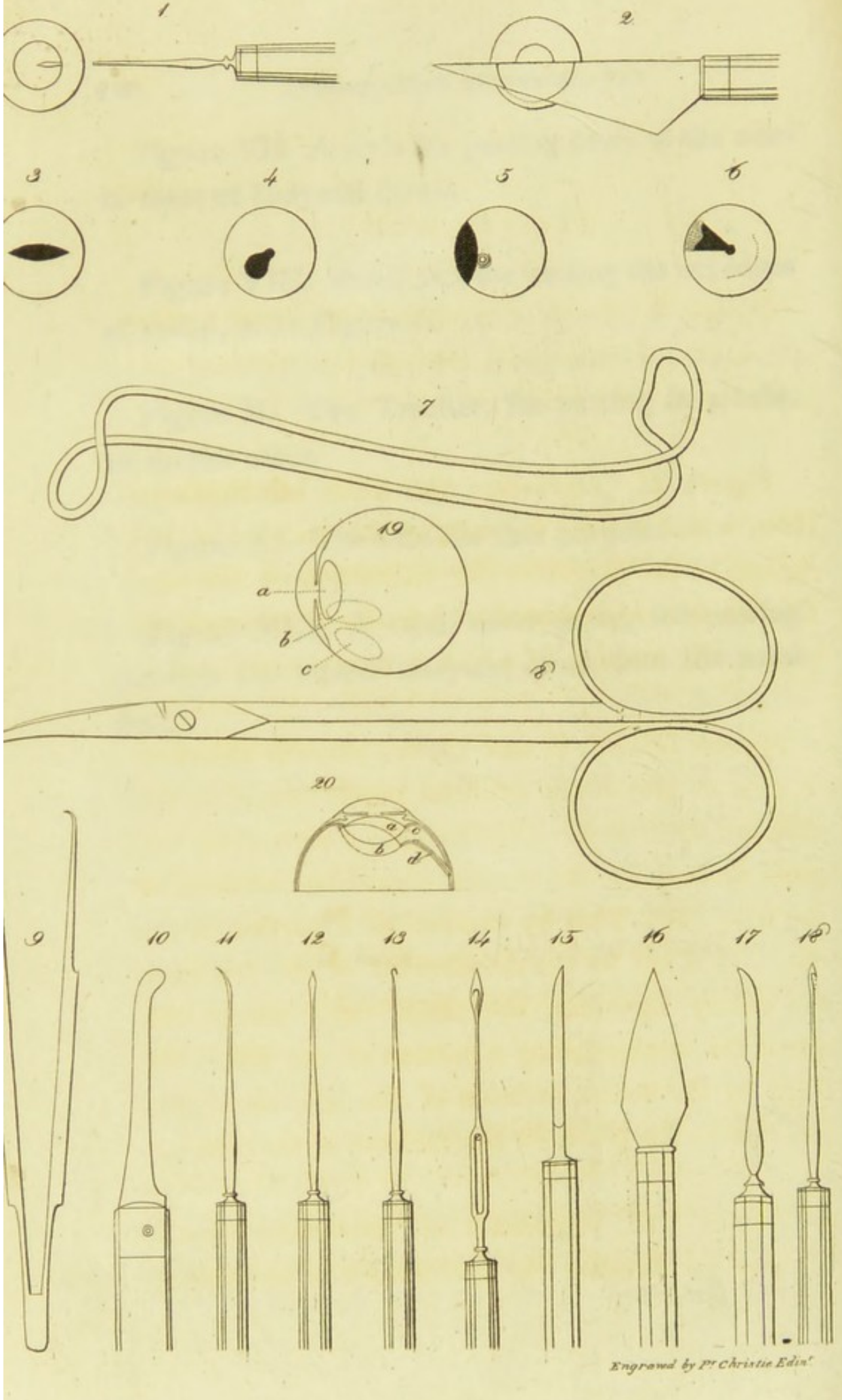
Figure VIII. Small pin, for uniting the cut edges of eyelid, as in Figure II.

Figure X. The Trochar, for putting in a tube, in similar cases.

Figure XI. The tube for this purpose.

Figure XIII. A small silver probe, for passing through the lateral lacrymal canal, into the nasal duct.

PLATE XVIII.



Engraved by Pr Christie Edin.

PLATE XVIII.

Figure I. shows the manner in which a cataract needle is introduced, through the sclerotic coat posterior to the iris.

Figure II. represents the knife of Professor Bëer, which is used for making the incision of the cornea, in the operation for extraction of the lens. The knife is represented as introduced through the cornea, the incision of which is nearly completed.

Figures III, IV, V, and VI, are plans or sketches, to give an idea of the artificial pupils formed by the different operations. Figure III. representing the pupil formed by the simple transverse incision of the iris. IV. That by excision of a portion of the iris. V. That by the detachment of the iris from the ciliary ligament, the small circle marks the place for strangulating a portion of the iris. VI. That by the double division of the iris, the dotted line marks the place for the incision of the cornea.

Figure VII. represents an instrument formed of wire for keeping the eyelid open in performing

operations upon the eye. This, is called, the speculum or elevator of Pellier.

Figure VIII. Scissars used for dividing the iris in performing operations for artificial pupil.

Figure IX. Fine hook-pointed forceps for pulling out a portion of the iris through an opening in the cornea.

Figure X. represents the best form of an eye scarificator.

Figure XI. The curved pointed needle of Professor Scarpa.

Figure XII. The straight lance-pointed needle of Professor Bëer.

Figure XIII. The small hook, used for laying hold of the iris, in performing operations for artificial pupil.

Figure XIV. Small hook upon the side of a needle, the point of which may be drawn back from the hook after it has been introduced into the eye, in order that the hook may be used upon the iris.

Figure XV. Small iris-knife, for performing the operation of Cheselden for artificial pupil, by the simple division of the iris.

Figure XVI. Lancet-shaped knife, for making an opening or puncture in the cornea, in the formation of artificial pupil.

Figure XVII. Small knife for enlarging the incision of the cornea in the extraction of the lens, when the extracting knife had been withdrawn on account of the iris falling under its edge.

Figure XVIII. Small needle having a portion removed from its side near the point so as to form a hook. This instrument is intended to be introduced through the cornea for the purpose of laying hold of, and pulling out a portion of the iris, without previously making an opening in the cornea.

Figure XIX. represents by dotted lines, the situations in which the lens is placed in the operations for cataract by displacement.

a. The lens in its natural situation.

b. The lens depressed or reclined backwards. This is called the operation by *Reclination.*

c. The lens depressed into the vitreous humour.

Figure XX. Illustrates the changes produced by an operation for depression of the lens, performed without the laceration of the posterior part of the capsule of the lens and vitreous humour.

a. c. The natural situation of the lens and vitreous humour with their tunics.

b. The displaced lens.

d. The hyaloid membrane and retina detached from the choroid coat.

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