

**A complete physico-medical and chirurgical treatise on the human eye /
[Pierre de Gravers].**

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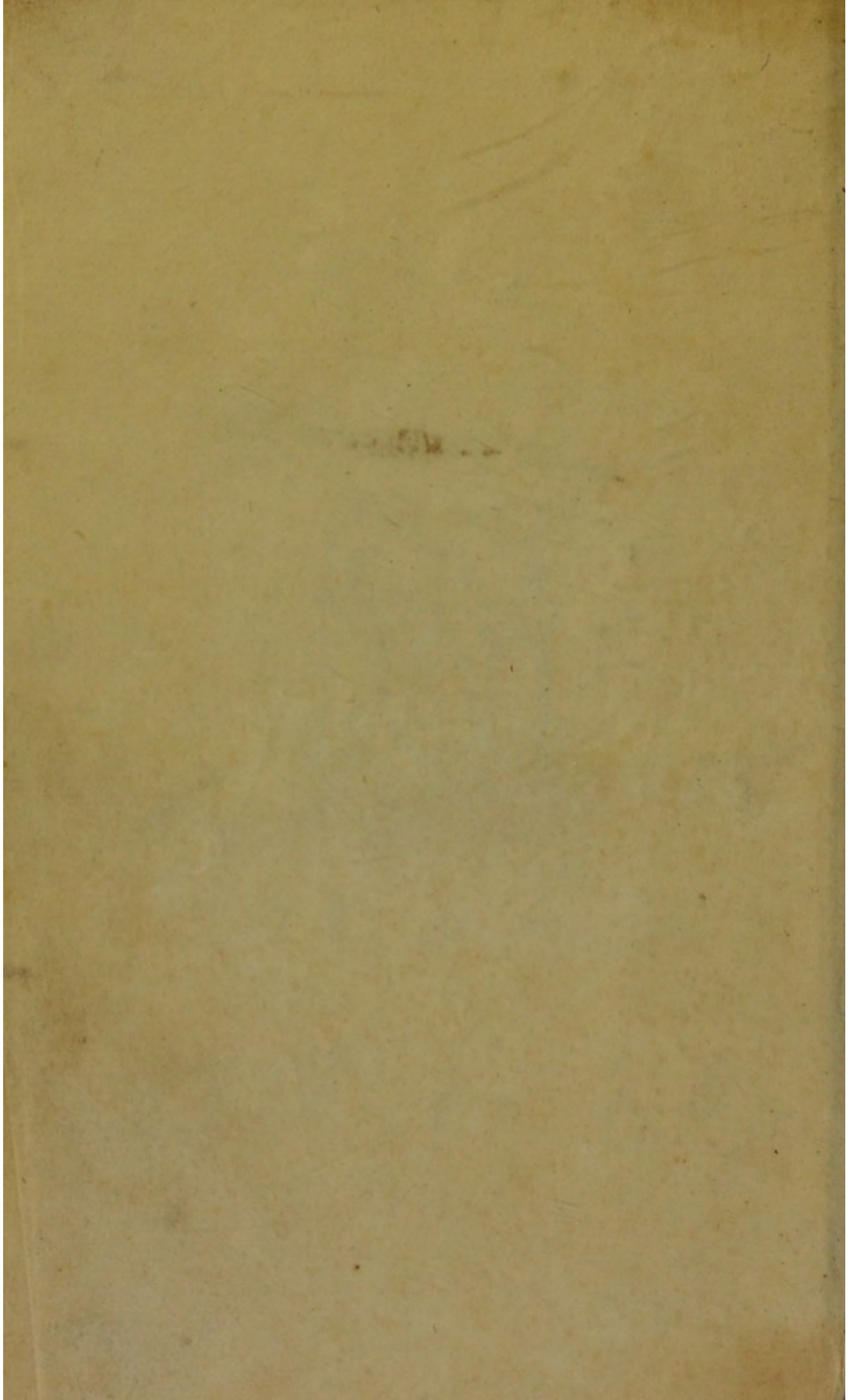
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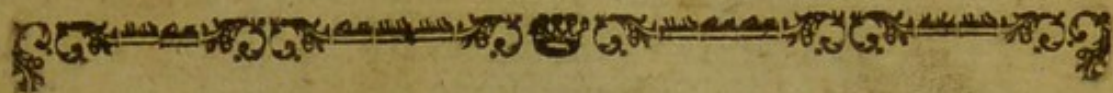
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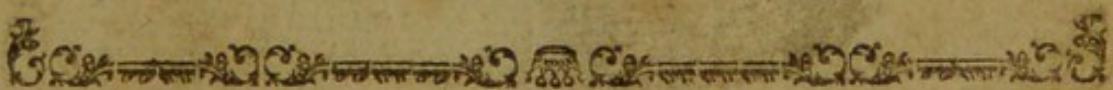
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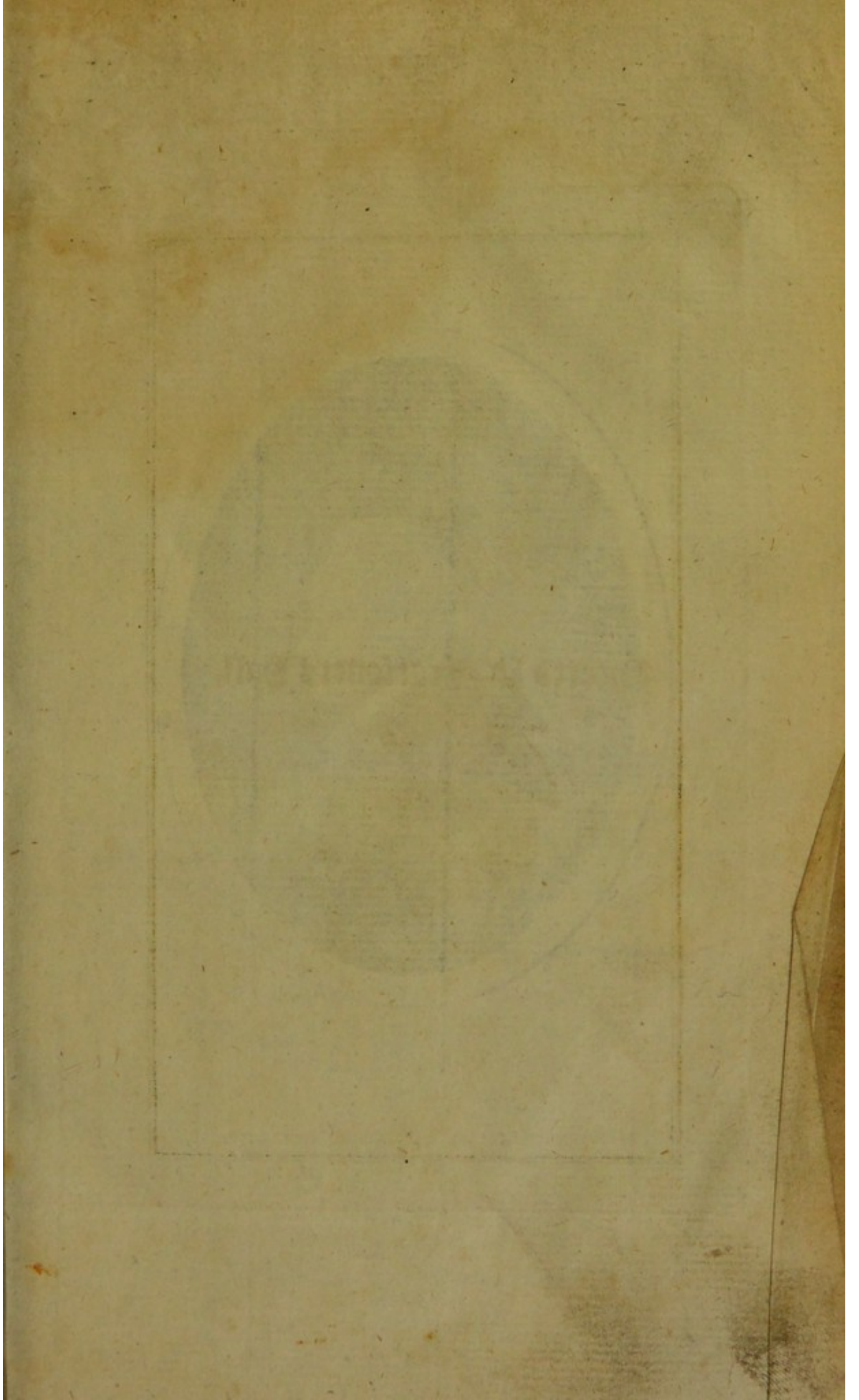




A COMPLETE
PHYSICO-MEDICAL AND CHIRURGICAL
TREATISE
ON THE
HUMAN EYE AND EAR.



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A COMPLETE

PHYSICO-MEDICAL AND CHIRURGICAL

TREATISE

ON THE

HUMAN EYE.

THE SECOND EDITION,

CORRECTED AND CONSIDERABLY ENLARGED.

TO WHICH IS NOW ADDED,

A TREATISE ON THE HUMAN EAR.

AN ENTIRE NEW PUBLICATION.

WITH A

PLAN TO STUDY PHYSIC AND SURGERY,

BOTH IN FRANCE AND GREAT BRITAIN.

THE WHOLE ILLUSTRATED WITH PLATES AND CASES.

By PETER DEGRAVERS, M.D.

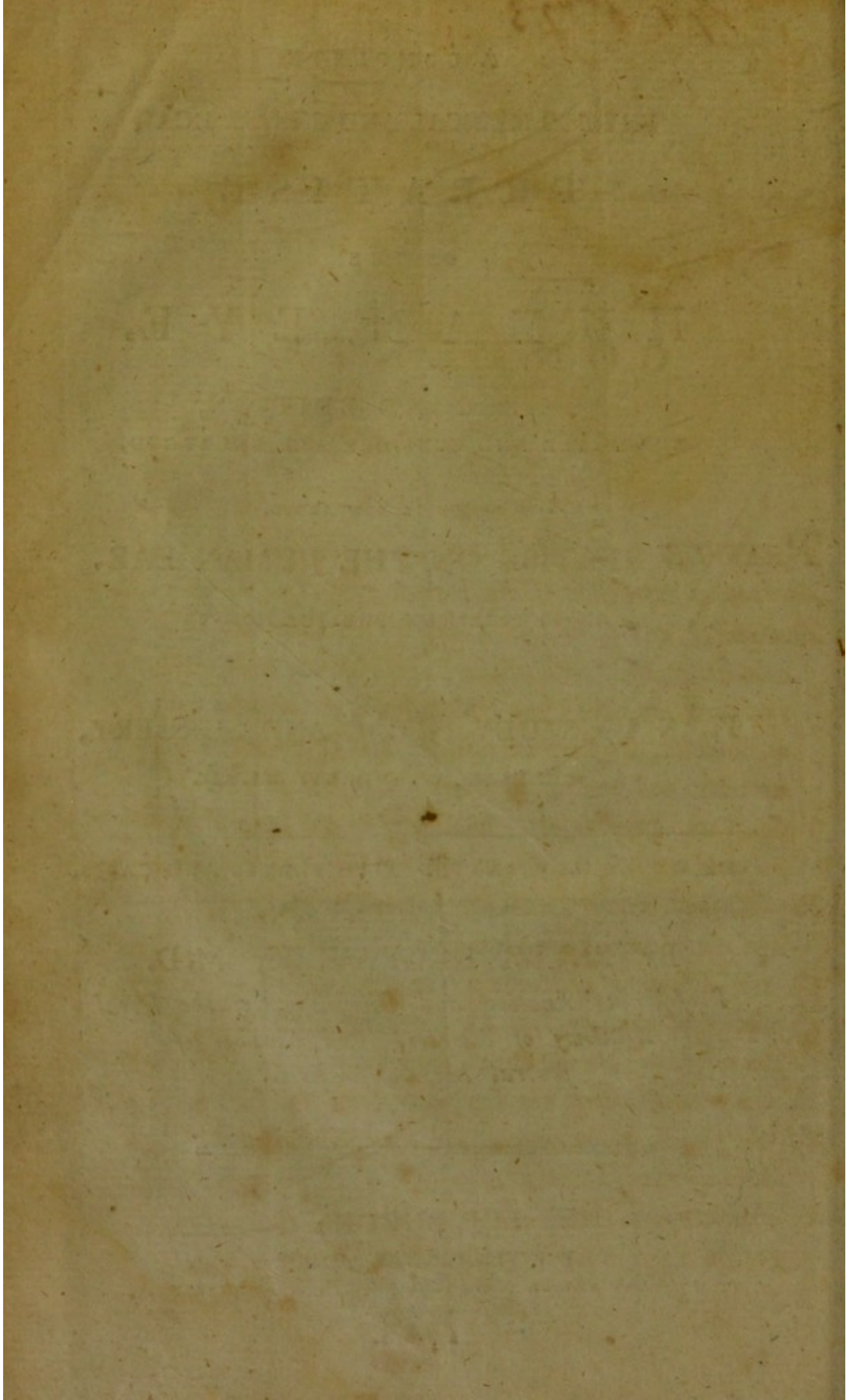
*Professor of Anatomy and Physiology, of the Royal
Academy of Sciences, and Member of
several Medical Societies.*

EDINBURGH:

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P R E F A C E.

WHEN I first of all took it in my head to publish this *Physico-Medical and Chirurgical Treatise on the Human Eye*, I resolved to print not only my own discoveries, but also such as were made by others upon the same subject. I have been so very often disappointed on reading medical authors, and in imitating them on points of practice, that I have, through my own experience, deemed them not only insufficient and erroneous, but detrimental to humanity, discouraging to practitioners, and perplexing to students.

A WORK of this kind will always be of use to the medical world in general, as it contains nothing but what is true. I have endeavoured to

select the most striking cases; to unite pleasure with instruction. Most of the diseases mentioned in the whole I have attended, or operated myself, after they had been given over by others; and the remarks which follow every subject are entirely my own. Anatomy and physiology have always been attended to particularly, to engage not only the attention of youth, but that of the medical and chirurgical practitioners. The curative methods are supplied with the remedies I employ in my practice: Men of the greatest abilities have generally adopted them, to their credit, and the benefit of their patients. This branch of physic and surgery is difficult, but I am now in hopes to have it nearly explored to its very *minutie*.

As a science advances in its progress, the steps become more and more difficult; the generality take disgust, and it is no longer cultivated but by a few obstinate men, who take it up at heart, either by habit, or in hopes, well or ill grounded, to become famous in surmounting difficulties wherein some great men have failed. How uncertain should not be our knowledge? Our organs are so weak,—our means so short,—our studies so interrupted,—our life so harrassed,—and the objects of our enquiries so vast!—

vast!—work without intermission, Naturalists, Physicians, and Chymists of all sorts; after centuries of united and continuous efforts, the secrets that ye shall have taken away from Nature, compared to her immense riches, will be but as a drop of water carried away from the ocean!

BETWEEN a number of agents that Nature employs, we know but few, and yet we know them imperfectly. Who knows if the others are not of a kind to escape for ever from our senses, instruments, observations, and trials? Who will give a check to that inclination to analogy,—a manner to account and judge—so seducing—so convenient—and so deceitful? Hardly have we some facts, than we build systems on them, which carry away the multitude, and suspend the researches of truth. The time employed to form an hypothesis, and that to destroy it, are almost equally lost.

IT is by a multiplicity and variety of effects that we are sometimes enabled to guess the causes of some intricate disorders, and find out their remedies. No doubt, it is possible to an attentive and reflecting genius to foresee some events: But, so one lucky conjecture, how many errors! Since industrious anatomy and scrupulous

physiology have destroyed many of our chimeras, we have struck on a new shoal. We depend upon the opinions of a man *in place*, without considering whether he is right or wrong; and, by that implicit faith, we multiply mistakes without number.

MANY late writers, of avowed abilities, have not scrupled to advance, for facts, *things* which in reality are but anticipated, conjectural ideas, resulting from errors; this is not the fault of the inventors, but that of the imitators. It seems that in Great Britain, more particularly than in any other country, the body of medical and surgical practitioners is divided into three classes. What is the inferior but a mere body of quacks? Are not they consulted in the beginning of disorders? Are not they the monkeys of the first and second? Do not they make a branch of trade of the lives of their fellow-creatures? The empirics, who are generally despised, or envied on account of superior particular abilities, prove of more service to mankind, in several instances, than what we call the *regular bred* of this last class.

WHEN I published this WORK, it was with the view to take this branch of physic and surgery from
improper

improper hands ; and, in that intention, I have only imitated those learned physicians and surgeons who had published before me. All itinerant medical men are generally looked upon as ignorant or intruders ; and, in that respect, whether learned or not, considered like so many of the third class. Monsieur Portal, a French physician, well known by his writings, courted foreign men, as he was conscious, that, in their practice, they are consulted mostly in chronical or incurable cases, through which they acquire extensive knowledge, and possess useful means, which became of use to his countrymen ; but pride and antipathy to such practitioners entirely precludes an intercourse in this part of the world, on the ill grounded idea, that their theory and practice are *unexceptionable*.

THIS *Physico-Medical and Chirurgical Treatise on the Human Eye*, was published in the year 1780, with a variety of anatomical prints. The size of a Quarto made it rather too dear for medical students and others to purchase ; on that account, I have thought proper to reduce it to the present Octavo, with a few etchings. I have added to it, *A Physiological Enquiry into various Subjects*, and a great many *Observations on difficult Cases*, which will prove of singular advantage to those who

who cannot command a general practice; and these additions, I hope, will be received with more general satisfaction than the finest engravings.

THE reader will find annexed to it, an entire new publication on the *Human Ear*, a subject never attempted before by itself, the materials of which I have been collecting these fifteen years past. Besides, I have subjoined to this, *A short Plan to Study Physic and Surgery in less time than is usually employed*; having found by experience, that what I have been learning these twenty years, I might have done in three; and, in this particular, it will be of great service to young students.

IT will appear in this work, that I have criticised Dr Alexander Monro on some anatomical and physiological points. Dr William Cullen's curative indications for the ophthalmia have likewise come under my notice, and also several surgeons of London and Edinburgh on practical operations. I would wish the reader to understand, that I took such liberty neither through envy nor malice, but merely as the cause of humanity is interested in it. I am well aware that Dr Monro possesses extensive knowledge, as the other medical gentlemen, in their distinct capacities;

ties ; but as some of them are public teachers, and of course sooner believed than any other, I have thought these criticisms just and absolutely necessary. Some may indeed think that my expressions are harsh, and my conduct impolitical : What is that to me ? I have but a few years to live ; and if interested considerations had been consulted in a Work which must survive me, it would have defeated my intention of leaving behind—a Monument to the service of Humanity.

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ANATOMICAL EXPOSITION.

THOSE who were skilful in anatomy among the ancients, concluded, from the outward and inward make of an human body, that it is the work of a Being transcendently wise and powerful. As the world grew more enlightened in this art, their discoveries gave them fresh opportunities of admiring the conduct of Providence in the formation of an human body. There are, indeed, many parts of which the old anatomists did not know the certain use; but as they saw that most of those which they examined were adapted with admirable art to their several functions, they did not question but those, whose uses they could not determine, were contrived with the same wisdom, for respective ends and purposes. Since the circulation of the blood has been found out, and many other discoveries have been made by our modern anatomists, we see new wonders in the human frame, and discern several important parts, which uses the ancients knew nothing of. In short, the body of a man is such a subject as stands the utmost test of examination. Though it appears formed with the nicest wisdom, upon the most superficial survey of it, it still mends upon the search, and produces our surprise and amazement, in proportion as we pry into it. But to pursue this thought still farther: Every living creature, considered in itself;

has many very complicated parts, that are exact copies of some other parts which it possesses, and which are complicated in the same manner. One eye would have been sufficient for the subsistence and preservation of an animal; but, in order to better his condition, we see another placed with a mathematical exactness in the same most advantageous situation, and in every particular, of the same size and texture. If the anatomy of the human body in general presents so many objects of difficulty to the understanding, how many more shall such a delicate part as the globe of the eye, when considered and anatomised in all its particularities?

The Eye is situated in a cavity, which is called Orbit; it is made up of seven bones, *viz.* the os frontis, os sphenoidale, os mallæ, os maxillary, os unguis, os ethmoides, and a little portion of the os palati. The os frontis forms the superior part of the orbit, and a portion of the angles; the os sphenoidale, the external posterior and lateral inside; the os mallæ, a portion of the external angles, and the inferior part of the orbit; the os maxillary, the remainder of the inferior inside and portion of the internal angle; the os unguis, the anterior lateral part on the same side; the os ethmoides, the lateral and posterior inside; lastly, the portion of the os palati takes up the inferior and posterior part.

The particular situation of the orbits represents two funnels, placed laterally at a small distance from each other, and in such a manner, that their apices are almost joined, their nearest sides almost parallel, and the other side turned obliquely backward. The bottom is perforated by the *foramen opticum*, through which passes a branch of the second pair of the nerves, and the external side near this foramen, by two long, irregular, and orbitary fissures, one superior, called sphenoidalis, the other inferior, called spheno-maxillaris. These fissures

fures give passage to the nerves *motores oculi*, *pathetici*, *ophthalmici*, and to the portion of the *dura mater* which lines the orbitary cavity.

Under the arch of the orbit, near the temples, is a cavity, wherein is situated the *glandula lacrymalis*; and, towards the internal angle, a small ring, where the pulley of the *obliquus major* is adherent. To the inferior part of the internal edge of the orbit, we find a foramen which extends from the middle of the *spheno-maxillaris fissure* to the inferior and external part of the orbit, and takes the name of *inferior orbitary foramen*. This foramen is partly covered with a thin plane of bone, and partly with the *dura mater*. A nerve, and some blood vessels run through it. In the posterior part, on the inside of the internal angle, are the holes *orbiter interni*, through which pass a filament of the nerve *ophthalmicus*. On the same side, but on the anterior part, you see the groove of the *os unguis*, and that of the *maxillary*. These grooves form the bony lacrymal duct, whose superior part is cut off; and near it, upon the *os maxillary*, where the *obliquus minor* is fixed, are many wrinkles.

The Eye is composed of several tunics or membranes, transparent bodies, and a limpid humor. These tunics are set in one another at their adjacent edges, and closely connected in their whole extent by some nervous filaments, blood and lymphatic arteries which send them a juice fit for their nutrition: the blood vessels are some ramifications of the carotid arteries; the nervous filaments are some subdivisions of the *motores oculi*, *pathetici*, and *ophthalmici*.

The optic nerves arise backwards from the *nates & testes* towards the posterior part of the *thalami nervorum opticorum*. They are parted, and very large in that place, and ascend at first from bottom upwards, and

from within outwards, between the branches of the medulla oblongata, and the middle lobes of the brain; afterwards they descend a little in going from without within, and from behind forwards, until they come before the *infundibulum*, where they draw nearer and nearer, and at last unite together. The place of that union represents a square more or less elongated, and whose dimensions vary extremely in different subjects. They afterwards part anew and go from behind forward, from within outward, and from upwards downwards to the foramen opticum, through which they go out of the *cranium*. The optic nerve is situated about the internal posterior and lateral part of the globe; it is the most considerable of the eye by far.

Twelve membranes make up the Eye, *viz.* the conjunctiva, albuginea, sclerotica, cornea, the tunic of the aqueous-humor, iris, choroides, retina, crystalloida which is divided in crystallo-anterior and crystallo-posterior, the capsule of the vitreous body or hialoïda, and the cellular tunic or arachnoïda.

The conjunctiva takes up from the limb of the cornea to the internal edge of the tarsi of the eye-lids: it is of a soft texture, and mixt transparency; it is perforated by a great many ducts which have no communication with each other. They have their origin at the top of that membrane, and descend in parting from each other to the internal face of the superior eye-lid, and open a little above the tarsi.

In the internal angle under the conjunctiva, is a reddish protuberance, framed by a conglomerated gland, called *caruncula lacrymalis*; it forms, together with the conjunctiva, a semilunar fold, termed *valvula lacrymalis*, where the tears gather, to pass afterwards through the puncta and ducts lacrymalia, *saccus-lacrymalis*, and *ductus ad nasum*. This gland is composed of a great many
small,

small, oblong, and whitish ones; they furnish a sebaceous humor, which is a part of the lacrymal fluid; and sometimes after, this humor is changed into a matter vulgarly called the gum of the eyes, which foretells the atony of the filters of this glandulous body: when it is destroyed, an habitual flux of tears ensues, because the puncta and ducts lacrymalia, though in their perfect state, have not power enough to absorb the excess of this fluid.

Under that part of the conjunctiva which lines the globe, is the albuginea, which forms the white of the eye; it is framed chiefly by the tendinous expansion of the *musculi recti*, and that of the obliquus major.

The sclerotica takes up the lateral and posterior parts of the globe; it is whitish and opaque in its whole substance; its texture is very close, and its fibres directed every way; it is less hard and thick in its lateral parts than in the posterior and anterior. This tunic is perforated before and behind; in the posterior part, to let pass the optic nerve; and in the anterior, to adapt as in a groove the limb of the cornea, as the glass of a watch. Besides, it is perforated, at its posterior part round the optic nerve, to let in the globe many arterial ramifications which arise from the arteria ophthalmica, and laterally by some other branches of the same artery, which take the name of ciliary arteries. Their number is between 25 and 30, and are spread in the internal and anterior parts of the eye; such as the choroides, processus ciliaris, iris, &c.

The *cornea* takes up the anterior part of the Eye, and is much thicker than the lateral and posterior parts of the sclerotica; it forms a portion of sphere which makes it more convex than the other tunics contiguous to it. This tunic is made up of several pellicles situated on each other, and united by a texture of lymphatic arteries

teries and nervous filaments. Each *laminae*, or pellicles, keeps its extent from the circumference to the center; and may easily be separated with a knife, or by maceration. Another way to know its structure is, when this tunic is cut in two portions, to introduce a small and round probe between these pellicles. A great many inorganic pores perforate this tunic, through which part of the aqueous humor runs, and produces a great portion of the tears.

Many anatomists have been of opinion, that the cornea was an expansion of the sclerotica; meanwhile these tunics are not continuous. You will be convinced of it, if you boil the eye of a calf for five or six hours; as soon as you take the eye out of the water, you'll have an opportunity of observing the cornea separated, if not entirely, at least a great part of it, from the tunic to which it was contiguous. If the cornea was a continuation of the sclerotica, could it be possible to separate them in such a manner?

In the concave part of the cornea only, there is a transparent and elastic tunic, which is adherent to it; it is termed the tunic of the aqueous humor; but improperly, as it does not surround or inclose the humor within itself. The extent of that tunic does not exceed the size of the cornea, tho' many recent authors speak to the contrary, at whose extremity it terminates; many facts, ascertained by a multiplicity of cases, particularly the cataract and staphyloma, leave no room to doubt upon the subject. When an ulcer with loss of substance has corroded the cornea throughout, without hurting the tunic of the aqueous humor, this tunic passes through and forms a tumor more or less considerable, called staphyloma. Several have been of opinion, that this tumor was only occasioned by the iris being out of its place; it is very uncommon to see both these tunics
form

form the same staphyloma. The irregularity of the pupil, together with the blackish or blueish color of the tumor, announces it produced by the iris: when it is occasioned by the tunic of the aqueous humor, then the tumor is water color or greyish, and the pupil keeps its natural shape.

Beyond the *cornea* you see a membrane variously colored, which is called iris; between both these membranes, is a space called the anterior chamber. From the center of the *cornea* to the hole of the iris, there is an interval of a line's distance. This chamber is full of a diaphane fluid, termed aqueous humor, which is a secretion of the vitreous and crystalline's. As soon as the aqueous humor is renewed, it runs through the excretory pores of the *cornea*, to lubricate the external parts of the globe, and at the same time help the refraction of the rays of light.

The Eye is called black, grey, blue, &c. from the color of the iris. The variety of this tumor is produced by more or less quantity of *nigrum pigmentum* or *meconium*, which penetrates its substance. The iris has, almost in its center, a round hole called pupil; it is dilated during sleep, as if the eye was exposed to a great darkness; its occlusion is the cause of blindness, but not without remedy. The pupil in the *fœtus*, is covered by a vascular membrane, extremely thin, contiguous to the iris, which disappears commonly about the seventh month, and sometimes later. It has been observed to exist after birth, and occasion blindness. The blood vessels, which ramificate over it, come from the anterior face of the iris, but not from the capsule of the crystalline lens, as has been advanced by Dr William Hunter, who did not admit a posterior chamber, which, however, is as evident as twice two make four. This vascular membrane is called *membrana pupillaris*, and has been discovered

swims in the aqueous humor. The *plexus ciliaris* may also be looked upon as a muscle appointed to sustain forward the crystalline lens. The want of action in this muscle is the cause of the presbyopia.

The iris is lined by a transparent and elastic membrane, which has almost in its center a round hole, parallel to that tunic. These distinct membranes have the same extent and adhesions: The transparent tunic of the iris is almost like that of the aqueous humor. The too great dilatation in the pupil, and its too great contraction, fortell a spasm in the fibres of the iris, unmovable between these states, the *-gutta serena*; meanwhile, there are some particular cases wherein the Eye is afflicted with perfect *gutta serena*, though the pupil changes its diameter; that is to say, it dilates and contracts itself, by a more or less quantity of light. The too great dilatation in the pupil is called mydriasis.

Between the posterior part of the iris and crystalloida, is a space termed the posterior chamber; it is filled up by the aqueous humor which passes through the pupil, in the anterior chamber. The posterior is very narrow in proportion to the anterior: they are two reservoirs to supply the tears. When a purulent matter is shed into the chambers of the eye, this disorder is called hypopion.

The choroides is immediately under the *sclerotica*; these membranes have the same extent: The choroides is made up of two lamina closely connected together; one which touches the *retina*, is called *membrana ruyfchiana*; the other, reticular. These lamina are formed by a texture of fibres, nervous filaments, lymphatic and blood vessels: from the latter flows a black matter or *meconium*, which is diffused through the whole extent of these laminae, but in greater quantity, over the ruyfchiana. This kind of ink is not to be found in the anterior part of the choroides, which is opposite the pupil,

pil, in the eyes of many quatruded and other animals; it is sometimes defective even in the eye of man. Though the choroides be composed of two lamina, it is however very delicate, and stronger in the posterior parts of the globe than in the lateral. When the *meconium* or *nigrum pigmentum* passes through the vessels of the vitreous body, or those of the crySTALLINE, then it tarnishes their transparency, and is the cause of blindness. The swelling in the vessels of the choroides, occasions always internal inflammations, suppurations, &c.

The *retina* lines, and takes up the same extent as the choroides: both these membranes end at the plexus ciliaris, where they are closely connected. The *retina* is of a soft texture, and like a kind of paste spread upon a fine reticular web: it is of a mixt transparency after death, and like an oiled paper. The *retina*, in living animals, is very bright, especially in the natural state, and loses of its transparency, as well as the diaphanous bodies of the eye, after death.

The *retina* is a production or expansion of the medullary substance of the optic nerve: in its texture, are very apparent blood-vessels, whose diameters diminish in proportion as they go from the optic nerve: it is the immediate organ of sight. This opinion is generally received, and is the only one which can be wisely admitted. The paralysis of the *retina* and optic nerve bring on the *gutta serena*.—Dr Alexander Monro, in his Nervous System, chap. xii. p. 37, says, that the pia mater is not laid aside in the retina or within the cochlea, nor at the extremities of the nerves in general. It is, however, a fact, that the pia mater cannot follow the retina, because this nervous expansion arises from the center of the optic nerve, and not from the edge, consequently the pia mater cannot accompany the retina, nor be support-

ed by it. As to the cochlea it will be mentioned, in the treatise on the Ear.

The vitreous body is like a transparent jelly; it takes up from the posterior part of the globe to the plexus ciliaris. The elasticity of this body comes from its structure; it is made up of two tunics, and of a very limpid water, the very same kind as that of the aqueous humor. The external membrane, which is its general coat, is called the vitreous capsule or *hyaloida*; it is perforated by a great many holes, some to give passage to the vessels which go from the *retina* into the vitreous body, to furnish it with the necessary juice fit for its nutrition, and renew the fluid contained in its cellular spaces; the others are pores through which transudes this humor.

The cells of the vitreous body are composed of the internal tunic, which is called cellulary or *arachnoida*; it is much thinner and more delicate than the *hyaloida*. The cells of the vitreous body are very small; they differ from each other in their form and size; the fluid contained in them passes from one cell into another, through some very little pores, to renew the aqueous humor.

In the anterior part of the vitreous body, is a cavity termed *fossula*, wherein the crystalline is lodged, exactly after the same manner as a diamond is set in a ring. This cavity keeps a conical form, as soon as the crystalline is out of it. The vitreous body, on account of its being less dense than the crystalline, proves the refraction upon both these transparent bodies very different from each other: for which reason, those who have undergone the operation of the cataract by extraction, cannot read easily without the help of a convex glass; meanwhile, some may do without it. The vitreous capsule or *hyaloida* is adherent to the *retina*, by a great
many

many lymphatic arteries, but much more about the circumference of the *plexus ciliaris*. You may see, at the circular edge of the *fossula*, a coat full of radiated *fulci*, which contain the *processus ciliaris* of the *uvea*. The diameter or thickness of the vitreous body is commonly about three quarters of an inch.

The vitreous body is to keep the coats of the eye in a perfect state of tension, to hold the crystalline lens, help the refraction of the rays of light, supply, by the convexity of its *fossula*, the want of the crystalline lens when it is out of its place; lastly, to supply as aforesaid the aqueous humor.

The opacity of the vitreous body is known among the moderns under the name of *glaucoma*; its melting occasions not only the atrophy of the globe of the eye, but the irreparable loss of the organ.

The *processus ciliaris* are many straight fibres, whose basis is adherent to the *plexus ciliaris*, and the remaining part of their extent, to the vitreous body; they are as full of the same *meconium* as the *plexus ciliaris* and choroides. Several have been of opinion, that they were a continuation of the plexus; for which reason they termed the whole *corona ciliaris*; meanwhile they are contiguous, and not continuous, because they may be put asunder very easily without tearing.

Extract the vitreous body out of an eye, then you will see the whole *processus ciliaris* attached to it, consequently their basis is separated from the *plexus ciliaris*. The use of the *processus ciliaris* is to sustain forth the crystalline, together with the *plexus ciliaris*. When these parts are paralysed, the eye becomes presbit, what commonly happens to old men; but the use of a magnifying glass, or remedies proposed in such a case, may be of great benefit: there are, however, some who have occasion for neither.

The crystalline is not only lodged in the fossula of the vitreous body, but likewise wrapt up in a capsule called crystalloida; it is made up of two spheroides and concave tunics adapted to one another about their edges. The portion which covers the fossula, is termed crystallo-posterior; the other, crystallo-anterior: The latter is less extensive and thick than the former.

The posterior part of the crystalloida is perforated by a great many blood vessels, which come from the inside of the vitreous body, and the long ciliary arteries to supply morgani's humor, and serve of nutrition to the crystalline lens. The crystallo-anterior is composed of several laminae connected one upon another. They may be divided very easily in the eye of a horse, after six days maceration in water. The crystalloida is adherent to the edge of the fossula, by a great many vessels. You may see in the whole circumference of the limb of the crystallo-anterior, a great quantity of small grooves, wherein is set a little portion of the fulci-ciliaris. Sometimes after the extraction of the crystalline lens, the crystalloida becomes opaque, what we call a secondary cataract. It may happen too, that both become opaque at the same time; but this is a very uncommon case.

The crystalline lens is a small lenticular body, more convex in its posterior part than in its anterior: anteriorly it is almost flat, and posteriorly parabolic. Its transparency is analogous to the most diaphane crystal, but only in young men's eyes. At thirty years old, it begins to acquire a light yellow color, and, by degrees, increases till it be quite opaque. There are, however, a great many causes which may alter the transparency of the crystalline lens, and of course produce a cataract.

The crystalline lens is composed of a great many segments or curvi-lineal pellicles heaped one upon another,
after

after the same manner as those of an onion. When it is dried by the sun or before the fire, you may separate them, if you squeeze it betwixt your fingers.

Between the crySTALLINE lens and its capsule, is to be found a space full of viscous and limpid humor, discovered by the famous MORGANI. This humor, called *morgani*, is supplied by a great number of blood vessels, which penetrate through the crySTALLOIDA, and serves of nutrition to the crySTALLINE; when they are obstructed it becomes stagnant and afterwards whitish, an evident symptom of a begining cataract.

You may see under the depression, observable in the arch of the orbit near the temples, a conglomerated gland of an oval, and a little flatted form, sometimes divided into several lobes. Many different inequalities, caused by the irregular assembling of the small glands which compose it, are moreover, to be seen: it is wrapt up in a capsule, from which a great many ducts proceed, and run down almost in the whole extent of the *tunica interna* or *conjunctiva* of the superior eye-lid, and afterwards pierce it inwardly near the internal edge of the tarsus, from whence exsudes a part of the tears. The *glandula lacrymalis* may not only become schirrhous but voluminous, and to such a degree, as to be able to squeeze the globe of the eye, and occasion its suppuration.

The motions of the globe of the eye are ruled by six muscles, *viz.* four recti, and two obliques: The third, fourth, fifth, and sixth pairs of the nerves send them some nervous filaments.

The four *musculi recti*, and the *obliquus major*, are fixed by their posterior extremities at the bottom of the orbit, near the *foramen opticum*; they are made up of straight fibres involved in a capsule, and their aponeurosis end at the limb of the cornea, where they form
the

the albuginea. The position of the four *musculi recti* renders them almost of an equal distance.

The muscle which is situated at the top of the globe, is called superior, or *levator*; it moves the globe upward. The inferior, or *depressor*, is placed at the lower part of the eye; it brings the visual pole downwards. The internal, or *adductor*, is in the internal angle; it carries the globe towards the nose. The external, or *abductor*, is in the external angle; it turns the eye towards the temples. The successive action of the four *musculi recti* occasions a circular motion, and their simultaneous action fixes the organ horizontally.

The *obliquus major* is likewise called *trochlearis*, because it passes through a small cartilaginous ring, as over a pulley, which is situated on the inside of the internal angle, and joins the globe of the eye by its aponeurosis.

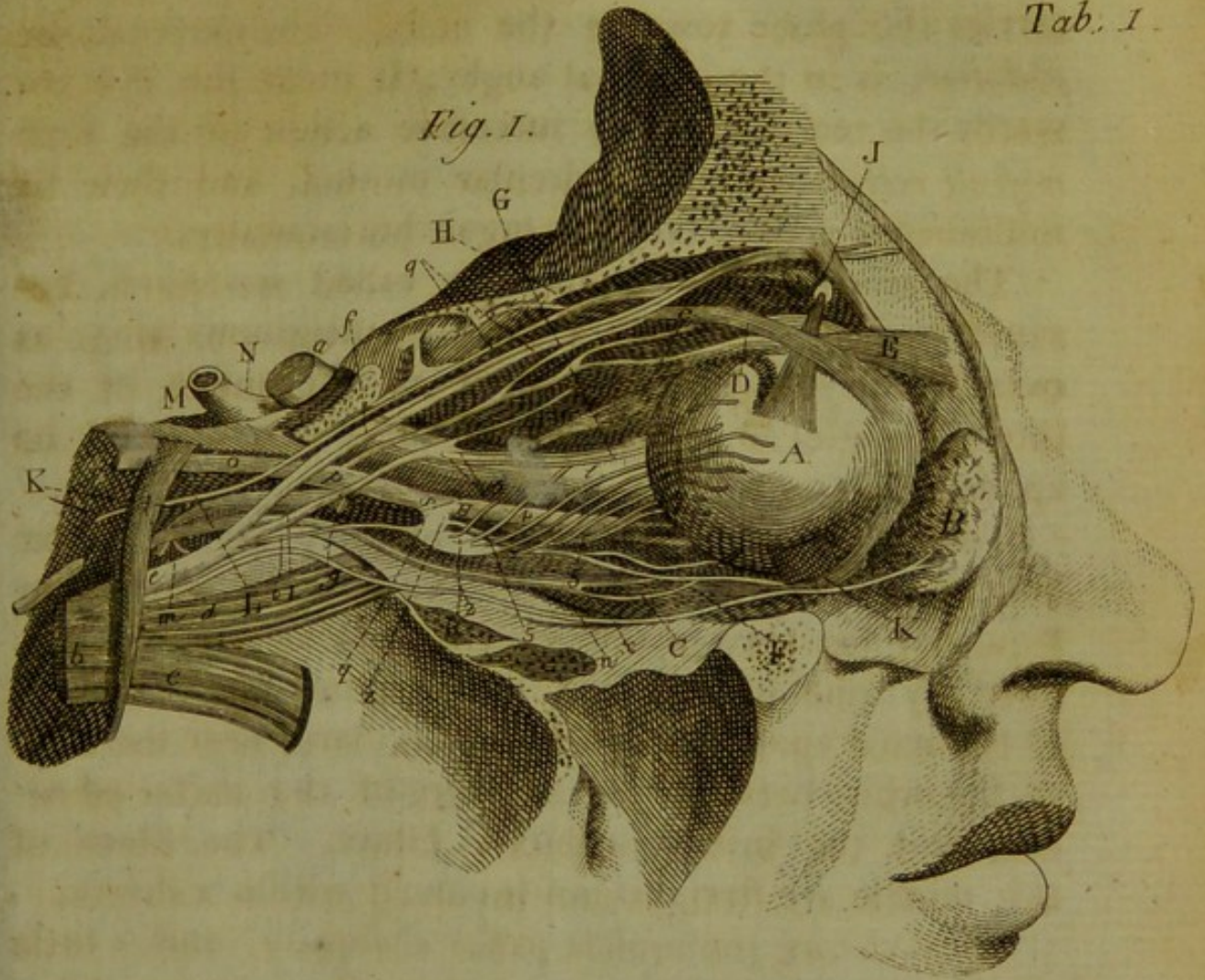
The *obliquus minor* is situated obliquely at the lower side of the orbit, under the *rectus inferior*, which consequently lies between this muscle and the globe. It is fixed by one extremity a little tendinous to the root of the nasal apophysis of the os maxillary, near the edge of the orbit, between the overture of the *ductus ad nasum*, and the inferior orbitary fissure. The fibres of this muscle are straight and involved within a sheath.

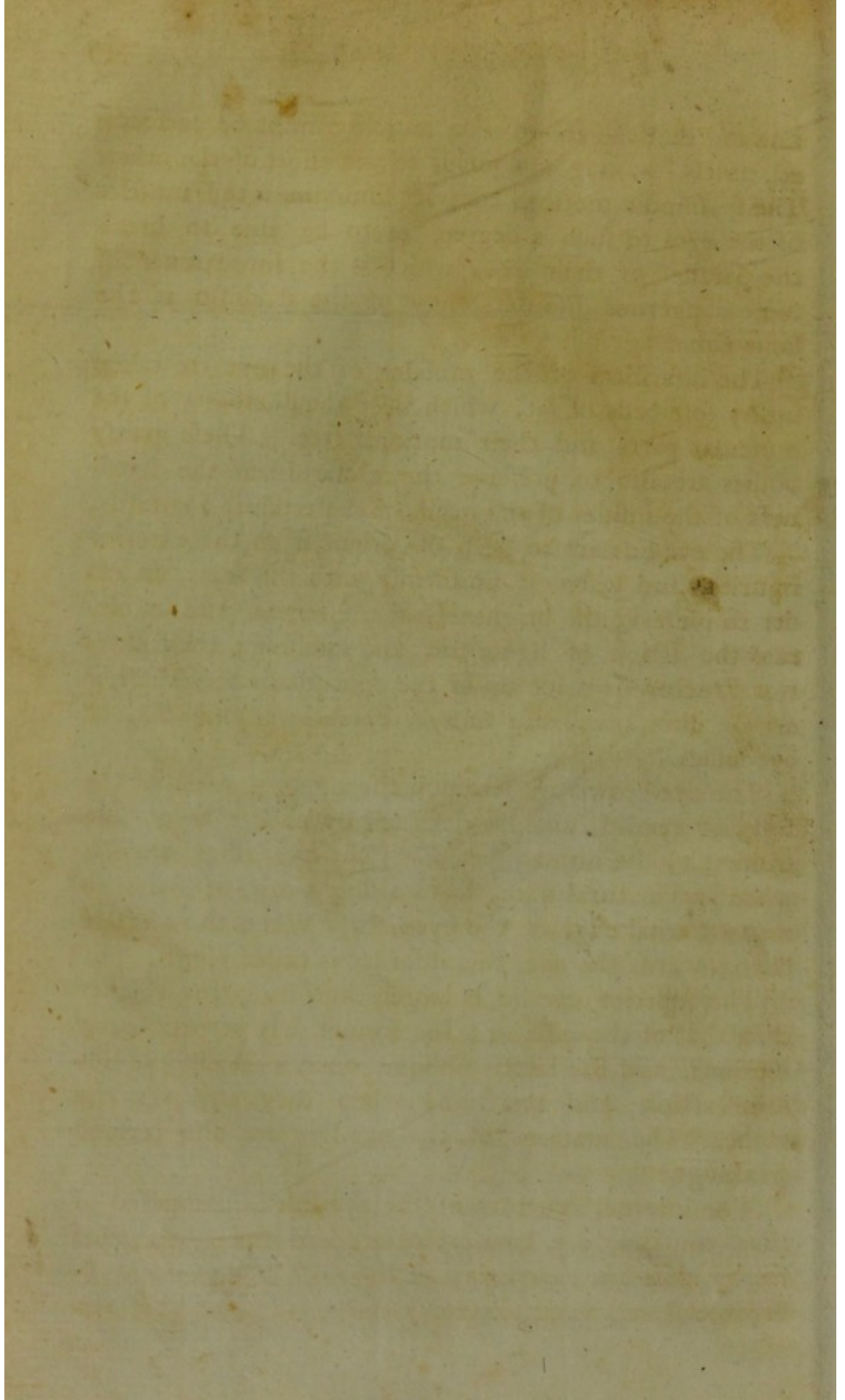
From thence the muscle passes obliquely, and a little transversally backward, under the *rectus inferior*, and is fixed in the posterior lateral part of the globe by a flat tendon, opposite and at a small distance from the tendon of the *obliquus major*; so that these two muscles do, in some manner, surround the outer posterior part of the globe.

The use of the oblique muscles is to move the globe towards the nose, especially when it is horizontal, and to render parallel the *axis* of the eyes. Every body

knows,

Fig. I.





knows, that the action of a muscle cannot be performed, unless its antagonist yields to the effort of the other. The spasmodic motions contract sometimes the muscles of the eyes to such a degree, as to be able to break the parallel of their axis, which is the fore runner of some dangerous disorders, nay of the strabism at the same time.

The interstices of the muscles of the eye are taken up by soft beds of fat, which keep the flexibility of the muscular parts and their motions free. These greasy bodies are also to preserve the globe from the hardness of the insides of the orbit, and stretch it forwards.

The eye-lids are to keep the organ from the exterior injuries, and water it uniformly with the tears, in order to preserve the brightness of the *cornea*, and moderate the action of light, air, and rubbing; their exterior structure is made up of the continuation of the *epidermis*, skin, *membrana adiposa*, eye-brows, and *cilia*, or eye-lashes.

The eye-brows are set upon the upper portion of the superior eye-lid, and are designed by nature as an ornament to the human species. The eye-lashes, or *cilia*, when in a natural state, form a single row of hairs to each external edge of the eye-lids. When the *cilia* are bent towards the eye, this disorder is called *ptosis*.

The superior eye-lid is larger, and its tarsus thicker than that of the inferior; the former has perpendicular motions, and the latter oblique ones. Both eye-lids have action and re-action, when they uncover the globe. The motions of the eye-lids are also termed winking.

The internal structure of the eye-lids is composed of three muscles, *viz.* two orbicular, and the other called *levator palpebra superioris*; of the *tarsi*, the *glandulæ sebaceæ meibomii*, their excretory ducts, those of the *glandula*

dula lacrymalis, the puncta and ducts lacrymalia, and of a portion of the *conjunctiva*.

The superior eye-lid has two muscles, the one called *levator*, the other *superior orbicularis*. The levator is fixed at the bottom of the orbit, from thence it goes to the edge of the cavity: When it is arrived under the arch, it bends to adapt itself to the superior eye-lid; its fibres run forward, increasing gradually in breadth, and terminate by a very broad aponeurosis in the tarsus of the superior eye-lid. This muscle being in action, lifts up the eye-lid.

The *orbicularis* of the superior eye-lid is made up of curve-lines connected one upon another; their extent is from the internal angle to the external. This muscle is larger in the center of the eye-lid than in the angles, where it is fixed at a tendon in each angle. The action of this muscle is to bring down the superior eye-lid.

The inferior eye-lid has but one muscle, called *inferior orbicularis*, and less large than the superior: it has oblique motions, by which means it is impowered with action and re-action as the other. Every one of these muscles has a particular sheath, and their extent and structure are the same: the middle tendons are common to them all.

The *tarsi* are thin half circular cartilages forming the principal part of the edge of each eye-lid; they are united together at the angles, which is termed *Commisures*. The superior tarsus is thicker than the inferior, and their extremities or *commisures* more slender than in the center. Each tarsus is disposed in such a manner, that its interior edge is a kind of groove to let the tears run towards the internal angle.

The eye-lashes are produced by some bulbs, which are set over the whole extent of the external edge of the

the tarsus. When they take rise in the internal edge, this disorder is called *trichiasis*. The brushing which happens upon the globe tarnishes the *cornea*, and inflames the *conjunctiva*.

In the internal angle upon the end and edges of the *tarsi*, are two little holes, one at each eye-lid, called *puncta lacrymalia*; each has a sfincter which contracts and dilates itself, and their ducts have a vermicular motion, which is repeated at each winking, what helps the passage of the tears into the *saccus lacrymalis*, and from thence through the *ductus ad nasum* into the nostril.

Jane Gilchrist, who was in the Edinburgh Infirmary about November 1786, has three *puncta lacrymalia* to her right Eye only, two inferiors, and one superior. The inferior *puncta* are very distinct, and distant from each other of half a line; they have each a distinct duct, which extends to the common duct. I passed two small probes at the same time, to convince me that there was no communication of the ducts until all three were ending at the common duct. She was troubled with a violent inflammation, but not on account of these *puncta lacrymalia* and ducts, as she never had bad Eyes till she came at the age of seventeen.

The lacrymal ducts are formed by a muscular membrane, whose fibres are straight, and those of their sfincters interwoven. These ducts join together a little before they communicate with the *saccus lacrymalis*, under the commissure of the internal angle, to form but one duct, which is adapted to the lacrymal sac, to pour out the tears into it.

The *saccus lacrymalis* is an oval, irregular, and a little flattened bag, or reservoir; it is made up of a spongi-ous membrane, interwoven with fibres, blood vessels, and a great many small glands, through which flow an excretory humor more viscous than the tears: it is

lodged in the groove of the os unguis, and the inferior part of the channel formed by the os maxillary and unguis.

The *saccus lacrymalis* has in its inferior part a duct, termed *ductus ad nasum*, which terminates the reservoir of the tears. This duct has its diameter larger in its superior part than in the inferior. The constant contraction of the sphincter forces the tears to stay in the lacrymal sac.

If you squeeze with your fingers the *saccus lacrymalis*, when this sphincter is obstructed, a purulent matter will discharge out of it: this malady is termed fistula lacrymalis. If this matter is too thick, it cannot get out through the puncta lacrymalia, then a great dilatation in the bag takes place. Sometimes this fluid corrodes the sac and its teguments, and causes a general inflammation. This last case is an evidence of a complete fistula lacrymalis.

Almost all the parts of the Eye receive their arteries from the *ophthalmica*; this artery is a branch of the internal carotid. It passes under the optic nerve, and when entered into the orbit, its divisions are various and irregular, as we do not find them alike in several subjects. The first ramifications are very small; some go to the globe of the Eye, the remotest parts of its muscles, and the *dura mater*. It produces also the lacrymal artery, the ophthalmic arteries, the central and visual arteries of the optic nerve, and the ciliary arteries; in short, many other arteries, which do not deserve a particular name, on account of their smallness and irregularity.

The veins of the eye have been a mystery or rock on which the most accurate and industrious anatomists have fairly wrecked. I have made several experiments to discover the number of the biggest, and their situation, and among the numerous and finest injections I have been

been able to operate, I remain firmly convinced that there is not one vein, that can be properly distinguished as such, except those commonly called vorticosae of the choroides and iris, and their receptacles which join the vena ophthalmica. Scrupulous observation on different cases has fairly indicated me to believe, that many arteries above mentioned have no veins, and that the blood does not return from them into the general circulation, but serves to supply the vitreous body, crystalline lens, aqueous humor, and the tears which are not produced by the globe of the eye, besides the nutrition of its coats. This idea being entirely new, will appear very strange to opinionated anatomists, but not so to such as are practitioners. The conjunctiva and cornea are often overrun with varicous vessels, that I have been obliged to destroy, in order to effect a cure; and what is most singular, these varicous vessels grow amazingly fast, and keep their ground as long as they are not destroyed. In inflammatory cases, I have frequently seen the blood in the transparent cornea of the Eye, and in the iris, and profuse bleeding unable to dispel it; therefore, it is no wonder if anatomists have been at a loss to describe the veins, and their situations; but we ought to wonder why they have hazarded to qualify so many vessels, as veins, whilst they are in fact real blood and lymphatic arteries. See the physiological enquiry which follows the anatomical exposition.

The optic nerve is not the only nerve which goes to the Eye; some branches come from the common *motores oculi*, the ciliary nerves, the superior maxillary nerve, the *ophthalmici*, *pathetici*, and a branch of the hard portion of the auditive nerve.

ANATOMICAL AND PHYSIOLOGICAL
ENQUIRY

Into the CIRCULATION of the BLOOD through the ARTERIA OPHTHALMICA, and the VENA OPHTHALMICA; wherein is included, a short ACCOUNT of the BRAIN, the NERVOUS and MUSCULAR FIBRES, the SEAT of the SOUL, and other SUBJECTS analogous to the HUMAN EYE and EAR.

THE carotid artery, before its infertion into the cranium, gives the ophthalmic artery, which accompanies the optic nerve through the foramen opticum; this last artery gives other small branches which are spread in the orbit. Many of these branches have no corresponding veins, through which the blood can return in the principal veinous trunk, that go out of the orbit.

Several diseases have long ago made me believe, that the blood thrown into the orbit, and the globe of the eye, through the ophthalmic artery and its ramifications, did not return from many of them to the vena ophthalmica. When I had injected through the carotid artery, the venæ vorticosaë were filled; if I injected through the jugulary vein only, the venæ vorticosaë were likewise filled, but the ramifications of the ophthalmic artery did not fill. It seems to me, that anatomists have too much depended upon Zinn, who has been at a vast deal of trouble upon the subject. I have followed all the branches of the ophthalmic artery, and I
never

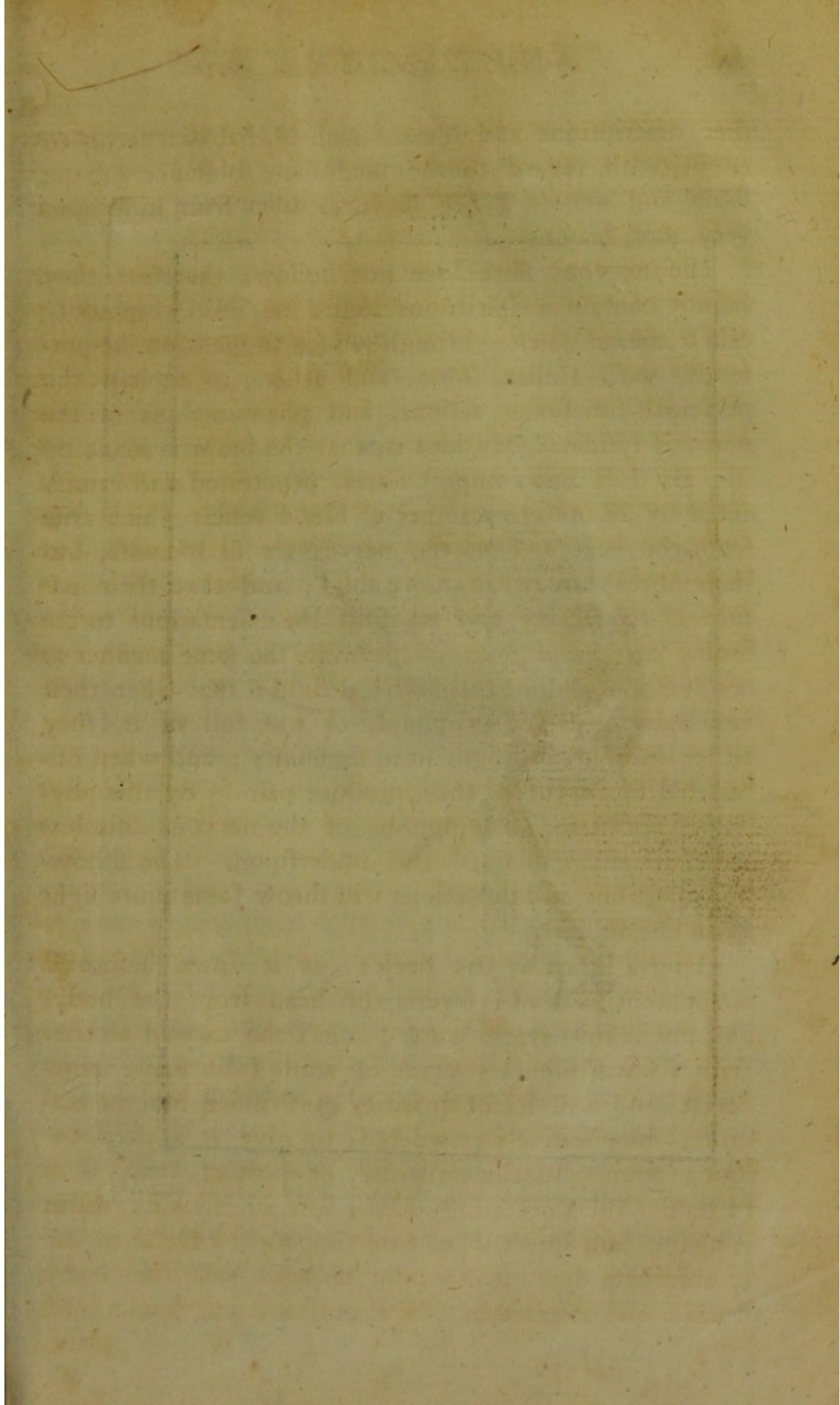
never was able to discover that they had corresponding veins, except five of the ciliary arteries, which join the *venæ vorticosaë* of the choroides, and four small long arteries which project on the face of the iris, to join some whirlings similar to those of the choroides. My enquiry was, what might be the reason why so many small arteries did not bring the blood back in the general circulation? The result of many fine injections, supported by several cases, have convinced me, that nature has designed them to supply the vitreous and aqueous humors, the tears through the ducts of the *glandula lacrymalis*. and those of the conjunctiva. Some of the smallest branches are lost in their course, such as the visual arteries below described, which terminate at the insertion of the optic nerve; the ramifications of the *arteria centralis* of the optic nerve, which end with the retina, near the internal part of the *processus ciliaris*; the varicous blood-vessels of the conjunctiva, which are lost on the surface of the cornea, or worn out by the frictions of the lids on the globe; and several ramifications which are lost on and in the muscles of the eye, and other parts of the orbit.

The nerves, according to *Monf. Sabatier*, author of the best treatise on anatomy at present, are white chords arising from the brain, *medulla oblongata* and the vertebral, which go to every part of the body. Their colour is greyish and somewhat reddish, on account of a great number of blood vessels which penetrate into them. The nerves are neither elastics nor irritables; their external coats are not equally thick, being extremely thin at different parts, and absolutely wanting over those which pass through foramens, and protected or supported by planes of bones. This assertion evidently proved by dissections, shows the error of *Dr A. Monro*, quoted in the anatomical description of the eye. As to the other

ther descriptions and ideas which M. Sabatier seems to adopt with regard to the medullary substance of the brain and nerves, I beg leave to differ from him upon very good reasons.

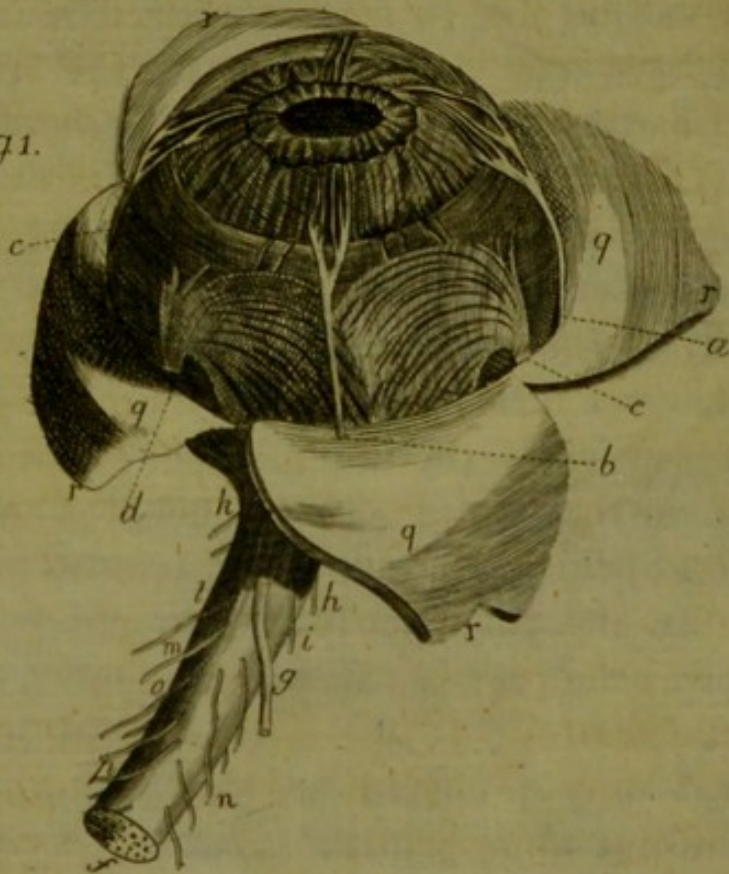
The nervous fibres are not hollow, therefore they cannot contain a spirituous liquid or fluid commonly called *animal spirit*, through which supposition he pretends, with Haller, Zinn, and others, to explain the principal functions, actions, and phenomenons of the nervous system. My idea is, that the brain is made up of very soft but compact fibres, penetrated and ramified by an infinite number of blood vessels which arise from the heart: That the nerves are so likewise, but their fibres somewhat more solid; and that their nature is to receive and transmit their sensations to the brain, *the grand focus of sense*, in the same manner as conductors transmit the electrical fluid; that when their vessels are deprived of blood, or too full of it, they either diminish or augment in sensibility; and when obstructed or ruptured, they produce pain. By this physiological system, all symptoms of the nervous disorders are rationally explained and understood. The following injections and dissections will throw some more light upon the subject.

Hang a sheep by the neck; cut it down before it is apparently dead; sever the head from the body, and put it into warm water; inject the carotid arteries with a warm injection made of white rosin finely powdered, and a sufficient quantity of Prussian blue or carmine, likewise finely powdered, to give it a deep colour; pour a sufficient quantity of spirit of wine, so as to render the injection middling soft when cold; warm it again, and inject when you suppose the blood entirely absorbed, but inject while the head is in the warm water; and afterwards take it out, and put it in a cold place,



TAB. II.

Fig. 1.



place, before you dissect the nerves. By repeated injections of that sort, you will discover the insertion of the *arteria centralis* of the optic nerve to be at about an inch from the posterior part of the globe of the Eye, and its course into the middle, and two branches arising from it, which ramificate over the *retina*. You will also see, that several other smaller arteries have their insertion into the optic nerve, for an inch long or more; and on cutting only the coats of the nerve longitudinally, and putting small bristles between the nerves and the coats, you will be able to see the biggest with the naked Eye. I have once counted nine in the space of an inch; and I had every reason to suppose there were many more. This done, divide the nerve transversally with a sharp knife, at three lines from the globe, you will see a vast number of blood vessels injected, which go longitudinally to the very insertion of the optic nerve in the globe, where I believe they end; but these are more distinctly seen with the microscope. I recollect very well, that, in the year 1781, when I was employed with Mr John Sheldon, professor of Anatomy in London, in dissections, and particularly the human Eye and animals, there was the part of an human optic nerve, wherein we could see four of the arteries above mentioned, and it was only prepared with a common red injection. I had put some bristles between the nerve and the coats, and we observed, that after their passage through the coats, they ran along the optic nerve for a line long, and then inserted diagonally in the substance of the nerve. I gave them the name of *visual arteries*, and to those of the portio mollis of the auditive nerves, which I discovered two years after, *aurial arteries*; those in other nerves, and the substance of the brain, *sensual arteries*.

I imagine that the most subtile part of the blood, thrown into the substance of the brain by these blood vessels, does not return, but serves to vivify its substance, the quantity being duly calculated by nature for that purpose. Monsieur Sabatier says, that he has observed two central arteries in the optic nerve. I do not wonder at it; but, if he will take the trouble to enquire clofer into the matter, he will easily find, that the pretended second central artery was one of the principal trunks of the visual arteries. The injection above described does not pass into the substance of the brain, on account of too many gross parts which it contains, and the small diameter of the blood vessels; but if Prussian blue be properly dissolved in spirit of wine, and immersed with some clear water, mixed with a little size, and injected through the principal arteries of the *dura mater*, with Anel's syringe, used for the lacrymal ducts, the injection of the sensual arteries will be seen with the microscope into the very substance of the brain.

I turned my thoughts to see further into the matter; and, after repeated tedious injections and dissections, I have likewise observed many blood vessels into the substance of the auditive nerve; but the trouble and expence which attend these experiments is such, that it is no wonder to me, if these observations have escaped us so long. My enquiries did not stop there: I have dissected many other nerves, to see if I could find a confirmation of the above observations, and the result of more easy dissections have evidently convinced me, that whenever these blood vessels end, a new insertion of arteries supplies, as it were, the absence of the above, and so on smaller and smaller, to the very end of each nerve, which I suppose, from analogy, is vivified by a very small one. But I must not omit to mention here, that I have been disappointed many times, on account of
rupture

rupture in the vessels when the animal hung too long, and when I had pushed the injections with too much or too little force, and, in dissections, by spoiling the part.

From these experiments and observations, I think that the brain and nerves are vivified or nourished by the blood, and not by an animal spirit different from it; nor are their hollow fibres in them, as Hovius pretends; and some authors of some anonymous publications in the Academical memoirs of Berlin, wherein a magnified print of the optic nerve is exhibited, and in the *Journal des Sçavans*. I fancy that these authors have taken the blood vessels for hollow fibres. By these experiments, the structure of the internal parts of the brain, and its vivification, which were not yet known, and which *Steno* and *Sabatier* despaired of ever being discovered, are at last come out. The vascularity of the pia mater, so well injected by *Ruyfch* and *Albinus*, together with its considerable extent and circumvolutions round the brain, between which it manifestly folds and refolds again and again, should have indicated to these great men, that their injections through the carotid arteries could not penetrate into the sensual arteries, which are undoubtedly contiguous; and that those several folds of the pia mater were absolutely necessary to maintain equally the substance of the brain, whose fibres are by far too delicate to resist the specific gravity of such a soft nervous mass.

Our mind is naturally inquisitive, and we unreasonably wish to know more than our faculties will allow; I shall be candid to confess myself guilty of the charge, and pursue my thoughts as far as they possibly can reach. Why are there soft and hard parts in the brain and nerves? To the first part of this question it is rather difficult to answer. I imagine that the softest and inner-

most parts of the brain, either distant or separated in lobes, have the particular faculty of interrupted and continual reflexion, a sense commonly understood by the operation of the mind: But sense had previously its origin through the production of some sensation effected by outward objects; consequently some parts of the brain must be softer than the others, in order that it should be susceptible to keep or retain a continual sensation, and whenever it becomes interrupted, it may be looked upon as a disease, commonly expressed *want of memory*. For example, if I am struck, the sensation is carried to the brain, and I reflect upon it. This I am apt to forget, and I need no sensation to recall it to my mind. Our retina retains the sensation of the rays of light longer than they are effected, for if they become intercepted, we however continue to see them, though our eyes are shut in the dark by way of sparks, and this sensation is improperly called fancy of the sight. This analogy indicates that the retina is nearly alike to the softest parts of the brain. To the second part of the above question, I offer the following comparison for an answer: If we compare the retina with the optic nerve, we will find that nature has designed the first to receive the sensation, and the second to transmit it; therefore, since the rays emitted from objects cannot produce a great shock, it was absolutely necessary that the retina should be softer than the optic nerve: If we compare likewise the *portio mollis* of the *nervi auditorii*, its several ramifications in the cochlea, with the commotions of the air vibrating towards the ear, commonly called sounds, we will find that the shock effected by them did not require a soft nervous expansion like the retina. The same comparison may be properly extended to the operations of the senses of smell, touch, and taste.

When

When we have been informed by anatomy, that the brain is a kind of white medullary substance, of a moderate consistence, and of a greyish colour on its outer surface; that its mass is of two kinds, distinguished by two different effects and qualities; when we have been convinced, as far as dissections will go, that the extremities of the nerves are appointed to receive our sensations, and the rest to serve as conductors, What can we want more? All other inquiries are needless for, or towards medical purposes. It would be presumption to enquire whether it is the soul or the brain itself that think. Such investigations belong to metaphysicians. I cannot conceive how Descartes, Willis, and others, could pretend to explain the functions of the brain and nerves, by attributing to a particular lobe a particular quality; I rather think that they wanted to amuse the world by imaginary systems, protected by their great fame. If we will consider, that the human body is composed of fluids, soft, and solid parts, we must naturally conclude, that the solids are appointed to support, the soft parts to facilitate motion and other functions, and the fluids to nutrify the whole. If these great men looked for the seat of the soul in the human body, I wonder why they should have imagined that its particular seat must be in some part of the brain. They were undoubtedly convinced, that it is immortal or immaterial, and of course invisible; therefore, they could not expect to discover it in any particular part of the brain. I recollect a very singular passage of a treatise wrote by Father Craffet a Jesuit; it was an answer to a book entituled, *Avis Salutaires*. “ A highwayman
“ having fasted every Saturday in honour of the Virgin
“ Mary, one day that he was executed, his head, on
“ being severed from the body, cried three times as it
“ flew off, *confession, confession, confession*. A priest came
“ and

“ and put the head on the body. The Devil had taken
 “ hold of his soul to drag it into hell; but the Virgin
 “ Mary interposed, in order that the soul should keep
 “ within the body till confession might be over.”—

Query, At the time of the separation of the head from the body, Where could be the soul? It would appear that Father Craflet thought it placed in the body, as the head was the organ through which it might only speak. Let the soul be whatever it may, it ought to be diffused through the whole human fabric; and if by some particular essence unknown and inexplicable to us, it is susceptible to contract itself, that part of the human body which lives the longest ought to be its last seat; consequently, the right ventricle and auricle of the heart being the longest in life or motion, should most probably be the seat. To pursue this subject still farther: The soul, as immaterial, must be in the blood, because where there is no blood, there is no life; the soul, as material, must be the blood itself, by the same reason. Whether the first or the last, the Divine has fully convinced me in favour of the former.

When a person is dying, the sensual arteries, which penetrate from the dura mater and piæ mater into the very substance of the brain, vivifying no longer that organ, the operations of the mind cease, and afterwards the *ultimum moriens*, clearly demonstrated by Galen, Harvey, Boerhaave, and proved by the illustrious Haller, takes place. The manner we lose our senses, in state of life, is sufficiently accounted for, by the want of blood in the sensual arteries, particularly those which nourish the substance of the brain, and shows the impropriety of immersions of cold water over the head to effect their recovery, except when lost by obstructions or plenitude of blood in such small vessels, what in general produce madness.—Not long ago, a little boy was brought to me, to
 help

help him in the following distressed situation: He had lost his speech, and was incapable of reflexion. If a tune was plaid or sung to him, he whistled it perfectly well. He appeared frightened at the sight of a stranger, and seemed to be entertained by his touch. His eyes were blue, and could see at an amazing distance. I think that the sensual arteries, which vivify the substance of the brain, were obstructed, without any other injury to the other parts of that organ. As to the loss of his speech, I could not account for, as the disorder took place after his birth. This accident, tho' uncommon, should prompt us to enquire by what mechanism the larynx produces the different sounds of the voice: That question is one of the *inquirenda* in physiology to this very hour.

Dimness of sight in old age comes on after an obstruction or want of blood in the visual arteries of the optic nerve, or the principal ramifications of the arteria centralis on the retina, what must diminish their sensibility and communicative powers sooner than the flatness of the cornea in changing the direction of the rays of light. In the incipient gutta serena, or paralysis of the retina, a pain in the forehead, or in the orbit, are generally symptoms which indicate an obstruction in the arteria ophthalmica, or its branches: If the light becomes painful to the organ, the circulation in that artery, or its branches, augment the sensibility of the retina and optic nerve. However, there are many exceptions to that general rule, especially in complicated cases, which shall be mentioned in their proper place. In a fit of the gout in the lower extremities, the pains generally subside after the inflammation takes place; because then the blood revivifies the nerves, and when obstruction retakes place, the disorder and its symptoms reappear. A practitioner will have many opportunities to observe, that persons afflicted with nervous complaints,

plaints, and of thin habit of body, are frightened at the least unexpected noise, because the blood circulates too freely through the sensual arteries, and renders the nerves more sensible of quick communicative powers, which overtake the reflexion of the mind about the noise. On this principle, I have been directed in practice; and I do not scruple to advance, that I have been successful to astonishment in nervous complaints, and particularly in the gutta serena, the beginning glaucoma, and inflammations in the lids, which had baffled the applications of general practitioners.

The muscles are bulks or heaps of fibres, red, middling firm, capable of contraction and relaxation, spread in the orbit, as in all the parts of the human body, and from which depend most parts of the motions. The fibres whereof the muscles are formed, are called fleshy fibres, or motory fibres; they are placed in bundles easily distinguished with the naked eye, and divided in others smaller; these, sub-divided in smaller still, without it be possible to distinguish the last fibres, which enter into their composition: The smallest that one can perceive, appear folded on their length and placed in zigzags. Some think that they are solid, others hollow. These maintain that their cavity is not interrupted; those that they are divided in small cells which communicate with each other. Some say that they are filled with a kind of velvet. In one word, there are as many opinions on the elementary fibre, as persons who have wrote on the subject.

As the muscles well injected are not only tinged in red, but assume the colour of the nature of the injection, some anatomists have thought that the arteries did end in the cavity of the muscular fibre; other that this effect is owing to the extravasation of the injection in the cellular texture which surrounds them. The reader may

may easily apprehend that these different opinions came from inattention or carelessness in dissections or injections. The nervous and muscular fibres have exactly the same compactness, but not the same firmness; the nervous fibre is naturally soft, and the muscular fibre firm: the nature of the first is to receive and convey sensation, and that of the second to effect motion; the nutrition of both is operated by the same mechanism, and it will be evident to ingenious anatomists, that the blood which flows through the smallest branches of the arteries which penetrate in the fibres, does not return, but serves to their nutrition. This is obvious in dissections, as the smallest branches of these arteries cannot be traced so as to demonstrate to us their connections with any veins: It follows from this principle, that the number of the arteries exceeds that of the veins by far, and that anatomists have often taken for veins many of the arteries above mentioned.

Whenever the processus ciliaris, which support the vitreous and crystalline humors towards the posterior parts of the inside of the globe of eye, have lost their power of elasticity, the vitreous body, and the crystalline lens, push the iris forward, and there remains no chambers in the eye. When that takes place, the aqueous humor flows out of the globe through the inorganic pores of the cornea, and by that disorder the vitreous humor increases in bulk, the pupil becomes extremely dilated, and keeps an oblong figure in most of these cases; besides, the capsule of the crystalline lens being in contact with the iris, becomes opaque, the arteries which correspond with the *venæ vorticosa* of the iris do not circulate, pains in the forehead, temples, are continually increasing. If the bulk of the vitreous humor increases to a degree so as to press on the choroides, the *venæ vorticosa* of that vascular membrane cannot receive the blood from

the ciliary arteries, then inflammation takes place with intolerable pains in the head. If the patient is bled at the arm or temporal artery, the pain will subside for a while, and return again with more violence. If the same symptoms are existing without the same cause, bleeding, assisted with emollient fumigations, will dispel the complaint without return.

The lacrymal artery at its insertion in the glandula lacrymalis is divided into several small and short branches, and these in smaller still. The blood, when arrived in these small ramifications, becomes lymph, and afterwards is secreted through the ducts of the conjunctiva, to constitute part of the tears. Nature does not present us with the same results, whenever the arteries have no corresponding veins; for which reason, we meet with two lacrymal arteries, and from that variation derives mistake. If there are several arteries, their principal trunks are a great deal smaller than when there is but one; and, in such cases, the disorders in the organ are more or less frequent. Many of the other arteries experience the same circulation, except those which nourish the parts; and those, which have corresponding veins cannot be but conjectured, from difficulty in dissections which require sawing the orbit at several places, before one is able to observe their situation. The finest and most lucky injections through the jugular veins and carotid arteries, followed by cautious and dexterous dissections, have plainly convinced me of what I have advanced above. Anatomists who will go through the same trouble and expence, may receive the same information; but I question whether they shall have sufficient opportunities for it, and practice to help them through such difficulties. A few cases which have occurred to me will further illustrate the subject;

subject; and some remarks relative to them, seem altogether absolutely necessary.

Henry Warrington applied to me in December 1782 for an inflammation on both eyes, attended with violent pains. Before I saw him he had been bled three times at the arm, and once at the temporal artery, in the space of five days. He had some relief from the loss of blood; but the disorder returned with more violence a few days after. Blisters behind the ears, and on the nape of the neck, were made use of, with some purgatives, and yet the disease increased, even with these medicaments; he could, however, bear the light in that state. The cornea was found, but elevated, and the pupil of the left eye did contract and dilate in some degree; but the right was motionless, when I saw the case for the first time. The blood vessels of the iris were so distended and full, that this vascular membrane looked like an anatomical preparation well injected. I prescribed emollient fumigations every two hours, for ten minutes, each eye at a time, and, during the intervals, compresses dipt in the emollient infusion. Three days after, the iris of the left eye appeared less red, but there remained some white spots upon it, at some distance from each other; these were pustles which changed in small ulcers, and subsided the ninth day. The right eye continued painful, and many fibres of the iris were pushed forwards in form of small reddish threads, which afterwards became adherent to the cornea, and the pupil took an unnatural shape. The left eye cured in some degree, but the right was irrecoverably lost.

Remarks. The right eye began to be inflamed three weeks before the left, and it was evident that the stagnation of the blood, in the vessels which ramificate the iris, had subsisted too long to give way to the medicaments.

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The original cause of the complaint was an alteration in the fluids, and a pressure on the veins, as the globe of the eye was excessively extended. It is probable that the fumigations, applied in time to the left eye, relaxed the globe, and promoted circulation; but being applied too late for the right eye, the blood, by a too long stagnation in the blood-vessels, became acrimonious, and this brought on the rupture of the vessels, and of course the loss of the organ. The distension of the globe was produced by an increase of the vitreous humor. The inorganic pores of the cornea were not able to emit the aqueous humor, in proportion to the augmentation of the vitreous, consequently, the vitreous body, becoming too bulky for the extension of the coats of the globe, the choroides was pressed, and the veins could not take up the blood continually supplied by the arteries, notwithstanding the pressure to carry on circulation. In that case, such of the lymphatic arteries and veins as serve of nutrition to the iris, were distended and full of blood, which became acrimonious, and produced the small ulcers above mentioned. These lymphatic arteries and veins being also distended, far beyond their power, they never were able to re-assume their elasticity by the help of the medicaments;—and this accounts for the loss of the right eye.

Miss Benson, aged 30 years, applied to me in February 1784, to give her some assistance in her trouble. Both eyes were cataracted; the right eye was free of pain, and the left so painful, that she could take no rest for several nights together. The sight of both eyes being past cure, I prescribed five and twenty drops of laudanum at bed time in a cup of plain water, and increased successively the dose to fifty drops in the same quantity of water. She obtained relief, and the pains subsided entirely in the course of a month. Here is an account

count of the state of the case and its progress. The processus ciliaris of the left eye lost their elasticity, and in consequence of that, the vitreous body and crystalline lens had come forward in the posterior chamber, close to the iris. In course of time, they projected by degrees to the anterior chamber, and when the aqueous humor had entirely evacuated through the inorganic pores of the cornea, the iris became in contact with it. As they could advance no further, the coats of the eye extended as much as possible, and when this could no longer be the case, the pupil dilated, the iris became pressed between the cornea and the anterior part of the vitreous body and crystalline lens; this pressure stopt the circulation between the ciliary arteries and the corresponding veins of the choroides and iris; from that disorder, intolerable pains in the forehead, temples, and the ball, without any external inflammation of the eye.

I have observed, that in the swelling and hardness of the globe of the eye, the cornea projects more than common, the pupil dilates difficultly, and that the symptoms are great pains in the head, temples, and the internal parts of the eye. When this is the case, the retina must be pressed by the posterior parts of the vitreous body, if the processus ciliaris keep their elasticity. The arteria centralis, and the visual arteries of the optic nerve, must likewise enlarge, and vision becomes less and less, as the parts are every day wanting their nutrition from the blood, whose circulation is intercepted by pressure. If the branches of the arteria ophthalmica, which penetrate into the substance of the optic nerve and retina, had corresponding veins, such diminution of sight to blindness could never take place so suddenly. If the varicous vessels, which I take to be real arteriols, extend from the conjunctiva over the cornea, and sometimes penetrate into the substance of that transparent membrane, had corresponding

corresponding veins, I cannot conceive how veins could grow as these arteriols and meet them; for they are generally annihilated by the frictions of the lids over the globe of the eye, or removed by surgical and medical operations.

The above cases tending only to prove a partial circulation of the blood through the arteries and veins of the eye, the following will illustrate the vivification of the brain and nerves. On the 17th of February 1721, a woman about 26 years of age, received a wound by a pistol clapped to her head. The wound was situated at the inferior part of the right parietal, between the temporal bone and the right ear. The motions of the brain were excessive and increased daily. A grinding of the teeth, delirium, and fever, preceded by shiverings constantly attended each dressing, but a calm succeeded for six or seven days, after which the same symptoms returned, with a copious suppuration, proceeding from the very substance of the brain, which washed off five shots and three slugs lodged in a fungous excrescence. The quantity of pus decreased when these extraneous bodies were discharged, whose weight had occasioned an inflammation before. She languished in a dying manner for thirty five days; at last the delirium and lethargy ceased on a sudden, after this extraordinary suppuration, and the patient recovered her senses. There was a sensible regeneration of the dura mater, the bones and wound were healed in the space of four months. She continued in a good state of health, except that she was sometimes troubled with vapours, and a slight heaviness.

On the 20th of August 1765, a young gentleman of Corsica received a blow on the head with a knotted club stuffed with 20 or 30 steel nails at the end. The nails were long enough to penetrate into the substance of the brain. He was trepanned and treated the common way,

way, and recovered from all the accidents attended with loss of substance. I spoke with him at Paris in the years 1775 and 1779. He showed me a silver box containing a piece of his skull taken off with the trepan, and told me that whenever he drank wine or any other spirituous liquors, he always lost his judgment, let the quantity be ever so small; and whenever he became intoxicated, he turned convulsed and furious mad, and remained for some days so stupified, that he had no recollection of any past transaction. He was even so nice in his taste, that he could tell, when he eat any pudding wherein a few drops of spirits had been mixed.

Remarks. The first case shows, that we cannot lose any part of our brain without some detriment in our reflection, and the second, that there is no difference between each lobe of the brain; for, if there was, the sound part would perform its functions, and the disordered produce sensations of pain relative to the injuries done. These cases and a great number of others of the same nature show likewise, that whenever some ramifications of arteries, which convey nutrition to the internal part of the brain, are destroyed, dullness and stupification must take place; and that the principal trunks of these arteries and ramifications which subsist, being of a larger diameter, must convey into the brain the spirituous fluid disengaged from its gross parts, and produce sudden drunkenness and madness. Those who are used to hard drinking and inflammations of the brain, ought to have their sensual arteries very much enlarged; and if they reassume their elasticity or tone, they however are susceptible to enlarge again with more facility, and by time lose their judgment without a return. Such persons as labour under these defects of faculties, should live upon a milk diet, which would obviate the above disease.

disease. The functions of the brain and nerves, together with their nutrition, being of great use towards the explanation of the senses of hearing and vision, I could not leave out without some impropriety, as *Steno*, in a learned dissertation on the brain, and quoted by *Winflow* and other anatomists, seems to acknowledge that he is entirely ignorant about it; and that the most modern anatomists have said no more, nor made any further progress concerning its determined functions.

Dr Alexander Monro, in his observations on the structure and functions of the nervous system, published in folio, in the year 1783, and illustrated with common etchings, has the following paragraph, chap. x. § iii. page 33. “ If we do not admit that the pia mater
 “ accompanies the medullary matter of the retina, or
 “ portio mollis of the ear, How are we to suppose the
 “ accompanying blood vessels to be supported? How
 “ are we to explain the difference of their color, or the
 “ greater bulk and greater toughness of them than of
 “ the pure medullary matter sent off from the brain,
 “ cerebellum, and spinal marrow?” I have often wondered that the Doctor could not solve these easy questions without grasping at evident errors. I am apt to believe, from his own expressions, that he has only guessed things, and accounts for them on that score, or else he would have roundly proved them by the very same dissections that he seems to be at a loss.

Let us solve his questions without prolixity. How is the medullary matter of the retina supported without the pia mater? The retina is not a medullary matter, but a nervous medullary expansion. How is the retina supported without the pia mater? By the ophthalmic and ciliary arteries, described page 5. and 20. Some of these arteries enter the globe near, and round the optic nerve, others penetrate laterally through every coat; and, in
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running directly into the vitreous body, they support equally the retina. As to the portio mollis of the ear, See the Physiological Enquiry into the Human Ear. How are we to explain the difference of color in the brain, cerebellum, and spinal marrow? The choroides and the internal surface of the pia mater are equally vascular, and the smallest ramifications furnishing these coats more immediately, the grossest parts of the blood are deposited on them. On the choroides to absorb the rays of light, and on the external surface, called cortical substance, for the purpose of centering our sensations on the soft parts of the brain. This physiology has been treated of in its proper place.

PHYSIOLOGICAL ENQUIRY

INTO THE

PROPERTIES OF LIGHT, AND THE THEORY OF
SIMPLE VISION.

OUR sight is the most perfect and most delightful of all our senses. It fills the mind with the largest variety of ideas, converses with its objects at the greatest distance, and continues the longest in action without being tired or fatiated with its proper enjoyments. The sense of feeling can indeed give us a notion of extension, shape, and all other ideas that enter at the eye, except colors; but, at the same time, it is very much straitened and confined in its operations, to the number, bulk, and distance of its particular objects. Our sight seems designed to supply all these defects, and may be considered as a more delicate and diffusive kind of touch, that spreads itself over an infinite multitude of bodies, comprehends the largest figures, and brings into our reach some of the most remote parts of the universe.

It is this sense which furnishes the imagination with its ideas; so that by the pleasures of the imagination or fancy (which I shall use promiscuously) I here mean such as arise from visible objects, either when we have them actually in our view, or when we call up their ideas into our minds by paintings, statues, descriptions, or any the like occasions. We cannot indeed have a single image in the fancy that did not make its first entrance

trance through the sight; but we receive mirrors, or containing, altering, and compounding those images, which we have once received into all the varieties of picture and vision that are agreeable to the imagination: for by this faculty, a man in a dungeon is capable of entertaining himself with scenes and landskips more beautiful than any that can be found in the whole compass of nature.

Every body knows that *things* would make but a poor appearance to the eye, if we saw them only in their proper figures and motions. And what reason can we assign for their exciting in us many of those ideas which are different from any thing that exists in the objects themselves, (for such are light, and colors of which I have been just speaking above) were it not to add supernumerary ornaments to the universe, and make it more agreeable to the imagination? We are every where entertained with pleasing shows and apparitions; we discover imaginary glories in the heavens, and on the earth; and we see some of this visionary beauty poured out upon the whole creation. But what a rough insignificant sketch of nature should we be entertained with, did all our coloring disappear, and the several distinctions of light and shade vanish? In short, our souls are at present delightfully lost and bewildered in a pleasing delusion, and we walk about like the enchanted hero in a romance, who sees beautiful castles, woods, and meadows; and, at the same time, hears the warbling of birds, and the purling of streams: but upon the finishing of some secret spell, the fantastic scene breaks up, and the disconsolate knight finds himself on a barren heath, or in a solitary desert. It is not improbable, that something like this may be the state of the soul after its first separation, in respect of the images it will receive from matter; though indeed the ideas of colors are so

in the imagination, that it is possible the soul will not be deprived of them, but perhaps find them exciting, by some other occasional cause, as they are at present by the different impressions of the subtle matter on the organ of sight. I have here supposed, that my reader is acquainted with that great discovery, which is at present universally acknowledged by all enquirers into natural philosophy, namely, that light and colors, as apprehended by the imagination, are only ideas in the mind, and not qualities, that have any existence in matter. As this is a subject that has been proved incontestably by many philosophers, and is indeed one of the finest speculations in that science, if you would see the notion explained at large, you may find it in the eighth chapter of the second book of Mr Locke's Essay on the Human Understanding, it being not of my competency here.

Optics is a science which teaches the nature, properties, and laws of vision, arising from the rays of light, either reflected from the surfaces of bodies, or refracted in passing through them, and touching the retina on the bottom of the eye. This science comprehends also, in its most extensive acceptation, the whole doctrine of light and colors, and all the phenomena, or appearances of visible objects. Optics, therefore, consists of three parts, *viz.* catoptrics, dioptrics, and chromatics; but all these subjects being too much for my work, I shall only speak of the doctrines of light and natural vision.

The Sun is the great illuminator of the day, a glorious planet, the spring of light and heat. This luminous globe sends forth flashes of light all over the world, and, by its presence, constitutes the day. Its substance is a fiery matter, or fluid, which is continually expanded in the air, if not intercepted; because it lightens,
and

and that its rays, gathered by concave mirrors, or convex glasses, burn, consume, and melt the most solid bodies, or even turn them into ashes or glass. It is from this luminous Being that light propagates itself every way, and that the rays which come from it spread on all sides in right lines, and with a swiftness almost incredible; for if a dark room be suddenly opened, this very luminous matter, or fluid, is immediately and uniformly propagated into it, according to the laws of reflection and refraction; and if you intercept the communication through which it went in, it vanishes as fast as it came in. Light spends about seven or eight minutes of an hour in passing from the sun to the earth; that is to say, in running over a space of 23,000,000 or more leagues, its swiftness is 10,000,000 times greater than that of a bullet which goes out of a gun.

The attraction of one ray of light, considering its quantity of matter is to the gravity that has a projectile, considering also its quantity of matter in compounded *ratio* of the swiftness of the ray, to that of the projectile, and of the bending of the line that the ray is drawing in the refraction, to the crookedness of the line that the projectile describes also on its side; provided, however, that the leaning of the ray on the refracting surface, be the same as that of the direction of the projectile upon the horizon; from this proposition, it follows, that the attraction of the rays of light is more than 1,000,000,000,000 times greater than the gravity of the bodies upon the surface of the earth, considering the quantity of matter of the ray and of the terrestrial bodies, and in supposing that the light spends from the sun to the earth seven minutes of an hour. The velocity of light cannot be retarded, but only diminished to a degree of proportional transparency of the body which intercepts it, unless it be admitted in a dark room
through

through a hole to which a denser body than the air is objected.

The rays of light are small corpuscles, which move with a great deal of swiftness from the luminous body. What ought to make us distinguish light into two species is, that it is an heterogeneal mixture of rays differently refrangibles. That, whose rays are equally refrangibles, is called homogeneal, simular, or uniform light; and that, whose rays are inequally refrangibles, is called heterogeneals. The light of the sun consists in rays, which differ from each other by indefinite degrees of refrangibility: the rays which differ in refrangibility, will differ also proportionally in the colors they are to represent when they will have been separated from each other: there are as many simple and homogeneal colors, as degrees of refrangibility. The rays of light are a compound of dissimilar or heterogeneal parts, some being very likely greater than the others: consequently the smaller those parts are, the more they are refrangibles; that is to say, the easier they divert from their rectiline ways; moreover, the parts which differ in refrangibility, and of course in volume, differ at the same time in color; from these principles, the whole theory of colors may easily be deduced. The expansion or space of the propagation of the parts of light is not to be conceived. Dr Hook shews, that it has no bounds but with the universe; and he proves it by the immense distance of some fixed stars, whose light is however sensible to our eyes by the help of a telescope. It is not only the great bodies of the sun and stars that are able to send forth their light to the remotest points of the immense spaces of the universe, the same may be with the least spark of a luminous body, even with the smallest globule the flint of a gun will produce out of the steel. A great many various examples testify the artificial

cial production of light by the attrition of bodies which are not naturally luminous; as amber rubbed upon a woollen coat, glass upon a woollen stuff, glass upon glass, oyster-shells upon a woollen stuff, and woollen stuffs upon one another, the whole in *vacuum*.

All fixed bodies, when they have been heated above a certain degree, become luminous; a quality they appear indebted to the motion of vibration of their parts. In short, all bodies which abound in terrestrial and fulfureous parts, produce some light, if they are sufficiently agitated in what manner soever. Thus the sea becomes luminous in a tempest; quick silver, when it is shaken in vacuum; cats and horses, when they are rubbed in obscurity; wood, fish, and flesh, when rotten. The different species of bodies produce different species of light, which differ either in color, strength, &c. and the same attrition has various effects, according to the different preparations of bodies that bear it, or the different manner of rubbing them; and that the bodies which have produced a certain light in particular, may be incapable by the friction to produce any more of the same specie. Mercury, amalgamated with pewter, and rubbed upon glass, produces in the air a great light.—Gold also produces it, and to a greater degree. Finally, of all these species of light produced artificially, the most perfect is that produced by the attrition of diamond, which is as dazzling as that of a red coal which is forcibly blown upon.

The fundamental principle of the whole optic science is, that light propagates itself according to a right line, in a manner that is less unknown to us; and the right lines, according as it propagates itself, are called rays. The leading principle of catoptric is, that the rays of light are reflected by an equal angle to that of incidence. The rays of light which go from one *medium*

in another, are broke in such a manner, that the sine of incidence is to the sine of refraction in constant *ratio*: this last is the principle of dioptric. With these very simple propositions, the theory of light becomes merely a geometrical science; and all its properties are demonstrated, without knowing positively in what it consists, nor how its propagation is effected.

Light is so subtile, that its particles are not susceptible of gravitation; because, when once expanded into the air, it cannot be dispersed, but only intercepted. The artificial light may be looked upon as an emblem of the primary's. The impression of the rays of light on the *retina* continue as long as they are admitted upon it, and immediately ceases, as soon as they are off.

Vision is as easy to conceive, as it has till now seem'd difficult. If you will take upon yourself to observe attentively the history and present state of the discoveries relating to vision, you will see, that a great many false applications of the experiments, made upon this head, have much contributed to put off the real knowledge of it; and then you will be no longer at a loss how to find out the causes, and even wonder why they have not been removed sooner. How came it to pass, that all direct rays cross each other, before they arrive upon the *cornea*, or any other convex transparent bodies, from the points of their emission? Is it because there is an inversion of pictures upon the *retina*, or that the representation of objects on a sheet of white paper, by means of a lens placed at a hole in the window-shutter of a dark room, is perfectly similar to our eyes, according to physicians, opticians, and philosophers? How came it they could grant, that objects are seen perfectly or imperfectly, when pictures are painted perfect or imperfect upon the *retina*? Is it because the refractions of the rays of light through the transparent capsules and humors of the eye, unite
and

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ТАВ III.

Fig 1.

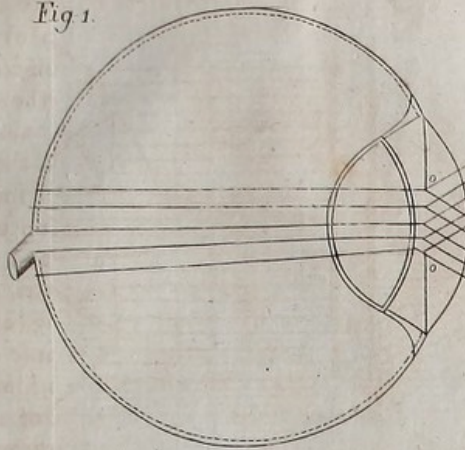


Fig. 2.

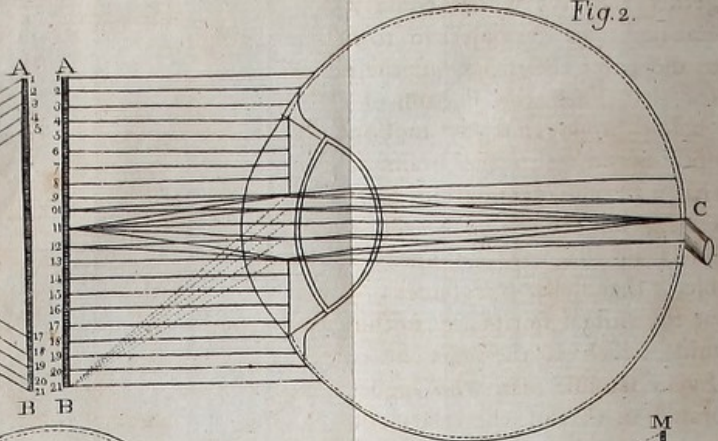


Fig. 3.

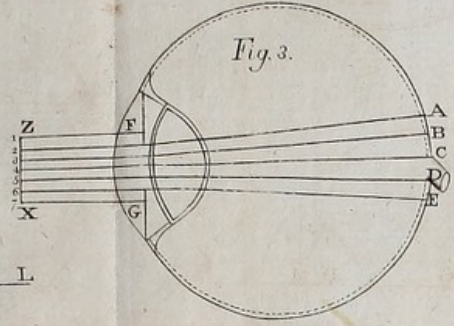


Fig. 5.

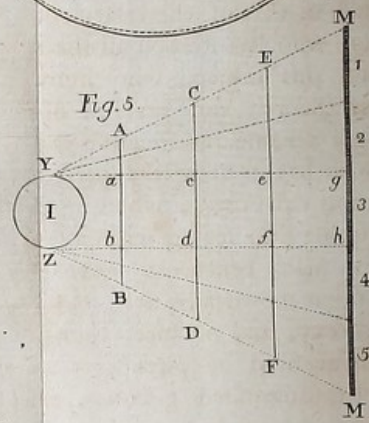


Fig. 4.

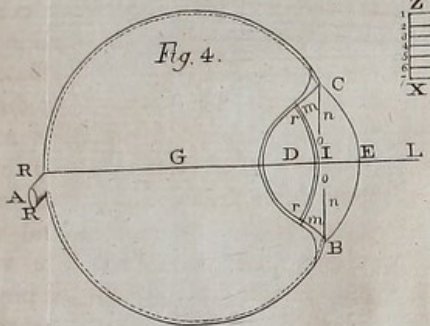


Fig. 7.

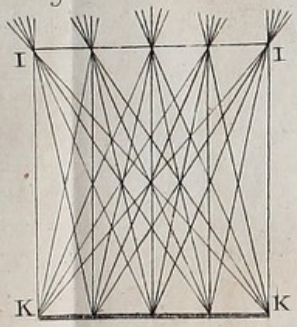


Fig. 8.

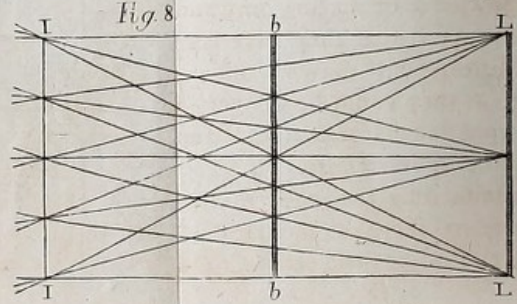
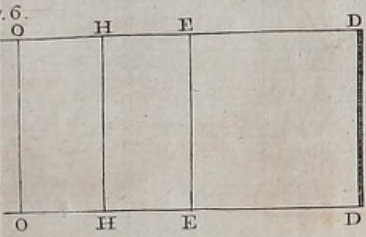


Fig. 6.



and bring together the rays which come into the eye from the several points of the object in so many corresponding ones, and paint the image of the object upon the *tunica retina* that lines the bottom of the globe; which image being propagated by motion along the fibres of the optic nerve up to the brain, is the cause of vision. What a strange imagination, to set forth that our sensations are produced only by the concurrence of the animal spirits in the nervous fibrils, and various contacts of objects that strike our senses! Is it on the probability that the animal spirits are nothing else but an electrical fluid, which is the efficient cause of our sensations?—Every sensible man who applies himself to so delicate a branch as that of the treatment of the disorders of the eyes, who has studied all the authors that have written upon this subject, who knows perfectly well the systems, theory, and practice of those that have acquired a great name and deserve the confidence of the public; who has in view the perfection of this branch of physic and chirurgery, when he thinks it susceptible of it, cannot help seeing with astonishment so little progress in so many centuries. As for my own part, I will take upon me to advance, and prove, that all the systems, theory, and practice, though in many respects built and invented by physicians and philosophers of the most distinguished geniuses, are very far from the real knowledge of the anatomy and physiology of the human eye, and that they have launched themselves in conjectures, and drawn consequences from them, as absurd, as they could be of very little use to the object of simple and natural vision, and promoting proper methods to cure its defects.

The works published by the modern writers are in a manner so opposite to those of the antients, that one needs not go far to find out the cause. The latter be-

gan by tracing plainly and exactly the discoveries; their followers copied them with the improvements; but if, as it happens now-a-days, they continue to contradict each other in order of acquiring a reputation, what shall be the consequence? A stop to the progress of this delicate art.

This part of my treatise, though an abstract or compendium, may be considered as elements particularly depending upon this branch of medicine already too long in the dark, as it was dispersed in a great many books of different subjects. Besides, one might look upon it as new elements in the optical science, as the whole is founded upon the first principles adequate to it.

In so short a description of vision as this, my intention is not to display all the systems that have been invented, nor give the analysis of every one of those that have been published in the several treatises of optic, dioptric, catopric, &c. to establish mine upon the ruin of them; because I should be obliged to waste away more paper and time than they are worth for my present work, as I reject them all. Such an analysis and enquiry will be, I imagine, not only amusing, but useful, as it will be an ample instruction in this science; at least, it will be more so than any rhapsody of general reflections, huddled together with little order or design, for these leave no systematical impressions on the mind; nothing but a confusion of ideas, often bright and glittering, seldom instructive. And a work of this kind would be too voluminous, and too aspiring for this little essay or *compendium*, and the humble author of it. I will therefore keep to my point, and content myself with making some of those observations alone, which seem proper to illustrate and prove what I have advanced, That natural and simple vision is not yet known, or at least explained as it ought to be; and that no author

thor has given any physical reasons concerning it. In order, therefore, that I may give some more satisfying account how this noble sense is produced, I think it is absolutely necessary to premise the following principles.

The rays emitted from objects which surround us go to the *tunica retina*, and make an impression against our will, provided our eyes be open; but of a quantity of rays which are emitted from a quantity of objects, there is but one of these objects that takes up our reflection. The rays emitted from an object pass into the very bottom of the globe of the eye, if they are not intercepted in their direct way without the globe; because the capsules, and humors it comprehends, are transparent.

Suppose, (Fig. 4. Tab. I.) an object, marked by a point, indicated L, from which a single ray is emitted and sent forth into your eye, when you stand motionless; the ray shall pass through the center of the *cornea* at the point E, the pupil I, through the chryselline D, and, crossing the vitreous humor G, it shall stop on the *retina* R, and be absorbed there* by the *meconium* that lines the *choroides*. As soon as the ray is arrived upon the immediate organ of sight, a sensible touch, which is propagated to the brain, is given upon it; from thence SENSATION. This operation performed, you reflect about the object from whence the ray is emitted, whether upon its colour, if you have a primary knowledge of colours, or about its roundness and other forms by the same reason; then you form an idea of it in yourself; from thence CONCEPTION. If this ray was not absorbed upon the *retina* to the point R, it would continue its way to the surface of the *choroides* or *sclerotica*, if it was no more absorbed on the *choroides* than on the *retina*, without producing a complete sensation: In this last case, your organ is deprived of that agreeable satisfaction which we call

call seeing, though day from darkness might be distinguished.

I will, however, make an observation here, which is, that there are some animals whose choroides are void of *meconium*, and who enjoy, for all that, the faculty of seeing. But such a fact cannot be any objection of weight, that, by its absence, a man whose organ would be deprived of it, could be bereft of sight; because it matters very little if the rays be absorbed by *meconium*, or by any other dispositions or constitutions of the parts which make up the eye of these animals. The absorption of the rays of light in the ox's eye is performed by a tincture of mixt green and blue; for which reason, I think those animals or others as have such eyes, cannot see the objects as distinctly as we do. Besides, the cornea being thicker, and the humors denser, the refraction is also in proportion to it; and the choroides being also different, must of course produce several varieties. My intention being confined to the natural vision of man, I shall not pretend to enlarge upon the subject, though it might be very curious and entertaining to many of my readers; but when I consider about many more interesting subjects which fall to my share, I presume it would be rude to detain them any longer about it. What is most certain, according to many observations, is, that there are in general no man who can see in such a state; that is to say, without *meconium* on the choroides.

The single sensation produced on the immediate organ of sight by some rays emitted from an object, is not sufficient, even with the help of reflection, to make it conceivable in all its qualities and modifications, if you are totally ignorant of the various ideas it may present. A cataracted born-blind man who has undergone the o-
 peration

operation of extracting, is an irrefragable proof of this assertion.

The basis of this system is, that the nervous system is the principal of our sensations; and that our conception is effected by two operations, SENSATION and REFLECTION; that we feel without reflecting. But that this last operation cannot exist without the first, is a fact disputed by nobody. Thus, when we have reflected on any object whatever, a sensation must have preceded; consequently sensation and reflection are dependent upon each other to produce simple perception. A fool is susceptible of feeling when he is struck, but not of reflecting about the object that strikes him, and what may be the reason; because, if he did reflect, he would cease being a fool the very moment of the reflection, which is a knowledge the mind takes of its proper operations, and their manner of operating. In our first born days, we have the faculty of feeling to a certain degree, without having that of reflecting; otherwise it would necessarily follow, that we have innate ideas, and that exterior objects do not produce our simple ones, what would be as ridiculous as absurd.

The whole extent of the retina is susceptible of receiving the impressions of the rays of light; but the more rays taken in, the more the sensation is felt. When an object is considerable in its extent, and near the eye, all the rays which are emitted from it in right and oblique planes, cannot be admitted in the bottom of the eye, without some of them be intercepted; therefore we cannot perceive and conceive the whole object at the same time, and such as it is, without surveying successively all the points, (when I say all the points, I mean such a quantity of them as are in proportion to the pupil's diameter, with regard to the distance from the object to the eye, that produce a perfect vision of
such

such a part of the object,) by the help of motions of the globe or head; because the rays that contributed to the reflection about that part of the object perceived, are independent of all those that cross each other by numberless inclinations, before they come upon the *cornea*; that is to say, the rays which are emitted from the superior extremity of the object, supposing it be placed vertically and of a long figure, do not come (after their insertion in the globe) to the inferior part of the circumference of the pupil; and those emitted from its inferior extremity do not pass to the superior part of the circumference of the pupil, to arrive from thence on the immediate organ of sight, as I shall demonstrate it hereafter. Were it not thus, the person could perceive and conceive the object entirely and at the same time, without any motion of the globe of the eye, or of the head, or of both together; what cannot exist according to the following experiment.

Describe upon a smooth white wall, exposed to a very clear light, a black transversal *line* of one inch in breadth and six feet in length; shut one eye with the tip of your finger, and fix at the same time, (if you can) the extremities of the black line with the other eye only at one foot distance; then you shall perceive, that the globe of the eye shut, moves under your finger, to perform the same motions of the open eye with which you endeavour, but in vain, to fix the black line entirely. Go back at six feet distance, one eye always open, and the other shut, you will observe, that the globes are not subject to so extensive motions as they were at one foot distance. Go back till you see the black line without any motions of the globes and head, then you will easily conceive, that the remoteness of the object and its diameter, are visibly become proportioned to that of the pupil; therefore all the rays emitted from this black
line

line have their direct passage into the bottom of the globe of the eye, consequently all the rays, when near, being not able to arrive in the eye directly, have no power on the reflection, since the eye is obliged to move for surveying every point of the object, to make you conceive a perfect idea of the whole by succession of time. Were I to enquire here minutely into the physical laws of the power of the rays, on the immediate organ of sight, emitted from objects at a given distance, I might no doubt determine by that method at what distance such an object, of such a quality, and of such an extent, might distinctly be perceived: but when I reflect upon the variety of the sensibility of the *retina* in mens eyes, together with the respective faculty of the contraction and dilatation in the pupils, my pen stops short with my abilities. If a man, able of such a nice task, were to undertake it, I am confident that optics would make a grand step of improvement by it, as opticians could easily determine what glasses might be properly made use of, either for magnifying or drawing near all kinds of objects, with respect to different eyes.

What may be the reason why the black transversal line is perceived at once, but without distinction, and with a sort of confusion in the mind, when at the first place, or at a middle distance? To this I answer, that the rays emitted from the transversal line, coming into the eye by different ways, and without intercepting each other from their several points of emission to the eye, (according to the position of the globe and objects) cannot all, though admitted into the bottom of the globe, perform a complete sensation, as there can be but those which are in proportion of the diameter of the pupil, and come by or in direct planes on the immediate organ of sight; for though the oblique rays, which are more extant than the diameter of the pupil to that distance, enter

ter into the globe every way, and produce a weak sensation, nevertheless, they cannot take up reflection at the same time to complete vision, like those which are proportioned to the diameter of the pupil, and admitted in direct planes into the globe of the eye. The sensation being performed on several parts of the *retina*, by several objects at the same time, the reflection being successive, cannot but confuse at first; because the reflection must preferably be taken up by the strongest sensation, (which is undoubtedly produced by the direct rays that enter into the eye) than by that effected by a multitude of weak rays which come in the eye obliquely, and consequently cannot equal it. I am going to explain the whole in the following paragraphs.

Demonstration. Suppose (Tab. I. fig. 3.) a long perpendicular object Z X, from which are emitted seven horizontal rays close together and equal; suppose the pupil equal to five of them in diameter, and the globe situated as in the figure, being a fixed distance; the rays 1 F, 7 G, cannot go parallelly into the bottom of the eye, because they are intercepted by the iris to the points F G; but the rays 2 A, 3 B, 4 C, 5 D, 6 E, have the faculty of going in without being intercepted, if the eye be sound. The central ray is transmitted from its emission into the bottom of the globe, without undergoing the least refraction. As for the other four, they describe a parallel one, as they go from the central convexity of the crystalline: if its convexity be less or more on one side of the crystalline than on the other, the rays are refracted in proportion, *et vice versa*.

After so clear an explanation, it is obvious to every body, that, to see the whole object without any motion of the globe, or object itself, it must be removed at a farther distance, in order its diameter be equal to that of the pupil; then there will be no difficulty of conceiving

ceiving the transmission of the seven rays into the bottom of the globe, according to the rules of confusion, in the points from which the rays are emitted, and which I shall demonstrate hereafter. If the globe, at the same distance, was to move perpendicularly downwards, of one ray only, the 1 F shall be introduced in the bottom of the globe, and the 6 E, 7 G, shall be intercepted by the iris; of course, the ray 3 B shall become central, supposing always that no other rays interfere in our demonstration. For besides the seven horizontal rays emitted from the perpendicular line ZY, that come straight, and, as in a plane, to the globe, there are as many seven others which are emitted from the perpendicular line, as it is possible the object and eye itself may have positions, some of them being more or less inclined, according to the various positions of the eye, and those of the object.

Suppose the same globe in the same position as above, but an object forming a perpendicular line at the same distance from the eye; what can be the number of all possible rays, and their different effects, dependently or independently of each other, from their emission into the eye, as light propagates itself every way? I hope the following demonstration will make it intelligible, even to the meanest capacities. Let us suppose an object AB (Tab. I. fig. 2-) forming a perpendicular line, divided in twenty distances, which make one-and-twenty points, supposed closed to each other, so near as to admit of no distance ever so small, and that from these 21 points, 21 rays be emitted horizontally, as described by the figure; besides, let us suppose that the five central rays are equal in diameter to the pupil, and enter the globe in undergoing a proper refraction; it is very clear that the horizontal rays 1, 2, 3, 4, 5, 6, 7, 8, are intercepted by the globe, as well as the rays 14, 15, 16, 17,

18, 19, 20, 21; but the 9, 10, 11, 12, 13, being equal in diameter to the pupil, pass into the bottom of the globe, make an impression on the retina (together with all the other oblique rays emitted from the points 9, 10, 11, 12, 13,) and produce a sensation: from thence a reflection ensues, which occasions what we call the agreeable satisfaction of *seeing* what the object is, or may be, according to our notions of such a part which comprehends five points; but as the whole line sends forth as many possible rays as there is possibility of horizontal and oblique ones, let us now only demonstrate those that may be admitted into the bottom of the eye, to produce vision, independently of those that are intercepted by, or go out of the reach of the globe; then we shall next consider how many rays this perpendicular line emits, either oblique or direct, at the same time, in different planes. I mean here, by the word *plane*, a bulk of rays taking all the same direction: For example, the 21 horizontal rays (Tab. I. fig. 2.) form a plane. The oblique rays 1, 2, 3, 4, 5, (Tab. I. fig. 1.) form an oblique plane, as well as the 17, 18, 19, 20, 21; which planes, united together, form a body, that I denominate by the appellation of *bulk of different planes of rays*.

Every point of the perpendicular line out of which the rays are emitted, sending forth around as many as there are points in one circle, it is very easy to conceive, that five being the diameter of the pupil, none but five rays of all those emitted from each point shall be admitted into the bottom of the globe: therefore, if we multiply five by five, the number of the pupil's diameter, we must conclude, that five-and-twenty rays of the perpendicular line are the only ones that are necessary to perform a complete vision of such a part of the object that comprehends five points, without any motion of the globe of the eye.

This

This being understood, it remains now to demonstrate, how many rays emitted from the same line, tho' admitted into the bottom of the globe, have no effect upon the retina, as every point of the line sends several rays every way. If the one-and-twenty points send one-and-twenty circles of rays, and that the pupil's diameter be equal to five rays, let us multiply one-and-twenty by five, the number shall be one hundred and five; out of which take away five-and-twenty that perform the natural vision, eighty rays from the line shall be the number that have nothing to do in the execution of the sensation to operate it.

It follows, from what I have been demonstrating, that the planes of the 25 rays which operate the sensation, are transmitted into the globe from their emission, as they are described (Tab. 1. fig. 7.) supposing no distance between all the rays, though I have been obliged to describe it so, to make it more sensible to the eye.

Moreover, as a circle of rays is emitted from every point (see the five rays emitted from the point 21 (Tab. I. fig. 2.) independently of the horizontal one, which cannot be admitted into the bottom of the globe) we must conceive a confusion of them; that is to say, that the rays run over each other through the same points of the pupil, and are transmitted and admitted in the bottom of the globe as in a direct plane or mass, except those that have nothing to do in performing a complete vision, as they go out, or are intercepted by the globe.

After such an explanation of the passage and interception of the rays, there is another object to consider, and which is of no small difficulty to account for: Every body's experience is a proof that the rays of light have such a penetrating power, that they pierce through the

eye-lids, and so are admitted into the bottom of the globe; but the sensation they produce upon the *retina* is very different from those which are taken in without any objection; therefore the sensation of the rays of light is always in proportion to the thickness of the atmosphere and objects that intercept them, before they arrive upon the immediate organ of sight.

To be convinced of the penetrating power of the rays through the eye-lids, shut your eyes, and expose them to a very clear light; then pass and repass any object very thick and impenetrable to the light, you shall distinguish the day or darkness, as it will be off or on; consequently the rays which go through the eye-lids in the eye when shut, shall more easily pass through the iris which is not so thick, and still more through the pupil, and all the transparent humors of the eye. There is, besides, another thing to infer from this, which is, that the rays of light may be hurtful to the immediate organ of sight, when too strong or powerful, if the humors, through which they go, are also too transparent. So that we must look upon the equilibrium of our eyes as a very delicate and well-regulated one, that shews plainly the work of the all wise Creator: therefore every body has a right to suppose, that when a physician knows perfectly well the mechanism and the natural state of this beautiful organ, he may the easier remedy its deformities and disorders.

But I must return to the further explanation of the emission of the rays of light, how and in what manner objects emit them, according as they are distant from our eyes. To comprehend it better, let us enquire into the cause why the distance of the object makes its diameter less according to our eyes. When you look at an object of a given extent to a determined and known distance, you must always understand, that so many rays
are

are emitted from it, if there are so many points, and that these receive a sufficient degree of strength from the primary light, either directly or indirectly, in order that the rays emitted from them may be strong enough to operate a sensation upon the immediate organ of sight; for in a given position of the object, we ought to conceive a certain number of them, which shall diminish or augment in proportion of the different distances; that is to say, that the number of the points from whence the rays shall emit, and which we will suppose separated from each other, shall augment if you draw the object near the eye, and diminish if put back from its first place: because, being put off at a greater distance, it is clear, that the reflection of light shall be effected on several points, instead of one as before, in order that a ray, being the confused emission of so many at such a nearer distance, be capable of producing sensation on the *retina*; for which reason, the object diminishes in appearance to our eyes as soon as it is put farther back, since two, three, or more points become but one at a less distance, from whence only one ray is emitted, able to produce a sufficient shake on the immediate organ of sight. From thence we must therefore conclude, that when an object is of a considerable extent and near our eyes, it is impossible we can see it entirely at the same time, without motions either of the globe of the eye or head, consequently there can be admitted into the globe but a certain quantity of rays. We must also conclude, that the passage of the rays into the bottom of the globe, is always in proportion to the pupil's diameter and the object's distance, when a part of the object is perfectly seen.

Demonstration. Let us suppose (Tab. 1. fig. 8.) an object *b.b.* representing a perpendicular line, which comprehends only six points, from which six rays are emitted,

ted, the pupil II being five in diameter ; it is very clear, that the six rays but one, shall be transmitted into the bottom of the globe, and the object shall be seen and conceived at the same time, without any motion of the eye or head, in five points only. Let us suppose the same object removed back one equal distance more from the eye, the six points of the object shall be confounded in three ; then the pupil's diameter shall be too large of two points, instead of being narrower of one at the first distance. This diminution makes the object appear but one half of what it was ; because, the rays of light being less powerful when they reflect from a small point, must be multiplied in bigness, to correspond and be in proportion to the strength or sensibility of the immediate organ of sight.

The reason why we see objects of the same nature at given distances, when others are imperceptible to us, is very easily explained and conceived by this confusion of rays and diminution in their number. Let us suppose, that the pupil I (Tab. I. fig. 5.) be five lines in diameter, and the object M M twenty lines distant from the pupil ; the third ray, whose diameter is equal to that of the pupil, being emitted from the middle of the object distant of four lines, shall be equally sensible to the immediate organ of sight, as five other objects, each of the same diameter and joined together, from which five rays shall be emitted at twenty lines distance from the pupil. To have a convincing proof of this fact, let us calculate the confusion of four inclined rays 1 Y, 2 Y, 4 Z, 5 Z ; then we shall have an opportunity of remarking the exactness of our calculation of the severall objects in AB, CD, EF, MM. If we compare the distance Dd to that of Mb, which describes the inclination and confusion of the rays, we shall see that the first is but one half of the second : If we compare the distance

distance

stance Bb to that of Ff , we shall see that the first is but the third of the last, because the objects are distant from the pupil one third less than the other; that is to say, that Bb is to Ff , what Dd is to Mb ; from whence we may conclude, that an object of the same nature is equally seen at five lines distance, if it comprehends five lines in diameter, and the pupil as many; as this same object would be seen at twenty lines distance, if it comprehended five-and-twenty lines in extent, since the confusion of the inclined rays is always in proportion to the distance and extent of the object from whence they are emitted.

But I shall observe here by the way, that two objects of the same extent, and at the same distances, but of a different nature, operate a great disproportion in the distances, as a light of one inch in diameter may be seen from one end of the horizon to the other, when any other object of the same diameter, and at the same distance, shall be even insensible to the immediate organ of sight at a hundred feet distance, supposing its quality not of a luminous one. There is also a very great difference when these objects are exposed to a stronger or weaker light; because the more an object receives of the particles of the primary light, by reflection or otherwise, the more it is able to emit of itself a greater quantity of strong rays, according to its extent, quality, distance, &c. &c.

Let us return to our demonstration. Suppose an object DD (Tab. I. fig. 6.) distant from the pupil of your eye OO of four given and known distances, but equal in diameter to the pupil, though at the furthest distance from it; what can be the number of points in your pupil's diameter that shall become empty; that is to say, through which no rays, emitted from the object, shall go into the bottom of your eyes? If you suppose the
object

object *DD* equal in diameter to your pupil *OO* at the furthest distance, containing eighty points, which send 80 rays into your eye; when you will place the object *DD* in *EE*, there shall be forty points in your pupil, through which no rays are transmitted; and when placed in *HH*, sixty; because the object in this last place, though it contains eighty points from which eighty rays are emitted, is contracted in such a manner that being nearer your eye, the points are multiplied, and produce, though smaller than they were before, a degree of light which is also multiplied in proportion, that shakes sufficiently the immediate organ of sight at such a distance, as to operate simple and natural vision.

We should not wonder why, with both our eyes, we can see perfectly only one object at the same time, though each eye is susceptible of receiving separately the impressions of the rays of light. If we examine two objects at once, one placed at our left hand and the other at our right, we shall conceive an impossibility of fixing them separately with each eye at the very same instant. But if, by a kind of violence, with the tip of one finger, we break the parallel axis of one eye only, we are immediately sensible of the sensations received distinctly in each eye, without being able of forming a perfect idea of each object at once; because our eyes being accustomed to follow the same motions, that which is put out of its parallel axis is immediately hurt, and feels a greater sensation by it than by the impressions of the rays emitted from the object itself; consequently the reflection must be employed about the touch of the finger, and not the rays coming from the object.

Besides, as we cannot reflect at the same time about two different sensations, though felt in the same instant

as I have explained above; it is, besides, necessary it should be so for the help of each eye, and to save us from a continual confusion; because, if we admit that squinting eyes, as it happens, see at once two different objects with each eye, we cannot, by the same reason, grant two reflections without any sort of interval whatever. You have a power of staring at a multitude of objects at the same time; but you cannot reflect about them, and conceive a perfect idea of them, all at once, or in the same instant.

Having candidly laid down the principles on which the theory, and phenomena of vision are to be thoroughly acquired, I shall now proceed, by prying into the causes that have given ground to the different systems, and demonstrate, at the same time, what could be the reasons which led opticians to such great errors as those they have fallen into. Nothing is so obnoxious to physic, and the human sciences in general, as to lay down for truths of fact mere systems grounded on calculations, and geometrical demonstrations, when facts, and experiments able to ruin them, are wrapt up, disguised, and very expensive. This is still worse, when such systems are transmitted to us with an air of the firmest assurance, by truly eloquent, and sublime men, whose superior talents have acquired the approbation and admiration of their contemporaries; it is, then, with all due respect to these great men that we ought to oppose the stream, keep up the imperceptible right of truth, and give an ample satisfaction concerning such facts, as the finest and most brilliant systems cannot maintain themselves. When we are once launched out in a false system, the most gratuitous cost nothing to defend it.

Mr Locke has given us a complete apprehension of our ideas and perceptions, in his Treatise upon the Human Understanding: therefore, if the sense of vision

must be compared and reasoned upon as that of touch, *in sensation*, it is clear, that all our greatest philosophers have not conceived and distinguished the effect from the cause. That any object is represented on the immediate organ of sight, or on any other surface, when its rays emitted from it pass through a convex glass placed at a hole in a window shutter, is undeniable; but to conclude that it is seen and conceived from its being so represented, would be as absurd as to advance, that a dead eye should see just the same, since the picture is existing at the bottom of it, when its anterior tunics have been taken away. By what phenomena then is this picture operated?

Make your room as dark as you can, perform a round hole of a quarter of an inch diameter in the shutter, opposite the top of some houses upon which the funnel of one or two chimnies are to be easily espied, present a white sheet of paper one foot and a half distant from the hole; then you will have an opportunity of observing, that the top of the opposite houses are described inverted, and that the images of all the anterior objects are also represented, upon the sheet of paper, just of the same color as they really are: As an addition to the experiment, oppose a lens whose focus be six inches, at two inches inwards from the hole practised at the shutter, the sheet of white paper placed as it was before; then you shall see the pictures of the exterior objects painted upon it a great deal more clear, than you was able without it; and if you place another lens, whose focus be but three inches, at three inches distant from and with the first, you shall certainly see the pictures of the objects still clearer, than you did with one lens only.

All the objects (as I have already observed) which surround the hole, emit as many circles of rays as there are points contained on their surfaces, that are suscepti-
bles

bles of painting their several colors on the paper, which we will consider here as a point of absorption. If, in pursuing our enquiry, we look for the difference in the nature of the rays which are admitted to pass through the hole, and distinguish the number, either of direct or oblique, in order of acquiring which of them produce more painting; we shall undoubtedly find, that the number of oblique rays surpasses that of the direct ones; consequently if, of all these rays, the first surpasses in number the quantity of the last, it must necessarily follow, as the rays paint the images, that the pictures of the objects be inverted, as there are a greater number of these to operate painting. If, on the contrary, the direct rays were to surpass in number the oblique ones, the pictures of the said objects should certainly be represented on the paper as they naturally appear. Suppose now, as I am sure it does, that our organ receives the inverted picture of the object in its bottom; do you, or can you conceive, that the rays which produce this inverted picture, produce also a sensation of the object inverted? No, certainly; for were it so, we must necessarily conclude from thence, that one might see the object inverted, what does not exist in the least, unless it be in the imagination of those builders of absurd systems. If philosophers are fond of making hypotheses, their disciples are as zealous to defend them. The honour of a whole sect is thought to be engaged, and every individual is piqued that another should shew that to be false which he has, all his life, taken to be true: so that, notwithstanding all the graces of novelty, a new truth will have much to do to dislodge an old error. Instances of this sort are innumerable. Is it reasonable, when we cannot draw, from observation and experiment, such conclusions as may be safe foundations on

which to proceed by a just method, in the pursuit of truth, to assume certain principles, as if they were founded on the analytic method, which have never been proved, nor perhaps suggested, by the phenomena, in hopes that they may be so afterwards? In a word, when the only cue we have fails us, which is most reasonable, to stop short or to push forwards, without any cue at all, into a labyrinth of nature? I make no scruple of deciding in a case so plain, that it would be a silly affectation of modesty to hesitate. When the phenomena do not point out to us any sufficient reason why and how a thing is as we discover it to be, nor the efficient cause of it, there is a sufficient reason for stopping short and confessing our ignorance; but none for seeking out of the phenomena, this reason and this cause, which we cannot find in them. This is learned ignorance, of which the greatest philosophers have no reason to be ashamed.

But to return: The hole, practised at the window-shutter as described in the above paragraph, being neither susceptible of contraction nor dilatation, the rays emitted from the objects ought to be the same in number; therefore an alteration in the pictures, supposing *things* keep their place, cannot exist, though light be successively strong or weak. Wherefore is it possible for any man, who is perfectly acquainted with the anatomy and physiology of the human eye, to form a comparison between it, and the *camera obscura*, without being taxed of a systematical genius, especially when a clear experience is naturally against it? In a *camera obscura*, the place of absorption is without any variation with regard to the effect; the *retina*, on the contrary, being situated on the choroides, which membrane is tinged with *meconium*, is the place of absorption in the human eye. What a difference! If the objects are exposed to

a strong light, their pictures are seen in proportion on the place of absorption in the *camera obscura*; but as the rays are constantly the same in number, so the images keep to their magnitude and appearance: on the contrary, when the objects emit such a pencil of strong rays, the impression they operate on the immediate organ of sight is such, that the circular fibres of the iris enter immediately in a motion of extension, which produces a contraction in the pupil; then you easily conceive, that the same number of rays, emitted from the objects, are not admitted into the globe, what diminishes of course the sensation, without any alteration in the reflection. How nice is so admirable a mechanism! Is not such a fact, supported by experience and observation, sufficient to ruin all the systems of our present opticians?

Let us push on our enquiry still further: That an image or picture of an object which sends rays on the place of absorption, is equally perceivable in the *camera obscura*, as it is into the bottom of the human eye, is undeniable: but to advance that this very image or picture of an object is the conveyance of the idea we form of it in our minds, is an absurdity that I cannot submit to. When we compare the formation of the picture on the place of absorption in the *camera obscura* with that on the immediate organ of sight, we understand plainly enough, that in this light they are equally the same: But when we examine the effects on both, we must perceive a vast difference, as one is capable of feeling, and the other totally deprived of it; consequently the sensation produced on the immediate organ of sight comes from the shock of the rays upon it, as soon as they are absorbed by the *meconium*. This very shock then causes a vibration in the neighbouring and contiguous nerves, which communicate their sensation

tion to the musculous fibres of the iris; then a contraction in the pupil takes place; the shock ceasing or diminishing by degrees, the action of communication yields in proportion, and dilatation gradually takes place. Besides another impossibility of producing a sensation might also happen, though the picture of the object be represented into the bottom of the globe, if the retina, or optic nerve itself, were hurt by any pressure, or afflicted by any disorder whatsoever. To conclude, I may certainly advance, that the shock produced by the absorption of the rays on the immediate organ of sight, performs sensation, and not the picture of the object on the retina, as has been advanced by philosophers, physicians, and opticians

If the retina be yellow, the objects, say they, ought to appear so too, because their pictures being represented upon it, convey this sensation to the mind, though the objects might be red, green, or of any other color. This is the kind of assertion you meet with in the best authors in physic and optics upon that head. Having demonstrated above, that the picture of the object on the retina does not produce the sensation, it would be needless to bring any other proof against it, were it not conducive of enlightening and instructing the reader. In order to do it more effectually, I will lay down the following experiment. Perform one hole of two inches diameter in a shutter, and make the room as dark as you can; place outwards a white discernible object of the same diameter, at three feet distance from the hole, and look at it with attention. If you are in perfect health, you shall certainly see it white; but if you place at the said hole, a flat yellow glass, and look at the white object through it, you shall perceive it of the color of the glass. What is the reason? To this I answer, that the rays emitted from the white object at first, being
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always the same, the sensation must be so too; but if you change their color by the interception of a yellow glass, the rays susceptible of assuming immediately the color of the bodies they go through, it is natural that the sensation they produce be the very same, as they are last admitted into the bottom of the globe. You ought to look upon the cornea in this experiment, when a person is afflicted with the jaundice, as the yellow glass at the hole of the shutter; because this disorder being occasioned by some castaneous concretions, which, obstructing the *duodenum*, from an obstacle to the flux of the bile, are compelled, by this means, to reflux in the blood and lymph: and as the cornea of the Human Eye is made up of pellicles ramificated with lymphatic arteries, it is clear, that the fluid contained in these little vessels give a tincture to the whole body of the cornea; therefore the yellow appearance of the objects in the jaundice, is only, or at least more dependent, on the state of this last membrane, than upon the immediate organ of sight.

If physicians and opticians had consulted the state of their own natural vision, which can alone afford means of acquiring knowledge concerning so curious an organ, instead of harkening to such idle traditions, and raising chimeras of their own upon those of other men; if they had proceeded, in the analytic method, from particulars to generals, as far and no farther, it seems to me, that they could scarce have imagined the *impression* produced by the rays on the immediate organ of sight, absolutely distinct from that of the air on the auditive nerves. When you pass from a dark room to a well lighted one, you cannot, for some time, see clearly the objects it contains; and, if you leave this last room, as soon as your eyes are accommodated to the degree of light, to come back to the first, you
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ought to have generally experienced, that you are not able to discern any object at all for a considerable time. In what manner ought we to account for this fact? If you pass from a dark room into a well lighted one, all the objects which surround you, send immediately such a quantity of strong rays on the retina, that your reflection is quite taken away by their too violent impression; because, the fibres of the iris not being so quick in their action to operate a motion of extension, which produces a contraction, as the introduction of the rays into the globe, the too great quantity of these rays cannot be intercepted in time, to become in proportion to the sensibility of the immediate organs of sight: If, on the contrary, you pass from a well lighted room into a dark one, the contraction in the pupils, necessary to moderate the strength of the rays, when in the first room, operates such an interception of them at the time you arrive in the second, that the number is not sufficient to operate a sensation on the retina, as they are emitted from objects which receive themselves no sufficient power from the primary light; because you are obliged to stay a long time in the dark room, to give the fibres of the iris a proper time of operating a dilatation, in order to admit a sufficient quantity of rays on the immediate organ of sight, capable of producing a sensation upon it. There are some eyes, I know, whose pupils are more susceptible of contraction and dilatation than others; but this must be out of the general rules I am now speaking of. If, now, we are to form a conclusion from all these observations, without any further reasoning about them than such as they justify, what must it be?— It must be plainly this, that there is in the whole animal kind one intelligent spring, common to every species, but vastly distinguished in its effects; that tho' it

it appears to be the same spring in all, yet it seems to be differently tempered, and to have more elasticity and force in some, and less in others; and that besides this, the apparent difference in the constitutions and organizations of men, seems to account for the different determinations of the visual powers, and the surprising variety of its effect.

If there were any possibility to ascertain the refractive power of the human eye, the sensibility of the *retina*, the elasticity of the fibres of the iris, and the thickness of the *cornea*, I could give a satisfactory account of all the different sights men are in general provided with: but I candidly confess my doubts, therefore I shall not pretend to trouble the reader, as some writers have. However, before I put an end to this part of my treatise, I will say one word or two on the effects of spectacles, or glasses on the eyes. It is a very nice case, if a physician has six objects to combine together, when he looks for the cause of the defects in the sight. The variation of elasticity in the fibres of the iris, abstractedly considered, may be, in some measure accounted for, especially if you make the following experiment, upon the eyes of a person well constituted and in perfect health. Let the person be seated motionless before a window, when the light is continually and uniformly the same; put a pair of spectacles forty-eight inches *focus* upon his nose; examine with the strictest attention, if by putting them on and off, the pupils contract and dilate. This done, repeat the same experiment with several spectacles of known *focus*, such as 24, 12, 6, and even 3 inches; what shall be the result? The dilatation in the pupils shall augment with the *focus*, because the thicker a glass is, and of course short *focus*, the more the rays of light, which go through it before they arrive on the retina, are intercepted; consequently an insufficient

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sensation

fenfation, not operating a motion of extenfion in the fibres of the iris capable to perform a contraction, the dilatation muft take place. The change of the fpectacles for the fame experiment, will always produce a variation of dilatation in the pupils of different mens eyes, as it is impoffible to meet with two men, whose conftitutions are the fame in every particular. Such experiments will give you an opportunity of diftinguifhing the dilatative and contractive powers of the pupils, the ftiffnefs and elasticity of the fibres in the iris.

It would be now a proper place to fpeak of the effect of fpectacles on the fight; but as this fubject belongs to the optician, I fhall not encroach here upon his right. Befides, to avoid repetitions, I will not fpeak any more about the effects of the rays on the immediate organ of fight, and the change that happens in the fibres of the iris, it being facts which are obvious to every capacity, after what has been faid concerning this fubject.

Some phyficians and philofophers have advanced, that the cryftalline had a motion of forwardnefs and backwardnefs, if I may be allowed the expreffion, to facilitate the refraction of the rays of light, and receive them as foon as they enter the globe. Comparative anatomy and phyfiology are of very great ufe to us in this conjecture. I have mentioned in the anatomical defcription, that the cryftalline lens is placed in a foffula at the anterior part of the vitreous humor, and kept faft by the proceffus ciliaris, confequently, I look upon the above affertion as groundlefs.

The cryftalline lens of quadrupeds and fuch as have the membrana nictitans, do not prefent us with the fame anatomical ftructure and phyfiology as the human eye, therefore no comparifon can be properly made between them. The moft perfect eye in the creation is, I believe, the cat's eye, and other animals of his kind. The

Sclerotica is excessively thin, but it is strengthened by the aponeurosis of nine muscles, whereof seven of them surround the lateral parts of the globe, and end at the cornea. The cornea comprehends almost one half of the globe, and is much more transparent and of a closer texture than that of a man. The cat's iris does not divide the anterior part of the eye into two chambers, but is placed immediately and loose, except at the edges, on the anterior part of the vitreous and crystalline humors: its pupil is vertical and does not dilate and contract according to the laws of that of man, the texture being different, and having neither longitudinal nor circular fibres; but it dilates and contracts by a projection and retraction of the vitreous humor and crystalline lens, which motion is operated at will, by the three posterior muscles. The retina is more nervous, and overspread by a greater quantity of arterial branches than that of man; besides a greater quantity of visual arteries vivify the optic nerve, which render it more sensible of communicative powers. Consequently we can easily account why and how the cat sees by night and day, and preserves his sight unhurt, though he frequently passes from a dark place to a light one, *et vice versa*. The membrana nictitans is the preservator of the cat's eye in two respects; in one, because that part which comes immediately in contact with the external parts of the globe, is smooth and furnished at its extremity, with nine glands, continually supplied with a sebaceous humor, to temper the acrimony of the tears, and keep the cornea in its natural transparency. If the cat goes from a dark place to the sun-shine, his sudden faculty of contracting the pupil not being sufficient, the membrana nictitans and the lids come immediately to intercept the rays,—a function that we generally supply by the use of our hands on our eyes shut. From what has been

advanced, it will evidently appear, that observers, who thought that there was a motion of forwardness and backwardness of the crystalline lens to answer some purposes in the sight of man, ought not to be depended upon. Mr Locke, who was the proper writer to consult upon the subject, has been the only one that has not been mentioned by them all. When authors have been sufficiently sensible, that it was impossible to detect them in hazarded opinions, they have ventured all sorts of systems. Thus have they in all ages amused mankind with systems of imaginary knowledge, raised in fantastical ideas and notions, rather than confine themselves within the limits of real knowledge. Instead of mixing our opinions by evident truth, and giving our minds any solid foundation whereon to rest, they have involved us in doubts, and eternized disputes.— Like *Noctambules*, they have staggered about, and jostled one another in their dreams. Since the torch of experimental philosophy has been lighted up, these hypothetical reasoning have been exploded, or else confined under certain conditions, in all that relates to corporeal nature.

After all these reflections and observations which I have laid before the reader, merely to deter him from the reading of such writers, as they occurred to my experience, nay, after all those which some others suggest, or which a man of better parts, more knowledge, and more leisure, would be able to make, I doubt not but one of our most precious senses will be better understood.

OF THE
DISORDERS OF THE EYES
IN GENERAL.

IT is as easy to distinguish, by looking at the eye with attention, if it be deprived or not of the faculty of seeing, as it is difficult to know the true cause. The want of contraction and dilatation in the pupil, foretels a privation of sight, whose causes may be numerous and diversified. It happens, however, that contraction and dilatation exist, though the organ be deprived of sight; but it is easy to discern one and the other case. The immediate organ of sight is the only part of the human body, delicate enough to be sensible to the impressions of the weakest rays of light; therefore, the more rays there are united, and absorbed on the retina, by the meconium which lines the choroides, the completer the sensation, otherwise this last operation does not exist, as well as reflection, which both contribute, dependently of each other, to make us perceive. If the rays arrive and are absorbed on the retina, the stroke it receives is sufficient to agitate the fibres of the iris; then a contraction in the pupil is operated. If the stroke become less, the fibres return in their natural state, what operates consequently a dilatation. The inquisitive observers will remark this contraction and dilatation augment or diminish, exactly in proportion to the conuscations of light; and if the rays arrive on
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the retina, without being absorbed there, they pass on the choroides, without producing a sufficient shake to put the fibres of the iris in a regular motion; insomuch that the pupil contracts and dilates by fluctuation,—a symptom which gives to understand, that the vessels ramificating in the choroides, have no longer their natural elasticity to keep the meconium upon its surface, in order to facilitate the absorption of the rays on the retina; or, in short, that this membrane is inflamed or unable to perform its functions by any cause whatsoever. This malady is no less common than dangerous. It is no sooner arrived to its last period, then it is deemed incurable, and characterised of a gutta serena, what should not be, as this is liable to lead practitioners astray. So that it is very easy to conceive how many times this mistake did, and still does, furnish occasions of quackery, if you take upon yourself the trouble of examining the conduct of the artful writers and practitioners upon the disorders of the eyes, either in their writings or practice. It is from their ignorance and cheat, that so many misuses have arose, and still exist; in fact, they have characterised of gutta serena every privation of sight, when the globe of the eye was not exteriorly affected, except that of the cataract and glaucoma, which have been since distinguished.

The gutta serena is either perfect or imperfect. The paralysis of the retina and optic nerve, more or less confirmed, constitutes one and the other. Menses and hemorrhoides suppressed, blows on the head, apoplexy, overflowing of the milk, morpheus kept in, scorbutic virus, venereal relics, &c.; obstructions, sanguinous and lymphatic tumors or others, either in the interior of the globe of the eye, or around the optic nerve, known by the opening of dead bodies, are capable to produce blindness. The perfect or imperfect paralysis in the retina

retina and optic nerve occasions more or less sensibility in them. Of all the symptoms that foretell a disorder of the retina or optic nerve, there are none surer than the state and motion of the pupil; because after having observed, that nothing intercepts the rays, and that they are absorbed upon the immediate organ of sight, there may be no other symptom to lead in a mistake. If a *meconiumless* exists, the bottom of the globe of the eye looks grey, or of a very clear water color. The only case which obliges us to conjecture is, when the meconium is of a grey color; because we cannot positively say if this blindness is occasioned for want of meconium, or by an affection in the optic nerve: we may, however, get information from the patient's discourses, and the different progress of the disorder. All this depends very much on the skill and penetration of an able man, especially if he has himself keen eyes. It is physically impossible to cure a gutta serena, considering the difficulty there is of disobliterating such small vessels, placed into the bottom of the globe of the eye; especially when the obstructions are old, or the internal membranes tore to pieces.

If the imperfect paralysis of the retina is the consequence of some lymphatic obstructions in the vessels which ramificate it, caused by a thickening in the humors, bleeding cannot bring to circulation all the coagulated humors that are contained in the extremities of such delicate and small vessels, whose diameters diminish in proportion to their length; because the swiftness of the evacuation is in compounded *ratio* of these vessels diameter and fluids coagulation, and that a contraction must necessarily happen and stop up these humors in the extremities of these tubes, whose diameter is smaller there than at their source: consequently bleeding shall only desobliterate the humors in a limpid state. Physic,

fic, in such a case, indicates an emollient fumigation for external remedies, and diluting drinks for internals, whose end is to keep open the pores of the membranes of the eye, and facilitate the resolution of the local stagnation. The effect, though slow, is however very sure of success, when every particular incident is attended to with the greatest precision and skill. The sight, after the use of such external applications, becomes generally very dim; but, to counterbalance this defect of sight, which is occasioned by a relaxation in the parts, you recommend spirituous or astringent lotions, or evaporations of such strong spirituous fluids over the eyes as may well answer your purpose according to circumstances. I give a complete explanation of the effect of these external remedies in the following observations, therefore I need not mention it here.

When the optic nerve is pressed in the bottom of the socket by some tumors or other accident, whose consequences are more important than the disorder to which you will remedy, that case ought be excepted from the general rule. It is as impossible to cure the complete paralysis in the retina, as the gutta serena; every physician who boasts of success in these two cases, is a downright empiric, or ignorant of the real case.

The glaucoma is an opacity of the vitreous body, which becomes afterwards of a green color. Let us distinguish the species and causes of this pernicious malady, which every able physician deems incurable; in order that it may not be mistaken for a paralysis in the retina, an affection in the optic nerve, or a want of meconium on the choroides. The vessels, which, from the choroides, pass to the retina, and from thence into the vitreous body, to furnish it with the nourishing juices so necessary to keep up its perfect state of fullness and transparency, are liable to be obstructed or ruptured
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after some internal inflammations. By these accidents, the vitreous humor becomes tarnished for want of receiving its nutrition, and is not a long while to change this state for that of the opacity, which then intercepts all the rays of light. Are not the pores in its capsule susceptible to be obstructed? Cannot an abscess be fixed on the posterior part of this capsule, and produce there an opaque cicatrice, without any loss of transparency in the humors, in the above two cases? Most certainly: Because the blood vessels continue, in spite of these accidents, to bring in their fluid. If the whole part of the hyaloida, which is placed on the retina, became opaque, or the vessels which ramificate it, only obstructed, and that the vitreous humors and the anterior part of its capsule were transparent, would it not be very easy to mistake this case for a gutta serena, if but a superficial examination of the eye was made, or if the observer's eyes were not exceeding keen and good? Very likely. It is the very same mistake of the contraction and dilatation in the pupil that have given reason to some antient and modern writers to say, that it was sometimes susceptible of it in the gutta serena: an error that brought a great many others after it. If we enquire into the cause of such a contraction and dilatation in the pupil (the organ being deprived of seeing) we must be sensible that the hyaloida, being become opaque, or obstructed in its pores to its posterior part only, that it does not intercept entirely the rays of light which penetrate, for all that, on the retina, but whose impressions are not strong enough to produce a sufficient sensation to effect perception. When the vitreous humor begins to tarnish immediately at the point the rays of light pass to arrive on the retina, the pupil is dilated by degrees to let them go in; and when it is entirely dilated, and remains so, you may rather conclude, that this is a

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symptom

symptom by which the glaucoma began. One or several cells of the vitreous body may also become opaque, together with the internal tunic, called arachnoida, without the whole becomes so too. These different causes constitute the more or less perfect glaucoma, and diversify it either in dry or humid. Internal or external inflammations, very ill attended to during their existence, are sources of the glaucoma.

There is another disorder which belongs particularly to the vitreous body, and would be difficult to understand, if I did not begin the description by its symptoms. I have often seen patients who complained of a pain at the anterior part of the head, and in the eye, some on one side only, and others on both: After that pain, which subsided in some, and in others continued, the globe of the eye, on the side of the pain, did appear a little bigger and more prominent, the pupil more dilated than ordinary, contracting but very little, and difficultly to a great light, and even to the sun-shine; besides, the sight did diminish so quick, that, in a short time, they could hardly distinguish the light, and very obscurely, common objects; some not being able to find their way, in a few days, without a guide. In most of those patients, the above accidents happened to both eyes, either at the same time, or some time after. To some, the pains which preceded the dimness were not considerable, feeling only some heaviness at the part; in others, they were sometimes so violent that I could hardly remark, whether the eye was in its natural state, or more prominent than ordinary, particularly with those who had naturally dark eyes; but with those who had grey, or large blue eyes, and who had only one eye disordered, I could distinctly observe, that the eye was bigger. In short, by the use of remedies which I shall mention hereafter, these symptoms did

did diminish by degrees, and the patients recovered their sight, some slowly, others suddenly; but most part a while after, except those who did not go through the same remedies, the disorder terminating always in an incurable glaucoma.

Reflecting on all these symptoms, I think that the globe of the eye cannot acquire a bigger size, unless some humor gather within itself; and, if that happen to be the case, the vitreous body must indeed be increased, and the pupil unable to dilate and contract freely; therefore, I have every reason to believe the increase only partial in the vitreous humor, and particularly in the above case. If you recollect what I have said concerning the structure and nutrition of that body in the Anatomical Exposition, it will be easy to conceive a kind of contraction and dilatation in the pupil; since the aqueous humor being abundantly supplied, it must be equally distributed in both chambers, consequently the iris cannot be more pressed on the one side than on the other. If the vitreous humor is viscidous, and stagnates in its capsules, the vitreous body will increase in size; and that cannot take place, unless the following symptoms appear: *Primo*, The globe of the eye ought to be a little bigger, since the vitreous body in its natural state takes up most part of it. *Secundo*, The cornea ought to be more prominent, because the aqueous humor is violently pushed forward. *Tertio*, Patients ought to feel pains in the eye at the beginning and progress of the disorder, on account of the extension of the membranes of the globe and those contained in it, and by sympathy to the anterior parts of the head. *Quarto*, The pupil ought to be dilated and almost immovable, because the vitreous body in extending, brings the crystalline lens forward, and presses on the posterior part of the iris. *Quinto*, The sight ought to diminish
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excessively,

excessively, because the refractions of the rays of light are altered on account of a change of situation of the crystalline lens, and the retina pressed backwards by the vitreous body. *Sexto*, When this body returns to its natural size, sight comes on again but not so perfect as it was before, for such an alteration cannot take place without some slight disorders remain in the other parts of the globe of the eye.

The disorder in its beginning is very difficult to distinguish from the true cataract, the symptoms of both being nearly alike; but as its progress is afterwards quicker, without any appearance of alteration in the crystalline lens, we become sure of its kind in due time. Men of a cacochimic and melancholic constitution are commonly afflicted with that disorder, but those who are most subject to it are women with child who come within the above constitution. The disorder begins about the second month, and continues till they are brought to bed, or often long after it; also to women who have not their courses, or have them irregularly. Practitioners mistake this disorder for the gutta serena, because no other alteration of the eye takes place, except a great dilatation in the pupil. It is sometimes cured when the eyes are blue, but seldom when they are dark, because the coats and tunics of the former are soft and more porous than the latter.

The disorders of the crystalline are few in number, but very well known. Physicians are only divided in their opinions as to its nutrition. Some pretend that this lenticular body keeps its transparency by the help of the nourishing juices brought by some blood vessels, which penetrate from the capsule of the vitreous body in the crystalloida; others that it is by imbibition, as it swims in Morgani's humor. Without being able to satisfy and convince every body by any physical reasons
whatever,

whatever, to the support of one opinion more than of another, (as these vessels are almost invisibles, and that the crystalline, which is a solid body, cannot of course soak a great quantity of morgani's humor to keep it transparent) I think that both means contribute to preserve its perfect transparency. The alteration of the crystalline, called cataract, is the most common disorder of this diaphanous body. The surer method to cure it is extraction: when the capsule, which wraps it up, becomes opaque, we call it *membraneous cataract*, though the crystalline lens be transparent. If it be stony, *stony cataract*, and so on of all the other forms or species it may assume; but when several of these disorders meet together, it is called *complicated cataract*. The most common symptoms are a dimness in the sight, though the pupil dilates and contracts, when the organ is exposed to a less or greater degree of light; some flies, filaments, and many other objects, the patients fancy to see flying before their eyes, whose forms vary in proportion to the spots which are existing in the crystalline, or on the crystalloida. The different treatments change the symptoms according to the alteration of the disorder, its periodical causes, and the patient's health, as shall be explained at large in the following observations on this head. If the cataract be formed by want of circulation in the humors, which is very often the case, the remedies, which are conducive to promote it, shall be the properest indications; but great precautions, skill, and experience are required, in order to chuse them right; for some of them may be very dangerous, as they occasion a running of meconium from off the choroides. All this depends very much on the particular care of the physician. The prescriptions of internal medicines, in such a case, are seldom of use. They, indeed, can retard the formation of the cataracts; but I have observed, that, in general, they are formed

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in spite of the strictest attendance. This disorder cannot be distinguished but by those who have a great deal of experience and skill, and exceeding good eyes.

The iris is susceptible of inflammation, as well as all the other parts which compose the globe of the eye. When it is only fixed on its anterior lamina, it looks of a reddish color; and on its posterior, you can but conjecture it by the pains the patient suffers. The manner of curing this disorder will be laid down in the following observations. When the inflammation is properly attended, no defect remains on the iris; but if a suppuration takes place, the abscess generally opens of itself, and its matter empties into the globe, without any detriment to the other parts. I ought to observe by the way, that on the abscess's place, a whitish or blackish spot, called cicatrice, is the never failing consequence. If the abscess be considerable, and the matter acrimonious, it very often ends with the dejection of all the other internal parts of the globe of the eye, or at least some of them.

The Hypopion is a gathering of corrupted matter, which continues for some time within the coats of the eye, particularly in the cornea, and afterwards evacuates either within the chambers of the eye, or out of the globe. This gathering may be produced by an abscess or extravasated blood, occasioned by a blow or a violent inflammation, the small-pox, extraction of the crystalline, &c. There are a great many methods of proceeding in the cure of this disease: first, it is absolutely necessary and important to be well assured of the cause. This gathering of matter may be evacuated if it be fluid, by the use of warm emollient lotions or fumigations; sometimes bleeding will be necessary at the same time, if positively the violence of the inflammation requires it. If you do not succeed, and that the
matter

matter be solid and acrimonious so as to endanger the loss of the organ, you should open the cornea to let it out.

The disorders of the cornea are very common. The albugo and spots which grow on this membrane are produced by inflammations very ill attended to. The obstruction in the vessels of the cornea are the very causes of this disorder, as they destroy its transparency. After a violent inflammation in the eye, inflammatory pustles, such as very often happen on the cornea by several causes, and especially during or after the small-pox, are also conducive to it. The little scars made after the resolution of an abscess, and the cure of a wound in the eye; the action of sharp or corrodent remedies fallen by chance on the globe of the eye, or ignorantly applied on; in short, the abscesses, or gathering of humors, which are formed during or after the inflammation, even betwixt the *cornea's laminae*, when these humors become hard by degrees, form almost always the opacity. The albugos, and spots in and on the cornea, are always of a very difficult cure; but all do not oppose the same resistance. They are more or less easy to cure, in proportion to their extent and situation in the external or internal *laminae*.

The Pterygium is a rising, fleshy membrane, which begins growing to one or the other angle of the eye, and extends slowly from the conjunctiva to the cornea, to such an extent, as sometimes to intercept entirely, or in some part, the rays of light. It is very often formed on the conjunctiva, and sometimes betwixt this membrane and the albuginea. People accustomed to periodical and habitual inflammations in their eyes are the most subject to this disorder. The varicous-vessels occasion a discharge of nourishing juices, which find their flowing intercepted between the interstices of the membrane,

membrane, and become by degrees solid in producing some excrescences, which vary in color and size. The pterygium, as well as an infinity of tumors, which grow under the eye-lids, may be extracted without the least danger to the organ; and when the patient will not undergo the operation, they may be destroyed with the use of deterfive pomatums, as are recommended in the following observations.

The Staphyloma is a tumor produced by a membrane pushed out of the globe by the humors of the eye. For example, the staphyloma of the iris is so called because part of it appears without the globe, through a hole, either in the cornea, sclerotica, or between one or the other of these membranes. The staphyloma of the sclerotica and cornea are so called, when one or the other of these membranes become thinner in one place than in the whole extent, and are dilated by degrees, so as to form a more or less considerable tumor over their natural convexity. The prognostic of these disorders is always unfortunate: for, besides the loss of sight, and extreme deformity they occasion to the eye, they often produce head-aches, wakes, very violent and severe inflammations, suppurations; and it is not even very rare, if they degenerate into a cancer.—Great attention to the size, causes, and patient's health, during the treatment of this dangerous disorder, ought to be attended to.

The eye-lids, which adhere to each other, or to the globe of the eye, either naturally or by disorders, by what cause soever, are so uncommon cases, that we meet with observations upon them in authors, except their uniting by a glutinous matter, which flows very often in the small-pox; but this is very light and superficial, as it cannot be looked upon as a true coalition. This deformity is sometimes to be met with in infants.

infants. The cure consists chiefly by separating with dexterity one eye-lid from the other, and taking proper means to palliate the violence of the inflammation, that such an operation must necessarily occasion. All this depends upon the skilful operator, who must take into consideration what may be the most proper means, in order of disuniting the eye-lids the better, and destroy their adherence from the globe, to set them at liberty. As it is very difficult to satisfy an inquisitive reader by imaginary descriptions, I refer his curiosity to the following observations upon this head.

The Trichiasis, or Phalangosis, are three rows of eye-lashes, placed in such an inward disposition, that it is termed a disorder, as they continually inflame and rub on the globe of the eye, produce excruciating pains, and sometimes the loss of sight, if they are not plucked out.

The overturning and retraction of the eye-lids are commonly looked upon without any hopes of a perfect or radical cure. This disease depends upon the inferior eye-lid: it exists in the orbicular muscles, on account of their weakness or relaxation, especially in old people, without the least cicatrice. When the eye-lid overturns of itself, and shrinks in such a manner, as to cover no more the globe of the eye, and that the part of the conjunctiva, which lines it inwards, is turned outwards; you have nothing left but the operation, after having tried, to no purpose, the use of emollient and humecting fomentations, agglutinative and astringent plaisters. In short, such cases are always of a very difficult curation: the main end is, to re-establish, as much as possible, the natural dimensions of the eye-lid.

The Schirhus in the eye lids, is a very common disorder, occasioned by intercepted perspiration, thick humor, which remains in a particular place for a long while and becomes very often a hard tumor. Any lotion that

softens, is of great service in this case, but not sufficient to destroy the malady without return; then you have nothing else to do but to attempt the re-establishment of the glands of Meibomius, whose obstructions are the principal cause.

The *Fistula Lacrymalis* is a disorder existing in the canals leading from the eye to the nose. It is produced by an obstruction in the natural course of the tears, and makes them trickle down the cheeks. This defluxion indicates sometimes a purulent serosity, or true corrupted matter contained in the *saccus lacrymalis*, which flows from the great angle of the eye (either spontaneously, or in compressing the *saccus lacrymalis* with the tip of the finger) over the cheeks. It comes very often from the ulceration of the *lacrymal ducts*, and oftener from that of the bag. If the ulcer is of an acrimonious nature, the *fistula lacrymalis* is to be feared. This ulcer corrodes oftener the *saccus lacrymalis* than the teguments, which wrap up the bag, and very seldom the neighbouring bones. In a *fistula lacrymalis*, the purulent serosity goes out of the bag through the *puncta lacrymalia*; when the bones are at the same time corroded, there is a solution of continuity to the skin and complication with caries, then the matter runs down into the nose. A physiological account of the *lacrymal ducts*, and some observations, will be sufficient to give a comprehension of all the diversities to be met with in a disorder so very common and difficult of curation.

PHYSIOLOGICAL ENQUIRY

INTO THE

LACRYMAL DUCTS, AND THE ORIGIN OF THE LACRYMAL FLUID.

EVERY one may judge of the importance of the lacrymal organ by its function. Nature formed it to receive the fluid which runs through different excretory ducts to lubricate the eye, and the internal parts of the eye-lids: at the same time, this fluid keeps the transparency of the cornea; without its help, the functions of the eye would be suspended, or at least very much injured.

The harmony which exists between the *productive lacrymal ways*, and the *absorbent* ones, deserve all our attention. On the one side, we remark a constant exudation which drops from a great many pores and excretory ducts; on the other, two lacrymal points and ducts to pump or absorb all the lacrymal serosity, except what is evaporated in the air.

Though anatomists have been employed this great while about that essential part, the description they have given of it leaves still a good deal to desire for the perfection of our knowledge. The greatest number amongst them have said, that the immediate spring, or source of the tears, came from the *glandula lacrymalis*: nevertheless, the inorganic pores of the cornea furnish a great deal of the lacrymal serosity. The excretory ducts

of

of the *caruncula lacrymalis*, the conjunctiva, and those of meibomius glands, furnish also part of the tears, inso-much, that it is very easy to prove, that the *glandula lacrymalis* does not produce one third of them.

The knowledge of a greater quantity of excretory ducts of the tears would not be of considerable importance, if it were only matter of anatomical curiosity; but it demonstrates the true cause of several disorders of the lacrymal ways, to which no attention had been paid, or which had been confounded among the rank of the other disorders of the eyes. In fact, no treatise has mentioned, 1st, The atony or dilatation against nature in the inorganic pores of the cornea, nor those in the conjunctiva; meanwhile, this disorder causes so great a quantity of tears, that it may have imposed upon several practitioners to such a degree, as to make them believe that there was an obstruction in the *ductus ad nasum*, whilst it might be in the most perfect state. If, in this case, the puncta and ducts lacrymalia do not absorb the tears, it is because the proportions are not relative, there having more of the lacrymal secretion than may be contained into their diameter. 2^{dly}, Our authors have also been ignorant, that an obstruction in the glands of meibomius is the cause, that the oleaginous fluid, furnished by them, is in a less quantity than necessary to defend the conjunctiva and the cornea from the acrimony of the tears, and the injury of the air; for from it proceeds a flux of tears, and an inflammation in the eye, which stands against the best and well prescribed remedies, till these glands be in their natural state. 3^{dly}, They have not been less silent upon the true cause of the Hydrophalmy. This disease is produced by the obstruction in the inorganic pores of the cornea; it is the retention of the superfluous of the
aqueous

aqueous humor, which extends the tunics of the eye at that time, and increases the bulk of the globe.

If we examine their description of the puncta lacrymalia, the sacculus lacrymalis, *ductus ad nasum*, and the mechanism which they settle to these parts, for pumping the tears; if we compare what they have said, with what the anatomy and mechanism of these parts present us, we shall observe that they have neglected to describe a great many essential parts, which manifest themselves to the inquisitive eye. It is then of the greatest consequence to enquire into every subject which establishes the lacrymal organ, to make us acquainted with its true mechanism and functions, in order of distinguishing the various causes from whence proceed the maladies which disturb its harmony, and point at once, and with more precision, at the curative indications.

Nature has divided the lacrymal ways, *1st*, In parts which furnish the tears, and those which are bathed by them. *2dly*, In parts which pump or absorb this fluid, and in those which contain them.

Of the production of the Lacrymal Fluid.

THE excessive fluxes of the tears which are occasioned by the introduction of an extraneous body in the eye, have this great while given an opportunity of supposing, that the lacrymal fluid had some other excretory ducts than those of the *glandula lacrymalis*. The frequent inquiries and inspections of sound and sore eyes have at last thrown some light on the subject.

§ 1. *Of the Glands of the Conjunctiva, and the Excretory Ducts of the Glandula Lacrymalis.*

THE whole surface of the conjunctiva is covered with a great many excretory ducts, and inorganic pores:—

But,

But are the first membranous, and the second the extremity of some arteriols? If the secretion through the pores of the conjunctiva was furnished by some arteriols, the consequence would be very sensible in the humid inflammation: the flux of tears is occasioned by the atony of that tunic, and manifests itself by the dilatation of its excretory pores: in that case, a flux of tears should ensue; but this is what never happens.

Will any one object, that the excretory pores in the conjunctiva are lymphatic arteries, and conclude from thence, that the serosity which is furnished through the pores of this tunic cannot be but diaphane, even in the atony state of that membrane? To this I answer, Every body knows that the inflammations are caused by the passage of the particles of blood into the lymphatic arteries, whose tunics have almost lost their oscillation. How could it be possible, in the case of a great inflammation, that the excretory ducts in the conjunctiva might, though dilated against nature, put an obstacle to the passage of the blood? Let us rather conclude, that this serosity is furnished by a great many glands spread over the whole surface of the conjunctiva.

Have you seen these glands that you admit upon this tunic? I answer, that it is impossible to distinguish them in their natural state; but when they are swelled, they are not only visible, but you may discover their very frame.

Upon the conjunctiva, at two lines from the limb of the cornea in the external angle, you will see sometimes little tumors very near each other; every one of them are of the size of a millet seed: take of this portion of the conjunctiva, and you will observe, 1st, That these tumors are in the substance of that tunic. 2^{dly}, Cut several of them, you will have an opportunity of discovering with a microscope, that they are, as to their
frame,

frame, like those glands which are known to us. 3dly, Having left the others to be macerated in water, they shall increase in bulk, and you will remark, that every one of them is wrapt up in a capsule, and that their internal parts do not differ from the first.

If these little tumors be some pustles, do you suppose they should have the frame and consistence of a very close web? Do you think they should have an exact conformity with the texture of the glands? Do but consider the eyes of several men, you will often remark some of these little tumors upon the conjunctiva. They are nothing else but some glands swelled to such a degree, as to give you an opportunity of distinguishing them from the little abscesses which attack that tunic. Pustles are purulent, or form some hydatides; these have a fluctuation, which does not exist in the tumefied glands.

Most part of the little abscesses which attack the conjunctiva are caused by the swelling of the filters in the glands of this tunic, and by the introduction of heterogeneous parts, or by the alteration of the lymph which is become stagnant. The acrimony and purulent matter disturb and destroy the glandulous bodies. The pustles which afflict that tunic are similar to those which are formed all over the human frame.

It is needless to describe a greater number of these facts, because, without having recourse to the tumefaction of the glands in the conjunctiva, there will be no room to doubt of their existence, if you take notice, that this tunic is in every thing alike to most parts of the membranes in the human body, which have a great quantity of them.

For what reason would you exclude these glandulous bodies from the conjunctiva, since almost all anatomists agree, that they are to be found over the whole web of
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the skin? Is it because one is more united than the other? No, certainly. Have we not in all cavities whatsoever of our bodies some tunics whose texture is a great deal thinner, or at least as delicate, which have some glands and excretory ducts, from whence flow, without intermission, a fluid fit to water all the parts in the spaces which inclose them, to impede the drying of the fibres which compose them, and that of the tunics which involve them? Every body knows, that the sacculus lacrymalis and its ducts have some glands, from whence flows continually a secretory humor. Where is the exception why the conjunctiva should not share the general construction? Did it not receive in its formation the same organization, and the same prerogatives, as the other membranes which are analogous to it?

The following experiments will prove, moreover, that its perspiration is also abundant, nay more sensible.—Overturn the eye-lid of any one whose organ is sound; wipe it with a very fine piece of linen cloth, you will observe, with the help of a magnifying glass, or without it, some little drops which transfuse through the pores of the conjunctiva. These drops shall increase by degrees, till they form, in a little while, a sheet of water. Wipe now and then this part, you will distinguish a new secretion, which shall be as limpid, viscous, and brinish, as the first. You will remark too, that during this experiment, the eye is very much bathed in tears, on account of their abundant secretion, and want of action in the puncta and ducts lacrymalia, which are not in a direction to pump or absorb the whole fluid, furnished by their excretory pores and ducts.

Let the eye-lid be overturned during twenty minutes or upwards, you will perceive not only a constant transudation, furnished by the ducts of the conjunctiva, but also the flux of the tears increasing till they fall drop
by

by drop, with as much celerity, as if the subject was grievously weeping. The cornea shall loose of its transparency, by want of brightness under the water which covers it; but as soon as the eye-lid is in its natural state, its motion shall equally extend the lacrymal fluid, by which means this membrane will re-assume its former transparency.

This experiment is a proof, that if the glandula lacrymalis be alone able to furnish the tears, it should be necessary it had some more and other excretory ducts than those which are known belonging to it. It follows also from this experiment, that the glandula lacrymalis, being not able to furnish the eye with lacrymal fluid, when the superior eye-lid is overturned, that the abundance of the tears which gather at the valvula lacrymalis come from some other sources.

If this lacrymal fluid, furnished by the glandula lacrymalis, was as abundant as it has been believed, it would manifest itself by a copious secretion to the edge of the tarsi, when the superior eye-lid is overturned: but, on the contrary, you may remark, that these excretory ducts do not furnish more tears than those in the portion of the conjunctiva.

Here you may object, 1st, That the copious secretion of the tears, which happens during that experiment, is occasioned by the compression of the eye lid overturned upon the globe of the eye, and that the tears must be in a less quantity than when this eye lid is in its natural position. 2dly, That the liquor produced by the glandula lacrymalis is intercepted on account of the overturning, which must occasion a compression upon the excretory ducts, to a degree sufficient as to intercept a great part of them.

Answer to the first objection: 1st, The globe of the eye cannot be squeezed by the overturning of the eye-

lid, because its web is very soft; besides it should be necessary, for the existence of this compression, that the eye-lid should be bent, whilst there is a space between it and the globe, what stands for a proof to the contrary. 2dly, If the eye was pressed, the eye-lid and the globe would be fixed, and their motions suspended. 3dly, The globe, on account of its rotundity, leaves in its superior part a space which cannot be filled up by the eye-lid. 4thly, The person whose eye-lid is overturned, feels no pain at all in this part, which should happen if the eye was squeezed by it. 5thly, Every one knows that all compressions intercept more or less the flow of liquors in the vessels, from whence proceeds inevitably a stagnation in them, and of course an inflammation. Let us conclude, then, that the eye is not squeezed during the experiment, and that the flux of the tears comes rather from the secretion which continually runs through the pores of the cornea, those of the conjunctiva, the caruncula lacrymalis, and through those called *glandulae sebaceae meibomii*.

Answer to the second objection: The overturning of the superior eye-lid cannot be an obstacle to the flow of the secretory fluid from the glandula lacrymalis; 1st, There is no impediment; 2dly, The ducts of that gland cannot sink, though the eye-lid be overturned, considering that any fluid, by its impulsion, has strength enough to widen the insides of the ducts which must give way to it; lastly, Because, if these ducts were to swell during that experiment, it should happen, after the re-establishment of the eye-lid, an abundant effusion of tears, on account of the discharge of these excretory ducts, whereas the exudation is much the same.

These are sufficient reasons and experiments to establish, beyond any doubt, that the glandula lacrymalis furnishes but a part of the tears. Will you object, that
this

this experiment alone is not able to prove the existence of the excretory pores in the conjunctiva, and that it might be possible these tubes belonged to the glandula lacrymalis? The following experiments are proofs to the contrary.

Overturn the inferior eye-lid; desire the person to lift up the axis of his eye, in order to give the conjunctiva a greater convexity: put, betwixt this tunic and the globe, some lint, to keep the tears out of that part of the conjunctiva which is the subject of your examination, and wipe it with a fine linen cloth; then you will observe, in its whole extent, a great many drops, which increase by degrees just as they are coming out, and in a little while join each other. Remark, at the same time, that this fluid is wholly alike to that which exudes out of the internal part of the superior eye lid; and that the quantity seems equal in both, proportionally to their extent.

Introduce a *speculum oculi* in the eye of a living animal, to remove the eye-lids from each other; dry, with a linen cloth, that part of the conjunctiva which covers the globe of the eye, then you will observe the same transudation as that in the interior part of the eye-lid. The dilatation of the pores in the conjunctiva is also a convincing proof of it; and the flux of the tears, which is the consequence, demonstrates also the very kind of this fluid, and what must be its destination.

§ 2. *Of the Inorganic Pores of the Cornea, and the Origin of the Secretory Fluid, to which they give passage.*

The cornea furnishes also a secretion through a great many inorganic pores, dispersed upon its surface; and, if a great number of anatomists have been ignorant, or said nothing about this function of the cornea, some have favoured us with an account of it.

The aqueous humor is produced, or regenerated into the eye, by a kind of transfusion, through the vitreous and crystalline humors which having filled up the space between them and cornea, flows afterwards through the pores of this membrane, to let some of the new humor in its place. You will be certain of it, if you take notice that the anterior part of the vitreous body incloses always in its cells an aqueous humor.

The filtration of the aqueous humor through the excretory pores of the cornea, is evident; but this is not sufficient; we must endeavour to prove, that this fluid is a great portion of the tears. To be convinced of it, clear and exact notions upon this head are necessary. Let us consider, *1st*, The nature and quantity of the secretory fluid, which runs through the pores of the cornea; *2^{dly}*, The reservoirs of this humour; and, *3^{dly}*, The sources which furnish it.

Introduce into the eye of a living animal, a *speculum oculi*, which may keep the eye-lids from each other, and make a soft pressure round the globe; wipe the cornea with a linen cloth; then you will observe a great many little drops, following one after another, transfusing through its pores: In a little while, these drops shall increase till they join and spread over the globe of the eye. If you continue this experiment for twenty or thirty minutes, and wipe now and then the globe with a linen cloth, the secretion shall be as equal as copious, without any diminution in the bulk of the eye. This experiment, performed on the eye of a subject newly dead, produces the same, with the difference of decay in the eye; which is a proof that this secretion is supplied by the aqueous humor, which, in renewing itself continually in the living eye, hinders it from withering.

There

There will be no room to doubt concerning the abundant secretion of the aqueous humor, through the excretory pores of the cornea, if you take notice of the quantity of fluid furnished by the eye, when a cataract is extracted out of the organ. The cornea does not sink, though the aqueous humor is continually running out, till this tunic be entirely healed of the wound practised upon it.

This kind of secretion is no less abundant when an ulcer has corroded the thickness of the cornea; for the eye would be very soon melted away, if the impulsion of the aqueous humor did not compel part of the iris to go through the hole of that tunic, in order to stop the too quick effusion of it. The epiphora, (a dilatation against the nature of the pores in the cornea) is another proof that this secretion is the superfluous part of the aqueous humor, and how quickly it is renewed.

After such an exposition, you may consider the globe of the eye as a great source of the tears, and the chambers of this organ as two reservoirs appointed to furnish this secretion; but now it behoves to know, and enquire into the sources which renew it so quickly.

§. 3. *Of the Vitreous Body, considered as a Source of the Aqueous Humor, and consequently of the Tears.*

The vitreous body is composed of two tunics, one cellulous, which occupies the interior; the other capsular, which wraps up the whole. The cells are full of a diaphanous fluid, which filters imperceptibly, and flows from one cell into another, as far as the excretory pores of its capsule. This fluid is conveyed into each cell through a great many lymphatic arteries, which, from the choroides and retina, end in the interior of the vitreous body.

Cut;

Cut, in a circular manner, the middle part of the eye of a subject newly dead, without cutting, if possible, into the vitreous body; perform another half circular section in the posterior part of the globe, in order that both extremities join the first; remove lightly the divided portions, and you will see that the vessels, which from the retina end into the vitreous body, are all lymphatics, of a diameter more or less small, and very near each other, especially towards the *plexus ciliaris*. As soon as you put away the retina from the vitreous body, the extension of these vessels shall sooner determine the rupture of some of them than of the others, according to their thinness.

Take away the vitreous body, and wipe it with a linen cloth, you will observe that its surface has the most exact smoothness, a transudation shall take place all over its extent; squeeze it superficially in its centre with a buttoned probe, it shall yield to its pressure; but as soon as it is discontinued, its elasticity shall re-establish it.

You will conceive the cause of this elasticity if you squeeze very hard betwixt your fingers the middle of the vitreous body. The touch will give you an opportunity to feel a little breaking, which proves the sinking of the part, and the rupture in the insides of several cells, wherein is contained the vitreous humor. This is a proof that the fluid has been forced into the neighbouring cells.

These cells are so well supported and heaped one upon another, that they have the same faculty communicated by any motion to a globulous body, pushed by any cause whatever. You may comprehend, that, after such a structure, the vitreous body must yield to the least compression, and reassume its former state, as soon as you cease to squeeze it. At the time of a strong pressure,

pressure, the fluid must break the inside parts of the cells which contain it, and cause a sinking in that part, whilst those that are near them keep still their elasticity.

But the vitreous fluid must tear the insides of the cells which contain it, in removing from the point of compression, though light, since the tunic which forms them is very delicate? To this I answer; Every fluid is compressible, and when compressed, it does not occupy so much room as before: besides, this aqueous portion conveys itself in the lateral parts, and runs into the neighbouring cells through little pores which exist in their sides; infomuch, that all this fluctuation is performed without rupture, and the fluid re-establishes itself as soon as the pressure is finished. This last case never happens, when the compression is too strong; because the inside of the cells cannot sufficiently spread of themselves, and with celerity enough, to obey the active impulsion acquired by the vitreous humor.

At the time of a quick pressure, this fluid tears and forces the obstacles which oppose its extension; from thence no elasticity, because this fluid is dispersed and unable to produce a retro-active effect, for want of being inclosed in the cellular spaces: the heap of the cells gives the elasticity to the vitreous body, as has been already observed.

The following experiment will give you a clear idea of the communication which exists between the cells of the vitreous humor. If, after an extraction of the vitreous body, you put it in a spoon over two or three lighted coals, you will observe, when the ebullition begins, a decrease in the vitreous body, by the contraction of its capsule, which evaporates the fluid contained in the external cells, through the excretory pores of the capsule, and fall into the spoon; but the tunics of the vitreous humor shall (though the total exudation of the

the fluid) keep their roundness during their heat, and they shall sink as soon as the exterior air will penetrate them again.

The cause of this change comes from the introduction of the igneous parts into the cellular spaces, which give the capsule a round form: but as soon as the particles of fire have no motion at all, and that the pressure of the air, or of the atmosphere, obliges them to yield to their weight, they run through the pores of the capsule: from thence the total sinking of the tunics of the vitreous body.

Take the vitreous body out of an eye, and put it upon a sheet of paper; then its tunics shall sink by degrees, till no fluid remains in its cells. Observe, during this experiment, that the vitreous fluid equally filters through the whole pores of its capsule, and that each cell furnishes so exact a proportion of this exudation, that it is impossible the sinking be quicker in one of these parts than in the other.

Let these tunics macerate into the water during three hours, you will observe, in taking them out, that the water has run into all the cellular spaces, which shall be half filled. But the exudation of this water is much quicker than that which is natural to the vitreous humor. This gives to understand, that if the fluid of the vitreous body had not a certain degree of viscosity, its exudation should be very quick,—cause the atrophy of this body, and the loss of the organ.

These three experiments prove, that the cells of the vitreous humor communicate to each other the fluid contained into them. Were it not so, should it be possible, that the water might equally run through them, to occupy a part of these cellular spaces? The following exposition confirms more and more that intercourse.

Perform

Perform a little hole in the tunic of a vitreous body, void of fluid; convey, with precaution, some air into it with a pipe: and, when these cellularly spaces shall be full, bring these membranes to the hole of a window-shutter, through which some rays of the sun can come over it; then, with the help of a microscope, you will remark, if you blow carefully from time to time into these tunics, that the interior air easily runs out, as the cells are very porous, and their size prodigiously varied. The vitreous body of an ox is by far preferable to any other for that experiment.

Their form shall be still more sensible, if you expose, in a warm room, or to the rays of the sun, the globe of an eye frozen; for, as soon as you have cut it into two hemispheres, each piece of ice will afford you an opportunity of distinguishing their figures and sizes; some are round, others oval, triangular, and so forth. It is easy to take out these pieces of ice with the point of a pin, without hurting the tunics of the vitreous body.

The density of each of these tunics is different; the capsullary is much denser than the cellularly: you will be convinced of it, if you cut into two parts a vitreous body newly extracted, and make a light pressure with a buttoned probe over its capsule; there you will feel a resistance, which shall keep the probe from piercing; and if you put it in the cells, it shall penetrate entirely into the interior part of the vitreous body, and almost without any opposition at all.

It is unnecessary to enlarge any further upon the subject; therefore, as nothing is wanting now, but the proofs that the secretion of this transparent body is appointed to renew the aqueous humor, it shall be my next consideration. After you have taken out of the orbit the eye of a subject newly dead, perform a section thro'

the cornea, as to extract a cataract without touching the iris; put the globe, a little inclined, upon a small grate, and the whole over a tumbler; then shall flow, drop by drop, a diaphanous fluid, like the aqueous humor, and, in less than six hours, the eye shall become flat: cut the membranes, which compose the shell of the eye, you will find the tunics of the vitreous humor without fluid. Take equal parts of the vitreous fluid and aqueous humor, put them in different vessels, to be evaporated upon a small fire, till the diminution of the two thirds; after which time you will remark, that each of these fluids has got the same degree of viscosity as a light dissolution of Arabic gum, and that some crystals swim over when they are cold. Finish the evaporation, each of them shall produce an equal quantity of alkaline salt: weigh them, you will know that the salt consists of about the tenth part or upwards.

You conceive, after these experiments, that the fluid, secreted through the vitreous body, is to renew the aqueous humor: if you make a doubt of it, you may convince yourself, in observing the swiftness of this regeneration, when the humor has been entirely evacuated in the operation of the cataract by extraction. The abundance of fluid furnished by the eye, when the cornea is ulcerated, is also a complete proof of it.

As soon as the crystalloida is opened, when a cataract is couched with the needle, you may remark, if the fluid contained in it is opaque, that it is hurried away towards the anterior parts of the eye: it runs not only through the pupil in form of a vortex, but it spoils the aqueous humor of the fore chamber, and ends by precipitating itself downwards in form of a sediment. It is not light enough to run of itself into the fore chamber, were it not hurried away by the flux of the humor
which

which is secreted through the vitreous body, when it renews the aqueous humor.

But if the tears, furnished by the globe of the eye, are not in so great a quantity as the secretion produced through the vitreous bodies, (which have been the subject of the above experiment,) this lacrymal fluid is very little in comparison to the exudation that has been observed upon the conjunctiva. I answer: It is impossible to set a just comparison between a living eye, and one deprived of life. The impression communicated to the vitreous fluid by the circulation of the lymph, which acts without intermission into the living eye, determines a more abundant secretion through the pores of the capsule of the vitreous body; whereas, in the dead one, it is but in proportion to the specific heaviness or gravity, if the vitreous fluid runs from the centre to the circumference: consequently, this secretion is exceedingly slower and less than in the other.

The spontaneous motion of the vitreous body is accelerated, in some manner, by the simultaneous action of the *musculi recti*; at each winking this action is reiterated, but more considerable, and repeated oftener, when an extraneous body is introduced in the eye, than by a flux of tears, either abundant or common. Besides, at each winking, the tarsi make a soft pressure over the globe of the eye, which produces a great secretion of the aqueous humor through the pores of the cornea. You will observe this pressure, when you are very sleepy. You may also conceive, that every time the corona ciliaris begins to contract itself, a greater exudation must happen through the excretory pores of the capsule of the vitreous body, and those of the *crystalloida* than is commonly existing. Look, for instance, at a word of small print, and suddenly lift up your eyes towards a distant object; at that time you will be sensible of a motion

motion of sinking which happens into the interior part of your eyes. If you look towards a distant object, and hastily upon a near one, then you will observe a contrary movement.

If the aqueous humor was not renewed without intermission, and if its superfluity did not run through the pores of the cornea, the most chronical disorders should happen to the eye on account of the stagnant humors. When, for example, a cataract is couched, a degree of putrefaction in the aqueous humor should ensue, and, of course, the destruction of the organ.

Put a cataract, newly extracted, into a little glass bottle, full of water and well corked, the liquid shall acquire, in less than eight days, a cadaverous putrefaction, and become yellowish and slimy. The effusion of a purulent matter into the chambers of the eye, would be the cause of the same disorder, and the loss of the organ. The resolution of this purulent matter cannot be effected but by the spontaneous motion of the aqueous humor, which forces it to pass through the excretory pores of the cornea.

§ 4. *Of the Crystalline Humor, deemed as a Source of the Aqueous Humor, and consequently of the Tears.*

The crystalline humor is lodged and confined in a cavity on the anterior surface of the vitreous body, opposite the pupil; it is wrapt up in its capsule, and bathed in a diaphanous fluid, found out by the famous Morgani. This fluid nourishes the crystalline lens, as some say; but, let the matter be what it will, it cannot be stagnant without becoming opaque: Nature has foreseen this alteration, in dispersing over the surface of the crystalloids a great many excretory pores, to
give

give way to the superfluity of that humor as soon as it is renewed.

You may observe this secretion in exposing to a great light the vitreous body with the crystalline humor extracted altogether. To that effect, wipe the anterior part of the crystalloida, you will see, with the help of a microscope, a transudation which manifests itself through its pores. If you cut only the crystalloida a limpid and viscous humor, which occupies the interstice of the crystalline lens and its capsule, shall come out. It flows without intermission into the back chamber to renew a portion of the aqueous humor, which, compared with the secretion of the vitreous, will be found of the same kind.

§ 5. *Of the Globe of the Eye, deemed as the most abundant Source of the Tears.*

The great number of excretory pores in the vitreous and crystalline capsules give an idea of the quickness with which the aqueous humor is renewed, and how much its exudation through the pores of the cornea must be accelerated and abundant; for which reason one may venture to say, that the globe of the eye furnishes almost as much of the lacrymal fluid as the ducts of the glandula lacrymalis. If you doubt of it, overturn the eye-lid of a living animal, and put over the globe of the eye a very fine piece of cambric, sufficiently large to cover it; then you will observe, that the transudation of the fluid which comes from the cornea, and penetrates through the linen, is much more abundant than that which flows from the ducts in the conjunctiva and its pores. If the eye were not the most considerable source of the tears, from whence should come those that we shed when overwhelmed either with
grief

grief or joy? You conceive, that in both these states of the soul, every part is in a spasmodic motion, and that the simultaneous action of the six muscles gives a stronger pressure upon the globe of the eye at that time than at others; what determines a greater exudation of the aqueous humor through the pores of the cornea, from whence comes this abundance of tears. Besides, the action in the *corona ciliaris*, by squeezing the anterior circumference of the vitreous body, and the lateral part of the *crystalloida*, may in some manner contribute to its profusion.

If the globe of the eye furnishes a great effusion, he who weeps feels a kind of pressure in the lateral parts of his eyes, and some pains for some while afterwards, because, when the organs want to make a motion, these pains are still much more sensible in the bottom of the globe of the eyes, especially when these organs are brought to a great light. This sensibility comes from a swelling in the vessels of the retina and choroides. The want of a free circulation manifests itself even upon the vessels of the conjunctiva, which at this time becomes red, as if the eyes were afflicted with an inflammation. Besides, you may remark, that the cornea has become more transparent, as well as the diaphanous bodies of the globe; and this is the reason why people, who have been crying for some time, cannot easily bear a strong light. These signs are not to be remarked with a flux of tears in the eye, occasioned by an obstruction in the *ductus ad nasum*, or in the *puncta lacrymalia*, for such weeping dims the sight in proportion as the fistula is of an old standing: Meanwhile, in these disorders, the weeping is almost continual, and it is not the tears alone which swell the conjunctiva, but the power of the simultaneous action in the muscles of the eye, and the great contraction in the *corona ciliaris*.

§ 6. *Of the Glandula Lacrymalis, and the Caruncula Lacrymalis, considered as a Source of the Tears.*

The glandula lacrymalis secretes without intermission through its ducts an acrimonious fluid, which is corrected by an oily humor produced by the glands of the conjunctiva, together with that furnished by meibomius glands. Without this oily humor, the whole lacrymal fluid would injure the conjunctiva, and occasion a continual inflammation and flux of tears. When this disorder happens, the fluid, which spreads itself over the globe, and afterwards over the cheeks, causes some excoriations in the skin, which proves how much the tears are naturally acrimonious.

You may know what is the nature of the secretory humor in the caruncula lacrymalis, if you take it off from a subject newly dead, and squeeze it softly between your fingers; the fluid which flows from its excretory pores is yellowish, and similar to that extracted from the ducts of the ears: It is easily diluted in water.

The caruncula lacrymalis is formed by many little oblong, whitish glands, united together, and pretty near the size of a poppy-seed, and every one of them have their particular capsule and excretory ducts; their orifices are seen upon the portion of the conjunctiva, which covers this glandulous body. You may distinguish their secretion with a microscope, in removing the eye-lids. I have seen the caruncula lacrymalis deprived of its external capsule, and that part of the conjunctiva which generally covers it was then destroyed; the glands were separated from each other and adherent at their basis, like so many little bladders tyed together by the neck. That disorder was, in my opinion, incurable, and the little glands, in that state, had a reddish

reddish appearance : The eye was found in every other respect.

When the filters of this gland are in an atony state, the secretion furnished by the excretory ducts is very abundant, and like a purulent matter, commonly called the gum of the eyes. In this state, the humor does not dissolve with the tears ; for which reason, this disorder is never existing without a flux of tears, that discontinue as soon as the caruncula lacrymalis is re-established in its natural state.

The caruncula is not only necessary to mitigate the acrimony of the tears by its secretion, but also to impede them from spreading into the great angle, and from thence down the cheek. The *valvula semilunaris* formed by this gland, together with the conjunctiva, serves to direct the tears towards the puncta lacrymalia.

§ 7. *Of the Glandulae Sebaceæ Meibomii, deemed as a Source of the Tears, and their Corrective.*

Moreover, it was necessary that the tears had some corrective able to assuage the sharpness of their acrimony, because the caruncula lacrymalis cannot produce a sufficient quantity of oleaginous humor to do it : besides, the situation of this gland is not fit to convey this humor, and spread it over the whole surface of the globe of the eye. Nature has taken care of that, by the means of a great many glands, situated under the tarsi of the eye-lids. They are dispersed in a row, and have each their own duct, whose orifices open at the internal edge of the tarsi, at an equal distance from each other. These glands are in a greater number at the middle of the tarsi than towards the commissures. It is essential to observe too, that there are a great quantity of them in the superior eye-lid, than in the inferior. Each of these glands are

are commonly of the size, form, and color, of a little white poppy seed; every one of them has a particular excretory duct, which pours out the oleaginous humor into the common duct; and this pours it out again to the edge of the tarsus, where it is diluted into the tears at each winking. The color and consistence of this humor is like the white honey, lightly mixt with amber; and it is not only fit to correct the lacrymal fluid, but yet to help the motion of the eye-lid, and moderate the action of air upon the visual organ. You may also consider this humor as a kind of plastering, proper to diminish the too great secretion of the tears. Meibomius glands are never diseased, without the consequence of an immoderate flux of lacrymal fluid.

These glands are attacked with the same indisposition as those of the *caruncula lacrymalis*. The gum of the eyes is not wholly diluted by the tears; for which reason, it gathers at the edge of the tarsi, and glues the eye-lashes to one another in the night time, to such a degree, as to close the eye-lids so fast, that you can hardly open them, and take it off when dry.

If you compare the number and diameter of the excretory ducts of meibomius glands, and those of the *caruncula lacrymalis*, with the excretory ducts of the tears placed at the internal side of the superior eye-lid, you will know that this sebaceous humor may amount to the eighth or ninth part of the lacrymal fluid.

You may, besides, convince yourself that the secretion of meibomius glands is diluted by the tears, if you examine that the eye-lids are sufficiently closed, to hinder the tears from falling over the cheeks; that the canal formed by the union of the tarsi, is not full enough of lacrymal fluid to force them, as to be distant from each other; that the middle of this canal is occupied, and the remaining part of it filled by the vapor of the

tears that dilute the oleaginous humor of the glandulæ sebaceæ of the superior eye-lid: so that every thing proves the secretion of meibomius glands to be a part of the tears.

§ 8. *Of the Quantity of the Tears, their principal Functions, and which Way this Fluid flows.*

The tears are not only to water the internal part of the eye-lids, to keep, soften, and moist them in a suitable state, and maintain the brightness and transparency of the cornea; but to moderate the action of air which strikes this organ, to carry towards the internal angle, and from thence out of the eye, the extraneous bodies which are introduced in it. To that end, nature increases the secretion of this fluid, by a stronger simultaneous action of the six muscles of the eye, to assist the organ in getting rid of them. The tears help also the refraction of the rays of light. It was consequently essential, that the lacrymal fluid should be uniformly spread over the surface of the globe, and that the winking were repeated; in order the tears should not form some inequality, which, in causing false refractions, might be hurtful to the quickness of our perceptions.—Moreover, the flux of the tears being continual, hinders those tears which water the interior of the eye-lids, to go back into the excretory ducts from whence they came. You may conceive the quantity of the lacrymal fluid in proportion to the rotundity of the globe; and when it is too copious, or in less abundance than in the natural state, various and dangerous disorders must ensue. In fact, the too great secretion of this fluid occasions the epiphora, or flux of tears, which diminishes the perceptions. A less quantity than is necessary to water the eye and eye-lids, causes

causes a great deal of pains by the immediate touch of these parts, especially at the time of their motions: This indisposition is a symptom of spasm in the fibres of the organ.

In the space of four-and-twenty hours the secretion of the tears, produced by each eye, is commonly two ounces or upwards. To have the proof, put to the circumference of one of your eyes, a little drinking glass to keep the exterior air out, and let it remain so for half an hour; you will observe a light vapor, which, in a little time, forms some drops over the whole extent in the inside of the drinking glass; these drops will amount to the weight of twenty, or five-and-twenty grains. If you examine the kind of this fluid, you will find it free from the viscous and salted parts which are mixt with the tears. It is doubtless one of the causes which renders the fluid squeezed out of the *faccus lacrymalis* more viscous, when the *ductus ad nasum* is obstructed. This fluid is also more viscous than the aqueous humor, which becomes so too, as soon as it covers the surface of the globe; because it is mixt with the secretion of meibomius glands, and that of the *caruncula lacrymalis*.

Every body knows, that the puncta and ducts lacrymalia absorb the tears, which cannot be evaporated; but it remains to know what may be their quantity. If you would be acquainted with it, squeeze with precaution the *faccus lacrymalis* when the *ductus ad nasum* is obstructed, and gather exactly the fluid contained in it, from twenty to twenty minutes. In the space of an hour and a half, you will gather the weight of thirty or thirty-five grains, what amounts to a drachm, with the portion evaporated; consequently the total of the tears, spread over the globe of the eye in the space of four-and twenty hours, amounts to two ounces or upwards. People who make use of spectacles, have had

several opportunities of observing, that the evaporation of tears tarnishes very much the glasses, as well as the circle which surround them.

It is needless to observe, that it was necessary the lacrymal organ had some ducts to pump the superfluity of the fluid for its perfection. Let us now consider what they are, and their mechanism.

OF THE ABSORBENT LACRYMAL WAYS.

The absorbent lacrymal ways are made up, *1st*, Of the groove in the os unguis, and the bony *ductus ad nasum*; *2dly*, Of the ducts and puncta lacrymalia, with their common duct; *3dly* Of the sacculus lacrymalis; *4thly*, The nasal duct. All these parts, but the first, compose one and the same continuity.

§ 1. *Of the Structure of the Puncta Lacrymalia, Sacculus Lacrymalis, and Ductus ad Nasum.*

The puncta lacrymalia are cartilaginous, and always open in a sound state. If they were membranous, the least compression would sink and put them in such a situation, that they could not continually receive the tears, as soon as they are gathered at the valvula lacrymalis.

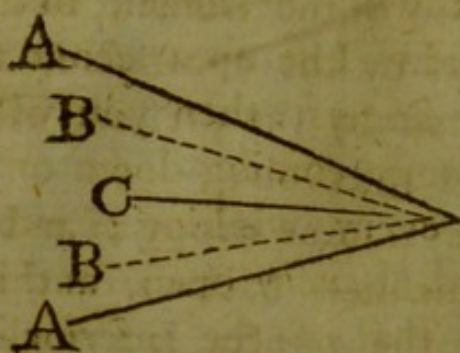
The puncta lacrymalia contract, when an extraneous body touches them, and dilate when out. They have very sensible vermicular motions, which happen at every winking. To be convinced of the truth of it, lift up the superior eye-lid, and touch the lacrymal point with a buttoned probe, this orifice will immediately contract. Overturn a little the inferior eye-lid, and try the same experiment.

experiment upon the other; then you will have an opportunity of observing the same contraction, with this difference, that it will not shrink so much as that of the superior eye-lid. Lift up a second time the superior eye-lid with your fingers, then you will see a kind of nipple of a line long, coming down on the inferior lacrymal point at every winking; and that the hole, which is at its end, is very open, and its diameter larger, than usually that of the inferior lacrymal point. The direction of this nipple is towards the *valvula lacrymalis*, and a little inclined upon the groove of the *caruncula lacrymalis*. If you let the eye-lid more downward, it will come down the *valvula lacrymalis*. As soon as the eye-lid is up, the orifice of the nipple is closed, and its exterior length diminished to such a degree, as to be entirely out of sight. This gives to understand, that there is a peristaltic or vermicular motion in the whole extent of the lacrymal duct, when this nipple gets in again.

Overturn the inferior eye-lid, during its action, you will see a nipple, which goes out from the lacrymal point as a kind of convexity, from within the inside of the duct, and that this nipple is shorter, the diameter of its orifice larger, and its contraction less, at the time of its re-action, than that of the superior eye lid; but it will disappear as quickly as the superior. Compare, furthermore, the *puncta lacrymalia* together, you will see that the inferior is twice wider than the superior.

If you remove with your fingers both eye-lids from each other, you will observe that the superior goes up and down perpendicularly, and the inferior obliquely. The action of the latter moves its tarsus from the external angle to the internal, in raising the lacrymal point upwards; its re-action makes it retrograde, and, for want of action, it remains horizontal.

The lacrymal ducts, in joining together in the internal angle, under the middle tendon, look like this figure:



When the eye-lids are entirely open, their tarfi are in the situation A A; then the inferior lacrymal duct is horizontal, whilst the superior is inclined. When the tarfi are in the position B B, the inferior lacrymal duct keeps a small inclination, and the superior is less inclined than it was in A A. When the eye-lids are closed, the ducts are in C; then the superior lacrymal duct is horizontal, and the inferior inclined; insomuch, that the superior runs over the globe three times more than the inferior, to arrive at the point where the tarfi meet together. These changes happen at every winking, and produce some particular effects, like the nipples of the puncta lacrymalia.

By what mechanism the puncta lacrymalia do contract, dilate, and stretch forth their nipples, and pull them back to a degree that nothing of them remains, is a question we must enquire into. You will believe that these orifices have a sphineter, and their ducts a plane of straight fibres, if you examine their motions: this idea comes of itself, after the knowledge one has of the subject. As the speculation is not sufficient, we must have recourse to observation and experiments to sustain it.

Every thing tells that the tears are detained, during some time, into the sacculus lacrymalis, as the urine is in-

to the bladder; therefore the retention cannot exist without a sphincter in the lacrymal bag. The tears are also poured out into the nostril, but only when this sphincter is dilated by the contraction of the *faccus lacrymalis*, occasioned by the pressure of this fluid over the bottom of its reservoir.

Instil in your eye some drops of a bitter liquor, and put your head inclined backward, this fluid will very soon go through the *puncta lacrymalia*. If the tears flow directly into the nose, and from thence into the throat, you will taste an insupportable bitterness: but if there is a space of two or three minutes before you taste it, you may conclude, that this liquor has been detained into the *faccus lacrymalis*; consequently the tears gather in this bag to a certain quantity, till it contracts itself to open its sphincter, and let them run through the *ductus ad nasum*.

If the *ductus ad nasum* had always had its diameter open, a very sensible effect should have been the consequence at every time you would have blown your nose. In fact, the air, by going in through the *puncta lacrymalia* and nose, should force the tears to run back into the eyes. This is what generally happens to those who have occasion for an artificial tube into the *ductus ad nasum*, when the *faccus lacrymalis* has been destroyed by any disorder.

If you squeeze with your fingers upon the *faccus lacrymalis*, to force its obstacle, and give an issue to the tears through the *ductus ad nasum*, you will doubt no longer of a retention of tears into it, on account of a contraction in the sphincter. You conceive easily the impossibility to let the tears out by a simple pressure, through so great an obstacle, if the retention of this fluid is really occasioned by a total obstruction in the *ductus ad nasum*, phlegosis, or a callosity in this part.

Every

Every body knows that there are some retentions of tears which do not yield to the strongest pressure upon the *faccus lacrymalis*; and even when you squeeze with your fingers, this fluid, instead to flow down the nose, runs up through the *puncta lacrymalia*. This, however, is not a proof that the obstruction in the *ductus ad nasum* is not occasioned by the contraction of its sphincter. If there are some subjects in whom the sphincter yields to the effort of the pressure, this is because its fibres are not in a spasm or crithism; for they have softness enough to be dilated, but not sufficiently to be submitted by a contraction in the bag, and the specific gravity of the tears contained in this reservoir.

Every practitioner may have had an opportunity of observing, that some people have almost a continual flux of tears during the day, and the *faccus lacrymalis* swelled; whilst this tumor disappears, as well as the flux, during sleep, and that both these disorders appear again as soon as they are up. The glands of the *faccus lacrymalis*, though smaller, are analogous to those of *meibomius* glands and *caruncula lacrymalis*. If the latter furnish some purulent matter, commonly called the gum of the eyes, when these filters are obstructed, why those of the former should they produce none? It is most probable, that these glands furnish the same humor, when their filters are in an atony state, and that this humor is acrimonious enough to irritate the nasal sphincter, to such a degree, as to intercept, by its contraction, the passage of this purulent matter, as well as that of the tears.

These fluids extend the inside of the *faccus lacrymalis*, by gathering into it: this is what forms a tumor more or less considerable, especially when the membrane of this reservoir does not keep its natural oscillation. If the fibres which compose it have strength enough, the stagnant fluid goes up through the *puncta lacrymalia*; but

but when the humor which flows through the glands of the *faccus lacrymalis* is acrimonious to a greater degree than usual, then the sphincters of the *puncta lacrymalia* acquire the same corrugation. In this case the purulent matter cannot get through; it gathers, extends its reservoir, corrodes its interior parts and teguments, and at last forces every obstacle to spread itself over the cheek. This thick and yellow matter may be mistaken for some pus, and make one believe there is an ulcer in the interior part of the *faccus lacrymalis*.

It is a very uncommon case to see the *os unguis carious* without an external cause. Let us suppose, for a moment, the inside of the reservoir ulcerated on the side of the *os* so as to furnish a quantity of matter; in such a case, the loss of substance should be unavoidable on that side, and the thinness of the membrane would lay bare the bone in a little time: from thence the most chronical disorders would ensue, by the impossibility of healing the *faccus lacrymalis*; and the exfoliation of it, together with an irregularity in this part. The humors, and their too great abundance, the want of systole in the tubes, the passage of the particles of blood into them, the stagnant tears in the reservoir, the erethism in the nasal sphincter, the atony state of the membrane of the *faccus*; lastly, the acrimony of the tears and humors, which irritate the nasal sphincter by their touch, and produce a stay in this reservoir, are some other causes sufficient to produce several disorders.

Every one may justly conclude, that a retention of tears has been very often mistaken for the *fistula lacrymalis*. However, there is no impossibility to meet with an ulcer in the *faccus lacrymalis*, as well as in the other parts of our body; but the case is very uncommon. A disorder in the glands of the lacrymal reservoir, is

often deemed an ulceration; and this is as common as the former.

§ 2. *Of the Mechanism of the Absorbent Lacrymal Ways which pump the tears.*

The puncta lacrymalia, the faccus lacrymalis, and the ductus ad nasum, compose but one channel, whose form and use should be termed lacrymal syphon. Two things are necessary in a syphon to pump the tears; first, that it be full of fluid; secondly, that the branch which soaks into the liquid be shorter. When the syphon is full of tears, and the holes always open to the lacrymal fluid, the tears flow from the highest branch into the lowest; and this is sufficient to give the tears an opportunity of running continually into the nose.

The action of the eye-lids must be considered as one of the causes which force the tears to flow down the puncta lacrymalia. You meet with a convincing proof of it in a retention of tears: in fact, the tears run into the faccus lacrymalis during this disorder, and not by the mechanism of the lacrymal syphon, because it is shut: therefore the action of the eye-lids, in this case, is the only cause which forces the tears to run down the puncta lacrymalia into the faccus lacrymalis; for which effect, the eye-lids force the tears through the puncta lacrymalia, with the whole power of a spring set loose. Let us begin to describe the motions of this wonderful hydraulic engine in its natural state; this will be the only way to know the exact pathology which refers to the lacrymal organ, and improve in the physiology of this part.

As soon as the action of the eye-lids begins, the longitudinal fibres in the lacrymal ducts acquire a quick movement of extension, which forces the anterior extremity

tremity of every one of these pipes, to stretch forth in the form of a nipple. This dilates at the same time its orifice, which, being a little inclined towards the globe of the eye, runs swiftly into the groove of the caruncula lacrymalis, and steep into the tears by the power of the oblique motion of the inferior eye-lid. At the same time of the re-action of the eye-lids, each nipple, in going back quickly towards its ducts, acts as a piston, able to pump a bulk of fluid relative to the superfluity of the tears. Besides the contraction in the sphincter, which happens at that time, quickens their intromission into its duct, and the systole and vermicular motion of it, hurries away the tears into the reservoir. This forcing and lifting pump renews this mechanism at every winking, what is sufficient to absorb or lift up the superfluity of the lacrymal fluid.

The two pistons of the lacrymal ducts are also in action, to pump the tears during sleep. It is not the oblique rising of the inferior eye-lid, which forces this fluid to run into the groove of the caruncula lacrymalis; but it is by the junction of the tarfi, which form a kind of gutter to direct the tears, together with the continual action of both the lacrymal pistons.

This mechanism is grounded upon the most exact rules of hydraulic and hydrostatic. You will be convinced of this assertion, when you compare the structure of the absorbent lacrymal ways with that of a pump which draws up water by attraction and weight. To one of this kind, levers and power to put them in motion are necessary; here both are existing, or centered in the eye-lids. Pistons which go fore and back, in proportion to the action given by that of the levers, are also necessary; here, the lacrymal nipples act as pistons. But the pistons of a pump would be without effect, if they were not involved in a pipe, whose dia-

meter should not be proportioned to the bulk of the piston. The same thing is existing in the lacrymal nipples, since they have no effect but when involved in their ducts. In order that a pump be forcing and lifting, the piston must stretch forth with a sufficient power, to squeeze the fluid appointed for its action, and compel it to go in with much celerity into the pipe of the pump: The lacrymal fluid performs it. To quicken the intromission of the fluid into the pipe, the piston must have a retrograde motion: It is the effect produced by each lacrymal nipple, in going back into their ducts. The pipes of a pump, are not only to help the aspiration of the fluid, but yet to convey it into the reservoir which is for that purpose: The lacrymal ducts answer this object, in pouring out the superfluity of the tears into the *faccus lacrymalis*. A reservoir of any kind has occasion for a spiggot, to make way for the fluid, or its superfluity: That of the tears has its own, in the *ductus ad nasum*, as a sphincter which is opened or shut when necessary to perform the same function.

You conceive, after this parallel, that the constant occlusion in the *ductus ad nasum* cannot be an obstacle to the passage of the tears from the eye into the *faccus lacrymalis*, because here it is not necessary, as in the mechanism of the syphon, that the inferior branch be opened, to give the lacrymal fluid an opportunity of running through the ways appointed by nature for its descent. In a word, the passage of the tears exists by the action of two lacrymal points, not only during sleep or awake, but in every situation of the body. This mechanism is fixed and permanent in its manner of being, unless the parts be afflicted with some disorders. In fact, there is nothing but a decay in the puncta lacrymalia which may disturb this harmony; the spasm or atony in their fibres may also suspend it.

The tears cannot run out from the internal angle of the right eye, when you lie down on the right side; because at every winking, the oblique motions of the inferior eye-lid lifts up this fluid towards the internal angle to be pumped. They cannot also flow into the internal angle of the left eye, though you lay down on the opposite side; because the lacrymal pistons pump the fluid as soon as it gathers there.

The momentaneous action in the lacrymal pistons is sufficient to pump the tears while awake; because there is a certain quantity evaporated into the air. During sleep time, a constant action in the eye-lids supplies for the air, as the secretion is less, on account of the inaction of the muscles. The action in the superior piston is quicker than in the inferior, because the specific gravity of this fluid opposes a resistance when it is lifted up; and if the effort of the piston could not overcome it, the tears would not spout into the superior lacrymal duct. So great an activity was unnecessary in the inferior piston; because the fluid acquires in its fall new degrees of swiftness: besides, the piston and systole in the action of the duct quicken it. The heterogeneous parts which compose the tears, as extraneous bodies, salt, &c. increase the specific gravity of this fluid, and of course its fall into the lacrymal duct.

After such an exposition of the difference which exists in the diameters of the lacrymal ducts, you comprehend, that the inferior duct gives way to a greater quantity of tears than the superior; and that the inferior piston would not have been able to perform its functions, if its eye-lid, by its oblique motions, had not directed it into the groove of the caruncula lacrymalis, and given to its duct such a direction to its nipple as it might be higher than the extremity of the angle, formed by the junction of the lacrymal pipes:

in like manner, the superior piston should never have been able to pump the tears, if its eye-lid had always been kept open. Intervals between the winkings were also necessary, for otherwise the puncta lacrymalia should pump the tears without intermission, and occasion, in many peoples eyes, a kind of aridity, which would be hurtful to the organ.

The smaller the globe of the eye is, the greater distance the eye-lids are from each other, when their eyes are open, *et vice versa*; infomuch, that there are a great many of the latter class, in whom the inferior lacrymal point is so lifted up, that the piston is in continual action.

A great quantity of tears, in a voluminous eye, comes from a greater number of excretory pores, dispersed upon the surface of the cornea, and that of the conjunctiva, together with the other parts whereon the excretory ducts of the tears are to be found. We may reasonably conclude, by closing the subject, that this lacrymal fluid falls into the throat, and from thence in the stomach, to help digestion.

C U R A-

CURATIVE METHODS
FOR THE
FISTULA LACRYMALIS.

THE disorders of the lacrymal organ, commonly known by the name of fistula lacrymalis, have been the enquiry of the most skilful practitioners, who have invented by turns different methods to restore the lacrymal ways in their natural state. If they have not always had the same success, we may say it was owing to the different diseases which affect the reservoir of the tears and its attributes: for if they were ignorant of such a theory as has been laid down, it is the strongest reason one can give of their having wandered in all ages, and thought these disorders to have something very intricate in their nature, and require a method of cure quite different from all the other maladies. It is no difficult matter to conceive, that so many different causes indicate so many different medicaments, which ought also to differ from each other, in proportion to the defect one has to struggle with. None of the great surgeons has better distinguished these disorders from each other than the famous PETIT; so that the discovery of the pathognomonic signs of each of them (which he possessed to the greatest degree) being very material, to meet with as many successes as he did, shall be my present consideration. These are the only means to perform a great number of cures, as one may be able, by such
helps,

helps, to point right at the curative indications offered in every disease of the lacrymal ways, and follow the steps of so uncommon a man.

The shedding of tears, which owes its existence to that of the hydrophy in the sacculus lacrymalis, comes from the erethism in the sphincter of the *ductus ad nasum*, as it cannot contract and dilate, especially when filled up with any fluid; because, in this case, the specific gravity of the tears, being not sufficient to overcome the resistance opposed by the contraction of the nasal's sphincter, this fluid, instead of flowing through the *ductus ad nasum*, remains in the reservoir. This dilates the bag, and occasions in it a tension, inflammation, rupture, and fistula; as, during that time, the productive tears continue to furnish their wonted quantity, which being barred from running into the nose, fall on the cheek. If the cause of this shedding of tears is an obstruction in the sacculus lacrymalis, clear it up; then the tears shall flow into the nose, the shedding and retention of tears shall cease, together with the inflammation, rupture, and fistula lacrymalis.

If a weeping is occasioned only by a contraction in the sphincter, whose cause is an erethism, the cure shall not be difficult. At first, press on the bag to compel its contents to flow up through the puncta lacrymalia, and make several luke-warm injections through one of the lacrymal points, or both, with the No. XXIII. — This cooling and resolute injection destroys the spasm of the sphincter, cleans the bag, and re-establishes the lacrymal organ in its natural state. These injections ought to be repeated three times a-day, without forgetting to make a pressure on the bag before. This trifling disorder requires sometimes four or six weeks of continual attendance. The method of proceeding in this operation is as follows: Take off the
crooked

crooked syphon from the syringe, and put the straight one, screwed up very close, in its place; then you must introduce the extremity into one of the lacrymal points, and inject softly and uniformly. When the injection does not flow down the nose (what is conspicuous by its flowing up through the superior lacrymal point,) you stop it with your finger, and begin afresh, till you think proper to put an end to it for the day. It is needless to mention the position of the patient and operator, as both chuse naturally their ease.

It is no indifferent matter to be perfectly acquainted with the nature of the obstruction in the *ductus ad nasum*, in order of chusing the properest means for the cure. In case the purulent matter flows into the nose, when you press on the bag, you may take it for a sign, that the obstruction is removed. It very often comes from thick humors which fill up the channel, and may be looked upon as the fore-runner of a chronical disorder; that is to say, the ulceration of the sacculus lacrymalis. This case, well known, seems only to require the detersion of the ulcerated part. However, it sometimes happens, that the local defect is not of such a nature as it can be removed by the injections, whose end is to clean and deterge. When the skilful Mr ANEL thought necessary to clear up the canal of the tears, he introduced a silver probe through the superior lacrymal point, down the *ductus ad nasum*, and injected afterwards with detersive fluids—what was very often attended with success; but, if the canal was obstructed by some callous tubercles or cicatrices, as it frequently happens in the small-pox, the obstacle was of such a nature as not to be overcome by injections, and introductions of the probe generally too weak to clear it; then, in such a case, he did not succeed with that method. This probe is commonly seven inches long, its diameter in proportion

tion to that of the puncta lacrymalia, blunt at one end, and equal in its length. If sometimes the operator obtains his wish by the above means, he may be assured that there was not a total obstruction in the *ductus ad nasum*; for, in case there should have been one, he could not have disobliterated it without the help of some strong probe.

To search in the *ductus ad nasum* by its inferior orifice, I advise every person to begin on dead bodies, in order of acquiring the use of it. The execution of this operation seems always so easy in these experiments, that one will very soon take upon himself to undertake it on the living. He will, however, find some resistances, which he will always get the better of. I think it may be of great service to describe them, as they might sometimes, for want of knowing, put him out.

The difficulties, or the easy execution of this operation, come from the variations which are to be met with in the situation of the sphincter, the different degrees of alteration it has undergone, the proportions one must find between this sphincter and the probe, and the situation of the inferior shell of the nose, which is sometimes so low, that, for want of a due attention, the most skilful operator might pass over and miss the inferior orifice of the *ductus ad nasum*. This shell is placed so low in some subjects, that, to the anterior part there is only one line distance from its inferior edge to the part of the maxillary bone which corresponds to it, and moulds the roof of the palate. In some other subjects it is so bent, that it forms rather, to the anterior part, a round hole than an oval aperture, which ought to be the natural state of this shell: on the contrary, it is sometimes so high, and the channel so short, that there is no difficulty to search into them. I must further observe, that sometimes the partition of the nose shrinks in
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in bending into one of the nostrils, leans upon this shell, presses and sinks it in such a manner, that its inferior edge touches the portion of the maxillary bone, which constitutes the separation of the nostril and sinus maxillaris, infomuch, that the probe has a great difficulty to run into it.

Moreover, if there be an adherence from the partition of the nose to the shell, and that it be anterior and inferior, it may be entangled in the crooked part of the probe, what would hinder it from going behind, where the inferior orifice of this channel is to be met with. Provided the reader be instructed in these anatomical variations, and intelligent enough to discover with attention the more or less alteration the channel may have sustained, in proportion to the seniority and extent of the disorder, he shall almost always be able to introduce easily the probe in the sound state and in that of the disorder, with more or less difficulty, according as the channel's obstruction shall be more or less considerable, though he operates by feel. The introduction of the probe into the bag cannot possibly be effected, when the channel shall be obliterated by a malady of an old standing.

The methods which were invented and practised by a famous surgeon of Paris for the cures of these disorders, were extremely simple, as they always consisted in disobliterating the *ductus ad nasum*. The instruments for that purpose are some Algales, and massy probes of different sizes, and proportioned to the sphincter's diameter; besides a slender silver wire, with one eye at one end, blunt at the other, and a syringe with a crooked syphon. All the probes ought to be bent as a semi-circle; because they are easily introduced into the sacculus lacrymalis through the inferior orifice, and exteriorly felt, as they jut out with the least motion

towards the teguments. The injections made into the bag, through the inferior orifice, either with the syringe only, or through the hollow probe, go out through the puncta lacrymalia; and what remains in the bag runs down of itself into the nose through the hollow probe. This is a sort of very useful seton, which keeps not only the channel in dilatation, but facilitates also a running of the lacrymal fluid.

These instruments must be of different sizes as I said before; because, if the malady consists in an obstruction of the *ductus ad nasum*, and hinders an hollow probe from going in, on account of its weakness, one ought to make use of a massy one. When the probe is once into the bag, let it be left there for some days, to facilitate the first injections; or if this cannot be practised, introduce a small straight and hollow probe through the same channel into the *faccus lacrymalis*, and let it remain there till the cure be quite obtained. In this manner one has the advantage that the patient may syringe himself, and save by this means a great deal of attendance. If the *faccus lacrymalis* be pierced on the side of the *os unguis*, and that it be altered, I do not advise to make a hole in the skin, and in the portion of the bag which corresponds to it, in order of applying proper remedies to obtain the exfoliation of it, as the injection alone is sufficient to produce just the same effect.

After having mentioned the necessity and possibility of searching the *ductus ad nasum* by its inferior orifice, nothing else remains now but to explain the manner of performing it. Simple as this operation seems, nevertheless one must be well acquainted with the structure and situation of these parts, the variations they are susceptible to undergo, and the proportions between the probe and *ductus ad nasum*, in order of obtaining a complete success. This theory is quite necessary. I

now

now suppose the reader has acquired all this knowledge by the above descriptions. The patient being seated on a chair, the head half reclined back, the operator shall introduce the probe into the nose, in conducting the end towards the arch formed by the inferior shell of the nose, to seek for the inferior orifice of the *ductus ad nasum*. He will know that the end of the probe is in this channel, when it will no more play under the shell; then he shall push it in by degrees, till its end be near the middle of the saccus, or its superior extremity. There are, however, many cases wherein the probe does not appear sensibly within, though it be arrived to the superior part of this channel; because it stops under a little portion of the maxillary bone, which forms the superior and anterior part of the *ductus ad nasum*. Then take up a little the end of the probe, and at the same time push it upwards; its top, which was only in the channel, shall go into the bag, wherein it may be felt with the finger. The hollow probe is introduced with the same precautions as the other. If one will have it entirely hid in the nose, he must make use of the probe bearer, to place it more conveniently; but the probe so placed, is very troublesome to make the injections. A small and round stiletto, made of whale bone, to clear the hallow probes, is absolutely necessary; and this little stick must not go farther beyond it than one or two lines. As to the method of injecting with the syringe, and the crooked syphon, the same precautions ought to be observed as to searching. The same syringe is sufficient for any subject whatsoever, requiring only a change of syphon, according to the shell of the nose; for it matters only to place its top in the channel's entrance, and squirt the liquor with the sucker, taking heed of not filling too much the saccus lacrymalis, for

fear

fear of a too great dilatation, which might make it lose its natural elasticity.

Each method may have its inconveniencies and insufficiencies, when the disorders vary. If the obstruction in the *ductus ad nasum* be complicated, one ought to make use of a massy probe, as I said before, to force open the passage; but there are inconveniencies and dangers by doing so, because, in searching on the living, one may not meet the orifice of the *ductus ad nasum* as easily as he would wish. It happens very often, that he does find it out, but after many painful and troublesome gropings, and in perforating false ways, an operation which may be attended with a great many accidents, on account of the tearing and irritation of the pituitary membrane. The most skilful operators, in such cases, are almost always liable to fracture in attempts made with care and sufficient precautions, *a fortiori* young beginners. From these difficulties, the method of searching this way, has met with founded criticism from the most learned surgeons; but yet those who have invented, improved, and practised it with success, are, I think, sufficient grounds to promote and credit so useful an operation, when undertaken by steady hands, and exact anatomists. This operation may be useful for persons who are unwilling to submit to an incision, as a great many would sooner go through any pain than undergo an incision.

The disorders of the bag may be of such a nature as not to be removed by the help of injections, or the searching with the massy probe; in this case Mr Petit's method must be made use of as the last resource. It is founded on the structure of the parts and mechanism of nature, to re-establish her functions. It has the advantage over the other, as it gives much less pains than that whereby one runs the risk of breaking the bones;
and

and if it has not been generally practised, it comes from the varieties in the fistula lacrymalis. We ought to look upon it as a stem, whereon they have grafted several particular inventions with more or less reflection, which, far from destroying its good advantages, do honor to their inventors, as all these methods tend to repair and preserve the natural ways of the tears.

Practitioners agree on the necessity of opening the bag by an incision, in case the injections and the above method cannot succeed. This happens always when the interior of the sacculus lacrymalis is become spongy and far ulcerated. This is very easily known by the quantity of matter which gets out with the tears. When the bag is open, it is very material to consider in what state may be its internal surface, and examine it, especially on the side of the os unguis, with a blunt probe. The alteration of a bone so thin ought to be closely inspected; but its orbitary face may be discovered by the ulceration of the bag. This bone posteriorly supported by the pituitary membrane and periosteum, in the circumference of the denudation, shall never be able to fall down of itself; and as it has no diploe, one cannot expect a fleshy coverture, which would help its consolidation with the neighbouring parts. In such a case, no other expedient is left but to destroy it. You may even have in this case an intention to establish an artificial way for the tears. This depends on the state of the *ductus ad nasum*. We have many instances, and full authority to prove, that Mr Petit had operated several patients after this method without success, though the *ductus ad nasum* was very well cleared up, and that they were perfectly cured only after the os unguis had been sunk. If the *ductus ad nasum* were shut up by the old cicatrices, and that by the above particular cases, it would be absolutely necessary to destroy the os unguis,

guis, I advise to do it in such a manner, as the tears may get their course by this new way.

Mr Petit practised this operation in the latter part of his life, in a different method to that of the year 1734. This is more simple, and proves the fecundity of the author's genius. An assistant puts his thumb on the commissure of the eye-lid, at the side of the little angle, and pulls them to bend the skin; what operates a small jutting out in the tendon of the orbicular muscle. The operator leads the extremity of his knife, from one of the sides of the groove (under the tendon) to the edge of the orbit; and at three or four lines from the commissures of the eye-lids, sinks it by degrees into the sacculus larymalis, without touching the bone, and performs an incision, which ends towards the tendon of the *obliqui inferioris*. If a little exterior aperture has been done, he crosses it in performing the incision. This over, and the back of the knife turned on the side of the nose, he leads the sharp end towards the *ductus ad nasum*, and then introduces, by the help of the groove's knife, a wax probe, which he pushes inwards by degrees, and leaves it there. It is observed, that this wax probe ought to be changed every day. He injects from time to time, through the puncta lacrymalia, and the bags aperture, a deterfive liquor, (No. XXIV.) to clear the ulcer, and keep open the exterior aperture of the teguments with a small pledget or algalie. When he thinks the channel well shut, and the ulcer cicatrised, he makes no more use of a wax probe, but only of a small plaister on the exterior wound, and continues still, for some time, to inject through the puncta lacrymalia. This method requires one knife whose grooves must be on each side of its back surfaces.

A practitioner must consider and weigh the several cases and methods offered above, and endeavour to know

to what length they may be serviceable or necessary. There are such proceedings as might be equally of use, but which do not deserve the preference over the other methods, though they could answer quite the same view. He ought to apply himself to the knowledge of the very cases which require the application of one method before another, instead of rejecting any one of them. It is above contradiction, that to know and distinguish the nature of the disorders is quite necessary, in order of being not perplexed at first in the application of the properest remedies; therefore, the curative methods for the fistula lacrymalis, requiring a variation according to the different cases, the practice for the cure of them shall be sure only in proportion to the justness of the pathologic knowledge, which consist in the preternatural constitution of a man's body or part, discovering the causes, nature, and difference of diseases.

These are not the only causes which may confound the harmony of the parts that compose the lacrymal ways; the tumors which happen, or take rise in the great angle towards the exterior of the sacculus lacrymalis, being liable to act or work no less powerfully with the others in producing them, I shall mention here. These tumors are commonly ascertained by two causes, first, by a gathering of humors, which gather in a centre, by filtrating between the reservoir of the tears and the teguments. It is, however, but very seldom when these elevations open exteriorly, as they communicate to one of the lacrymal ducts. Secondly, by the exostosis of the os unguis, or the apophysis of the coronal and os maxillary. Any practitioner may easily conceive, that a tumor situated in this part, ought, in proportion to its size, to squeeze the sacculus lacrymalis and the common duct, as to constrain the motions and functions of the lacrymal organ; consequently, that an epiphora,

or flux of tears more or less abundant, which exists as long as this unnatural elevation is not entirely dissipated, must be the consequence. All these truths summed up to the memory, one ought to understand, that each of these disorders is to be distinguished by symptoms which belong to it; but, in order of making them very familiar to the reader, I will draw a parallel between them.

In a fistula, the gum that runs up through the puncta lacrymalia (in pressing on the sacculus lacrymalis) is always in a little quantity, and comes up with a very small portion of the lacrymal fluid; consequently there is no lacrymal tumor, at least, to be observed; but then the edges of the tarsi are more or less tumified, sometimes hard and overturned; besides, the vessels of the conjunctiva are varicous and inflamed, especially on the portion which lines the inferior eye-lid. To all these symptoms is added a continual flux of tears; and when the glands of the sacculus lacrymalis produce a puriform humor, the tumor of the great angle is more exposed to the sight of the observer. When he squeezes upon it, a slimy humor, of an unequal colour, mixed of transparent, whitish, and sometimes yellowish parts, flows up through the puncta lacrymalia; but then the edges of the eye-lids and the conjunctiva are without alteration; insomuch, that if the patient takes care to squeeze very often the lacrymal tumor, an apparent sign of the nature of the disorder in the reservoir of the tears, by a single inspection of the organ, is no longer conspicuous. He shall know, that a tumor occasioned by infiltration, and coming off of the teguments from the great angle, and distinguish it from the foregoing by the pressure, which does not at first diminish its bulk; whilst, as soon as he squeezes the lacrymal tumor, the fluid is emptied immediately into the nose,

or

or flows up equally well through both the lacrymal points. The other tumor, on the contrary, cannot let out the fluid it contains, unless it be pressed hard upon, from its bottom upwards, and not so if squeezed quite otherwise. When this tumor is not too voluminous, a flux of tears is not always the consequence, though patients should neglect to squeeze it; because, in this last case, the *faccus lacrymalis* may be emptied only when one has a mind to avoid a conspicuous weeping.

The *exostosis* of the *os unguis*, apophysis of the coronal, and that of the *os maxillary*, are very easily distinguished from the tumor in the teguments, as this last is flexible, whilst the *exostosis* is hard, and sometimes unequal in its surface. The hydrophy in the reservoir of the tears, is known by the reflux of a diaphanous fluid, sometimes mixt with some ropy matter, but never with puriform's.

The ulceration in the *faccus lacrymalis*, is to be distinguished, by very different signs, from those I have been just describing. It does not settle commonly in this part, except after wounds and contusions; and it arises very seldom by an organic defect. However, the venereal, cancerous, scrophulous viruses, &c. may ulcerate the reservoir of the tears, rather than any other corruption in the blood. But it is very extraordinary, when they gain, even with their malignity, to this very part of the great angle. The purulent matter of an ulcer in the lacrymal ways, is distinguished from the gum and secretion of the glands in the *faccus lacrymalis*, by the whitish or slightly amber-greased color, whilst the pus is sometimes greenish, of a deeper yellow, and bad smell, in the other case. It is rare when the depravated humor in the glands of the reservoir of the tears is accompanied with a redness in the great angle and callosity in

this part ; for these accidents are commonly the consequence of an ulceration in the sacculus lacrymalis, especially when it has an exterior aperture. I will observe by the way, that this aperture is almost never cicatrised without the help of art ; whilst that, which has been formed by the corrosion of the matter which flows from the altered glands in the sacculus lacrymalis, is very easily cicatrised, and very often without the application of any remedies generally made use of to destroy the atony state of these glands.

Before dismissing the curative methods for the fistula lacrymalis, I will make one observation more, which is, that there are some species of weeping as troublesome to the patients as they are difficult of curation : there are even some whose cure it is very dangerous to undertake, because they very often produce a greater inconvenience than that which one has a mind to remove. If the cartilage of the inferior lacrymal point be destroyed, the least oscillation cannot exist ; consequently part of it must run down through the natural ways, and the other over the cheek, when the superior lacrymal point pumps alone. If the inferior lacrymal point be in its natural state, and that its duct be obstructed as to hinder the passage of the fluid in the bag, a more considerable weeping than in the above case shall be the consequence ; the cure of which shall consist in attempting to desobliterate it with the probe, and inject through the lacrymal point. If the obstruction be of such a nature, as not to be overcome, and that the injection, instead of going into the natural ways, does infiltrate in the cellular texture, then discontinue this operation, and let alone the patient along with the disorder. The inferior lacrymal duct and point are oftener out of order than the superiors. I conclude, by giving an advice to every practitioner, to make an injection

jection of common water through both the puncta lacrymalia, before he determines the character of any disorder whatever in the lacrymal ways; because, after such an operation, he may judge, with a degree of certitude, what can be the nature of the disorder he is to take care of.

“ Though I have excluded from my work all kinds
 “ of unnecessary criticisms, I cannot help taking notice
 “ here of the new publications concerning this branch
 “ of physic and surgery. One, I would not have thought
 “ worth mentioning, had it not accounted for a gutta
 “ serena cured by positive electricity: The other, a
 “ warm promoter of medical electricity, would have
 “ equally commanded my silence, had it not pretended
 “ to ascertain many physical and moral impossibilities.
 “ As to the other performances, though in many re-
 “ spects better calculated for instruction, I rank among
 “ the number of those extremely deficient. To the
 “ first I object, that a blindness may have been cured by
 “ electricity, as well as some other disorders; but that
 “ a gutta serena has, is one of the greatest absurdities,
 “ or a capital mistake. To the other, that a fistula la-
 “ crymalis is of such a nature as not to be removed by
 “ any shock whatever, when existing either in the la-
 “ crymal absorbent ways, or by a defect in these parts.
 “ I have, for the support of my assertions, the following
 “ observations and experiments made by M. Mauduyt,
 “ at the expence of the French government. See his
 “ extract for 82 patients electrified. Printed at Paris,
 “ chez Philippe-Denys PIERRES, Printer.”

OBSERVATIONS

ON SOME OBSTINATE FISTULA LACRYMALIS.

MISS COMB, the daughter of a clergyman who lived in Prince's-street, Cavendish-square, London, applied to me for my opinion on a fistula lacrymalis, in April 1782. She had undergone the operation twice, and having received no benefit, she had given up her case for some time; but a tumor which took place above the internal part of the superior eyelid, and gave great pains, obliged her to call for help. The surgeon who had operated her before was again consulted; and, after various applications, he was of opinion, that her case was turning cancerous, and of course helpless. This intelligence alarmed her, and she called a consultation, to which I was required to be present. To be short, the case was entirely left to my care, and here is a state of the case at that time. There was an obstruction at the *ductus ad nasum*, a large opening at the superior part of the sacculus lacrymalis, and the sac itself excessively dilated. The lacrymal points and ducts to the opening in the sacculus were found; a rupture of the sacculus towards the os unguis, which was intirely bare, indicated symptoms of exfoliation, and a little upwards, near the edge of the orbit, there was an inkisted tumor adherent to the coronal; the globe of the eye was continually inflammed, and could hardly bear

bear the weakest light. At first, she was bled at the arm, took some laudanum, and the eye was fumigated with emollients. The third day after, the pains subsided, and afterwards deterfive ointment was applied under the lids for some days, to destroy the superfluous varicous vessels. The eye being by that time in a much better state than it had been for some time past, I incised the tumor, out of which a black and greenish matter evacuated; she remained perfectly free from pain. Some days after, I passed a blunt probe down the *faccus lacrymalis*, and forced open the *ductus ad nasum*, through the superior orifice, which had never closed, and injected, during eight or ten days, with common warm water, to clean the *faccus*, and keep open the *ductus ad nasum*. By that time, the posterior part of the *faccus* healed, and there remained no communication between the *faccus*, and the place where the inkisted tumor was. I then applied a small algalie to prevent the superior orifice from healing, and injected both through the algalie and the lacrymal points. At last the tears kept their natural course; and having healed up the superior orifice, and continued to inject only through the *puncta lacrymalia*, she was in the course of nine weeks perfectly cured, and never had any complaint since.

Remarks. After what has been mentioned above, it will be obvious to all practitioners, that the inkisted tumor, and the rupture of the *faccus* on that side, were sufficient to prevent the orifice from healing, and occasion such great pains. I have often observed, that when the parts were not found interiorly, the opening never to heal, and be a clear symptom of a hidden disorder. I have also observed, that when the *ductus ad nasum* has been forced open with a blunt probe, the orifice never

to close or heal, when no injections were thrown by the lacrymal points, because the tears are always mixed with a thick matter, and unable to run down the nose, especially when the orifice, either performed with the knife, or natural breaking, is large, and too low. In the above case, the tumor and the contents of the sacculus kept the upper part in a continual state of inflammation, therefore the healing of the superior orifice could never be expected.

In January 1784, I was called to Liverpool in England for some private business. I visited the Royal Infirmary. Mess. Alanfon, Park, Dr Lyons, &c. received me with great kindness, and, after I had continued in the place sometime, they, jointly with the students, expressed a wish to hear a practical course on the diseases of the eye; and I having consented to their request, we collected all the eye-cases of the town, and those the Infirmary and Dispensary could produce. Amongst many of them, there was a barber who laboured under an obstinate fistula lacrymalis at the left eye, who had been operated before, and it was thought that no method could answer, unless the os unguis should be perforated, as the *ductus ad nasum*, after repeated probing, was too callous to practise a passage through it and keep open. At the time I saw the case, the *ductus ad nasum* was obstructed, but the sacculus extremely dilated, and without breaking; the puncta were so small that the matter contained in the sacculus could not easily flow up through the puncta, even with a strong pressure. I performed an incision above the common duct, at a line distant from its extremity; directed the point of the knife, its back turned towards the commissure of the internal cantus, into the middle of the sac, as low as the upper part of the groove of the os maxillaris would permit; then, without taking away the knife, I passed a blunt silver

silver probe along the knife, into the sacculus, took away the knife and left the probe, with which I forced open the *ductus ad nasum*, and, in three minutes time, the blood ran down the nose—a clear indication to the operator, that the passage was evidently pervious; and afterwards took the probe away, previously enlarging the passage with different motions. This done, I injected through the orifice, and cleaned the sacculus, and put in again the probe till next day, without dressing. This last proceeding was repeated for several days; and the *ductus* seeming to keep freely open, I healed up the wound, and continued for sometime to inject through the puncta, and the patient was thought cured of the complaint. Sometime after, the *ductus ad nasum* closed again, and the disorder re-appeared. The patient was willing to go through the same trouble, and, in consequence of that, the operation was repeated; but the probe was kept in the *ductus ad nasum* during three weeks, and the wound healed afterwards, and the patient was at last cured, without a return.

Remarks. It will not surprize a practitioner who has operated and attended many cases of that kind, to hear the *ductus ad nasum* close after the first or second opening. I have observed, that when the obstruction at that part is callous, it is absolutely necessary to keep in the probe so long as six weeks, before healing the wound; for, in such cases, the *ductus ad nasum* will never keep open till such time as there is loss of substance in the callosity, and often the practitioner will be deceived in that particular, it being extremely difficult to guess when it is proper to leave off the use of the probe. Patience goes a great length in such cases as these, and very often for want of it practitioners have practised through the os unguis an artificial passage for the tears,

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when they might have succeeded the natural way, had they had more perseverance; and I really think that the perforation of the os unguis may only be practised when there is an exostosis in the maxillary groove.

Jane Vaugh applied to me for a fistula lacrymalis about September 1786. She had been a patient in the Edinburgh Infirmary, and had been discharged in a fair way of doing well. Surgeon A—t, assisted by Surgeon L—a, had performed the operation. It appeared to me, by her account, and the state of the case, that the incision had been performed too low, and they thought proper to do it again higher, which incisions formed a very large orifice: he afterwards introduced a probe to open the *ductus ad nasum*, and injected from the orifice into the nose. Some days after, she was discharged; perceiving she was no better, came to me. I injected through the lacrymal points, and the injection passed through the orifice which was not then closed; I likewise injected through the orifice, and the injection passed in the nose. I thought at first that matters were right, but perceiving that the wound would not heal, I probed carefully, and found the probe was the outside of the sac, what made me guess the case; upon which intelligence, I introduced a blunt silver probe at the top of the sacculus lacrymalis, and searching down, I found that the *ductus ad nasum* was not open. To convince me of it, I put an algalie in place of the probe, and having injected through it, the injection did not pass into the nose. I took up the algalie, and put in the probe again, forced open the *ductus ad nasum*, and cleaned the sacculus with warm water, and left a lead probe as big as the parts would admit. Next day I took it up again, and cleared the sac. A few days after, the passage formerly practised at the out side of the sac, healed, and matters going on so well, I thought that the wound would give little trouble; but

but afterwards I discovered my mistake, for it took up near a month to effect it. After I had tried every method commonly used to no purpose, I stopt the lacrymal points with two lead probes, to prevent the tears from coming into the sacculus, and six days after I obtained at last my wish, and dismissed her free from the disorder.

Remarks. What I mentioned above concerning the passage of the probe at the outside of the sac by the first operator, will be an useful observation to avoid such a mistake; but I think it will be no less advantageous to the reader, to mention what was the cause the orifice would not heal. This was so large and so low that a small share of the tears could hardly keep in the sacculus lacrymalis, and find way through the *ductus ad nasum*, their specific gravity being insufficient to effect it; consequently, by stopping the whole quantity, the orifice was no longer prevented from healing, and injections through it kept the *ductus ad nasum* open. This last resource I had never employed. When these small probes were lodged in both lacrymal ducts, their head being made bigger for fear they should slip in, they gave very great pain to the patient; but she was ordered to her bed to prevent their friction over the conjunctiva, and other inconveniences.

Before I finish this subject, I must say a few words concerning the method of injecting mercury into the sac to desobliterate the *ductus ad nasum*. We have been favoured by Mr Blizzard, anatomist in London, with some observations; but having put that method in practice several times without success, I must confess that I think it useless, and that the cases cured by it were no obstruction, but merely a clogging in the lacrymal sac, which disorder is very common, and may be removed by a single injection through the lacrymal point, which injection has more power than twenty times the specific gravity of the mercury introduced in the sacculus lacrymalis.

CURATIVE METHODS
FOR THE
DISORDERS OF THE EYE-LIDS.

THE eye-lids may be disordered by all kinds of tumors which affect every part of the human body. They are subject to St Anthony's fire, phlegmone, œdema, schirrhus, cancer, warts, orgeolet, internal and external fleshy excrescences, anthracosis and adipous tumors. They are also liable to slackening and overturning, uniting against nature, convulsive motions, burnings, contusions, fistulas, purigenous ulcers, itch and tetter, disorders of the eye-lashes, and in short all fores.

If an inaction exists in the superior eye-lid, that its immobility, at the same time, occasions an obstacle to vision, and that the globe of the eye be disordered by it, it will be necessary to distinguish, whether this falling down of the eye-lid be occasioned by an erethism in this part, a relaxation in the skin, or a paralysis of the muscle, which, for want of harmony with the other parts, prevent its moving up and down. As soon as this eye-lid is in a spasmodic state, one observes a stiffness every time it is lifted up with the fingers. In the single sinking it is otherwise; for the too great extension of the skin causes only a soft and regular motion, very sensible to the touch. As to the paralysis

in the eye-lids, all the remedies which destroy the above disorders are absolutely of no use here. If the superior eye-lid be in a state of spasm, cover the globe of the eye, without having the faculty of lifting up naturally, and that no other malady besides be existing along with it,—it may be removed by the use of spirituous or aromatic fomentations, No. xviii. and in case they are insufficient, introduce, three times a day, under the superior eye-lid, some of the *pommatum deterfivum*, No. xxxi. If one be disappointed in his wishes, there is no room to doubt that the cause of the disease is a paralysis in the muscles; then no other means remain but an operation, otherwise it must be given up. I will observe here, however, that this operation brings on a great many inconveniencies and disorders, which are very often more dangerous than that one has a mind to remove, though imperfectly; therefore I leave it entirely to the prudence and judgment of the operator to determine.

The causes of the overturning of the inferior eye-lid (except the paralysis) are commonly a tumefaction in the conjunctiva, and particularly the portion which lines the interior of the eye-lid; a relaxation in these parts in old people, whose eyes are extremely watery and weeping; cicatrices which come from some wounds, ulcers and burning: in these last cases, the overturning is more or less, in proportion to the loss or increase of substance; so that the methods of cure for this disorder offer different indications relatively to the cause which produces it. When it proceeds from the tumefaction in the conjunctiva, one ought to have a particular care to distinguish if it be inflammatory or not, if recent or old. In the first case, bleeding, emollient fumigations, and relaxing topics, will be sufficient to dispel the obstruction, and permit the re-establishment in
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the parts. Such proceedings, however, would not do for a tumefaction of an old standing; for, in this second case, one must employ some resolute and aromatic collyrium in fumigations, (No. xvi.) tonic and stimulating topics, made up according to the No. xvii.

The relaxation of the conjunctiva in old people whose eyes are watery, and the overturning of the eye-lid, which is always the consequence, are very difficult of curation: they ought even to be looked upon as incurable disorders, relatively to an extreme atony, especially when of an old standing. The relaxed parts, brought by degrees in a vitiated state, cannot easily be re-established; for, in these cases, one ought never to expect any assistance from our art, unless it be with the help of spirituous liquors, tonic and strengthening collyriums, as the No. xxxiii. which, in stimulating the solids, may diminish the malady, or at least its progress.

If the overturning be considerable, the internal part of the eye-lid much protuberant outwards, and that the eye-lids do not come together in covering the globe of the eye; then one may take off with a knife a portion of the membrane which forms the jutting out (in its whole length) betwixt the eye-lid and the globe of the eye, or it even may be scarified. A disorder of this kind seems particularly more susceptible of curation than the others; and it is evident, that, in such a case, one may not only relax, but at least re-establish the parts in their natural state. This operation ought to be performed with a narrow knife fixed to its handle; and if, a little time after, the membrane makes still a small jutting out, a second operation ought to take place. There are many cases wherein the deformity is hardly sensible after this operation. Its dressing consists in introducing under the eye-lid, three times a day, three drops of the collyrium, made up according to the recipe,

recipe No. XIX. The operator will have an opportunity of observing, by degrees, a shrinking in the eye-lid, and a closer application of it over the globe, as the patient makes use of this remedy.

If patients do not apply for help in the beginning of the overturning of the eye-lids, they stand a chance of having their deformity a great deal more difficult of curation than at first, and schirrhous. This malady is very troublesome, and frightful to look at. However, one may not only apply remedies that will alleviate it, but even re-establish the eye-lids in their natural state. Such a cure may be looked upon of absolute necessity, as the globe of the eye is very much injured by the contact of the tumor, which produces ophthalmies and pains that stand against the use of all remedies whatever, till the eye-lid be restored to a sound state. Before undertaking any curative methods, I would have every practitioner to examine, if the schirrhous proceeds from a general or local cause; I mean from a bad state of the lymph; as morpewous affections, scrophulous viruses; in short, from a metastasis, or obstruction in meibomius glands, and those in the conjunctiva.

The internal causes are the plethory, as well as the other viruses which thicken the lymph; such as the venereal, scrophulous, scorbutic, cancerous, morpewous, or itchy humors, coarse and raw aliments always difficult of digestion, and which produce a chyle of the same quality, thicken the lymph to such a degree as to occasion many obstructions in these parts. This complicated disorder, and want of harmony, happen the rather, as the elasticity and oscillation in the vessels are very much weakened. The external causes come from the use of too dissecutive or resolute topics imprudently applied in the erysipelalous disorders of the eye-lids; for they sometimes change the malady in a schirrhous, by dissipating

dissipating the most fluid parts of the lymph. A cold may also condense the humors, and diminish the diameter of the vessels.

If the schirrhus be recent and without tumor; if it take up the whole extent of the edges of the inferior eye-lid; to be brief, if the eye-lashes be partly destroyed, and that the tears cannot have their natural way, on account of the destruction of the gutter which corresponds from the commissure of the external angle to the lacrymal points, these are sufficient grounds to believe, that the apparent disorder is occasioned by the destruction of the gutter, and its cause to the thickening of the lymph in general. In this case, recommend the use of a pint of whey for three doses per day, drank two hours before and after each meal. During the same time of this proceeding, one may prescribe a gentle dose of No. v. every other four days, as long as the patient's health will admit. The use of emollient fumigations, repeated in proportion to the hardness of the eye-lids, is also of great benefit. If, to the contrary, the disorder be of an old standing and local, that is, does not owe the continuation of its existence to the above mentioned cause, what happens very frequently, then one must not doubt, that the means already taken notice of, are quite insufficient, though he may look upon them as indispensable and antecedent to the use of resolute and stimulating pommatums, which shall determine the cure. See the recipe No, xxxi.

If the tarsi of the eye-lids be overturned inwards, and that the eye-lashes affect the globe of the eye, let the skin be bent outwards with the fingers, and apply a plaister on the cheek, to keep this eye-lid in its natural situation, and change it but when too slack. If after twenty or thirty days the eye-lid be relaxed, and that the conjunctiva be able to keep its natural state of tension

sion by the means of a cataplasm, No. xxvii. applied immediately on the part, then one ought to judge, whether there is sufficient elasticity to make an equal amends for the strength of the conjunctiva or not. This is conspicuous, when the eye-lashes are no more directed contrary ways, and do not brush the anterior part of the globe. Another method to remedy this disorder, consists in taking off, with curve scissars, the exceeding part of the skin in the eye-lid, and make several seams. This done, the operator covers the whole with a plaister, and a double piece of linen cloth, to keep it tight. Six or seven days after, the edges of the wounds unite sufficiently to take away the seams. However, one shall continue the use of the above plaister, till the twelfth or fourteenth day, during which time the cicatrice takes place. The eye-lashes are no sooner in their natural state, than the patient is quite free from pains, consequently from the disorder itself.

As I have already spoken of the disorders of the eye-lids above, to which I refer the reader for particulars upon this head, in order to avoid repetitions. I will only quote a few cases that have fallen within my practice, and say, that one cannot lend too strict an attendance to these disorders; for otherwise, a schirrhus in the eye-lids must be the never-failing consequence. Besides all the above precautions in the removal of such diseases, it is still of great importance to avoid a repercussion, without having thrown some corrective into the blood. Experience and discernment will lead a great way, and be the guide of an intelligent practitioner, for chusing always the properest remedies; but he ought to remember, that there are some complicated and old disorders which will not, nor cannot yield to the best methods indicated by art: These kind of cases will, I hope, always be looked upon by the skilful practitioner as incurables.

OBSERVATIONS

ON SOME

COMPLICATED CASES.

AN American Gentleman being in a country garden about London, in August 1781, was stung by a wasp at the inferior eye-lid, a little below the lacrymal point. Two or three hours after, a violent inflammation and swelling at the part took place; next day it increased to the size of a pidgeon's-egg, and gave excruciating pains. A surgeon, who was called to give his assistance, recommended a lotion of the vegeto-mineralis; this repercussive, instead of producing some relief, increased the complaint, and, in six days time, he thought proper to apply a caustic on the part, but to what good purpose I could not guess. The effect was such that the tumor was entirely consumed with loss of substance, the inferior lacrymal point and duct, together with the upper part of the sacculus lacrymalis, were likewise burnt, and the greatangle so disfigured, that one would have hardly thought that so much mischief had been operated in so short a time. In that situation, he applied to me in October following; but, What could I do? Nothing; for the complaint was past remedy. However, I recommend
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ed warm emollient lotions to alleviate the pain and temper the acrimony of the tears.

Remarks. There is no need of a great effort to think that the wasp's sting was left in; this produced inflammation and swelling. If, according to common-sense, a warm emollient cataplasm had been applied on the part, the swelling would never have increased to that degree. As to the application of any caustic in such a case, a *tyro* will easily apprehend the impropriety of it.

Mrs Gairdner, a widow, 29 years of age, of a bilious constitution, and liable to hysterical fits, had been troubled with disordered eye-lids of both eyes, during the space of two years. Various applications had been tried to relieve her, but all that had been prescribed internally and topically proved of no use. About March 1782 I was called to her assistance, and found the lids excessively swelled, inflamed, and a running of thick yellowish matter between the lashes, with a continual itching. At first both eyes were fumigated with a decoction of elder and mallow flowers for six times a day, during seven or eight days, and drank a quart of whey *per day* divided in four doses, one fasting, the second two hours before dinner, the third two hours after dinner, and the fourth before bed-time. She was afterwards purged twice at three days interval, and the lids swelled to a prodigious size, but had neither pain nor itching. Next to that treatment, a cold lotion of *vegeto mineralis* was made use of four times a day, for three days running, and the swelling began to subside by degrees, but pain and itching began anew. These were of course disused, and warm emollient lotions substituted in their place, and afterwards cold lotions of the same quality: A few days after, the pains and itching were intirely gone. During the whole time, a great quantity of yellow

low thick matter came out from the lids, and reduced them to very near their natural size, but kept them closed every morning. The next treatment was the application of the deterfive pommatum, No. xxxi. spread at the edge of each lid once a day, to deterge the purigeneous ulcers. Its use was continued for ten days, and the lids had by that time an appearance of being cured, and all applications were given over for 15 days. The disease began to re-appear with the same symptoms, but not so violent. Since the return, she drank lemonade, took no other purgative, and compresses dipt in a solution of 15 grains of sublimated corrosive, in a drachm of spirit of wine, with a gill of common water, were applied over both eyes shut during day-time, till her sight began to grow dim, then it was disused, and cold emollient lotions were afterwards made use of, which put an end to the complaint without return; but she continued to drink lemonade for a whole month after, though she was perfectly well.

Remarks. It is more than probable that many applications which were used in the above case, both before and during my attendance, could not operate a cure, on account of their repercussive nature; since the purigeneous matter, although tempered by emollients, did still produce an itching at the parts, especially when it was dry. The compresses dipt in a solution of sublimated, operated on the same principle as in the *tenia capitis*, of which I have read several observations treated in the same manner, the humor being in my opinion of the same kind, as I have experienced several times. As to the use of the purgative and antiputrid, I must acknowledge to have co-operated greatly along with it and the deterfive, as a specific to re-establish meibomius glands in their natural state.

In September 1786, John Steadman, aged 49, who is now a servant to George Robertson at the Granton Farm, in the parish of Cramond, Mid-Lothian, applied to me for a complaint in his eyes, the beginning of which was 20 years before, and had laboured under it all that time, more or less, with violent and painful inflammations, so as to be unable to work for his bread these three or four years past. He had applied to the Edinburgh Infirmary, at three different times as an in-patient, but having obtained no benefit by what had been prescribed for him, he was obliged to receive maintenance of his friends. When I saw the case first, both eyes watered considerably, the lids were swelled, the lacrymal points covered, the lashes turned towards the globe of the eye, several specks over the corneas, the conjunctiva overspread with a multiplicity of big varicous vessels, both eyes could not bear the light, and the pains were so sharp, that he was at times distracted with them. I shall not take notice of what had been done before, it being irregular. The first thing I did, was to pluck out all the lashes, and recommend him to the use of frequent emollient fumigations. The pains subsided, and a vast quantity of thick humor came out of the eye-lids, and constantly kept them close together every morning. Sometime after, I introduced the *pommatum deterfivum*, No. xxxii. once every other day for a week; by that time, the number of the varicous vessels became considerably less, and he began to open his eyes, but could not see on account of the specks. As soon as I was able to discover the place of the puncta lacrymalia, I passed a probe into each through the vessels which covered them, and afterwards threw an injection which went into the nose. Sometime after, the eyes became less watery, and had a tolerable good appearance. I was obliged to pluck out all the lashes once or twice

a week, and, in time, the lids assumed nearly their natural size and functions. Five months elapsed much in the same way, both eyes mending gradually better and better, till at last he began to see by a regular application of the *pommatum deterfivum* above mentioned, which became necessary to clean the lids from the varicous vessels, and deterge the corneas from the specks. From the time I began the case, to the space of eight months, he was cured of his complaint, except of a little speck on the cornea of the left eye, but it is very thin, and from the center. Many of the lashes had always a tendency towards the globe; and to prevent further trouble from them, his daughter, by my directions, was taught to pluck out such as may become hurtful. The man comes to see me now and then; and I may say without vanity, that he owes both his cure and bread to the care I took of his case, which required as much patience as skill.

Remarks. The beginning of that complicated disorder was undoubtedly a simple inflammation, and the lids turning inwards, brought the lashes into contact with the globe, what produced great pains and the specks. I considered it as a local complaint, and of course cured him without any internal medicines. As to the specks and disorders of the lids, they were only the product of the superfluity of the varicous vessels, which extended from the conjunctiva over the cornea, and sometimes became interwoven in its lamina; for, as they disappeared, the specks diminished, and the lids performed their functions.

CURATIVE METHODS

FOR THE

EXTERNAL DISORDERS

OF THE

GLOBE OF THE EYE.

THE caruncula lacrymalis is a reddish elevation, formed by a conglomerated gland, and covered with the membrana conjunctiva. It makes up, together with this last tunic, a semilunary gutter, designed to help the passage of the tears into the lacrymal points and ducts. This gland, placed in the great angle, is composed of many others, very small, and of an oblong whitish texture. They furnish a sabaceous humor and a limpid serosity, which make a part of the lacrymal fluid. This humor is sometimes changed into a thick matter called gum of the eyes,—a disorder which foretels an atony in the filters of that glandulous body. When this gland is destroyed, the flux of the tears become habitual, because the lacrymal points perform their functions very imperfectly. If the small glands which form the caruncula lacrymalis, are in an atony state, one may cure them with the use of tonics, such as the white wine, wherein a very little quantity of white vitriol is dissolved; or any other remedy of the same class. This consists to let fall on the affected part, two or three drops of it three times a-day.

In the angles of the eyes some little whitish, and very painful pustles, are sometimes to be observed, just in the same form as those little pustles which may arise on every other part of the human body. They are not even a very long while before they are opened, and soon changed in small ulcers. Anodyne and cooling collyriums are the proper remedies before their opening; on the contrary, one makes use of the drying and mondifying ones when opened. If the ulcers are puriginous, they become very troublesome, as they hinder the patient from rubbing his eyes. They are occasioned by a salted and brackish humor, which infiltrates itself into the *caruncula lacrymalis*. To remedy this disease, make use of the collyrium according to the recipe No. xvi.

It very often happens, that some fleshy excrescences arise betwixt the eye-lids and the globe of the eye. Some of them are solid, soft, and divided from each other, as the grains of a mulberry. The cause of their existence is commonly an ulceration, or a bad state of the fluids: Those that are not voluminous, and occasioned only by an ulceration, will very easily disappear by the use of the ophthalmic pommatum, whose composition is described in the recipe No. xxxii. especially if the use of some emollient lotions before it be recommended. On the contrary, those that are considerable, and produced by a defect in the fluids, require absolutely an operation. To perform it, let the patient be seated on a chair sufficiently high; an assistant overturns the eye-lid with two fingers, in such a manner as to expose the tumor entirely outwards, or at least as much as it is possible. This well executed, the operator takes hold of the tumor with a pair of tongs, or some other instrument, in order to raise it up for dissection, without leaving any part whatever: but be cautious, as this is not so very easy to perform as one would at first imagine,

gine, especially under the superior eye-lid. If the patient will not undergo the operation, it may be consumed with butter of antimony, mercurial water, or any other gentle caustic: but one must take a particular care not to touch any other part. As soon as the caustic is applied, pour a tea spoonful of warm milk, and keep the eye-lids up for some time.

The inflammation in the conjunctiva, especially the part which covers the globe of the eye to the very limb of the cornea, has been very improperly divided by the ancient and modern authors. Without laying down the division as they have transmitted it to us, and asserting a just critic upon it, I will separate this external affection of the globe of the eye into two parts, the external shall be mentioned here. The other belonging to the nature of the internal curative methods of the eye, I will put off till its proper place.

Two causes may occasion the external inflammation: without investigating now their division and subdivision, I will proceed to the explanation of the above only, as the curative indications are almost the same. The first of these causes are blows on the eye, and extraneous bodies entered under the eye-lids; the second a bad state of the blood. If it be produced by extraneous, let them be extracted as soon as possible; and if small, or without acrimonious quality, the inflammation shall be slight and easy of curation with cold emollient lotions: on the contrary, if bigg, and of a corrosive quality, and have remained long under the eye-lids, bleeding and regular diet ought to be recommended altogether. It will be even very useful, in case the patient suffers violent pains, to fumigate the parts for ten minutes with an emollient decoction. These simple means are quite sufficient when conducted by a skilful physician, who knows perfectly well to multiply or diminish them as the case requires.

The cases wherein bleeding may be avoided are when the blood is thick, and the inflammation accompanied with no smart pains; because diluents and purgatives may be made use of, together with the emollient fumigations, with the same security. If the inflammation be slight, some cold lotions, repeated three or four times a day, will be sufficient to dispel it; however, bleeding, with all these external applications, may be practised when patients labour under excruciating pains. With the diluent drinks, No. I. or II. the blood and the other humors become fluid: Bleeding, practised in the first days of the ophthalmy, evacuates the biggest vessels. But if the blood has acquired an acrimonious quality, every one may conceive, that the lymph furnished by the glandula lacrymalis, being of the same nature, will irritate the membranes of the eye, and occasion a most violent inflammation. All persons addicted to drink a great quantity of wine, or any other spirituous liquors, may have had several opportunities of remarking, that their eyes become inflamed and painful, especially those whose eyes are prominent; but these kinds of inflammations do not exist six hours after an emollient lotion, which is a very strong proof of what is asserted above.

The cornea is subject to the ophthalmy, ulceration, opacity, and disuniting from the sclerotica. The ophthalmy or inflammation in this tunic is always the consequence of that in the conjunctiva; because the varicous vessels which ramificate naturally in this last membrane, slide in and over the cornea, to furnish it with necessary juices for contributing to keep its diaphaneity. The ophthalmy in the cornea requires the same medicaments as that in the conjunctiva, when the causes are the same. The pustles and abscesses which affect this transparent membrane, are much to be dreaded, and
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call for a speedy help, when produced by an acrimony in the lymph, or the malignant small pox; otherwise they change in hurtful ulcers, whose cicatrices, if large and opaque, are an obstacle to vision, without almost remedy, when of an old standing. When the cornea is affected by some pustles and abscesses, emollient fumigations will be sufficient to dispel them, with the use of diluents and purgatives. If an abscess on the cornea cicatrises itself, and that it be an obstacle to vision, a disorder vulgarly called *albugo*, when placed on the internal lamina of this tunic; then its cure shall be extremely difficult, even morally impossible, if its diameter be as large as that of the cornea, and the patient of a bad constitution. But in case it be small in diameter, and on the external lamina, one may attempt the cure with No. xxxii. used three times a day. If this membrane becomes opaque by the stagnation of the lymph, and an obstruction in the varicous vessels which ramificate it, the dissolving and attenuating medicines will re-establish its diaphaneity, together with the use of diluent drink, when the malady is recent. If the disorder does not give way with such means, recommend the use of brackish or volatile fluid, introduced three times a day, to the quantity of two drops, No. xxxiii. If a heap of blood vessels exists on the cornea, and that it forms what is commonly called a speck on the eye, large enough as to hinder the rays of light from going into the bottom of the globe of the eye; then one ought to prescribe the collyrium made up according to the recipe No. xix. in order to destroy the external lamina of the cornea. Its use, here, is to introduce three drops in the eye, three or four times a day. If this membrane separates from the sclerotica (to which it is contiguous) if not in the whole circumference, at least in some part of it, the humors of the eye shall go out of the

globe, and occasion the irreparable loss of this beautiful organ, if proper means are not made use of to prevent it; but if it be of an old standing, and that its cause be of a general disorder in the organ, then one ought to give up the cure, and pay attention only to the removal of the deformity if possible. If any abscess be the consequence of this disuniting, and that an inflammation had been existing sometime before, one ought to make use of the pommatum, made up according to the recipe No. xxxi. preceded by a lotion, with the collyrium No. xiv. Besides, the patient must keep a low and regular diet, and be purged from time to time, according to his constitution, and the case in consideration. If some internal membrane be pushed outwards in such a manner as to form a tumor called styphyloma, and exceeds a bulk incapable to be inclosed with the eye-lids, a little incision, to let out the aqueous humor, must be performed; and, immediately after this operation, let a dose of the pommatum, No. xxxii. be applied on the very part, whose effect will be to stimulate the membranes, and join them together. If the tumor appears again, let the same operation and dressing be repeated; for the success depends on the physician's experience and surgeon's dexterity, who must know perfectly well what sort of dangers they have to encounter by the operation, and the use of this remedy.

The staphyloma, properly speaking, is a tumor occasioned by the falling down or slackening of the iris, through any hole in the cornea. One may easily know this staphyloma from any other, by a change of figure in the pupil. The more this tumor is big and placed outwards, the more difficult it is of curation. In the undertaking of such a disorder, one ought to pay a proper attention to the cause that produced it, the accidents which may accompany it, and its different kinds.

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If it comes from a blow on the eye, bleeding, and all that tends to alleviate inflammations, are pointed by art as the best and surest means; and if the tumor remains after the removal of these accidents, one shall perform an incision, as I have observed above, in order to let out the aqueous humor, and replace the iris in its natural state. If an ulcer was the cause, and that the hole be considerable, a dose of the stimulating pomatum, No. xxxi. ought to be put in the eye, as soon as the patient is free from the violent pains, without minding the inflammation. The history of such disorders, by way of observations, are more capable of instructing young beginners than any other suppositious descriptions: therefore, to avoid repetitions, I refer them to the Subject that treats of each of these diseases.

OBSER.

OBSERVATIONS

ON SOME

COMPLICATED DISORDERS.

DAVID WALKER, wright, was in the Edinburgh Infirmary about August 1786, for a complaint in his left eye. Various applications were made for his relief; but for all the care that was taken of his case by the late Dr. Hope, he was turned out of the Infirmary without benefit. He laboured under very great pains; and being solicited by several people to apply different things, the disease became more and more troublesome. He applied to me for assistance about November following; and the case at that time was thus: The cornea was extremely thin, and a little below the center, there was a little hole, through which passed the capsule of the aqueous humor, and next to it the inferior part of the iris; the pupil was irregular, and had little or no power of contraction and dilatation.— He suffered great pains in his forehead, temples, and towards the os maxillaris, his constitution very much altered, and he had not been able to work for a considerable time. This complaint was a staphyloma of the capsule of the aqueous humor and iris. The pain in his head was occasioned by want of circulation in the humors. The disorder began probably by an inflammation,
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and degenerated into an hypopion, which, for want of the operation, had resisted the former applications. I incised the capsule of the aqueous humor without hurting the iris; the aqueous humor ran out, and the iris returned of itself in the natural situation. He was bled immediately after, and the eye bound with a compress dipt in an emollient infusion, and ordered to his bed.— Six days after, the cornea united and healed, but this membrane being extremely thin at the part where the staphyloma existed, the iris became adherent to the cornea, and the pupil has assumed an oblong form; but the eye is not deprived of sight, for he could see his way with it, in case another accident should happen to the right eye. Since I have operated him, he has paid me several visits, and complained of some slight pains over his eye-brow and below the eye. These pains are owing to the stretch of the iris pushed forwards by the impulsion of the aqueous humor, which flows more towards that thin part of the cornea than any other part.

Remarks. The above case brought in my recollection the case which will make the subject of the following observation. I thought at first, that it would turn cancerous; but, although it had been agreed that the eye was lost as to its sight, and that I should take out the vitreous humor and crystalline, yet I did incise the capsule of the aqueous humor, as a trial, to save the eye, if it should be possible to cure the staphyloma: and as it turned out better than I had expected, no further mention was made of destroying the organ. Since the operation for the staphyloma took place, he has often solicited me to take out the whole eye; but on my telling him the inconvenience arising from it, he has chosen to put up with the slight pains. I presume that the organ as it stands will be of very little use to him, but it
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is far preferable to have an eye of that kind, rather than none at all.

John Thomson, aged 38 years, a carpenter, who lived in Warner-street, Coldbath-fields, London, applied to me in February 1782, on account of a staphyloma on his right-eye. He suffered no pains, but the eye was entirely blind. The cornea was protuberant, and part of the iris had found its way through the cornea; a great quantity of varicous vessels covered the staphyloma whose colour was bluish. I advised him to let it alone. Some time after he called at Mr John Sheldon, surgeon; but he recommending him to me, the patient remained in peace till the tumor began to grow, and become painful. When he called again, the staphyloma had increased to the size of a pigeon's egg; and as the pains were intolerable, I advised him to part with the whole globe to prevent further trouble. He did not approve of my advice, and I did not see or hear of him for six weeks or two months. The pains were so excessive, that he was obliged to keep his bed at different times, and at last sent me a message by his wife, to know if I could relieve him without the extirpation of his eye. I called to convince him, that there was no time to lose, as his life might be in danger within a short time, the tumor having turned to a deep blue color; however, I recommended a poultice of bread and milk, which gave him some relief, and in a few days he was able to walk out. I was surprised when he called at my house a week after, but the tumor was by that time increased to the size of a hen's egg, of a purple color, and the pains very great. I did all in my power to convince him of his situation, and urged him to think seriously of his wife and childrens dependence on him; and he at last agreed to be operated next day. I went to his house with surgeon Kennedy and another at the appointed hour,

deterfivum, No. xxxii. and ordered her to bathe the eye with a cold emollient lotion, three hours after each dressing. She took two or three doses of phyfic, No. x. more for her health than for the eye. In six weeks, I began to distinguish the cornea; and, on continuing the above dressing, but more irregularly, I was enabled to see the iris through the cornea, and she soon began to see objects confusedly. I let the eye alone for a whole month, and all the blood varicous vessels which yet covered the cornea became lymphatics; and she was able to read after a month, by the same plan of dressing, only twice a week. Since I have done no more, nature has finished the rest, for the cornea is become entirely transparent, and she is able to work at her needle.

Remarks. The texture of her cornea was excessively good and transparent; for that reason the varicous vessels had not been able to penetrate in its substance; if that should have been the case, an hypopion must have been the consequence, and likely the loss of the organ. I have often observed, that the varicous vessels grow even at the time of dressing, and the more numerous they are, the more they become so, on account of the lids decreasing in their functions, for which reason the dose of the dressing ought to be regulated according to circumstances.

C U R A -

CURATIVE METHODS

FOR THE

INTERNAL DISORDERS

OF THE

GLOBE OF THE EYE.

THE hypopion, a disorder I have already spoken of, (page 86.) is a very common one, and not easy of curation. It is now very material to observe, that the hypopion, though situated in the interstices of the pellicles in the cornea, is easily distinguished from the specks and cicatrices, in or upon this tunic, by the following signs: The cicatrices are white, and the specks greyish; the hypopion, on the contrary, is not only yellowish, but always attended with quick and shooting pains, violent inflammations in the conjunctiva, wakes, &c. However, the same accidents happen when a gathering of matter, in the anterior chamber of the globe, is existing: but, in this last case, the matter occupies the inferior part of the said chamber; whilst, when it is infiltrated in the pellicles of the cornea, the opacity formed by it remains more or less opposite the pupil.

The cause and nature of the opacity of the crystalline and its capsule being sufficiently explained, I will mention now the manner of extracting it out of the globe, when couching is not preferable; as this is very
Y 2 often

often the case, when the anterior chamber is not sufficiently spacious to permit the passage of the knife betwixt the cornea and iris, without any risk of hurting this last membrane. After that, I will proceed to the explanation of such precautions as I think absolutely necessary one should be perfectly acquainted with, to perform the operation of couching. An operator well experienced and instructed ought to know every method. One manner of operating must never exclude another, when it may be good and fit for the case in hand. Besides, as it is not possible one might foresee every thing that may happen in common practice, I will omit nothing here, to instruct the reader about a disorder and operation which commonly establish the reputation of oculists.

If the patient be of a good constitution, in health, and cataracted in the right eye only; if the anterior chamber be as spacious as commonly, and the cornea sufficiently convex; if the organ distinguishes light from darkness, and that the pupil contracts and dilates easily; it will be unnecessary to prepare him for the operation, by the use of cooling drinks, bleeding, or any other indications, which are only proper when of a sanguine, cacochymic constitution, &c. &c. This well considered, the operator shall chuse an apartment as well lighted as he can, but without any appearance of the sun during the operation; then he shall shut every window, except that before which he has a mind to perform, and take care to provide for curtains, or window-shutters, in order of intercepting the brightness of the light when convenient; this being of very great consequence, as I shall demonstrate hereafter. Let him cover the patient's head with a cotton cap, and tie to it two compresses, each of six inches long, and three inches and a half large, made with four folds of a very fine and dry linen cloth, to keep each eye from the light: besides, let the patient
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be seated in an arm-chair, a little raised up, and situated in such a manner as he may present his right shoulder towards the side of the window; then he will lift up one of the compresses which covers the cataracted eye, and tie up its inferior extremity to the cap, leaving the other down on the left eye, in order of hindering him from seeing. The operator pinches the superior eye-lid slightly, and raises it up with the thumb and index of his left hand; then he takes the *speculum oculi* in his right hand, and places it softly round the globe of the eye, under the eye-lid on the side of the external angle. Whilst the assistant, (placed behind the patient, to keep the head steady, and lift up the superior eye-lid with the index and *magnus* of the right hand, and at the same time sustain it on the coronal with the left hand, in such a manner, as to give himself facility with his own arms, to keep the patient's head very firm), the operator takes his knife with the left hand; this done, he brings down the inferior eye-lid with the index of his right hand which holds the handle of the *speculum*, leans during this time the three last fingers of the left hand, which holds the knife, on the extremity of the patient's *os mallæ*, in bending the *magnus* whereon his knife ought to be fixed between the nail and extremities of the finger. At the time of the insertion of the knife into the cornea, at a line from the *sclerotica*, he makes a soft pressure with the *speculum*, in order of hindering the globe from turning towards the great angle, and discontinues it in proportion as he finishes the section. As soon as it is performed, that is to say, when the section is finished, and the knife from the eye, the assistant shall let the superior eye lid come down as slowly and with as great precaution as possible, during the time the operator replaces the inferior in its natural state; after that, he takes away the *speculum*.

Now,

Now, to give the patient an opportunity of coming to himself, he ought to stop for a minute or more if he thinks proper.

To finish the operation, the assistant lifts up again the superior eye-lid with all the precaution above described, whilst the operator brings down the inferior, with the index of the left hand; then he introduces the kyftitome by its sheath into the globe, to the inferior part of the section, observing to place its extremity on the crystalloida, without touching the iris in going through the pupil. This done, he pushes the little button of the kyftitome, with the finger index, to have its blade out of the sheath; then he incises inferiorly, transversally, and, at one cut, the capsule of the crystalline, and takes away the instrument. He ought to remember, that, at this time, he must diminish the light, in order to produce a dilatation in the pupil, and facilitate the extraction of the cataract, by the help of some soft pressures made under the globe. These pressures may be done with the extremity of the kyftitome placed horizontally, or with the fingers; but they ought to be made softly, repeated as long as the cataract remains in the globe, and diminish in proportion it goes out of it. To receive this opaque body on the flat part of the instrument is a good method. If some particles of the crystalline body remain under the cornea, he extracts them with the kyftitome made at one of its ends, just as an ear-picker. If after this operation the pupil appears of a blackish color, the operator may expect success. This over, the assistant shall let the superior eye-lid down, which, joining the inferior, keep the eye shut. At this time, the operator will untie the top of the compress, and cover the globe with it; in order that both eyes be motionless, to facilitate the cicatrising of the incision performed in the cornea; for, if one eye was to move, the other would

would follow the same motions, even against the patient's will.

When the operator places the speculum oculi round the globe, he ought to employ no pressure, except when he runs the point of the knife into the cornea; and during the time of the beginning of this operation, he ought also to direct its points towards the opposite circumference of the pupil, in order of having the facility to countenance the folds of the iris, with the flat part of the knife, in case the impulsion of the aqueous humor (occasioned by the pressure of the speculum) brings it under its sharp side: for, to avoid the cutting of it, he will find very easy by lifting it up, by degrees, in conveying its point transversally, and at the same opposite part of the cornea. When the knife has gone through the cornea transversally, it is at that very time the speculum oculi ought to make no longer a pressure, though kept in the same position till the cornea be opened inferiorly. The inferior part of the iris presents itself almost always under the edge of the knife, when the operator puts an end to the section; but as its blade is convex on that side, he finishes it in cutting round, observing, however, to do it the lowest possible, in order the division of the cornea be not opposite the pupil. I think it is very necessary that the patient should be instructed in every point which concerns this operation; because he certainly shall exert all his abilities to hinder the globe from moving under the superior eye-lid. For which reason, he ought to be told, that the above situation of the globe facilitates the operation, and that the pains he is to suffer are not really as violent as he might imagine.

The dressing which follows this operation, is next to be taken into my consideration, as being attended generally with numberless dangerous consequences, especially when a complication of accidents is existing at the same

same time. As soon as the operation is over, the patient shall be put to bed in a very dark room, laid down upon his back, the head as low as possible, and always straight, that is, his body laid down horizontally; half an hour afterwards let him be bled in the arm, the repetition of which I leave to the judgment of the operator. Every two hours after the operation, he lifts up the compresses (but never allows the patient the opening of his eyes, as he would perhaps pay very dear for the gratification of his curiosity) to make a lotion on the exterior part of the eye-lids, with a very soft hair pencil dipt in a cold emollient infusion; then he waits till they are dried of themselves, to let the compresses down, observing that they be of no weight over the globe of the eye, as any heaviness in such a case may be very hurtful. He shall continue this dressing regularly till the sixth or eighth day, at which time an overflowing of thick matter (but of no bad nature) commonly happens, which is the forerunner of a very lucky success: In the meanwhile, the patient must be kept to a low and regular diet, and particular care must be had to give him a nurse to watch him during the night, in order to deter him from moving his head when asleep. After this time is over, he raises up a little the patient's head, to refresh him from the fatigues, and diminishes the quantity of the lotions, in proportion he thinks it necessary. When the wound in the cornea is entirely re-united, and the cicatrice made, what is ascertained by no flowing of the aqueous humor, then he allows the patient the opening of his eyes, in the dark, for ten or fifteen minutes, from four to four hours; all this managed in proportion to the time, and according to the diminution of the inflammation; besides, the patient may be seated in his bed, and then go out of it from time to time, till he finishes, by exposing his eyes to the strongest light. With these precautions,

a deal of trouble and pains, which are commonly attended with a loss of sight, are saved to the operated.

If every particular above mentioned did go on as well as a description, it would be very agreeable; but as a great many accidents and obstacles, which puzzle very much a young beginner, happen during the whole time of this treatment, I will now take them into consideration. The continuation of these emollient lotions occasions commonly a slight but sharp excoriation on and round the eye-lids, and a lymphatic swelling in their texture; to get the better of these inconveniences, one ought to make use as a lotion, of the collyrium, No. xvii. and diminish the quantity of emollient lotions when the inflammation presents no eminent danger.— However, I shall observe here, that now and then, separately and alternatively, the emollient lotions ought to take place, together with the use of the said collyrium. This depends always on the cases that may require one or the other, by way of preference. All these lotions are only practised on the operated eye, except two or three upon the other, to mitigate the acrimony of the tears, as this eye remains continually shut. These contra-indications show plainly, that the effect of the first of these lotions is to relax, and the second to bind the parts together.

It happens very often, that the division practised in the cornea cannot be joined and united entirely, either by the iris or some extraneous bodies being placed betwixt the lips of the wound. In case this impediment be produced by any extraneous bodies, they ought to be extracted, and the patient laid down again upon his back, both eyes shut, and bathed with the lotions as above, till the running of the aqueous humor be quite ceased. If the iris leans on the cornea inwards, and produces a staphyloma; then a small incision on the tumor

ought to take place, avoiding to hurt this vascular membrane, to let the aqueous humor out, and facilitate by this means, the replacing of the iris; and in case this operation does not effect the entire re-uniting of the cornea, the incision must be renewed, and immediately after it, a dose of the ophthalmic pommatum, No. xxxii. for one or two days is required.

The pressure made with the speculum oculi, to fix the globe at the time of the section during the operation of extracting, does not produce an inflammation, as many would imagine. If any one will have a convincing proof of this assertion, let him introduce it in the eye of any body whose eyes are sound; then he will have an opportunity of observing, that the inflammation occasioned by it, will not last more than a quarter of an hour, or half hour, and the whole time without pains. Before to dismiss this paragraph, I will here observe, that when one has to struggle with a staphyloma and an inflammation at the same time, he must pay no regard to this last affection; for, considering two objects which require equally a speedy help, it will depend only upon his sagacity, to judge whether applying a dose of the said ophthalmic pommatum, which increases still the inflammation, be necessary, or not. A practice, grounded upon this theory, will very soon reconcile him to it. In fact, the inflammation diminishes to the third or fourth day, after the application of this remedy; because, being dissecative, it takes off the swelled and varicous vessels, and consequently puts an end to the disorder. This method is just as fire and water, if I may be allowed the expression, which a practitioner ought to manage with the greatest care and ability; for fear, that a more or less quantity of one or the other, may not produce greater accidents than those he intends to remove.

The operation of extracting the cataract is not always practicable: there are even many cases wherein it would be more eligible to reject it than to admit it. When the extraction is thought impracticable, either because of a small space in the anterior chamber, a defect in the pupil, or an overturning of the inferior eye-lid; then couching ought to be preferred, if the cataract be solid, ripe, and of a common nature. This operation is performed as follows, the patient being seated for that of extracting as above described; the operator places the fore finger of his right hand on the superior eye-lid, to lift it up, and his thumb on the inferior to keep it down; then he takes the needle with his left hand, betwixt his thumb and fore finger, just as if it were a pen, placed in such a manner as the middle finger be at the upper extremity of the handle, and the fore finger not more advanced than the thumb: this done, he leans the two last fingers on the temple, in order to avoid any shaking of his hand, and bids the patient turn his eye towards the nose; at that very time he sinks the needle into the sclerotica, at one line from the limb of the cornea, on the side of the external angle, endeavouring to shun the varicous vessels, if some appear at the very place of the insertion of the needle. When it is arrived opposite the pupil, he turns it by half, and directs its flat part upon the superior part of the crystalline, which he brings down under the pupil, in attempting to fix it there: after that, he sets his needle horizontally, and gives it a half turn, to take it out as it went in, in order that it may wound no other part.

If an effusion of blood into the globe happens, when the needle has been run through the coats, and that the aqueous humor be troubled in such a manner as to hinder from seeing in the back chamber, before the depression of the opaque body, then the operator shall take

away his instrument, and proceed no further till that effusion of blood be entirely resolved by the use of some emollient fumigations. If the cataract, when couched, happens to replace itself in the fossula of the vitreous body, either totally or part of it, jumping may be recommended at different times, when the patient is quite recovered; for though such a method may appear ridiculous at first, yet several physicians have observed, that it proved sometimes beneficial, especially when no adherence has been contracted; and in case this does not succeed, it ought to be couched a second time with the needle. There are, however, a great many circumstances wherein either of these methods is quite useless; but, as I proposed them only in case the other cannot be practised, an operator ought to make the most of them, without any further wishes. Before to wind up this paragraph, I think it will not be improper to remark here, that a cataract couched to the bottom of the globe, does not dissolve, as has been thought by many writers. For the support of this opinion I have several instances, three of which no body, who reads the medical and surgical journals for these twenty years last past, will doubt. Three persons, at different times, died in the hospitals of Paris: they were remarked by the students, and their eyes opened before a numerous assembly, who all saw the opaque bodies adherent to the bottom of the globe, though lodged there for seven years in the first, thirteen in the second, and seventeen in the last. However, I must observe here, that its dissolution will certainly take place, if the crystalloida is properly tore; this has been remarked by Mr Pott and myself. I have attempted to tear the crystalloida without couching the lens, and let it dissolve without any further trouble; but having been disappointed five times in six operations, I have entirely given it up. The method I practised for that purpose

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was this: A common couching needle was run through the cornea at a line from the circumference, then directed through the pupil diagonally, and then on the anterior face of the crystalloida, which was tore as much as I could find it convenient; this kind of operation I termed *detrition*. As to the whole and found crystalline, well wrapt up in its membrane, I think it would take more than a man's life-time, for its dissolution in the globe of the eye.

The foundation of our knowledge in the art of healing is just and exact anatomy: without such a help, the practitioner acts as in a maze, is apt to go astray, and make blunders every minute. It is allowed on all hands, that, for want of a due theory in the art, he produces many more accidents, and of greater consequence, than the disorders he pretends to cure. According to these notions, every reasonable man who follows the medical business, shall freely grant, that he cannot examine too closely all the parts which the human body is composed of, in order of becoming well acquainted with the structure, extent, limits, and adherences they have with those nearly related to them. It is on account of these considerations that I have thought necessary to lay down a long and particular detail upon the crystalloida, as a great many anatomists differ very widely about the nature of this capsule; through it pass a great many lymphatic arteries, which penetrate into the substance of the crystalline lens for its nutrition, and to suspend it in *morgani humor*, or else the crystalloida shall turn opaque, by becoming in contact with this capsule. When the crystalloida is properly incised, sometimes these lymphatic arteries detain the crystalline lens, and may give a suspicion to the operator that its capsule is not fairly incised. This has happened to me several times, and I discovered

discovered it to be particularly so when the crystalline lens was rather softer than usual.

The crystalloida is made up of two spherical and concave membranes; the posterior lines the fossula of the vitreous body; the anterior is less extent and concave than the posterior; but the first is thicker than the last: besides, they are united together by their neighbouring edges, as it will be further demonstrated hereafter than it has above. Almost all the anatomists have advanced, that the crystalline has a particular envelope, which is covered with the capsule of the vitreous body. Experiments, however, speak to the contrary; for it is a fact sufficiently cleared up, that the crystalline lens has but one, and which stands by itself. The opacity, to which it is subject, being so visibly fixed as not to be able to extend further than the anterior or posterior circumference, was a sufficient reason to make practitioners understand, that in case this envelope had been an extension of those of the vitreous body, these should have been more or less affected along with it. Besides, if they had enquired and assigned a physical cause, why a cataract precipitates itself to the bottom of the chamber of the eye, without any help of art whatsoever, they would have undoubtedly foreseen, that the membranes of the vitreous body do not wrap up the crystalline; for, supposing this envelope had existed, how could it be possible to conceive, that the crystalline body would naturally and of itself go out of its place?

What I have to say concerning the crystalline capsule requires a particular order, and will be divided into two parts. The first shall contain different experiments, to demonstrate, *1st*, That the crystalloida is the single crystalline's envelope. *2^{dly}*, That this kind of bag is only contiguous to the tunics of the vitreous body. *3^{dly}*, That it is made up of two calottes, adapted and contiguous

guous to each other, in the whole extent of their limbs. The second shall include many observations to bring these truths to a sufficient light, to which some analogous reflections on that head shall be added. Moreover, I will describe the causes that determine the total, or part, of the crystalloida's opacity, together with the properest means fit to check this disorder, or re-establish the organ whose sight might be impaired by it.

First Part. Let one perform a circular section in the cornea of the eye (when extracted out of its socket) of an ox newly killed, and introduce, through the pupil, the small handle of an instrument, and direct it obliquely towards the very circumference of the fossula, till it be arrived there. Let him separate softly the crystalloida from the vitreous body, with some small pullings or shakings, from right to left, *et vice versa*. As soon as the basis of the processus ciliaris shall no longer resist to the effort of the instrument, let him introduce it into the fossula, in turning, and leading it in such a manner, as to pass under the two thirds of the circumference of this cavity, to destroy the adherences which are to be met with, between the crystalloida and the vitreous body. If he places on the crystalline capsule a buttoned probe, he will have an opportunity of observing, that there is no floating portion of the membrane to be found. This furnishes a convincing proof, that the extension of the capsule of the vitreous body does not exist over the crystalloida. Let him overturn the eye, and pay attention to the few adherences there are between these two transparent bodies, as the point of their union is only existing in the circumference of the fossula of the vitreous body; let him separate them from each other, and put the crystalloida on a white sheet of paper; then, with the help of a good microscope, he will see the most exact polish all over its surface; in short, he shall remark, towards

wards the circumference of the crystallo-anterior, some small grooves very near each other, and that every one of them have about the third of a line in length: their function is to keep fast and steady the basis of the ciliary fibres. If some remain still, let him take hold of them with a pair of small tongs, they will give way to the smallest effort; and he will find, by looking with attention, that a great many lymphatic arteries, though small and delicate, are prolonged till their tunics will give way to the pulling, and be broke. If the crystalline capsule were an expansion of that of the vitreous body, it should naturally result from this, that a blunt instrument, such as a handle, could not well divide the tunic by tearing. Moreover, he will further observe, over the crystalline capsule, when taken out of the fossula, an exact continuity near all the edges, which could not be performed by the most sharp instrument. Besides, if the crystalloida were not a particular envelope of the crystalline body, it would not be possible to divide it from the vitreous body with the handle of an instrument, without producing some inequalities; but, as a gradual pressure is sufficient to separate the two transparent bodies from each other, it follows necessarily, that one needs neither sharp nor flat instruments to perform a circular division.

Let one cut circularly the middle part of the globe of an eye, that is, at about three lines from the limb of the cornea, without touching either the vitreous body, or the crystalloida; let him separate these transparent bodies, from the other tunics of the globe, and put them aside upon a clean plate, he shall see that the crystalloida is a great deal more dense than that of the vitreous body. If he thinks that the ocular lens makes its capsule look thicker than it really is, let him touch slightly over the vitreous body with a buttoned probe, and pay a proper attention to its elasticity in comparison

parifon to that of the cryftalloida, he will have an irrefragable proof of what is advanced above. To perform all thefe experiments, one ought to prefer the eye of an ox or horfe to that of a man; becaufe the parts of the firft being more voluminous than the laft, one may diftinguifh them a vaft deal better. Moreover, the cryftalloida in thefe animals does not differ in the leaft from that in the human eye, except by its greater bulk. However, the above experiments praftifed on the human eye fhall certainly produce the very fame remarks, provided one can diftinguifh as well.

To complete the above experiments, one ought to open, with a fmall pointed chirurgical inftrument, the cryftalloida feparated from the vitreous body, and, after its removal, take them deprived of the fluid, betwixt the fingers feparately; he fhall feel by the touch, that the cryftalloida is thicker than the two tunics of the vitreous body; then let him bring thefe tunics near a hole praftifed in a window fhutter, through which pafs fome rays of the fun, he will have an opportunity of obferving a multitude of pores, fpread over the whole texture of thefe membranes; with this difference only, that the cryftalloida has lefs of them than the tunics of the vitreous body. What then may be the caufe of the difference that one remarks in the thicknefs and foftnefs which are to be diftinguifhed in thefe envelopes? It is becaufe they are of a diftinft nature. Befides, let him macerate the globe of an human eye into fome brandy, he will remark, fome few days after, when he comes to cut it open, that the cryftalloida has acquired an opacity fimilar to that which occafions the cataract, whilft the membranes of the vitreous body will keep their natural transparency. Let him fink a tooth-picker, by its point, betwixt the cryftalline capfule, and that of the vitreous body, and cut the opaque body, to feparate

it from the fossula, he will find, that the posterior face of the crystalloida has acquired the same degree of alteration as the anterior. He may naturally conclude, after this experiment, that had the crystalline capsule been an extension of that of the vitreous body, this last membrane would have participated to the loss of transparency in the first; but as this alteration has not been the consequence, it is a very clear proof, that the crystalloida is only contiguous to the vitreous body. He will see, moreover, that the crystalline capsule is formed by two spheroid and concave tunics, when he performs the following experiments.

Let the crystalloida be separated from the vitreous body, and macerate in a little phial full of common water, within a few days afterwards, he will have an opportunity of perceiving that this envelope is opened in its lateral part. Let him take it out of the water, and divide it, setting asunder the disunited parts from each other, he shall see, that the crystallo-posterior is more extent and concave, but less dense than the crystallo-anterior.

Let him perform an incision, sufficiently large, in the cornea of a living animal, and squeeze the eye by degrees, till the crystalline goes out of its envelope, without cutting into this last membrane, then he may remark, at the time of the pressure, a great tension in the whole capacity, especially towards the anterior part, and will easily conceive, that the vitreous body, by its elasticity, operates at this very moment a compression over the crystalloida, which is much the same as that performed in the external parts of the globe. Let him diminish the pressure at the same time of its going out of the fossula, in order of observing the demi-circuit formed on the limb of the crystallo-anterior, then the crystalline will no sooner be extracted, than a mist, which did not
exist

exist before, shall appear beyond the pupil. Let him squeeze sufficiently the globe of the eye with the fingers to extract the vitreous body, he will easily observe, that the crystallo-anterior is become opaque in its whole extent, whilst the crystallo-posterior has kept its transparency as well as the vitreous body. The dilaceration continually operating at the inferior junction of the tunics of the crystalline's capsule, proves clearly, that they are only contiguous; and the opacity which happens in the crystallo-anterior, during this experiment, is a complete proof of it. It is very material to observe here by the way, that if this tunic loses its diaphaneity when dilacerated, it keeps also its transparency when an incision is practised to facilitate the going out of the crystalline: therefore, according to this remark, I think one will be sensible how necessary it is to make a large incision in the crystalloida when he extracts a cataract. For want of such a precaution, he commonly occasions a secondary cataract, which, as I have observed, is difficult to remove.

Second Part. I was present when a blind lady underwent the operation of the cataract by extraction. As soon as the section was performed, the aqueous humor ran down; and, in proportion, the cataract made its way out. It forced open the circular fibres of the iris. The section had hardly been finished, that the cataract went out, and precipitated itself on the cheek. We were very much astonished to see that this opaque body was exactly round, and its circumference neither gummy nor lenticular as the ordinary cataracts. It was as soft as a bag full of water, and kept an hydatide form. When it had been put upon a sheet of white paper, the other eye was operated and produced the same kind of cataract, but of a globulous form. We made a close examination of these two opaque bodies,

and observed, with a microscope, that their surfaces were as polished as a looking glass: it was not even possible to distinguish their posterior part from the anterior, nor to perceive the little excavations or grooves, wherein were placed the basis of the fibres of the processus ciliaris. After having cut open one of these opaque bodies, we then saw that the crystalloida opened, produced a mucous and yellowish matter, which spread itself over the paper. We observed also, that at the very instant the crystalline's capsule was divided or incised, that it sunk over the opaque lens, and had more consistence than in the natural state. One of us pressed over several places of the surface of the capsule of the second cataract, which always gave way to the pressure of the instrument; but as soon as the impression was not sensibly discovered on that tunic, the comprimated part re-established itself in its first state. He performed upon this opaque body the same incision as the above, but there was no different remark worth making.

I have extracted two cataracts of the same nature as the above, except that they were more voluminous and of a milky white color. When I squeezed on any point of their surfaces, (for I put them on a sheet of paper) I observed a fluctuation to the very lateral parts; and when I finished pressing upon them, the globulous bodies re-established themselves. As soon as I had performed the incision in the first crystalline, a whitish and mucous humor ran out of itself, and wetted a pretty good extent of the paper, though the diameter of the opaque body, which, of whitish and round as it was, became lenticular and olive-colored. I took up the crystalloida, and found it opaque in its whole extent, and thicker than in its natural state.

The second cataract offered quite the same remarks as the first. There is no doubt that the sphericity of these

these cataracts was only occasioned by the crystalline capsule, and mucosity they contained. These are also irrefragable proofs that the crystalloida stands by itself, and that it is not, as was believed, wrapt up exteriorly with the capsule of the vitreous body. If the crystalloida and its contents did not sometimes exfoliate, a cataract could never fall of itself to the bottom of the posterior chamber by a violent commotion; but as we meet with a good many instances of that kind, we cannot reasonably refuse ourselves to evidences.

A young man, born blind, with two cataracts in his eyes, had the advice of several oculists, who told his friends, that nothing but the operation of extracting was capable to restore him his sight; but as he was a very boisterous boy, no one of them dared to operate him, considering that he was able to find his way; in-somuch, that he remained deprived of sight till he was fourteen years of age, when an unexpected event procured it him. One day, as he was going out for a walk with some other boys, one of them, as they were strolling about in the fields, discovered a nest of birds on a very high tree, and immediately acquainted his companions with his discovery. Our blind boy being senior, and the most nimble that way of them all, desired he might have the glory to climb up to it. He had no sooner reached at the branch where the nest was lodged, than, having lost his equilibrium, he fell from branch to branch, till he came to the ground straight on his legs. This fall frightened him in such a manner, that he lost his senses for a while, and measured the ground with his whole length by a second fall. As soon as he was come to himself, he told his companions, who were frightened on account of his fall, that he saw several bodies in motion, and assured them, to their no small surprize, that he was seeing several objects which
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he was totally unacquainted with. Being returned home, surgeons were immediately sent for, to know if they might expect a happy continuance with regard to the boy's eyes. They all agreed, that the cataracts, which they had seen before in his eyes, had totally disappeared, and were lodged, very likely, at the bottom of the eyes.

Such an observation shall certainly be no advice for people afflicted with cataracts, to repeat the same experiment. This is too obvious for a single proof, that the *crystalloida* stands by itself, and that cataracts of that kind have their degree of maturity.

In fact, if the crystalline capsule had been still adherent to the vitreous body and *processus ciliaris*, (as in the natural state) would it have been possible, though the commotion had been more considerable, that the cataracts had precipitated of themselves to the bottom of the posterior chamber? Certainly not. It is very natural to think, that, at the time the boy took this lucky fall, the *crystalloida* were almost exfoliated from their fossula, as I said before; so that the commotion determined the cataracts to come down, being besides accelerated by the specific gravity of the ocular lens. One cannot suppose here, that the pretended portion of the capsule of the vitreous body was tore by the means of the commotion; for, though the ancient anatomists thought it did wrap up the anterior portion of the crystalline, it is very easy to refute such an idea by what follows, and many other assertions of as strong and powerful arguments as those here mentioned. Could it be possible, that a commotion were capable to dilacerate a membrane, as that of the vitreous capsule, without any such raptures in the soft and thin vessels of the brain, and other parts of our body, whose texture is as delicate? Could any one imagine that Nature herself, being

ing tired of blindness, determined the commotion and dilaceration of the vitreous capsule; in order that the opaque bodies might be precipitated the easier to the bottom of the globe, whilst she would have preserved the other parts of this organ? Indeed, this would have proved a very extraordinary phenomenon! But an objection presents naturally of itself to remove such a strange idea. Suppose the vitreous capsule should stretch itself to the very anterior part of the crystalline, and that it were dilacerated on account of the commotion, it would naturally follow, that this part would lose its oscillation, from thence an obstruction in the vessels, a stagnation of their fluids, and an opacity of this envelope. After all these considerations, one may reasonably conclude, that the vitreous body was not altered in the least at the time of the removal of the crystalloids, and that this last membrane is the only envelope of the crystalline.

I was present when a young girl, born blind, underwent the operation of the cataract by extraction. The operator had no sooner opened the cornea and crystalloids of her right eye than a milky humor came out of the globe. When this fluid was entirely run out, we observed, beyond the pupil, an opacity in the crystalloids; but it was impossible to extract it, as the vitreous body produced a great quantity of its fluid, and experienced a visible sinking. The operator proceeded to the other eye, but did not open the crystalloids in order to extract it along with the crystalline; for the effect of which he introduced through the pupil, immediately after the opening of the cornea, an instrument, made at its end just as an ear-picker, and directed it towards the inferior portion of the fossula of the vitreous body, in order of destroying the adherences that contracts its capsule with the crystalline. As soon as the instrument's end was in the interior of the fossula, he tore the crystalloids, out
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of which flowed a viscous and milky humor, and produced the exfoliation of it. The interior of this tunic contained not the least remain of the crystalline body, for which reason we conjectured it was liquified. If the crystalloida had been a continuation of the vitreous capsule, could it have been possible, that, by single touchings with the instruments, its exfoliation had taken place without a dilaceration to the circumference of this cataract? As none was existing, it is a convincing proof the crystalline capsule is independent of the vitreous's, and that it stands by itself.

Several physicians were called for their advice in a cataracted case, among whom I was one. We remarked, that the bulk of the cataracted eye was equal to that of the sound one: the pupil of the first was not only dilated, but immoveable to all degrees of light it was exposed to; a sure token of the complication of a perfect blindness. The crystalline looked opaque, and floated at the least motion of the globe: its whole surface was wrinkled, and less voluminous than the common cataracts. The posterior part of this opaque body was pyramidal, and only adherent to the superior part of the ring of the fossula. The vitreous body was transparent, its fossula appeared convex, and the aqueous humor limpid: in short, this eye was affected with a moveable and loose cataract. We asked him whether he had received any blows on his eye, or undergone the operation of couching; he answered in the negative, and added, that the disorder had occasioned neither pain nor inflammation. If the crystalloida were covered over its anterior part by a lengthening of the vitreous capsule, how could the crystalline body, with its capsule, have got out of the fossula without exterior cause? The ulceration in the crystalloida is always attended with an extreme contraction in the pupil, and adheren-

ces contracted between the posterior faces of the iris and the crystallo-anterior. The accidental displacing of the crystalloid body proves, 1st, That this cataract has a maturity which consists in the exfoliation of the crystalline capsule. 2^{dly}, That this envelope is not a continuation of that of the vitreous body. The following observations are further proofs and instances of it.

I have extracted a cataract out of the right eye of a gentleman who was of a very good constitution, and afflicted with no other disease. The opaque body was of a white pearl colour, and floated at the least motion of the globe. As soon as the section in the cornea was finished, I compelled (with a blunt instrument) the opaque body to an exfoliation, to have it out of the globe. The sight was re-established that very instant, and the treatment, after the operation, was carried on without accident. The crystalline was wrapt up with its capsule, but both were opaques; with this difference only, that the crystalline lens was of an olive colour, and the crystalloida of a pearl color. This envelope was a great deal thicker than in the natural state, and no remains of a dilaceration were to be distinguished upon any part of its surface. I chose to exfoliate this body with such an instrument, because I conjectured it was not fixed in its fossula, as it appeared quite loose in its greatest extent.

About ten years ago, I was called to give my advice for a young man, who had from his birth two cataracts in his eyes. They were of so singular a nature, and so very uncommon, that no body chused to extract them. When the young man directed the axis of his eyes downwards, the cataracts rose up of themselves, and the third inferior part of the pupil was quite discovered; but if the globes were fixed horizontally, they came down and obstructed the pupil. Thus the young man

was only able to see his way; and, as I said before, when the axis of his eyes were directed downwards. Though these cataracts had a kind of elasticity, and something extraordinary in themselves, I judged their extraction practicable, having remarked the pupils susceptible of contraction and dilatation, and the found state of the globes. As soon as I had practised the section in the cornea, the aqueous humor ran out as usual, and, at this very instant, the cataract changed its position. This lenticular body having been constantly fixed opposite the pupil, as long as the globe was horizontally situated, raised up for the first time, and its inferior limb found itself towards the middle of the pupil. I pressed softly under the globe of the eye, to oblige the opaque body to go through the pupil; but having observed that the vitreous body presented itself, and that the cataract had almost entirely hid itself under the superior part of the iris, I altered my way of operating, by taking hold of the opaque body with a pair of small tongs, and extracting it out of the globe, I succeeded as well as I could wish. This over, I undertook the operation on the other eye, which produced the same remarks, except that the cataract divided itself in two portions. I took hold of the inferior, which was the most considerable, and brought it out, whilst the other went towards the top of the globe, just in the same manner as a venitiá-blind let loose to the strength of its spring. What is most extraordinary in this is, that after the complete cure of this patient, I could not see any portion of the cataract which remained behind, having taken its quarters, as I suppose, to the superior or inferior part of the globe. These two cataracts were crystallines and capsularies: their form presented a spheroid more flat than the common sort. What might be the cause of the mobility of the above cataract? To this I answer,

swer, that they moved of themselves, because the crystalloida were exfoliated to their inferior and lateral parts, whilst their superior were still adherent to the circle of the fossula of the vitreous body; so that, when the axis of the eyes were bent downwards, the inferior muscle of each globe being in action, occasioned in this part of the organs a point of compression capable to change totally the form of the fossula of the vitreous body, and give it a conical figure. The aqueous humor of the posterior chamber, having in this situation of the eyes a great deal more facility to pass in the anterior chamber, shook the inferior limb of the cataract; and being compelled there by the convexity of the fossula, it produced a change in the situation of the opaque body, by placing it backwards, and opening a way for the rays of light, which left each organ a power to see some objects: when, on the contrary, the globes assumed an horizontal position, the pressure of the inferior muscle not existing, and the aqueous humor exercising a sufficient pressure over the vitreous body, obliged its anterior part to re-assume a concave form; then the edge of the fossula came forwards, and the cataracts did fall down where they were before. In this state, the luminous rays were intercepted, and the perceptions suspended. What confirms me more in this opinion is, that the aqueous humor had no sooner been evacuated, after the incision in the cornea, than the cataract raised itself up, though the axis of the eye remained horizontal; because then, the vitreous body being no more kept close by the action of the aqueous humor, its elastic strength altered immediately the form of the fossula, which from concave became convex, and compelled, by this means, the opaque body to change its position. Therefore, after having well weighed the cases, when a cataract is floating, an operator shall never

open the crystalloida to extract it ; because this envelope, in such a state, is commonly opaque.

Having extracted a cataract out of the eye of a girl, I observed, during the operation, that the crystalline went very easily out of the globe, by the help of some soft pressures under it, after I had performed the section in the cornea ; but, as soon as this was over, I saw beyond the pupil, an opacity in the anterior part of the crystalloida, which I extracted with a pair of small tongs, and brought it out with the usual precautions. These consist in pulling gently from left to right, and from right to left, as I have already observed in the above paragraphs : For, with such precautions, the operator allows a proper time to the adherences which fix this tunic, to separate from the vitreous body. The above remarks have convinced me, that the crystallo-anterior may become opaque, while its posterior keeps its diaphaneity ; and that this envelope must be made up of two membranes, one sometimes altered when the other is sound,

It is not sufficient to know with certitude, that the crystalloida is susceptible of opacity before or after the displacing of the ocular lens ; it matters yet to know the causes for which it loses its natural state : The internal are, *1st*, an alteration of the morgani humor, as I have already observed. *2^{dly}*, The obstruction in the vessels of this envelope, and the dilaceration in it, which all contribute to form its opacity.

The external causes are, *1st*, blows on the globe of the eye. *2^{dly}*, A too small incision in the crystalloida, when one operates the cataract by extraction ; because a very little aperture not giving easily an opportunity to the crystalline body of going out of its envelope, it tears the sides and edges of the incision when the operator presses under the globe of the eye to hurry its passage ;
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from thence a dilaceration or bruise, which is sufficient to opacify this tunic. It is absolutely necessary to pay the greatest attention to the performing of the section in this capsule, and not to press under the globe of the eye, but when the incision is performed, and sufficiently large to let the cataract out. Without this essential precaution, one runs not only the risk to produce a secondary cataract, but a violent inflammation, or occlusion of the pupil. This last accident would be the most dangerous, as it should require another operation, more delicate than any one else, to re-establish the sight; I mean the performing an artificial pupil. In performing a too small incision, and in pressing under the globe at an unseasonable time, the operator determines the melting of the globe, and its sinking in the orbit.

All these details, whose principal aim is to instruct the young beginner, are not always sufficient to acquire a perfection of practice in this branch of surgery: Every disorder produces new phenomena to the observers who have even a most extensive one. When the section in the cornea, and the incision in the crystalloida, are performed to extract a cataract, the operator cannot yet positively say, if this capsule be opaque, unless the crystalline be out, or the cataract floating. If the anterior part of the crystalloida be easy to take hold of with a pair of small tongs, and that after its extraction, the crystallo-posterior be intimately tied on the fossula of the vitreous body, every prudent practitioner shall let the eye remain in this state.

I have read an observation in a pamphlet, very well authenticated, that a man having undergone the operation of couching without success, was afterwards operated by extraction with success. What can be the reasons why couching could not answer the operator's views in that case? Because the cataracts were milky, membranous,

membranous, and did not yield under the needle. Here are the abstracts of both ways. The patient underwent couching five times upon one eye, and three on the other, without the operator being able to bring them down, nor even to tear the crystalloida, whose existence he was very likely ignorant of. The operation by extraction was as follows: As soon as the section in the cornea and incision in the crystalloida were performed, a milky humor ran out, and nothing else remained but the opaque crystalloida: the operator being prepared for the event, he introduced a pair of tongs in the globe, took hold of the capsule with the extremity of this instrument, and, by the means of some gentle pullings from the right to the left side, extracted it entirely out of the organ. The other cataract produced no different remarks, except that the operator not being able to extract the posterior part of the crystalloida, after an attempt of a whole half hour, he gave it up.

It is not so difficult to acquire a certitude of the adherences which contract reciprocally the iris with the crystalloida, as to prognosticate that a cataract is arrived to a degree of maturity. When one has successively exposed a cataracted eye to a strong and weak light, and that the patient distinguishes day from darkness, he may hope for success, though the pupil be immovable, by being adherent to the crystalloida, if the operator be able to destroy them, and surmount all these difficulties. These adherences of the iris to the crystalloida, are always destroyed with a silver blade, curved on its flat, as this cannot hurt the iris to its circular part. I will, however, observe here, that the pupil may be immovable without any adherence, as I hinted before, by a paralysis in the muscular filaments of the iris; for which reason, one cannot reasonably hope of re-establishing the
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visual organ, as this is what we generally call a complicated cataract, and of a very bad sort.

After what has been said, I may reduce and bring the cataracts into five classes, without including their complications and variations. The first consists in the single opacity of the crystalline, and may be looked upon as the most frequent: besides, it is not of the same color nor consistence in all men: it is whitish and like curdled milk, till 25 years of age; on the contrary, from that age till the end of life, it is solid, and of a yellow more or less deep; in short, the crystalline may become ossified. The second is a complication of opacity in the ocular lens, with that of morgani humor and crystalloids: it has in most men a solid or liquid consistence. The third is occasioned by the single alteration in the anterior portion of the crystalline capsule. The fourth depends only on the loss of the transparency in the tunic which lines the fossula of the vitreous body; in short, the fifth is produced by the thickening and opacity of morgani humor without any alteration in the crystalline lens.

The reader ought to have remarked in the above observations, that all these sorts of cataracts require some particular manner of operating. He will have many an opportunity of observing, that patients in general, give a great deal more trouble, through their indocility, than the disorders themselves.

The operation of a cataract, by extraction, may also be performed in opening the cornea vertically and inferiorly; but it is attended with so many inconveniences, that I do not advise its practice. The method, such as that I have proposed, is attainable without a great practice, as the fixation of the globe is the main point; but I must allow, that the performing of it in opening the cornea transversally, and without a speculum oculi, requires

quires more dexterity and practice than a surgeon can acquire. I make no doubt, that an operator who does consider this, will save many a one from blindness, though he might claim the greatest praise by it, on account of his dexterity. However, if any one has a mind to operate constantly without a speculum oculi, I advise him to have the blade of his knife a great deal narrower than common. The operation of the cataract by extraction has another advantage over all others when it is practicable; and this advantage consists in all removal of doubts whether the cataract be ripe or no, whereas in couching, it must be ripe or hard to resist the needle, or else every operator knows the disappointment; consequently, let the lens be soft, hard, or even milky, there are no objections to extraction, and do not produce any material consequence for the success of the operation.

All that needs of an ocular demonstration, requires in that of a typography, some very long and often very tedious dissertations. Those medical gentlemen who have made a particular study of the disorders of the eyes, and acquired an extensive knowledge in them, must allow, that nothing is so varied and difficult of description as the signs and symptoms of the internal maladies of the globe of the eye; besides, it is a very hard case to point right at their curative indications, and account, by physical reasons, for the state of the patient and that of the disorder. As I have already given a description of the symptoms of the cataract and glaucoma, I shall now mention their difference, in attempting to enlarge upon this knowledge by observation, and show what a practice, founded on physical laws, may furnish.

Observation. A gentleman about forty years of age, begged that I would look at his eyes, previous to any account from him; in order he might know whether I could

could, or not, distinguish the real state of his eyes and sight, as no body had been able to give him satisfaction in this particular. As soon as I had closely examined his right eye, I told him that he could not possibly see well enough to distinguish objects, though he might see his way with it: As to the other eye, it was found. I observed, that the right eye was exteriorly found: that interiorly, the pupil contracted and dilated perfectly well when the eye was exposed successively to a strong and weak light. Being well acquainted of the possibility of a blind state, though a contraction and dilatation in the pupil might be existing, I endeavoured to discern the one from the other, by inspecting the state of the humors and membranes which contain them.

To be brief, I discovered a kind of whitish pellicle, placed immediately after the posterior part of the crystalline, and directly conjectured, that it was sufficient to intercept the rays of light. However difficult the case was, I supposed the seat of the disorder to be rather on the crystallo-posterior, than on the capsule of the vitreous body, as the opacity was in some respect perceptible. What might be the cause of the extreme contraction in the pupil of the left eye was a very curious and proper enquiry. I conjectured that the strait fibres of the iris were undoubtedly a great deal longer than the circulary; because a dilatation took place, in proportion as the eye was deprived artificially of the strength of the rays of light. This opacity came on in the following manner: The gentleman happening to walk exposed to the sun, and when it was a very sultry day, experienced at once a great heaviness over his eye-brow, and in the internal parts of the globe of the eye and its socket. He imagined he was presented with a piece of clear gauze before his eyes; but having rubbed it along with the imaginary object, he became conscious that

some internal cause obstructed the sight of this eye, which remained in the same situation since.

Remarks. If such a disorder be so singular in itself, I think it will not be amiss to lay down the cause, as the same may be met with. Its beginning could be nothing else but the consequence of a slight inflammation, which was fixed on that part, and produced an obstruction in the excretory pores and lymphatic arteries of this capsule. I apprehended, that, had the eye been fumigated with emollient infusions, the obstruction would have been dispelled, especially had diluent drinks been also made use of at the same time; because, in such cases, the stagnation of the lymphatic fluid, not being remedied at first, an opacity over such thin pellicles must absolutely be the never-failing consequence.

OBSERVATION read at the Royal Academy of Surgery of Paris, in June 1775. A gentleman, aged about forty years, of a very strong but cacochymic constitution, who had been for a long while afflicted with several complicated disorders at the same time, through irregularity and the ignorance of different Quacks, called for my advice. Having examined his eyes, I found them sound exteriorly, and observed, interiorly, that the pupils did contract and dilate perfectly and equally; that two spherical globules of air were floating in the anterior chamber of the left eye, and that the globe was not at all atrophied. These observations being made in a very light room, I renewed them in a dark one, to know whether I might have the very same results; but, upon the trial, and to my no small surprise, I discovered them very different from the former, as the right pupil did not easily contract and dilate; and that the left remained more dilated and immobile than in its natural state, though I intercepted and exposed them by turns to the light. However, I discovered by these very symptoms, that one eye was deprived of the faculty of seeing,

seeing, and the other declining in sight. How and in what manner a physician ought to account for it, will be the subject of the following paragraph.

I asked the gentleman many particulars concerning the beginning of the disorder which preceded that under my present consideration; to which he answered: A month before the defect of his sight, he found himself so ill for some days, that he could not possibly tell to what accident he might attribute it, having lived very sober; that a sensible dimness in his left eye, which he presumed was the consequence of the first complaint, came on suddenly. The diminution of sight, he said, did not at first give him great concern, as both the exterior appearance, and the pains he felt over the eyebrows and in his head, were trifling and tolerable. In eight days the disorder made such a rapid progress, that he thought it prudent to call for advice, being hardly able to distinguish the largest object with his left eye. The substance of what his physician told him consisted, that it was an approach of a return of the gout, to which he had been subject these ten years past; upon which prognostic, he prescribed aperient medicines, together with bathing his legs in warm water, wherein a proportional quantity of mustard was entered. But having taken a wrong way, it is very clear the success could not crown his prognostication. Emetic then followed, but with a worse effect; for the gentleman, who could still distinguish the large bodies before the use of this vomitif, was totally deprived of that satisfaction. Afraid of losing the sight of the other eye, by the use of these remedies, he declared to his physician, that he had rather wait for blindness, than to be hurried into it in that manner; consequently he remained for sometime in this alternative, without any trial of medicaments whatsoever: Meanwhile, though he would not try any of these,

these, he did not refuse to listen to advices; for which purpose he called upon every oculist whose names he was able to pick up, and satisfied himself with regard to the denomination of a complete gutta serena. By some, who understood the disorder in this light, he was advised bleeding at the jugulary two or three times, as the only remedy; by others, who were of a different opinion, he was proposed to make use of numberless eye-waters of their own composition, which, if they did not procure any relief, could do no harm. After so many advices, not very much to his liking, he again called his first physicians, who insisted upon bleeding at the jugulary, as the most prudent and advisable means in such a case. But the gentleman being terrified at such an uncommon operation upon him, declared he would not submit to it, as there was no positive assertion of any real benefit resulting from it. At last, tired of shifting, he was prevailed upon, though with a great deal of reluctance, to bear the application of leeches at his temples, and that of a blister on his shoulders, being means capable of supplying the effects of bleeding. These were then practised for several days; but seeing he reaped nothing by it, except intolerable pains and continual wakes, he said he was ready to abandon every medical operation when I saw him for the first time.

After these my observations, together with the detail above mentioned, I told him that I apprehended the physicians had not thoroughly considered his case, for, though I could not assure him of a perfect cure, yet I certainly should check the disorder, without putting him to any trouble or pains. Here is the case as I understood it. I could not doubt that it was a lymphatic obstruction in the vessels which ramificate the vitreous capsule, and only fixed on its posterior part, to such a degree

degree as to intercept the visual rays, without being able to absorb those of a greater power; because no other accident intercepting them, (what was conspicuous by the contraction and dilatation in the pupils) indicated, besides, no affection in the retina and optic nerve. I concluded, that, employing such remedies as might undermine the cause, I had a right to expect success; so that I prescribed the continuation of the aperient medicines, and the blister behind the ears, removed there in the *interim* from upon his shoulders. The first was to prepare him for a strong purgative, and the second to take away the first as soon as possible. Four days after, he began to make use of the electrical fluid, No. xxxiii. three times a day, and the collyrium, No. xiv. one hour before every time: Four days after this, a strong purgative, No. x. after which the blisters were taken off; to which the diluent, No. i. was substituted, and the aperient medicines no longer made use of. He had not continued regularly this plan, than in a fortnight he had the satisfaction to see again the largest objects with his left eye, and with the right, as clearly as before the malady. The purgative, No. x. was prescribed a second time, and produced so great a benefit, with the continuation of the other, that every day he found himself better and better, both in health and sight, till a complete cure was operated two months afterwards.

Every practitioner who will not show himself imbued with the despicable principles of empirics, ought, in the history of a disorder, to expose its cause, state, what had been practised before he took it under his care, and, in short, what method he used to remove it. To all these points, I think I have already satisfied; so that it remains now to lay down the physical reasons by which the method operates, as well as the results, that one might expect from it.

As soon as I had been confirmed in my opinion, that the disorder was an obstruction in the lymphatic arteries which ramificate the hyaloida to its posterior part, as I have observed above, I did not doubt a moment, that this obstruction owed its existence to a want of circulation in the lymph; and as this state occasions a dimness in the capsules of the eye, the means which could remove it were naturally recommendable. After such a prognostic, grounded upon what I had remarked in the interior part of the globe, I prescribed the diluent drinks to re-establish the circulation in the lymphatic arteries; for the better effect of which I recommended, to second the first, a frequent use of the electrical fluid whose strength produced such violent shakes on the globe of the eye, that all the muscles contracting at the same time, compelled the humors to secrete a greater abundance of the lacrymal fluid out of the globe than usual, and give the regenerative powers an opportunity of supplying afresh, as to operate a forced circulation. Would this method have been sufficient to cure the disorder entirely? Most certainly not: because the cause not being destroyed, the effect, though suspended, might be susceptible of a quick return. It was for the defect of this prescription that I insisted, for a long while, on the continuation of the diluent drinks for internal remedies, though the disorder was quite removed.

If the obstruction had been fixed to such a degree as to admit of no remedy, the use of the electrical fluid would have produced an atrophy of the globe without any success, which is an indicative symptom to leave it off. Its volatility may be diminished according to the occasion. All these points well weighed, and thoroughly considered by an able and discerning physician, such a disorder, though susceptible of being wrongly understood by many who make but indifferent observations, becomes

a simple science of practice. For my own part, I look upon blisters applied either on the back, or behind the ears, as very absurd remedies in these internal cases, when there are so many gentler and safer ways to supply them. Let us suppose, for instance, that an obstruction be fixed in the bottom of the globe, or socket, together with any other causes which produce those kinds of momentaneous blindnesses, so numerous as many practitioners think of meeting with a gutta serena, is it not very clear, that if a success happens with the use of such remedies, that such and such remedies have cured this disorder, when it might be rather attributed, either to the effects of nature, or other means, for which an indifferent practitioner never knows to account? This is positively how most physicians have been led astray. When abscesses, pustles, &c. exist in the bottom of the socket or globe of the eye, the patient experiences intolerable pains: the globe swells by degrees, till a supuration takes place, with the irrecoverable loss of the organ. In such cases, then, the patient's life being in danger, those means are recommendable.

Observation. The more I advance towards the subject that treats of the affection in the retina, and the manner of distinguishing the symptoms which necessarily lead to the curative methods, the more delicate and conjectural it becomes; for which reason, I will keep within the bounds of some few observations upon this head, to render the matter less hazardous and more substantial. A young gentleman called for my advice in the following case: After a strict examination of his eyes, I observed that one was not quite sound, and the other, without being atrophied, sunk in its orbit; that the humors and membranes were in their natural state, and the pupils hardly susceptible of contraction and dilatation, but not immobile, as to make me conceive, after

a slight inspection, that the other organ was totally deprived of sight, which was, however, the real case.

Every practitioner will allow, that the present case was very easy to be mistaken for an affection in the retina, or optic nerve, when the patient will not acknowledge his defect of sight. But before I enter into the detail, I think it will be necessary to state an abstract of it. The patient caught a cold; some days after, a dimness was the consequence: the disorder not being checked, increased by ending with the loss of the organ; blisters applied behind the ears, with many other applications without advantage; then bleeding, and the use of mineral waters: these promoted a dimness in the other organ, instead of procuring relief. This is what preceded my interview with the gentleman. I will now lay down the pathognomonic signs of the disease as I understood it.

The perspiration being intercepted, as the consequence of the cold, at a time when both the blood and lymph were in an acrimonious state, (as I apprehended it by the patient's account) an inflammation took place, which dissolved part of the beds of fat in the bottom of the socket, either by the use of the medicaments above described, or the disposition of the disease; so that the optic nerve which runs through them, being affected for want of its natural support, became less sensible to the communication of the impressions of the retina, produced by the rays of light, than to the sharpness of humors and its bad state; consequently, it is easily conceived, that, being deprived of this support and ease, the pupil did not, nor could not, dilate and contract as when the eye is in its equilibrium. A practitioner must have had frequent opportunities of observing, that the pupil, instead of contracting and dilating regularly, has no regular motion of contraction and dilatation, when
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the iris floats in the aqueous humor, for want of a communicative strength, able to put its fibres in regular activity; because, if he pays a proper attention, and remembers, as I said above, that the impression of the visual rays are communicated from the retina to the optic nerve, and from thence to the brain, to complete the sensation, he must certainly be conscious, that during this operation of sensation, the retina communicates its motion or vibration to the processus ciliaris, which is afterwards propagated to the iris: for which reason, if, in such a case, the retina is not yet affected by the same disorder as the optic nerve, the impressions and motions, though in part interrupted, do not hinder those produced on the immediate organ of sight, to set the fibres of the iris in slow and irregular motions: therefore, this proves to be but a floating of the iris, instead of a regular contraction and dilatation in the pupil. These symptoms, I think, are sufficient to make any practitioner distinguish an affection in the optic nerve and retina from any other disorders of the eye; consequently, in the above disorder, to re-establish the organ in its first state, it would have been sufficient, not only to recommend the use of such internal and external medicines as would have corrected sharp humors, and such as bring the body to a due temperament, but yet to countermine such other effects which are continually arising either from such remedies, or habit of the patient.

The dissolution of the fat, which lines the bottom of the orbit, was a symptom sufficiently indicated by the sinking of the globe in its socket, and the want of regular contraction and dilatation in the pupil, the only visible symptom of that defect; to which, if proper remedies had been applied, no other inconvenience would have been the consequence. By reasons unnecessary to mention, I did not take that disorder under my care.

Remarks. The most scrupulous observer must daily remark, that, of all the symptoms which portend an affection in the optic nerve, there are none surer than the state of the pupil; and that those which announce an affection in the retina, without that in the optic nerve, there are none surer than the immobility of the pupil, though day from darkness may be distinguished. Because, in the first place, as soon as one is certain that nothing intercepts the rays, and that they are absorbed on the immediate organ of sight, the fibres of the iris receiving their motion from the retina, the contraction and dilatation in the pupil, is a certain indication of its being sound; on the contrary, and in the second place, those fibres not receiving their motion, is a clear symptom, that the retina is totally affected, though the optic nerve might be sound. But before dismissing this important subject, I shall observe here, that there are several circumstances wherein it is impossible to see the bottom of the globe, and consequently discern one from the other: For example, if the pupil be contracted in such a manner as to be almost occluded, and immobile in this state; if the cornea be opacified, or the crystalloida and crystalline, &c. &c. how can it be possible to look into the bottom of the globe? Now, let us suppose that all these cases be out of the way, there are still a great many others, whose prognostication is impossible. For example, If the nigrum pigmentum be of a grey color, one cannot precisely foretell whether blindness be occasioned for want of this ink, or by an affection in the retina and optic nerve. There are also many other cases, though better known, wherein one is obliged to conjecture, either by the help of an intelligent patient or his own experience; but when a practitioner performs what sound physic, and good reasoning enable him, he can neither be blamed nor responsible when

when his human faculties fall short to guess all the different changes, which Nature is susceptible of assuming. It is for man alone to lament, that the All-wise Creator did not think fit to proportion his faculties with his wants, and to bear in patience and humility the several afflictions that God pleases to send him.

Observation. A country woman, aged about thirty years, and of a very sanguine constitution, went to a pond for washing, at the time her menses were flowing. As the day was mild and warm, she did not take any precautions for her situation, and walked into the water till it reached her knees. She had not been in a quarter of an hour, till she immediately began to feel the consequences of it, by a sudden suppression: Palpitation of the heart, suffocation, intolerable head-achs, and some momentaneous convulsions were the results of her imprudence. Two days after the accident, she complained of a total defect in her sight, though her eyes appeared in their natural state. The physician who was sent for, recommended a copious bleeding at the foot, thinking that the disorder, which he called gutta serena, was the consequence of a sanguine obstruction fixed round the optic nerves, and in the internal parts of the orbits. This produced very little effect; but having repeated it twice, the menses began to flow by degrees, till they were perfectly re-established; and within six days, the accidents diminished so much to the advantage and comfort of the patient, that she began to distinguish the objects. The disorder having been well prognosticated and regularly attended to, the cure was completed a week afterwards.

This observation, and a great many others of the same kind, has been published in all the periodical books and pamphlets that France produces, as an assertion, that no other method but bleeding could be the curative indica-

tions for a gutta serena. It was given out at the time of this discussion, whether bleeding was not more detrimental to the sight of man than useful; and as the dispute was supported and carried on by several physicians of abilities, this rendered it the more interesting, though the question remained, as it is still at this present time unsettled. Now, if one considers the management of the physician, in the above case, he cannot refuse him those praises such a success deserved; but when he comes to weigh the opinion he gives out in this very observation, for the curation of a gutta serena, (grounded upon this and such other cases) *that nothing but repeated bleedings are directly pointed at*, I am pretty confident he shall think quite otherwise. It is from this bad method of explaining and laying down the history of disorders that numberless methods, for the cure of the gutta serena, have taken place. If the observer did relate plainly, that such a blindness, produced by such or such a cause, has been cured by such or such means, practitioners would clearly understand, that bleeding, advised by some, is absolutely necessary in such or such case, and contrary in such or such other. When some physicians have observed, that several people, blind of the gutta serena, have recovered their sight by frequent bleeding, and concluded there was no other means, they have done as bad a piece of service to human kind as they thought it excellent: Therefore, observation and a proper method to do it, is now the only way to clear up this matter, or at least to render it less obscure. In fact, to relate that such or such a blindness, occasioned by such or such a cause, has been cured by such or such means, is proving clearly, that one has a mind to be really useful in society.

“ The observation mentioned in one of the pamphlets (quoted page 141.) may be considered on this
 “ line;

“ line ; that is to say, that a gutta serena reported having been cured by the use of positive electricity, is apt to mislead a practitioner ; for such a disorder may be looked upon as physically incurable : If it be incipient, the term gutta serena is misapplied.”

Observation. Blindness is not always existing through the same causes, though no sensible difference over the exterior parts of the globe appears to common people. Nature presents so many variations of this kind, that it is extremely rare when a practitioner, even in the most extensive practice, has met with all those cases. A young man about twenty, called for my advice in the following disorder, which every physician he had consulted before had deemed an incurable one. Having looked into his eyes with the most scrupulous attention, I observed that the globes were found and regular exteriorly, that is to say, parallel both in their axis and size, though he was obliged to turn the head on the left side to see with his right eye. I at first took the disorder for a strabism ; but, upon further consideration, I was obliged to change my opinion. The discovery of the apparent causes of this phenomena seemed to me so curious and extraordinary, that I endeavoured to explore them, by every trial and experiment the occasion permitted ; for which purpose, I placed the young man just opposite the window, in order to discern clearly, not only the symptoms from the causes, but the signs that might ground both. Having desired him to put one hand over the left eye, to keep it continually shut, I raised up softly, and with precaution, the superior eyelid of the right eye with the fore-finger of my left hand, and brought down the inferior eye-lid with my thumb ; then I opposed my right hand near his eye, to intercept and expose it alternatively to the light, to know if the pupil was susceptible of contraction and dilatation : but
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when I had observed some difficulty, I immediately conjectured it came from a want of some meconium on the choroides; having remarked, besides, that the bottom of the globe was blacker on the side of the great angle than on that of the external's. This last remark grounded my conjectures, that the choroides was covered of meconium in its internal lateral part, whereon the rays of light came to strike on this part of the retina, and be only absorbed there. I proceeded afterwards to the examination of the left eye, wherein I observed, that the choroides was entirely deprived of meconium. This was very discernable by the whitish color in the bottom of the globe, immobility in the pupil, and blindness of the organ. But before proceeding, an objection naturally arises here, Could not the retina be paralysed in one half of its extent? To this I answer, that since a motion of regular contraction and dilatation in the pupil, ascertained by the state of the immediate organ of sight, (as being sensible to the impressions of the rays of light when absorbed upon it) it was a sufficient proof in favour of the negative. If this contraction and dilatation had only existed on one and the same side of the iris, supposed in paralysis, the objection might have some weight. I shall say, moreover, that this disorder derived its beginning from the young man's birth, and had augmented successively to the degrees I have just now mentioned.

I made many other curious remarks upon the sight of this young man; but as I am afraid of becoming too prolix, I shall finish this observation by what follows. I presented to him a crown piece placed horizontally at three and four feet distance from his eyes, which he declared only visible by his right eye, in turning his head from the right to the left, the axis being continually parallel. This done, I removed the crown to another
place;

place, where any other person might have been able to perceive it without motion either of the head or eye; but he said it was not in his power, without a motion of his head. In short, the several experiments I made furnished me with fresh proofs, that a want of nigrum pigmentum on the choroides, and not a paralysis in the retina, was the cause of his organ being deprived of the faculty of seeing the objects to all sorts of positions, without turning the head.

When I had strictly examined the above case, and weighed all the circumstances, it appeared clear enough to me, that this disease owed its existence to the want of nigrum pigmentum in the choroides, to operate the absorption of the rays of light upon the whole immediate organ of sight. The reality of this prognostication was obvious in the pupil's motion. When I pry into the remotest causes, I find that this disorder could not be occasioned but by a relaxation in the blood and lymphatic arteries which ramificate the choroides; and that for want of a sufficient tone in them, this black humour could not stay upon the surface of this membrane; because, as I have sufficiently proved elsewhere, the sight must be diminished in proportion to the want of this ink, as it is absolutely necessary to perform the absorption. I may now safely conclude, that the different methods of curing the gutta serena have been discussed with some foundation, and, to express myself at large, have never been as duly attended to as they deserved to be completely settled.

OBSERVATION. The following cases do not a little contribute to confirm what has been advanced in the above. A woman, aged 40 years or upwards, begged that I would look at her eyes, merely to satisfy her curiosity, as she was well assured, she said, by physicians
of

of great abilities, that nothing could relieve her. I observed that the exterior of one globe was perfectly sound, together with the parts which surround it; that the pupil, however, was immobile, and the bottom of the globe of a whitish colour, the choroides being entirely free from meconium. The other eye was sound, both exteriorly and interiorly. Now, to acquit myself in the best manner possible on so important and curious a subject, and, at the same time, leave nothing to wish for an inquisitive reader, I will begin by explaining the effects of this disorder, together with its causes, and the method employed to cure it, according to the woman's own account.

The beginning, she said, was the result of a laborious and unlucky lying-in, attended in a careless manner. She was recommended by a person of note to an eminent physician, who prescribed the use of diluent drinks, together with some light purges for internal remedies, and the respiration of spirituous liquors, with astringent lotions for external ones. She recovered the sight of one eye, whose use she had entirely lost, and the other, whose state had been very much impaired, was quite re-established in its former state. A little time after, she again lost the sight of this organ, and the other kept well; for which purpose, she called for assistance to the same. She did not meet with the same cure as at the first time; for she remained blind of this eye.

When I consider that vision cannot be effected without nigrum pigmentum on the choroides, I justly conclude, that if its absence comes from an obstruction in the blood and lymphatic arteries (as this case was certainly such) which bring and supply this black humor; it cannot be occasioned but by a cryspation in the tubes, and a defect of their contents. Besides, when I reflect, that the course of this humor, if intercepted before it ar-
rives

rives on the choroides, continues its exudation through the excretory pores and humors of the eye: I conclude also, that these membranes must inevitably be deprived of this ink, and that the rays of light, being no longer absorbed on the retina, the faculty of seeing must cease. I am very far from being surpris'd, that the respiration of a strong fluid has produced the recovery of the sight; that it may have failed, answering the same purpose, to all appearance, in the same case; because, every physician must allow, that a sagacity to distinguish, if it will do at one time and not at another, is such a profound skill, as it is not in every one to boast being possessed of. Upon this foundation, I think that the remedies being well indicated at first, they operated the desired effect; and if they did not the second time, the cause may be attributed to a change of the disorder, though in appearance the same: for as I have hinted above, the malady being occasioned by an obstruction, the use of the electrical fluid properly prescribed, removed it at first: but, on a second repetition, the effect was very likely too violent, as it operated an exudation more copious than the regenerative powers of the nigrum pigmentum could supply; consequently, the choroides discontinuing to be tintured with this ink, and the rays of light not absorbed on the retina, it is easily apprehended, that the faculty of seeing must of course cease. This is a clear demonstration, that the use and application of such remedies require the greatest care, intelligence, and skill; for otherwise it would be very rare, if they might be of any service in such doubtful cases.

The symptoms of this disorder, which I have already denominated meconiumless, (the words meconium and nigrum pigmentum are synonymous) are pains in the internal parts of the orbit, a whitish color in the bottom of the globe, and a diminution of sight, proportioned

to the want of this ink on the choroides : Moreover, an atrophy of the globe, and a constant exudation of the lacrymal fluid through the pores of the cornea, are the forerunners of this dreadful complaint, which, when arrived to a great degree, may be looked upon as incurable.

These few principles are sufficient, I hope, to convey an idea of the proper remedies fit for checking this disorder, and the manner of administering the electrical fluid, No. XXXIII. without running any chance of making a bad use of it, and to discern one case from another. Besides, if one pays a due attention to the case, and the difficulty there is to give some spring or elasticity with this electrical fluid, when wanted to all the languishing fibres which compose the internal and thin membranes of the globe, without producing a too great circulation in a meconiumless disorder ; he must be sensible, that it is difficult to describe the use and effects of this electrical medicine, and that it can be accounted for but by giving the detail of some observations grounded on physical laws. Amidst all these difficulties, there is another to explain, which is of no small weight ; it is the properties of this remedy. This electrical fluid, or spirituous liquor, used either by evaporation over the globes, or respiration through the nose, produces a coagulation in the humors, and an elasticity to the exterior membranes ; because the oily parts, which compose this remedy, are brought up along with the volatile ones into the interior of the eye, by joining together : So that, if one intends to disobliterate the gelatinous humors, it will upon first consideration appear contradictory considering this quality inherent in it : but when he comes to the experiment, instead of coagulating, he perceives the obstructions give way by degrees ; because, as I said above, the shock it gives to all the parts of the organ, produces
such

such an action in the fix muscles, that the humors it contains are obliged to go out through the lacrymal ways, to be then supplied by the regenerative powers of the humors. This operation produces such a quick change, that desobliteration takes the better of coagulation in a surprising manner, and without any danger to the organ when duly attended to.

But to return: I have observed this disorder very frequent in children; and I think, that if the meconium be not so black in children till they are arrived at two years old, it is to preserve the flock of the rays of light on so delicate a part, in so tender an age. Curiosity led me very often to a gentleman's who had a child afflicted with this complaint. The first time I looked at her eyes, I was so much surprised to see her globes in continual rotation, when she turned them towards the light, that I felt a great inclination to find out the cause. To be brief, I imagined that the bottom of the globes were not regularly lined with meconium, otherwise the globe would not have been continually in motion to endeavour to fix and absorb the rays of light on the retina. This action of rotation could be occasioned but by an endeavour of re-uniting the rays on the part of the retina whereon the absorption might be the most complete: Moreover, the contraction and dilatation in the pupils, which I remarked at different times, when the rays did more or less sensation on the immediate organ of sight, was a sufficient proof to ground my conjecture. I did not propose any trial of remedies, being myself conscious of their defect; and supported their hopes in the operation of nature, a credulity too often encouraged, when natural physic is against it. I have been consulted in a similar case for a child of two years old.—When he was exposed to the light, his eyes rolled with the quickest motions; when standing upon his legs, tho'

somewhat supported under the arms, frightful convulsions during the whole time, and a sudden inflammation in the eyes, were the never failing consequence. As soon as he was seated, the convulsions and inflammation disappeared, by degrees, in the space of ten minutes.—The reader may well imagine, that I did not propose any remedy, as such symptoms spoke clearly a complication of meconiumless, with an affection in the nerves.

Positive electricity, according to Mr MAUDUYT's account, produces generally the departure of the disease from one part to another, with very little change or effect; for which reason he candidly says, that having been appointed by government to make the experiments, and state the facts without accounting for them, he leaves this delicate point to be settled by the several physicians who sent him the patients, as being better able to judge of their different maladies. For my part, as I am concerned in it, I have some right to transmit my opinion, that the use of positive electricity is very immaterial in the medical disorders incident to the human eye. As to the negative electricity, which some have supposed to produce different effects, we are now convinced of being perfectly the same as positive; therefore, we do not think proper to recommend it.

CURATIVE METHODS.

FOR THE

COMPLICATED DISORDERS

OF THE

EYE AND ITS APPENDAGES.

IT is not sufficient to have investigated each kind of blindness in particular, and the disorders which are conducive to it; it is besides necessary that I should speak of such as depend upon one another, and their complications. Every body knows, that there is no other organ in the human frame which is subject to so many diseases as the eye. Some physicians and surgeons have thought, that the knowledge to discern the character of these various affections, and a proper method to remove them, was, or ought to be a particular art, which did not require the physical and chirurgical science in general. Of what benefit would this branch be susceptible if separated from its stump? The improvements in all ages has sprung from the greatest masters who practised it in all its plenitude, and whose experience,

experience, relative to the disorders of the eyes, has been enlightened by the principles that constitute indivisibly the science, without which it is impossible to exercise any part with judgment. The ancients have learnedly spoken of some parts which compose the eye; it even appears that they practised some delicate operations to cure them when disordered; but as the abuse of some principles of practice, recommended by physicians of reputed abilities, have great influence over the opinion of the medical world in general, as being too often improperly understood according to such a plan, I think it of great utility to investigate. I have read Dr William Cullen's works, whose principles are generally adopted; Dr Brown has severely criticised the whole, or at least most part of them. We know what motives induced him to take such a step, and that words are insufficient to overthrow a stupendous building, wherein the critic himself had a great share in the erection; but as my work does not admit to interpose in the contention, I will confine my criticism only about Dr William Cullen's principles on the ophthalmia, which are highly improper, and by no means grounded on the anatomy and physiology of the organ of sight. I could mention several cases like the following, to prove the impropriety of the method; but after what I have said concerning inflammations, I deem it unnecessary.

Donald M'Donald, aged 38 years, now a servant to Sir William Dick, at Priestfield, near Duddingston, applied to me about the latter end of August 1787.—He was then labouring under an ophthalmia, attended with violent pains in the head, temples, and wakes. The disorder began the 15th of June preceding, accompanied with rhumatic pains in his right thigh and leg. Sir William recommended him to Dr William Cullen, who prescribed laxatives and the peruvian bark; this plan was pursued

purfued for fome time, but proved of no fervice. Mr James Ruffel, furgeon, jointly with the Doctor, advifed blifters, leeches, collyriums, &c. and yet the difeafe increafed with their plan; when, at laft, they thought proper to fay, that its caufe was debility, and diffufed through the whole fyftem. The firft day that the patient called for my affiftance, the eye was fumigated with emollients five times a day, and took at bed time 35 drops of laudanum in two ounces of water, and continued increafing the dofe of one drop more every night, till the 7th day, when all pains fubfided. The 8th day a dofe of the pommatum deterfivum, No. xxxii. was applied at the edge of the fuperior tarfi of the eye-lid, and continued five times once every other day; fo that in the courfe of 16 days, he was perfectly free from all complaints.

Remarks. The cafe was fimply this: The varicous veffels of the conjunctiva had increafed to a prodigious degree; fome of them were ramifying over the cornea, which was very dim. The deterffion of thefe blood veffels being effected, a cure was obtained without any of the means recommended by Dr Cullen and the furgeon; and if the patient had been Dr Brown's, I have not the leaft doubt, that whifky would have been as ineffectual. There are many furgeons who fcarify the conjunctiva and cornea in fuch cafes, which, in my opinion, is the worft of all practice; although the principle feems to be the fame. This needs no refutation, by what I faid elfewhere.

I am confident, that had the patient perfifted on the above plan, the diforder would have degenerated into an hypopion, and perhaps the lofs of the organ. Whenever there is lofs of fubftance in the cornea, it is but feldom if a practitioner does not find it fafer to empty the
globe,

globe, than to attempt to palliate the case. Having said thus much on these cases which lead to a destruction of the globe, I shall now indicate the properest rules for the extirpation of the eye, it being an operation of great moment, as the patient's life is commonly in danger.

The falling of the globe, or its entire going out of the orbit, presents the very case wherein amputation is so well indicated, that it needs no further advice. Several observations prove sufficiently that the eye may be pushed by degrees on the cheek, on account of some tumor which may arise in the bottom of its socket. To avoid here a confusion between the falling of the eye, its prominence, excess of bulk, and going out of the orbit, by the same denomination of *exophthalmy*, this term shall be employed to signify only its going out of the orbit by extrusion.

The beds of fat which surround the posterior part of the globe, are naturally flabby; and this is very well designed by nature, to help the motions of the muscles. A great many practitioners have observed, that this texture is adipous, and becomes fungous, or schirrhous in swelling. In this case, the eye appears weeping at first: as soon as it is pushed outwards, the eye-lids cannot cover it; then it becomes inflamed.

If the tumor makes a rapid progress, the pains are violent and intolerable. When the disorder does not yield to the general remedies, such as bleeding and purgatives, the extirpation is very often indicated, to rescue the patient from death. This is very obvious by the following observation. A woman had the globe of her eye jutting out by a gathering of humors, which inflamed the beds of fat. Besides, this disorder was attended with violent pains and wakes. The physician who had the care of it, allwaged these accidents by proper remedies for such a case; so that the progress of the tumor

was checked for a while. About three years after this treatment, the globe of the eye became lead-colored, and extremely pushed outwards, on account of a protuberant deformity which had been left behind: Its membranes were tumified, and assumed a gangrenous quality. Some time after, the patient experienced a violent fever, with intolerable head-achs. The physician and surgeon who attended her, unanimously thought proper to proceed to the extirpation of the globe; and the necessity of this operation seemed so pressing, that it was performed the very next day: four or five days after the fever and all the other accidents subsided, and the cure quite completed the 20th day following.

The principle of the disease is sometimes to be found in the outward parts of the orbit, near the bony laminæ which form the inside of this cavity: they are so thin, especially at the inferior and superior parts, that one ought not to be surpris'd when they give way to the efforts of a fungous tumor, by the compression of which they are soon destroyed, nay worn out. A man aged forty years, to whom a carcinomatous fungous in the maxillary sinus had destroyed the bony laminæ of the top of the orbit, was so much afflicted by it, that the globe of the eye was almost on the cheek: his face look'd so hideous and disfigured, that it was frightful: There was at that very time carie in the maxillary bone, on the side of the palati and nasal cavities; in short, the patient died by the accident of a cancerous ulceration in these parts. The exophthalmy was an effect of the excessive bulk of the tumor, to which the bones had not been able to oppose a sufficient resistance, and limit its progress. There is no doubt, that one would have prevented such dreadful consequences, in attacking the disorder on the side of the mouth. The carcinomatous vegetation was an accident of the disorder in the bone,

occasioned by a venereal principle, which had been treated without method.

A child three years old, having his left eye entirely out of its cavity, and twice as large as a fist, died of this disorder, which only began to appear some months before. As soon as the skull was opened, a fungous tumor was discovered, whose basis was attached to the dura-mater above the orbit, without having produced any alteration in the brains. The protuberancy of the eye was only the accident of it; and the amputation, though very rightly indicated at first, would very likely have had no success. The cure consisted in destroying the fungous vegetations in the dura-mater. Since the brains were found after the extirpation of the eye, surgery would most likely have found some means to consume the tumor to its very root: the patient being given up to a certain death, it was sufficient to attempt the operation, in hopes of success.

It is not an uncommon case to see the eye driven out of the orbit by the compression of an exostosis: if it be exterior, one may attack it with advantage, without making a sacrifice of this organ. A woman aged thirty years, afflicted with a fistula lacrymalis, had undergone, without benefit, an operation which was thought proper for this fistula. The bones swelled prodigiously: Fifteen years afterwards, the exostosis of the os planum and internal angular apophysis of the coronal, acquired the bulk of an egg. The globe comprimated laterally, had been pushed out of the orbit, and fell in some sort over the cheek, on the side of the external angle. This exostosis was attacked with a caustic: it suppurated, and in a treatment of three or four months, the exfoliation of a considerable portion of the tumified bones was effected. The eye was re-established in its natural place, and perfectly cured some time after.

Practitioners have very often confounded the falling of the eye and its protuberancy, with the dilatation of the globe, which make it equally jut out of the orbit. These disorders, so different in their nature, have been pointed out by several authors under the same denomination. This confusion, as I said before, has not a little contributed to produce some ambiguity on the precepts, and consequently to make the theory doubtful, and practice uncertain. The term *hydrophthalmia* shall be used to express particularly the excessive bigness of the globe, by an augmentation against nature of the humors. This denomination, which in this case does not allow of any equivocation, as it would with the term *exophthalmia*, has been agreed upon by all regular physicians and surgeons. It is not always the whole globe, which is pushed outwards; its bulk is yet augmented by an excess of fulness. The elevation of the cornea and deepness of the iris, are the characteristic signs of it: on the contrary, when the largeness of the eye comes from the excess of the bulk, acquired in the vitreous body, the iris is convex, and forwarded into the anterior chamber: with all these symptoms, the hardness of the globe is sensible to the touch, unless this humor be fallen in a dissolution.

An intelligent practitioner will distinguish, by an extreme dilatation in the pupil, whether the vitreous body contributes to the prominency of the eye or not. The augmentation of the aqueous humor is sufficiently marked by the deviation of the cornea, and deepness of the iris. The patient, in such a case, feels continually in the bottom of the eye and head, violent pains, attended with fevers and wakes. This disorder is commonly chronic: it may, however, subsist in its state without change, when the eye is arrived to the last degree of extension.

The authors propose a great many remedies for this disorder, both general and particular, internal and topical, and varied according to the different indications. I will here give some few observations upon this head. Two young ladies were afflicted with the small-pox at the same time; one was twenty years of age, and the other four-and-twenty; the variolous matter fixed itself in a great abundance on the eyes; the pustles were dried over the whole body; and there would have been no doubt of an happy termination of the disorder, had not the eyes been very much affected with it. Their tumefaction occasioned a fever, and violent pains, attended with excessive heat and pulsation; so that the cutting open of the eyes were advised to save their lives. This advice was not followed, though it was given out that the organs were without any resource. The sudden death of one of these young ladies gave great concern, for not having taken the above advice. As to the other young lady, Nature herself saved her from this dreadful case; for a spontaneous aperture was effected, through which the gathered matter ran out of the globe; but she remained blind, after having stood a great chance of losing her life.

This remark will have its use in all the cases wherein the surgeon shall be obliged to empty the globe, (if the organ be irrecoverably lost) to calm the violent accidents which are the consequence of an inflammation in this organ, in case of wounds, considerable contusions, and abscesses in the interior of the eye. It is sufficiently proved, by a great many observations, that the pains, fevers, wakes, deliriums, and convulsions, which sometimes accompany this state, do not stop but when a rupture in the tunics of the eye has taken place, either naturally or artificially. When there are no hopes of preserving the functions of this organ, the patients will
be

be rescued from many accidents, if an incision be performed. Some practitioners have also advised the extirpation of the globe for a single fungous excreffence, which arises on its surface, though there are a great many that one might destroy without an operation. It is then very material to lend the greatest attention for discerning the character, from the extent of the disorder; the indications are less distinguished from the bulk of the tumor, than from its nature and roots. It is by the help of commemorative instruction, on the rise and progress of this disorder, that one may be well acquainted with this last circumstance; the pathologic knowledge will shew the particular kind and species of tumors. These principles, deeply reflected upon, ought to be the basis of the judgment through which a practitioner shall determine, whether he must, and how he is to operate: It is but after some facts of practice, that he may settle and fix a solid doctrine upon the several different cases.

It is demonstrated that the fungosities in the eye, suppurate very well after the application of dissecative remedies. These tumors having not their roots very deep, one ought to be contented, in this case, to separate the fungosity from the parts with which it is tied, and to consume or take away but one part of the globe. As to the treatment of the cancerous tumors in the eye, one ought also to discern the state from the case, to determine which method is the properest; for every one must know, that those which are not completely extirpated with all their roots and appendages, regenerate soon of themselves, and very often with more dreadful consequences or symptoms than at first. Therefore, if the operator suspects the propagations of the cancer in the eye, capable or susceptible to extend deeply, he must not hesitate to extirpate the globe entirely. We meet with

with numberless facts which do not leave one single doubt on the necessity and use of this operation; but the rules which he ought to follow for practising it methodically, having not been established in their whole extent by the ancient authors, shall be taken notice of here. The infallible loss of some patients, for whom this resource has not been made use of, the happy cures which are owed to it, ought to encourage modern surgeons to perfectionate this operation, and render it as simple, and easy as it is useful.

The operator shall begin by incising the strings of the globe, together with those of the eye-lids, without it be necessary to have a particular instrument for this preliminary section; but it may be performed with more or less method: inferiorly, it suffices to cut in the angle or fold which forms the conjunctiva and the internal membrane of the eye-lid; he ought not to forget at the same time the fixed string or tie of the *musculus obliquus inferior*, to the inferior edge of the orbit on the side of the great angle: Superiorly he shall direct the point of the instrument to cut the *musculus attollens* of the superior eye-lid, together with the membrane which lines this eye-lid; and in sliding a little the knife from top to bottom, on the side of the internal angle, he shall cut the tendon of the *musculus obliquus superior*. This performed, the eye is no longer fastened to the anterior circumference of the orbit: Then it remains to cut the optic nerve, and the muscles which surround the bottom of this cavity. This may be done very easily at one cut with a pair of curved scissars on their plane, adapted for this section. The side on which he ought to direct the extremity of the scissars in the bottom of the orbitary cavity, seems at first very immaterial. In the natural state, the obliquity of the plane of the orbit, and the situation of the globe near the internal inside, seem to prescribe

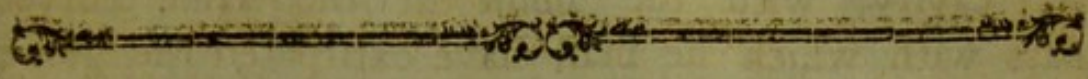
prescribe the introduction of the scissars, by way of preference, on the side of the external angle, in directing the cavity of the blades on the external lateral part of the globe: but as the protuberancy of the eye, its dilatation against nature, the tumefaction of the fat, and the schirrhous obstruction in the cellular texture, are confined in no bounds whatever; and that the fungous vegetations take their rise on the side, where is naturally the least resistance; the side of the external angle is that which he will find the most entangled. It is therefore at his disposal to enter in the orbit, with these curve scissars, on the side which will be most convenient to him. The muscles and optic nerve being cut, the scissars shut, serve as a sort of spoon to raise up the eye outwards. To finish this simple operation, he shall take hold of the eye, with the left hand, and if the cellular texture be still tied to the neighbouring parts, he shall cut it off along with the laminae.

Such is the operation thought proper for extirpating methodically the globe of the eye, in case the disorder is limited to the parts which constitute this organ. The treatment which is to be pursued afterwards, ought to be conducted according to the patient's constitution and health. Bleedings, regular and strict diet, are of absolute necessity, to check the inflammation: the dressings consist in an animated digestive No. xxxv, and a mixture of warm wine and brandy after it.

The necessity of extirpating the eye-lids with the globe, shall be determined by the exterior progress of the tumor, whether it be carcinomatous or not. The greatest difficulties to be met with, are not those which come from the extent of the disorder at the exterior: they are, as to this respect, before the eyes, and under the hands of the operator: the main point is, to consider what progress it has made in the orbit. It does not suffice

fice to have extirpated the eye; the fat which surrounds the globe inwards, are very often swelled; if he was to leave them behind, they would prove the sprouting of a new tumor: nay, the glandula lacrymalis, provided it be tumified, ought also to be extirpated. The operator shall cut it off easily from its particular cavity, with the point of the same curved scissars with which he shall have extirpated the globe. They are very convenient to take off the schirrhous hardnesses, which might exist in the extent of the orbit; in short, for the extirpation of all cancerous tumors.— Of whatever efficiency an operation may be, a prudent practitioner will always attempt the cure of any disorder by some medicaments, before the undertaking of it.— Every method in the art of healing, is equally in the power of an able medical man.

PHYSICO-



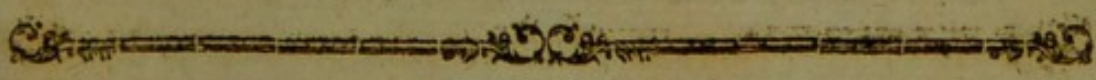
PHYSICO-MEDICAL

AND

CHIRURGICAL TREATISE

ON THE

HUMAN EAR.



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PHYSICO-MEDICAL

CHILDREN'S TREATISE

OF THE

CHILDREN'S TREATISE

ANATOMICAL EXPOSITION

OF THE

HUMAN EAR.

EVERY one knows that the ears are two in number, one situated on each side, at the inferior and lateral part of the head. Anatomists commonly divide the ear into two parts, the one external and the other internal; but I find it necessary to be more particular, by dividing it into four. Therefore, the first part will consist in what extends round the external orifice of the meatus auditorius; the second from this external orifice down to the superior part of the membrana tympani; the third from the inferior part of this membrane to the opening of the eustachian tube in the throat; and the fourth will consist in the labyrinth and its outlets.

The first part is subdivided into eminences and cavities. The eminences are four in number, called helix, anthelix, tragus, and antitragus. The helix is the large folded border, or circumference of the great portion of the ear. The anthelix is the large oblong eminence surrounded by the helix. The tragus is the small anterior protuberance below the anterior extremity of the helix, which in adults is covered with hairs.

The antitragus is the posterior tubercle, below the inferior extremity of the anthelix. The cavities are four in number, the hollow of the helix, the depression at the superior extremity of the anthelix, the concha that lies under the rising anthelix, and ends at the external orifice of the meatus auditorius. The back part of the ear shows only one considerable eminence which is a portion of the convex side of the concha, the other portion being hid by the adhesion of the ear to the os temporis.

This part of the ear consists chiefly of a cartilage, ligaments, muscles, integuments, arteries, veins, and nerves. The cartilage is nearly of the same extent and figure with the large solid portion thereof already mentioned; but it is not of the same thickness, being covered by integuments on both sides. In the lobe, or soft lower portion of the ear, this cartilage is wanting. The ear is not only fixed to the cranium by that cartilaginous portion, but also by two ligaments, the one anterior and the other posterior. The anterior ligament is fixed by one extremity to the root of the apophysis zygomatica of the os temporis, at the anterior, and a little towards the superior part of the meatus ossis, close to the corner of the glenoid cavity; and by the other extremity, to the anterior and superior part of the cartilaginous meatus. The posterior ligament is fixed by one end to the root of the mastoid apophysis, and by the other to the posterior part of the convexity of the concha, so that it is opposite to the anterior ligament. There is likewise a kind of superior ligament which seems to be only a continuation of the aponeurosis of the frontal and occipital muscles. The principal muscles of the ear are three in number, the superior, posterior, and anterior; they are all very thin. The superior muscle is fixed in the convexity of the anthelix

lix, and superior portion of the concha, from whence it runs up to the squamous portion of the os temporis, expanded in a radiated manner; the posterior muscle is almost transverse, and of a considerable breadth, being fixed by one end to the posterior part of the convexity of the concha, and by the other in the root of the mastoid apophysis. The anterior muscle is small, more or less inverted, and like an appendix to the superior. It is fixed by one extremity above the root of the zygomatic apophysis, and by the other, in the anterior part of the convexity of the concha. All the other muscles described by anatomists are so small, that they hardly look like muscular fibres. The integuments and skin of the ear are in general a continuation of those which cover the neighbouring parts of the temporal region. The arteries of the ear come anteriorly from the arteria temporalis, and posteriorly from the occipitalis, which is a branch from the external carotid; their corresponding veins are anastomosed as they join a branch of the vein external jugularis and the vena occipitalis. The portio dura of the nervi auditorii sends several filaments, which expand before and behind the ear. From the above description, the word *ear* comprehends only that portion called by the Latins *ala*.

The second part admits of no division. The meatus auditorius begins at the inferior, anterior, and internal part of the concha, and ends at the membrana tympani. The diameter of the meatus is rather oval than round, and narrower at its middle part than at its extremities. Its form is such, that it descends from behind forward, and from outward inward, but is a little curved on its length; and after its direction from below upwards, it descends from upwards downwards. The meatus is partly cartilaginous and partly bony; its cartilaginous part which is most external, is continuous to the carti-

lage of the concha. It is bent from bottom upward, and from hindward forward. There are likewise several incisures in the circumference, which represent obliquely transverse fissures; these incisures are covered outwards by the *musculus incisuræ majoris*, whose fibres are sometimes parted from each other, to form two branches. The extremity of the cartilaginous part of the meatus auditorius is adherent to the asperities which are at the edge of its bony part. This has a little more length: it ends by a groove nearly of a circular form, bent from top downwards, and from without within, interrupted to its superior and posterior part. The two portions of the meatus are intirely lined by the common integuments which creep into it, but the thickness thereof diminishes as it draws near the membrana tympani, so that it is extremely thin at that part: at the superior extremity, the meatus is covered with long hairs, which hinder corpuscles and insects to get in. The cellularly texture which accompanies them, represents there a kind of reticular web, whose eminences are full of corpuscles of a round or oval figure, of a dark brownish-yellow color, which are nothing else but some glands of the sebaceous kind. Each has its excretory duct through the skin, which pours within the meatus auditorius, a yellowish, bitter humor, like a thick oil, which is afterwards changed into a hard substance by the air. This humor, known by the name of *cerumen*, lubricates the meatus, and its more fluid part keeps the membrana tympani middling moist.

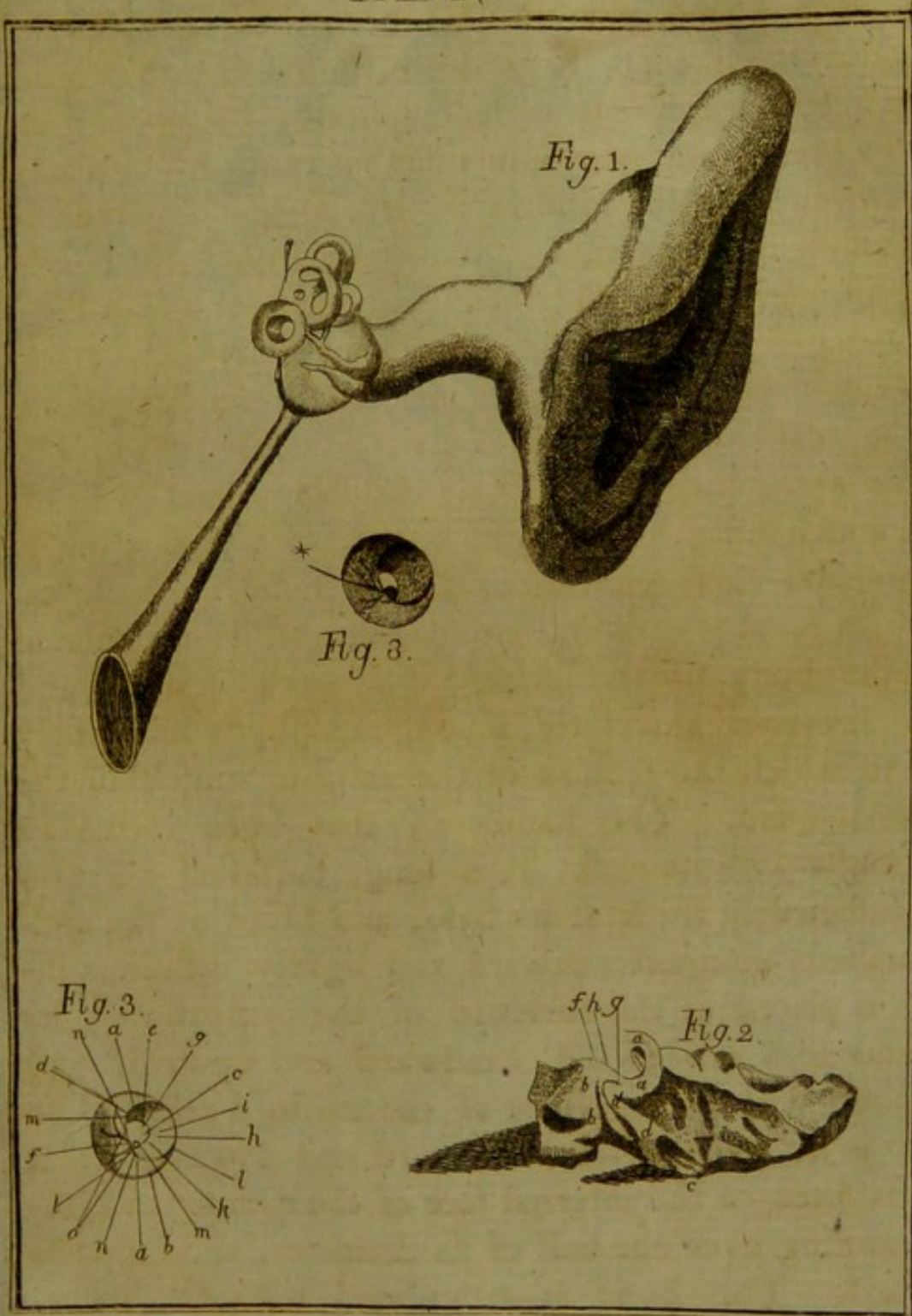
The inside parts of the meatus auditorius may likewise be distinguished by the external orifice; the superior, inferior, posterior, and anterior inside; besides, the occlusion by the membrana tympani. The external orifice varies almost in all subjects; its diameter in general is about three lines, and diminishes about the middle to increase

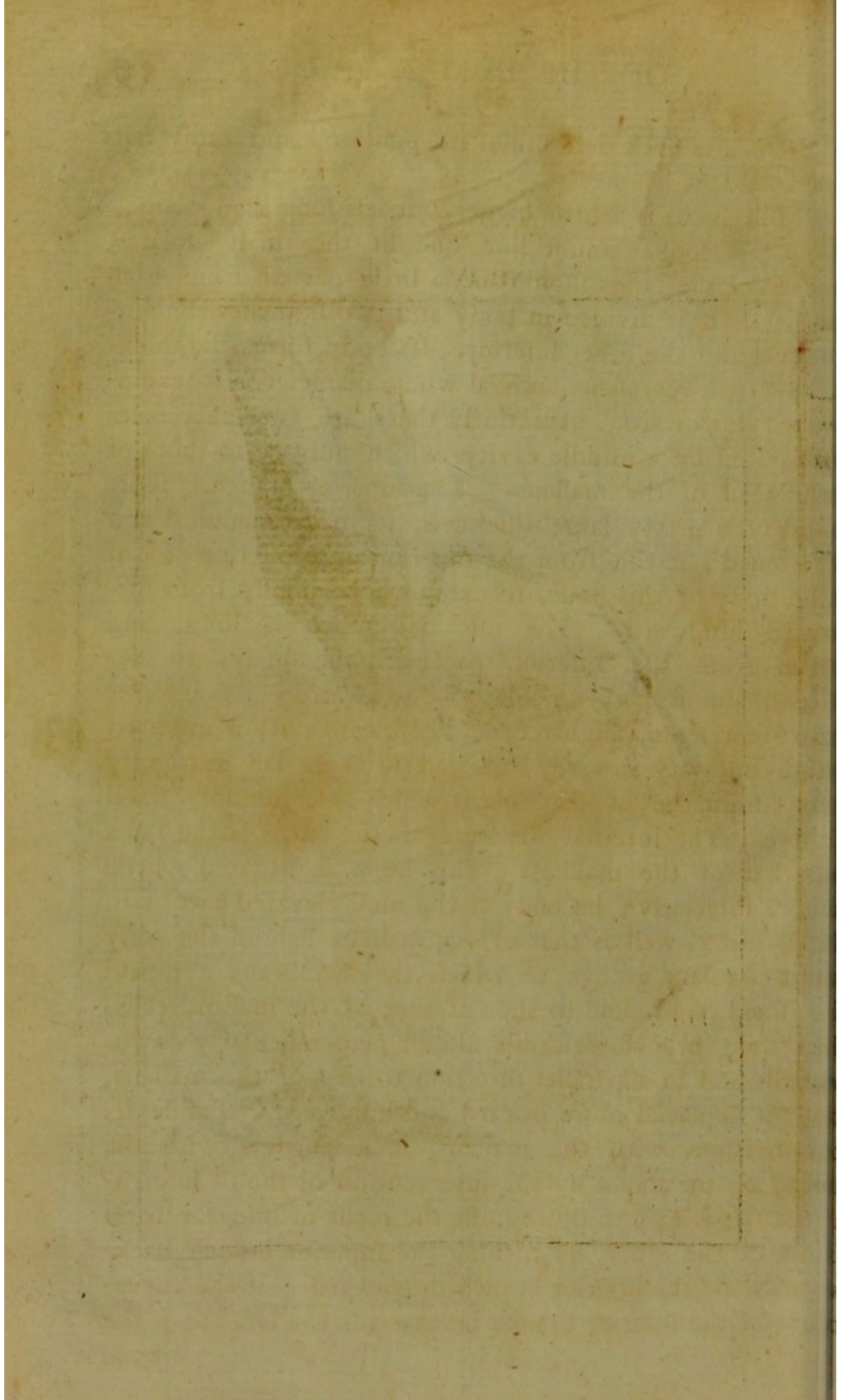
crease again towards the *membrana tympani*, to the extent of four lines : So that, the diameter of the meatus at its external orifice is less than near the *membrana tympani*. The superior inside part is in general more even and smooth than the others ; the inferior inside part is smooth from the orifice down to the middle, but further below there is a concavity, which is a kind of reservoir for the hard cerumen, and below it a small eminence ending in a round cavity till the adhesion of the *membrana tympani* ; the posterior inside part is smooth from the orifice down to the three fourth parts, where a small cartilaginous eminence is seen, and below is the adhesion of the *membrana tympani* ; the anterior inside part is in general smooth from the orifice down to the *membrana tympani*. The glands of the meatus auditorius are not equally spread, they are more numerous at the posterior lateral inside towards the cartilaginous eminence, and the membrane which covers them thinner than at any other part. These glands have excretory ducts of the same nature as those of the eye-lids called meibomius glands ; the humor secreted through them is of a whitish color, which changes by degrees towards the yellowish brown color, and becomes hard. The *membrana tympani* which terminates the meatus auditorius, is thin, transparent and flattish ; the edge is elevated at the posterior inside, declining towards the anterior, and equally fixed at the superior and inferior edge of the groove. This membrane is naturally stretched, and middling moist ; it is situated obliquely, the upper part of its circumference being turned outward, and the lower part inward. It is made up of several laminæ closely united together, supported and strengthened by the *chor-da tympani*, and ramificated by a vast number of various vessels.

The third part comprehends the *tympanum*, or barrel,

an empty cavity supported by four little bones; and the eustachian tube, with its appendix, the *velum pendulum palati*. The description of this kind of barrel, with its appendix, will be complicated, as it is absolutely necessary to comprehend the inside parts and the neighbouring ones. The tympanum has been thus called on account of its likeness to a drum, but it is rather more like a kettle drum. It is half spheric: Its upper part, which is covered by the *membrana tympani*, is placed outward and a little hindward; its bottom situated inward and a little forward. It incloses four small bones, called altogether *ossicula*; three eminences, and four large apertures, without including several others which cannot always be seen. The *ossicula* inclosed in the tympanum are the *malleus*, *incus*, *lenticularis*, and *stapes*. The *malleus* is the longest of all; it is distinguished in head, neck, and handle. The head is the thickest part of it. It represents some eminences separated by a middle cavity. Its form is oval and elongated, and is articulated with the body of the *incus*. The neck is short and thick. It carries anteriorly a long apophysis extremely close, to which the tendon of the anterior muscle of the *malleus* is fixed. The handle of that bone forms an acute angle with its neck. It is long, flattened on two sides, sufficiently thick at its basis, and blunt at the end. The *malleus* compact outward and lightly cellulous inward, is placed at the entrance of the tympanum; its head and neck are inward, hindward and upward, and correspond with the aperture of the mastoid cells: The handle is situated outward, forward and downward; it descends fixed to the internal face of the *membrana tympani*, running over one half of its diameter, and supports it upward. This bone is articulated with the *incus*, whereof it is only separated by a very thin cartilaginous lamina. The apophysis which arise from the anterior
part

TAB. IV.





part of its neck determines its position, and easily tells what side it belongs to.

The incus is a little bigger, but less long than the malleus; it looks almost like one of the small molares, whereof the fangs should be a little parted from each other. It is divided in body and two branches, one superior and the other inferior. Its body forms the thickest part, it represents an oval whose diameter is from upward downward. Anteriorly there are two eminences separated by a middle cavity, which answer to those of the head of the malleus. The superior branch is short and of a pretty large thickness, its basis is conical and flattened; it rises from the superior and posterior part of the body of this bone, to extend horizontally from forward hindward. The inferior branch is long, and rises from the inferior part of the body, to descend almost perpendicularly downwards; its inferior part represents a slight curve whose convexity is outward and concavity inward, hallowed in at its last extremity to admit the os lenticularis which is commonly fixed there. The internal structure of the incus is the same as that of the malleus. This bone is situated a little more interiorly; its body is the most elevated part of it. It is hid as well as that of the malleus behind the bony and circular groove to which the membrana tympani is fixed, and close to the entrance of the mastoid cells. Its long branch descends almost perpendicularly downwards and in a parallel direction to that of the malleus, but it is placed more inward and hindward. Besides its connections with the malleus, it is engaged with the head of the stapes by the intervention of the os lenticularis. It is easy to distinguish the incus of one ear from that of the other, by turning the superior branch backwards and the inferior branch downwards; if the curvature of the inferior branch be towards the left hand, the

bone belongs to the right ear, if towards the right, it belongs to the left ear.

The os lenticularis is very small, it is flat and a little convex on its two sides, which answer, the one to the long branch of the incus, and the other to the head of the stapes; it would be easy to mistake it for an appendix of the incus at the bottom of which it is always fixed.

The stapes is the most interior of the four ossicula; it looks exactly like a stirrup. It is divided into three parts, the basis, branches, and head. The basis is the largest part, the round part is oval on one side, and flat on the other, as the fenestra ovalis on which the basis rests; the two branches are not equal, one is of a larger curve, and the other less, the one is also anterior and the other posterior, and this last a little more curve and thicker. Both branches are stripped on the side they face each other, and forms with the external face of its basis, a groove to which is attached a very thin membrane that fills up the vacuum between them. The head of the stapes is supported upon a very short neck, made up by the re-union of its two branches; it is concave at its top to receive the internal side of the os lenticularis. Nothing but a compact substance is to be found in the structure of the stapes. Its situation is horizontal, and such, that its basis is fixed near the fenestra ovalis, by a membranous production which seems to be a continuation of the periosteum covering one and the other. The stapes is articulated with the os lenticularis, and by its middle with the long branch of the incus; the length, the curvature, and the unequal thickness of its two branches joined to its two basis, indicates exactly if it belongs to the right or left ear.

The ossicula above described, are covered with a very fine periosteum, ramificated with a vast quantity of blood vessels;

vessels; this kind of membrane communicating from the one to the other, strengthen their situation, and serve instead of ligaments. They are connected by some muscles which belong to the malleus and stapes. The muscles of the malleus are three; the internal, anterior, and external; the stapes has but one. The internal muscle of the malleus, tho' very thin, is however, that whose size is the most considerable; it rises by tendinous fibres from the cartilaginous part of the eustachian tube, and from the point of the os petrosa, which is between the small round foramen of the sphenoides, and the inferior aperture of the channel of the carotid. As soon as it is become fleshy, this muscle begins its adherences from forward hindward, from inward outward, and from downward upward, in a semi-bony channel hollowed in the substance of the apophysis petrosa, above the bony portion of the eustachian tube; it is inclosed there as in a sheath, and fastened by a very strong membrane. The tendon which terminates it turns round, and over a bony transverse of the tympanum, and runs from inward outwards, and a little from upwards downwards; it runs in that manner to be afterwards fixed at the inferior part of the handle of the malleus below its apophysis, and on the side which faces the bottom of the tympanum. Its use is to keep the membrana tympani in a state of tension, for if its tendon is incised throughout, the membrana tympani is immediately relaxed.

The anterior muscle of the malleus is thin; it rises from the apophysis of the sphenoides, and from the external neighbouring part of the eustachian tube by very short tendinous fibres. Its fleshy body re-ascends from inward outward, and from forward hindward and adheres in the articular scissure of the os temporis, thro' which it creeps within the tympanum. Before it is at that

place, it ends by a tendon which adheres to the extremity of the apophysis of the malleus.

The external muscle of the malleus looks rather like a ligament, tho' it is properly a muscle. Its situation is at the internal superior, and posterior part of the meatus auditorius. Its fibres assemble together to form a tendon which runs from upwards downwards, from forward hindward, and from outward inward; and penetrating within the tympanum by the weak side of the circular groove where the membrana tympani is adherent, it becomes fixed at the external part of the neck of the malleus. The use of the external muscle is to keep the membrana tympani in a state of tension outward, otherwise it would lean too much on the malleus.

The muscle of the stapes is the smallest in the human body. It rises from the pyramidal cavity of the posterior and superior part of the tympanum. The tendon which terminates it, goes out by the hole of that pyramid, and takes its adhesion at the convexity of the long branch of the stapes, near the head of that os. The situation of this muscle stretches the membrana tympani. The chorda tympani goes under the short branch of the incus, and passing between the long branch of this bone, and the superior part of the handle of the malleus, it ascends from downwards upwards, and from hindward forward to the very place of the insertion of the tendon of the internal muscle of the malleus; after it has contracted some adherences with this tendon, and ran above it, the chorda tympani increases in size and becomes firm, and descends with that of the anterior muscle of the malleus to go out of the tympanum through an aperture very near that by which this tendon is introduced.

The periosteum of the tympanum is very thin; that which covers and unites the ossicula is a continuation of it, as well as the membranes which close the fenestra ovalis

ovalis and fenestra rotunda. It produces likewise the periosteum of the mastoid cells, and adheres to the internal tunic of the eustachian tube; the periosteum is ramified by a prodigious quantity of blood vessels. These are the containing and contained parts of the tympanum, as they appear in dissections; but I must not forget to mention here, that there is but one free opening out of the tympanum, and that is the eustachian tube, which is a sort of appendix to the tympanum itself. The fenestra rotunda and fenestra ovalis, are closed, as I said above, by a thin membrane or pellicle; the first leads to the internal part of the cochlea, and the second to the vestibulum.

The eustachian tube, or *ductus auris palatinus*, is a duct which goes from the tympanum to the posterior opening of the palate; it is dug in the apophysis petrosa along the carotid canal, and lengthened out by the spinal apophysis of the os sphenoidale. In its natural state, this duct reaches from the cavity of the tympanum to the root or superior part of the internal ala of the apophysis pterygoides; and through this whole course it is made up of two portions, one entirely bony, and the other partly bony, partly cartilaginous, and partly membranous. The bony portion lies through its whole length, immediately above the fissure of the glenoid or articular cavity of the os temporis, and terminates at the meeting of the spinal apophysis of the os sphenoidale with the apophysis petrosa of the os temporis, that is to say, between that spinal apophysis and the inferior orifice of the carotid channel. The other, or mixed portion, reaches in the same direction from this place to the internal ala of the apophysis pterygoides, or to the posterior and outer edge of the nares; but to have a more exact idea of it, it will be proper to consider it as divided into four parts, two superior and two inferior. The two upper parts

parts are bony, and, of these, the innermost is formed by the side of the apophysis petrosa, the outermost by the side of the apophysis spinalis of the os sphenoides, so that the upper half of this portion of the eustachian tube is bony. Of the two inferior parts, the internal is cartilaginous, and the external membranous, so that the lower half of this portion of the tube is partly cartilaginous next the os sphenoidale, and partly membranous next the apophysis petrosa. The eustachian tube is thus formed: it is at first wide enough, and towards the middle it gets narrower, and afterwards wider and wider. It is at first flattened on its two faces, so as to be a little oval, and finishes by being like the lower extremity of a French-horn, a musical instrument well known. The cavity of this tube is lined by a soft, thick, reddish membrane, like that of the internal nares, of which it appears to be a continuation, and which becomes more firm as it goes towards the tympanum. Its external orifice opens behind the uvula, and the *velum pendulum palati* which rises up hindward in stopping up the posterior nares during deglutition, hinders the aliments to get into it.

The fourth part comprehends the labyrinth and the closed openings which lead into it, and out of it. The labyrinth is made of several cavities which communicate together, and these are distinguished in vestibulum, cochlea, semi-circular canals. The aqueducts are two outlets, which lead in the cranium.

The form of the vestibulum is almost spheric; this cavity is situated beyond the tympanum, whereof it is separated by the fenestra ovalis. It is more spacious forward than hindward. The bottom is divided into two slight excavations; one inferior, neighbour of the anterior extremity of the fenestra ovalis, whose form is round; the other superior, of a long form, which extends from
forward

forward hindward, called semi-oval. The first is the deepest, and seems to be of a bony substance, more white and compact than the other. They are separated by a bony point, which rises from the inside of the bottom of the vestibulum, and goes forward and outward. This point is terminated towards the middle of the superior edge of the fenestra ovalis by a bony pyramid, but very small, whose basis is triangular, and the top flattened and a little rough. The vestibulum presents seven apertures, one is the fenestra ovalis, the second belongs to the cochlea, and the five others to the semi-circular canals.

The cochlea takes its name from the resemblance of a garden snail. It is situated exteriorly as to the other parts of the labyrinth. It is distinguished by a basis, which is hindward and forward, towards the bottom of the bony duct wherein are admitted the two portions of the auditive nerve; and by a top which is forward and outwards, on the side of the eustachian tube: The basis is likewise a little more elevated than the top; it is hollowed and bored by several holes which communicate within the cavity of the cochlea. This cavity represents a double spiral, which at first turns round a common axis, which is bony and of a conical figure, and terminates towards the middle of the length of the cochlea, by a kind of funnel, excessively large at the end. It makes two turns and a half separated from each other by a partition entirely bony, which is called the partition of the windings to distinguish it from another bony partition on the side of the common axis, membranous on the side which faces the opposite inside of the cavity, which is called half partition. This last is flexible and thin, that of its two sides which faces the vestibulum is unequal and rough, whereas that the one which faces the tympanum presents jutting out lines, set in like
rays.

rays. At the place where the common axis fails, the half partition adheres to the inside of the funnel; it is totally membranous at its last extremity, where a very visible apperture is observed. The half partition mentioned before, separates the spiral part of the cochlea, into two very distinct parts; the one is internal and near the basis of the cochlea, the other is external and placed on the side of its point. The first is larger but shorter, terminates at the fenestra rotunda; the second narrower and longer, opens to the inferior and anterior part of the vestibulum: they are called *scala tympani* and *scala vestibuli*; they have communication together. The form of the cochlea of the right ear is like that of all shells; that of the left cochlea is contrary ways, by that difference they are distinguished from each other.

The three semicircular canals arise from the vestibulum, and return in it after they have gone a little way in the substance of the apophysis petrosa. They offer to our view but five appertures within the vestibulum, because the two longest unite to form but one common canal. The names by which they are distinguished, take their origin from the situation. The first is the superior vertical, the second the posterior vertical, and the third the horizontal. The superior vertical canal arises from the anterior superior part of the vestibulum, and after rising above the others, it forms a perpendicular curve to the horizon; it goes towards the posterior part of the vestibulum, and opens there with the posterior vertical. Its anterior orifice has an elliptic form, and more lengthened hindwards than forwards; its cavity is equally elliptic, and longer forwards than hindwards: Its length keeps the middle between that of the posterior, and that of the external. The vertical posterior canal arises where the superior ends; it is at first united to it, and forms with it a common canal of a line
and

and a half long, the cavity thereof large enough at the beginning, afterwards becomes narrower as a funnel, and terminates by an aperture which is observed at the posterior and internal part of the vestibulum. It is the longest of the three. The horizontal canal is almost parallel to the horizon; it is situated between the superior and posterior. This canal arises anteriorly from the superior part of the vestibulum, between the orifice of the superior vertical, and the fenestra ovalis, and ends at the posterior part of that cavity, between the common canal and the inferior part of the posterior vertical. Its anterior orifice is large, elliptic, and separated from that of the superior vertical by a little bony protuberance; the posterior is narrower and rounder. This difference of diameter is visible in its whole length, for its anterior half portion is the largest; it is the smallest of the three.

All the parts of the labyrinth are covered with a very thin periostrum, over which creep some blood vessels and a vast quantity of nervous ramifications, and filled up with a limpid serosity undoubtedly furnished by several excretory ducts neither to be perceived nor known at present; so that they are one of the *inquirenda* in anatomy. This serosity is of the same nature as that of the aqueous humor of the eye; when it is too full, or copious, it runs out of the labyrinth by two aqueducts, called *cotunnii aquæducti*. The first has its orifice at the bottom of the vestibulum, below that of the common canal, near the protuberance which divides the cavity I am speaking of. The aqueduct of the vestibulum rises from downward upward in the substance of the apophysis petrosa, in passing behind the common canal. When it has run the length of three parts of a line in that direction, it curves hindward and forward, and ends at the posterior side of the os petrosa below the middle part of its superior edge, by a crise of two lines and a half long, and

a quarter of a line wide, and whose superior edge is raised up. The diameter of that aqueduct is not alike in its whole length; it decreases from its orifice to the place of its curve, where it is very narrow; afterwards it widens very much, and looks very much like the large opening of a French horn which would be a little flattened. Its length is about three lines. It is entirely lined with a membrane which comes from the external lamina of the dura mater, and is continuous to the periosteum of the vestibulum; in so much that we might say it arises from the dura mater. At the place where it opens in the cranium, the internal lamina of the dura mater is parted from the external, and a small cavity of a triangular form between them is observed to be continually filled with some aqueous humor.

The aqueduct of the cochlea has its orifice at the inferior part of the fenestra rotunda. It is the beginning of a very narrow bony canal, hollowed in the substance of the os petrosa, which is always dilated, and goes from upward downward, for the distance of about three lines, ends in the cranium below the internal auditive foramen, by an aperture whose form is triangular, a little flattened, and sufficiently wide. This canal is interiorly lined by the dura mater, which is continuous with the periosteum, in the internal part of the cochlea. The aqueous humor detained in the cochlea goes through the canal in the cavity of the cranium, and supposed to be soon absorbed like the other fluids therein contained.

The fenestra ovalis is situated at the bottom of the tympanum; superiorly it is oval, and flat inferiorly. This aperture leads to the vestibulum, one of the cavities of the labyrinth. It is closed by the continuation of the periosteum, and fastened by the basis of the os stapes, which rests on it. The fenestra rotunda is smaller than the fenestra ovalis; it is situated below this last aperture,

aperture, whereof it is separated by a protuberance. It is inclined backward, and closed by a thin membrane, which is not a continuation of the periosteum as that of the fenestra ovalis, but a very thin pellicle, very much like a wet silk paper. It is set and fastened round the edge by a great many blood vessels, and is contiguous to the periosteum of the tympanum, essentially different from it, and well adapted for its particular purpose.

The arteries which penetrate in the internal parts of the ear are numerous and multiplied by very small ramifications. They come from the occipitalis, the posterior auricularis, the meningea, external and internal carotid, &c. The posterior auricularis sending more branches in the ear than any other mentioned, shall be particularly described. The veins are not so numerous, as there are many branches of the arteries which have neither *venæ vorticosaë*, nor immediate corresponding veins. The nerves of the internal ear are the *portio dura* and *mollis*.

The posterior auricularis is not very small; it arises from the external carotid, sometimes from the occipitalis. That artery goes from forward hindward, and almost transversally on the digastric, then under the apophysis styloid in giving some branches to the neighbouring parts, when it is at the superior orifice of the meatus auditorius, it produces another which penetrates within the meatus in passing through a hole of the cartilage that forms it. That artery, as I said above, arises sometimes from the occipitalis, and very seldom from the very trunk of the external carotid. Before it arrives at the stylo-mastoid hole, it sends a few ramifications to the inferior part of the meatus auditorius, and produces one of the trunks of the artery which runs over the *membrana tympani*, called *arteria tympanica*: arrived within the *aquæductus fallopii*, it ramificates over the mastoid cells,

cells, the muscle of the stapes, the semi-circular canal, on the periosteum which lines the aqueduct itself, and over the insides of the cavity of the tympanum.

The veins of the internal parts of the ear are few in number. The vestibulum and cochlea have each their respective ones, which open in the lateral sinus and the main trunk of the internal jugulary: The trunk of that of the cochlea, is very near the orifice of its aqueduct; it takes up several branches which come from the internal cavity of the labyrinth. The vein of the vestibulum is likewise near neighbour of the aqueduct above described; the ramifications which form these trunks come from the cochlea and the semi-circular canals, and pour out the blood in the jugulary vein.

The *nervi auditorii*, are nerves of the seventh pair; they arise from the lateral and posterior part of the great transverse protuberance of the medulla oblongata. Each of these nerves is double, which accompany each other very closely to the foramen auditorium of the apophysis petrosa, through which they pass with some small arteries along the foramen, and part from each other at its extremity. The *portio mollis* is divided into three branches, which penetrate at the basis of the cochlea, and are spread there in very small filaments on the surface of the periosteum.* The *portio dura* is totally different from that of the *mollis*. A branch of this nerve penetrates within the tympanum, by an aperture situated at its superior and posterior part, near the basis of the pyramid; it goes under the short branch of the incus, and passing between the long branch of that os, and the superior part of the malleus, it ascends from downward upward, and from hindward forward, to the very place of the insertion of the tendon of the internal muscle of the malleus: It runs over this tendon to which it is fixed,

* Objection to Dr. Monro's Nervous System.

ed, and becomes thicker and of a firmer consistence; then it descends with that of the anterior muscle of the malleus, and goes out of the tympanum by Glaffer's fissure, between the apophysis of the sphenoid and the neighbouring parts of the os petrosa: It is the chorda tympani. This nerve continues to go from upward downward, from hindward forward, and from outward inward, until it meets the lingual nerve of the inferior maxillary to which it unites in forming forward a very acute angle, and augments the bulk; this shows that the chorda tympani goes from the portio dura of the nervi auditorii to the lingual nerve. This portio dura furnishes other nervous ramifications, an account of which may be omitted here, as it becomes foreign to this treatise.

PHYSIO-

OF THE HUMAN EAR

and the sense of hearing is a sense of motion
and the sense of hearing is a sense of motion
and the sense of hearing is a sense of motion

PHYSIOLOGICAL ENQUIRY

INTO THE

ORIGIN OF SOUNDS

AND THE

MECHANISM OF HUMAN HEARING.

HAVING described all the parts which enter into the composition of the human ear, without mentioning their particular and general use towards the mechanism of hearing, I am now to open a new field to the inquisitive physiologist, and illustrate many systematical points which seem to have embarrassed the authors who have wrote on sounds, their difference, propagation, and their sensation on our organ. In this theory I have not been able to get great assistance from antient and modern authors, their systems being without exception contradictory to facts; therefore the reader will easily apprehend at what pains I have been to extort, as it were, the truth from anatomy on the one hand, and on the other raise a new theory consistent with the different diseases of the organ. The origin of sounds and their propagation,

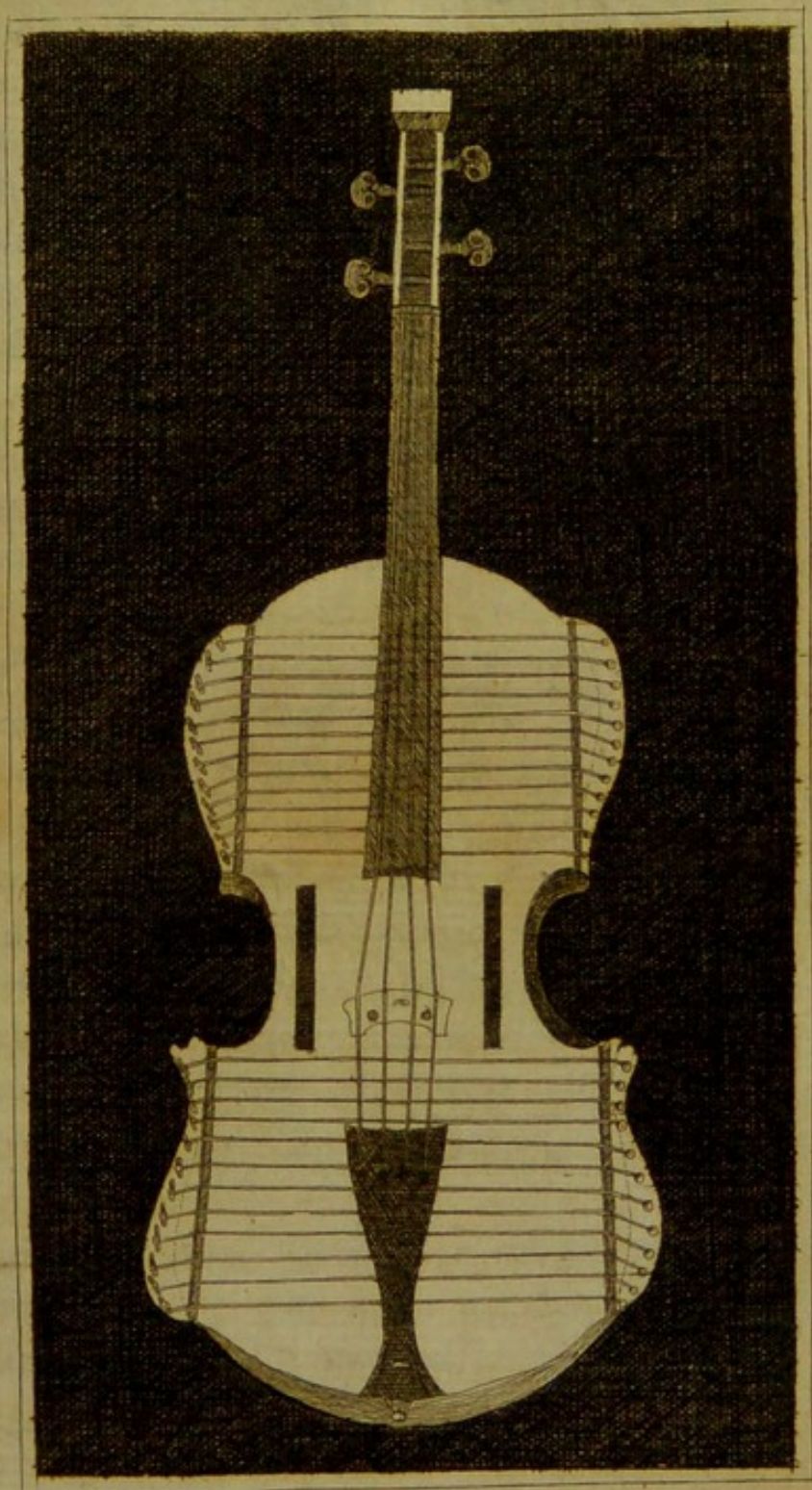
propagation, require my attention in the first place, and their sensation on our organ next to it, to avoid repetitions and prolixity.

Sounds are vibrations of the air excited by the concussion of solid bodies; there are several kinds whose impressions we sensibly distinguish from each other. The low and loud; the shrill and soft: these four species compounded properly together, form melody. They have all a different principle or origin. The writings on harmonic sounds, from Rameau down to Matthew Young of Trinity College, Dublin, an author perhaps not generally known, have indeed given us the theory of modes, but they have said nothing concerning the origin of the difference in those sounds; this point in particular has required many experiments, and how right I have drawn conclusions from them, I have not vanity to determine. But before to proceed by deducing the arguments which tend to prove that the concussion of solid bodies moves the air in form of waves, and that these assume the shape of different angles, the effect whereof I consider unaccounted by philosophers and musicians, I ought to describe the instrument constructed for the purpose of ascertaining that same principle or origin of difference in sounds.

The instrument I mean is constructed upon the same plan as a common violin, except that it is perfectly flat, and its openings, instead of being in form of \S are straight and parallel; besides it has 24 wire strings, 12 under the tail-piece, and 12 under the finger-board. On the right side, the wire strings are attached to brass pins with small heads, and on the left, with iron pins like those of a harpsichord. These brass nails and iron pins are fixed on a piece of wood, about half an inch square, and four inches long, framed or shaped like the rims, glued upon them, and even with the belly. The

24 wire strings are supported by four very low bridges placed and glued on the belly of the violin, near the iron pins and brass nails. I call that instrument *harmonica violin*; it has a most agreeable tone, and is, I believe, superior to the very best common violin. Matthew Hardie, of Edinburgh, made it in the year 1786, but I must observe that I altered it at the bar, which at first rested by each end on the blocks in the inside, so that the bar is quite square, and extends the whole length of the violin, except half an inch near each block. The four strings of the violin being tuned the common way D natural, which is founded by the third string open, will make unison with the lowest wire string under the tail-piece; for example: D natural, shall be the tuning of the lowest and first wire string, the second E flat, the third E natural, the fourth F natural, the fifth F sharp, the sixth G natural, the seventh A flat, the eighth A natural, the ninth B flat, the tenth B natural, the eleventh C natural, the twelfth C sharp. These twelve tones form a complete octave, in whatever key one plays on the *harmonica violin*, and produces the sweetest tones that I ever heard. The other twelve wire strings under the finger board are tuned in continuation of the above, so that the whole 24 wire strings make two perfect octaves; and I must further observe, that it will keep in perfect tune for 14 or 16 days, when the instrument has been constructed six months. The four lowest strings are of the size and nature of the fourth strings for a small guitar; the four following of the nature and size of the third strings of a large guitar; and the four last of this octave are of the nature and size of the third string of a middling guitar. The four lowest of the twelve under the finger board, are of the size and nature of the third string of a small guitar, the four following of the nature and size of the second string of a middling guitar, and the

TAB. V.



VIOLINA HARMONICA

the first part of the book is devoted to a description of the
various forms of the disease, and to a discussion of the
causes and modes of transmission. The second part
contains a detailed account of the symptoms and signs
of the disease, and of the various methods of treatment
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the four last of the nature but smaller size of the first of a small guittar. The violin is painted with oil color, and covered with one coat of copal varnish.

As sounds are produced by the concussion of solid bodies, and propagated by the air fluctuating different ways, according as the solid bodies move it, the difference in the fluctuation of the air ought to operate variety in sounds: For example, if any solid body moves the air in acute angles, the sound produced and propagated will be shrill and offensive to our organ, when near; if, on the contrary, the air is moved in obtuse angles, the sound will be soft and agreeable to the ear. I shall have occasion to prove, in the course of this Physiological Enquiry, that the membrana tympani has no power of moderating the shrillness of sounds, by assuming a different degree of tension; consequently, the several degrees of acuteness and obtuseness the waves of the air do assume, shall undoubtedly constitute and account for the variety of all sorts of sounds. This motion or waving of the air was generally understood by the word *vibration*, but there was no account with regard to its difference in producing variety of sounds. The low and loud sounds have their origin in the degree of concussion and quality of sonorous bodies, and their propagation by the more or less velocity of these vibrations; in this manner, every kind of sound will be explained, together with their origin and sensation on the organ of hearing.

When I play on the harmonica violin, *God save the King*, in C natural, the first note of the first bar being C, it is repeated by each C natural in the octaves of the wire strings; the third note of the same tune and bar being D natural, it is repeated by the third string open, and the two D in the octaves of the wire string; so that there are four notes or tones in unison at the same mo-

ment; and if we reflect on Tartini's system on grave harmonics, in the same manner as Rameau derived his from the acute, we will naturally conclude that all the discording tones are really acute. Why do not all strings vibrate when not in unison with the sound produced? The weakest part of any tight string is undoubtedly its middle; therefore, any sound propagated through the air cannot shake one that should be more or less tight than itself; and this is the reason why some strings receive and generate their vibrations to such only as are susceptible of assuming the same degree of angle, whilst those that are not, remain quiescent. It follows, that a tight string, when in vibration, will form more acute angles than one that should be slack. Strings which vibrate in acute angles, propagate these angles to the air, and as they go from it, become less and less acute, till they in some degree assume an obtuse angle, on account of the opposition of the air; from that alteration, shrill sounds become less disagreeable, when their sensation is felt by our organ at a great distance; consequently, the difference between shrill and acute sounds, comes from the difference in the angles.

Experience tells us, that high notes executed on the first string of the violin in shifting, are acuter than those of the back strings; and this is the reason why, in accompaniments, the same notes, executed on the second or third string, by great players, are always preferred, though the running notes should not be discordant. A note which contains a full tone, contains near 200 different tones, and as in an octave there are seven full tones, the whole shall comprehend 1400 different tones; consequently, as there are but 12 tones which are consistent with melody, there ought to be 1388 discordants in the whole octave. A false string will assume the same angles in its vibrations as a true one, but they shall cease or die away in an irregular

regular manner on account of its natural defect in point of size or compactness; from those irregular vibrations, the melody produced by it will become disagreeable, as if that same string should be continually stopped out of tune. I have likewise observed, that whenever several strings are tuned differently, they are not capable of receiving the same vibrations, unless the vibration propagated to them assume the same equal angle; consequently such strings as are capable of assuming angles adequate to that which will communicate its own, shall vibrate, and such as are not of the proportionate angle shall remain quiescent. But why does the *harmonica violin* increase in tone, by the addition of all the wire strings, since none but these which are in unison, and become harmonics on playing the instrument, are in vibration, whilst the greatest number of them remain quiescent? To this I answer, that all the quiescent strings, being in contact with the instrument, receive a tremor or single vibration, which cannot be continued, as these strings can but assume each an angle adequate to their tightness: This explains discord, if that or any quiescent string is vibrated by a different cause than the unison. But why are tones generated without friction? Because a sound or tone forms an angle which will be communicated only to, and propagated by such strings as are tuned in unison to it: A string tuned to any pitch cannot continue to vibrate to all sounds indistinctly, as all different sounds move the air in different angles; in this manner the origin of sounds, and their difference, are no longer suppositions.

The main point understood, it remains to know, how and in what manner sounds could arrive at that part of the cochlea, *the immediate organ of hearing*, and produce there a sensation, so as to be afterwards conveyed to the brain. This function of the ear becomes my next en-

quiry. I have often searched in the labyrinth, and particularly in the cochlea for a soft and tender nervous expansion similar to the retina of the eye, as the late Dr Monro mentions in his anatomy of the skeleton to have seen; but I have been always disappointed, because I looked for an imaginary object. I repeatedly poured the strongest spirit of wine in all the cavities of the labyrinth, and I could find nothing but nervous ramifications, without that these did form a continuous coat; so that the sense of hearing is operated in a different manner from that of seeing. The rays are emitted from objects, and susceptible of being intercepted; sounds are vibrations of the air, but cannot be so easily intercepted as I will ascertain it hereafter by dissections and cases. In order to leave no room for conjecture, and to go upon sure ground, my first enquiry into this difficult matter was to consider, which part of the ear is most probably the immediate organ of hearing; to which purpose I cautiously followed the *nervi auditorii* to their very extremities; and having observed that the *portio mollis*, after several ramifications spread in the cavities of the labyrinth, assembles a greater quantity of them at the basis of the cochlea, I naturally concluded, that this particular place of the cochlea must be the immediate organ of hearing.

Dr Alexander Monro, in his observations on the structure and functions of the nervous system already quoted, page 11. and 40. has the following paragraph, chap. xvii. sect. i. p. 45. “ In like manner, I have discovered in
 “ the ear, that the branches of the *portio mollis* form,
 “ upon the membrane and scala of the cochlea, a most
 “ elegant plexus; in which the nervous filaments are
 “ so intermixed as to form new combinations, so far as
 “ they can be traced with glasses, and seem at last to
 “ terminate in a retina or web, somewhat resembling
 “ that formed in the eye by the optic nerve.” If we
 compare

compare this description with the fourth figure of the thirty first table in that work, we plainly see the Doctor in contradiction with himself. The retina is a nervous coat of itself, and this is so evident, that when dipt in spirit of wine, it will resist pulling very near as much as a piece of wet paper. I have many times extracted this nervous membrane, and observed it with the microscope. It is certainly not supported by the pia mater, for this last coat is contiguous to the choroides, where it undoubtedly ends; consequently, it is obvious that the retina is only spread on the choroides, supported betwixt this vascular membrane and the posterior part of the vitreous body, and sustained by a multiplicity of lymphatic arteries which have their passage through it. When we look with attention at the nervous ramifications of the portio mollis in the cochlea, with or without glasses, we find that these ramifications are spread in and over a membrane similar to the dura mater; therefore, the Doctor's comparison is by no means admissible, for these nervous filaments, even described by his own plate, magnified to about thirty diameters, are laterally contiguous to each other, whereas the retina has no filaments, but forms a continuous nervous coat.

This information obtained was not yet satisfactory; it remained to explain how, and in what manner the vibrations were carried from the membrana tympani to that of the fenestra rotunda, and from this last membrane to the basis of the cochlea: Because all the authors have advanced, that the ossicula in the tympanum were appointed for that purpose, as the os stapes does immediately rest on the fenestra ovalis, which leads to the cochlea, as well as the fenestra rotunda. It became, therefore, a matter of doubt to the physiologist, which of the two ways nature has thought proper that the vibrations should be communicated to the immediate organ
of

of hearing. If the ossicula were the agents of communication between the membrana tympani, the fenestra ovalis, and the basis of the cochlea, it should naturally follow, that the ossicula being extracted out of the tympanum, the sense of hearing could not take place; however, it is by no means the case, for I have often met with diseases where the ossicula and membrana tympani were entirely destroyed, and yet the organ was not deprived of the faculty of hearing. Monf. Bertin says, that he knew a young man who heard tolerably well, although the four ossicula had exfoliated after an abscess in the tympanum. If the ossicula are not the agents of communication between the membrana tympani and the immediate organ of hearing, what is their use? When I had been informed that the ossicula were not absolutely necessary to the operation of the sense of hearing, it was not very difficult to find out, why they were only accessory, and appointed to some other particular purpose.—The reader ought to recollect here, that the labyrinth is filled with a limpid humor, and that there are two aqueducts to let it out from all its cavities, one at the bottom of the vestibulum, and the other below the inferior part of the fenestra rotunda; the aqueous humor contained in the cavities of the labyrinth cannot evacuate through these aqueducts, unless it is forced out by some assistance, otherwise the sense of hearing must be either impaired or suspended if the evacuation should easily take place; consequently, whenever the labyrinth is too full of that limpid humor, the membranes of the fenestra ovalis and rotunda are pushed out in the tympanum, but that of the fenestra rotunda in a greater degree, because the other is supported by the basis of the os stapes. In this case the sense of hearing becomes imperfect on account of the stretch of these membranes, until we move either voluntarily or unvoluntarily the *musculus levator auriculae*

auricula, to put the *officula* in action, that the *os stapes* may press on the membrane of the fenestra ovalis, and so help the limpid humor out of the cavities of the labyrinth, through the aqueducts, in the cranium.— The *officula* are likewise set in action, for that particular function when we shut and open our jaws, and more effectually when we are gaping or blowing forcibly our nose; when we apply the tip of our finger to the external meatus, by compressing the air contained in it, which moves the *membrana tympani*, and of course the *officula*: And it is owing to these motions that hard hearing people hear better, when they open their mouth very wide, or excite the *officula* to action, which forces the limpid humor out of the labyrinth, than by the intromission of sounds through the eustachian tube, as shall be proved in the sequel. As soon as this evacuation takes place, we feel it sensibly by a pleasing ejaculation of the limpid humor, out of the cavities of the labyrinth, which sounds within our ears like a kettle very near boiling, and at the same time we are sensible of an improvement in our hearing, considering its state anterior to it. I imagine, that when we are overcome by fatigue, our muscular faculties being exhausted, this action of the *officula* being quiescent, a singing within our ears stupifies our senses and lulls us a sleep, which no ordinary noise will be able to disturb, till by a refreshment, the *officula* reassume their action, and, by the means of the ejaculation, render us sensible of any noise, and then we awake.

When the *officula* are either destroyed or unable to act their part for that particular function, this evacuation or ejaculation may however be effected, but very improperly, and not without some detriment to the sense of hearing: For example, if the *officula* are exfoliated from the *tympanum* with or without the *membrana tympani*, if
they

they are dislocated or injured by any cause whatever, the membranes of the fenestra ovalis and rotunda shall become two conveyances for the sounds, and, in case of exfoliation, these will resist, as much and as long as it lays in their power, the impulsion of the limpid humor. If the ossicula are dislocated, and in their natural situation, the organ shall not suffer so much as the total want of them, but the sense of hearing will be impaired in proportion to the relaxation of these membranes, or the inaction of these small bones. These several accidents account for the hardness and loss of hearing, when the patient shall have laboured under abscesses in the tympanum, the dislocation of the ossicula, and their exfoliation. If the ossicula are existing, and unable to action for want of free articulation, or any other cause, this limpid humor being retained in the labyrinth, shall become too voluminous, and press or annoy the immediate organ of hearing; in that case, a ringing, or hissing noise in the ear will take place, with or without any other accidents, and produce dullness. It was absolutely necessary that the fenestra rotunda should be smaller than the ovalis, because the first is better enabled to resist the impulsion of the limpid humor, otherwise it would burst, and occasion instant deafness; besides, I looked upon this foramen and its membrane as a sort of pupil to moderate, or direct the angles of the vibrations of air. The fenestra ovalis being larger, the stapes has more power over its membrane, and of course presses a greater column of the limpid serosity, what operates more effectually the evacuation through the aqueducts.

The tympanum in its natural state is a perfect empty cavity, except that part which is taken up by the ossicula. The membrana tympani which covers the tympanum is naturally moist and stretched; if that was not the case, the sensation could be but imperfectly conveyed in the cochlea,

cochlea, as it becomes impaired or diminished in proportion to the dryness and relaxed state of that membrane. From this assertion, grounded on a variety of cases, a multiplicity of questions naturally arise. Does the tympanum fill with fluids when the eustachian tube is shut or obstructed? Could the membrana tympani keep its natural tension, when the ossicula are dislocated, loose, destroyed, or evacuated through the eustachian tube? Would it be a detriment to the sense of hearing, if the os stapes did not rest on the fenestra ovalis? Are the ossicula a kind of bracers to the tympanum?

Answer to the first question: Whenever the eustachian tube is closed, (what is easily known by blowing in the ears, in stopping both nose and mouth) the membrana tympani becomes dry, and loses part of its communicative powers; therefore the tympanum is a vacuum at all times, whether the eustachian tube be open or closed, unless it be moistened by some matter arising from abscesses, either on the coats which line the cavity, or retained there for want of a free passage in the throat. When it is open, the *velum pendulum palati* prevents any moisture or extraneous bodies from getting in, as, at every motion of deglutition, this velum pendulum covers the eustachian tube; consequently, the moisture of the membrana tympani does not come, or is not kept up by any fluid in the tympanum, but by the most fluid parts extracted from the cerumen, the grossest of which are sent off, or kept up by a compression of the air contained in the tympanum, every time we swallow our saliva, blow our nose, &c. This oily fluid, dripping or flowing uniformly, and round the external part of the membrana tympani, proves, that it is not fit to coincide in the operation of the sense of hearing when in a dry state since those whose ears are continually dry

and deprived of cerumen, become either hard of hearing or deaf.

Answer to the second question: Whenever the ossicula are dislocated, displaced, or loose in the tympanum, the membrana tympani being very thin, and always moist, will undoubtedly lose its tension; in the first instance, this is known by blowing in the ear as I mentioned above, for when the person does so, he shall regain his hearing, if a kind of snap is heard within the ears; in the second it will be known, if motions of the ossicula are not sensibly felt, as otherwise it will in the third instance. In case of evacuation of the ossicula through the eustachian tube, the patient shall either have been deaf a good while before, or experienced dreadful pains within the ear, or at least very dull, if the case be but recent.

Answer to the third question: Whenever the basis of the os stapes does not rest on the fenestra ovalis by either of the causes above mentioned, and loose in the tympanum, the vibrations are communicated to the immediate organ of hearing by the fenestra ovalis and rotunda at the same time; then the person's ear, thus disordered, becomes giddy at a common noise, as if it were the report of a gun: Therefore, the intention of nature, in placing the os stapes on the fenestra ovalis, was to deafen that communication, the fenestra rotunda being quite sufficient for the purpose of distinct hearing.

Answer to the fourth question: The ossicula, in my opinion, cannot be looked upon as bracers of the tympanum unless it be permanent, since their position and action do not indicate such a function, as the membrana tympani does not alter its tension at any particular sound. This opinion having been generally adopted by modern anatomists and physiologists, I have taken down all the cases which directly contradict their systems.

From

From the anatomical description of the ear and its physiology, it appears that the sense of hearing is operated in the following manner: As soon as any solid and sonorous body sets in motion the surrounding air, sound is effected; and according as the air is set in motion in more or less obtuse angles, the result is more or less grave or soft tones: consequently the sounds, which arrive on the membrana tympani, are conveyed by waves of the air assuming the shape of angles; these are transmitted to the membrane, which cover the fenestra rotunda, and this membrane being in contact with the limpid serosity, fluctuates the vibrations, just as it received them, on the basis of the cochlea, where it shakes the delicate nervous filaments spread very thick in the membrane of the cochlea, and produces a sensation, carried or conveyed along the portio mollis to the *grand focus of sense*. It happens very often, that this sensation is carried to the teeth, when the nervous ramifications are in a state of inflammation, especially the shrill sounds. Some think that the sensation is carried directly on the teeth, but since I raised sounds of that kind before a deaf person who had bad teeth and the tooth-ach, I remain perfectly satisfied that the contrary takes place, since the deaf person did not complain of any impression on his teeth.—Shrill sounds are carried and transmitted to the brain in the same manner, but the angles of the waves of the air are acute in proportion to the shrillness of the sounds.

In order to conjecture as little as I possibly could on the necessity of the os stapes resting on the fenestra ovalis, I contrived the following machine, and performed upon it the following experiments. I made with a bone a solid kettle-drum, nearly of the shape of the tympanum. At the bottom of it I perforated two holes of unequal diameters to represent the fenestra ovalis and rotunda, and covered them with two pieces of bladder unconnected

ted with each other. I fixed at each a tube closely adapted, and covered each end with a skin as the above, and, before I placed the artificial membrana tympani, a little bony stick in form of a stirrup, was fixed on the largest hole, the upper part of the bony stick touching the inside of the artificial membrana tympani. Over this last I raised an artificial meatus, introduced an accoustick horn at the mouth of it, and raised great sounds at the large opening of the horn. During this odd experiment, I observed that the skin of the smallest tube, practised at the bottom of the artificial tympanum, did forcibly vibrate at each sound, and that the largest stood still all the time. With various kinds of musical instruments, I raised different sounds, and I remarked with equal surprize, that the result was constantly the same. I removed the bony stick from within the tympanum, and both skins vibrated at the same time. The experiments, compared with the functions of the human tympanum, indicate fairly that the os stapes rests on the fenestra ovalis to intercept or prevent the vibrations, in order that they should be only communicated to the fenestra rotunda.

OF THE
EXTERNAL DISORDERS
OF THE
HUMAN EAR.

HAVING physiologically explained how the sense of hearing is operated, it is now time to investigate the disorders of this organ. We meet with few cases concerning them in our medical and chirurgical authors; whether the neglect of this branch of physic and surgery is owing to the difficulty of the subject, or particular neglect of our antient and modern practitioners, I will not take upon me to determine. The anatomy of the ear has made but little improvements since Eustachius, Albinus, Valsava, Duverney and Haller. Its physiology seems to have embarrassed even the most modern writers; and Cotunnus, who has but lately discovered the aqueducts of the labyrinth, has furnished us but with a few hints.

The subject has taken up my mind a long time past; and as I am acquainted with some languages, and been travelling these several years, I have been enabled to profit by the perusal of several foreign publications, and attend cases which I thought many of the medical gentlemen

tllemen did not chuse to be troubled with. It must be confessed, that a traveller is in general taken for an empiric, as many of this description appear to be so on account of inabilities to support a decent reputation ; and if one is able to procure good and sound information to the medical world, there will be a great many who will hurt their fellow creatures through a lucrative profit. I have often been taken for a quack, a witch, and a conjurer, by some people ; but if all these invectives have been conducive to the good of mankind, it shall be a great satisfaction to myself. Through all these difficulties, I have mustered a great many cases, which I am going to lay before the reader, yet I cannot say that I have acquired a great deal towards the removal of several kinds of deafness which afflict but too often the internal parts of the ear. I have observed, that in physic and surgery it is absolutely necessary that we should be perfectly acquainted with nature in a sound state, for which reason I have neglected nothing to make the reader conversant with her situation, design, and intentions.

The first and most external disorder of the ear, is a running of acrimonious serosity behind the ears, which happen to adults of a bad habit of body, such as scrophulous, scorbutic, &c. and children in general to whom it appears of service, when this natural evacuation answers the purpose of blisters, in diseases of the head. It is particularly a great nuisance to adults.

Observation. Mrs Elizabeth Bonnel applied to me in July 1777, in consequence of a continual running behind her ears ; it was so copious, and of such bad smell for three years before, that she computed the evacuation to be near half a gill every day, and, to the best of her judgement, she thought it rather increased more and more. It would be needless to mention what had been tried to relieve her from such a disagreeable complaint,

By

By her account, it appeared to me, that nothing had been forgot ; but, as every thing had been done without plan or aim, it is no wonder that a cure could not be obtained. When I saw the case for the first time, there was loss of substance in the common teguments, and the cellulary texture ; so that the greatest portion of the cartilage was almost bare. Having reflected upon such an obstinate case, I formed out in my mind, that some principal trunk of the small arteries which ramify over and under that region were destroyed, and that their extremities left, being of a large diameter, did bring the blood in a serous state towards the wound or sore part ; for which reason, I performed large scarifications underneath, and dressed it every day with an animated disgestive No. xxxv. It was left to suppurate with the above dressing for 18 days without interruption, and during the whole time the running above seemed to indicate an appearance of drying. The patient being extremely anxious to be cured, wished I might continue the dressing a little longer, to have a fair trial ; accordingly, I dressed it with the basilicum nigrum for eight days more, and afterwards healed it with the simple application of a vine leaf dried before the fire. Before the scarification she was let blood at the arm, and took some purgatives No. x. which were repeated during the dressings, and drank nothing else but a decoction of the althea root. This plan operated a radical cure.

Remarks. In considering my prognostic on the above case, it will be asked why the loss of substance, after the scarifications, did not produce a running at that place. To that it may be answered, that the ramifications which supplied the evacuations being destroyed at a place where the skin and membrana adiposa are strong, the running was sufficiently secured.

The cancer at that part of the ear I never saw nor heard of, but if it has or should ever take place, the extirpation of the external ear does not seem dangerous. Towards the latter end of February 1763, Mr John Dreux returning from the country very late at night to the city of Amsterdam, Holland, was attacked by two foot pads, who demanded his money; he made some resistance, but was at last knocked down. These two villains finding but little money about him, cut off both his ears and beat him most unmercifully. He, however, got into a neighbouring public house, where his ears were washed with cold water, and pieces of leather, covered with common ointment, were applied to the parts, till he should be able to be dressed by a surgeon. To be short, in six weeks he was cured, and suffered but very little in his hearing, because part of the concha was left round the meatus auditorius. In order to remedy or supply the defect, artificial ears were made of paste-board painted flesh color, so as to imitate nature, fixed in the meatus by a silver tube. I have this account from Mr Dreux himself.

There is a disease of the external orifice of the meatus auditorius which is pretty common, I mean the occlusion of that orifice. In April 1770, a boy aged seven years, was brought to the Hotel-dieu of Paris. He was deaf and dumb. Mons. Moreau, who was the principal surgeon of the hospital at that time, performed a large crucial incision, in the middle of the concha, through the skin and teguments; the os temporis being left bare, he was surpris'd to see no opening leading to the meatus, and on probing, found that the bone was uniform, and even in the whole extent of the incision, upon which he told one of the dressers to take care of it, and seem'd to give himself no further trouble about the case. One of the surgeons ask'd leave to try some
method

method to practise an opening towards the meatus, and it being granted, the boy was removed from the hospital a few days after. The surgeon dressed the wound with the suppurative for eleven days, when, to his great astonishment, he discovered a small orifice in the bone, beyond the anterior part of the concha. He probed it, and by degrees introduced a bigger probe, which was generally left in the orifice. At last he thought proper to heal the part, as no larger orifice could be obtained, and syringed the meatus, which was full of middling hard, blackish substance. A month after, the patient gave indications of hearing; and encouraged by that success, he attempted the other ear, but the orifice of the meatus being considerably wider and straighter, the boy was able to hear tolerably well by the help of a silver tube, made like a funnel, which was adapted to the meatus auditorius, for the more immediate admission of the sounds. Few years after, the boy spoke, heard better, and, as I have been informed since, still continues to do so, if his ears are now and then syringed with common warm water.

I have seen and attended many cases of that sort, but none where there was not some kind of orifice, more or less open, at the outside of the concha. When I was at Truro, in Cornwall, a young man applied to me, in consequence of dulness in his hearing. I observed that the external orifice of the meatus auditorius did not exceed a line and a half in diameter; I probed it, and found that the internal parts were of a common length and diameter, towards the middle. I syringed it, and observed, after this operation, that his hearing was considerably improved by it; as the patient could not afford a silver tube, one of tin was provided, and he was able, by its help, to distinguish low words, but not whispering. Whether he has continued in that state, I

cannot tell. Last year, a boy was brought to me with the same complaint; but I did not attend to the case, for reasons unnecessary to mention here.

If the meatus auditorius appears sometimes more contracted than it ought to be naturally, it is likewise much dilated either by disorders or errors in nature. This last defect seems to bring on some others in the sense of hearing; but these, in my opinion, are without remedy, unless a preventative should be employed in due time; and this should consist in using some artificial meatus, so as to answer an exact proportion which nature seem to require. I have no case that I can relate to illustrate this practice, though I have observed the defect.

The meatus auditorius is subject to excrescences, both glandular and fungous; the former is more common than the latter: besides these disorders, it has been often observed by many antient and modern writers, that a pellicle arises either by disease or naturally, in the middle of this duct; we have many instances of the kind, and I may say that I have met with it oftner than I should have expected it. But before I publish such cases as have come to my own share, I ought to mention the obstructions of the meatus, occasioned by the wax and extraneous bodies mixt with it.

In October 1786, a young man applied to me for dulness of hearing. He attributed the cause of that complaint to a cold, when he was on board a ship, or to a fever, but which he could not positively tell. I compared his hearing to mine with the pitch-fork, and found that the difference was about 15 seconds of the common pendulum; so that he was unable to hear words unless spoken near the ear and extremely loud. On looking into both meatus auditorius, I found them clogged to more than one-half, with hard cerumen which I extracted with precaution; and when the membrana tympani were quite cleared,

cleared, though part of the cerumen still remained in the left ear, he said his hearing had increased to a considerable degree. What remained of the cerumen I could not extract at that time, because it was so hard and voluminous, that I took it for a stone which had increased with the ceruminous matter round it. I injected the meatus with No. xxiv, filled it and stopped the external orifice with some cotton dipt in the injection. Next day I attempted to extract the stone, but could not succeed, therefore dressed it as before; the following day it broke in two pieces, which I removed, and the meatus was then quite free.

Remarks. I have often observed that the cerumen, when gathered to a certain degree in the meatus, becomes stony or excessively hard. As several practitioners recommend to clear the meatus with soap and water, I put one of these stones in it, and the other in the injection both warm and cold, and I found that their solution was slower in soap water than in the injection above mentioned. Since that experiment, I never made use of soap water, tho' I think, from my own practice, it will do no harm. Similar cases came under my care long ago, but I extracted every extraneous body without difficulty, in a quarter of an hour.

A musical instrument maker, whose name I cannot at present recollect, for the benefit of further information, applied to me for hard hearing, when I was at Haverfordwest, in Pembroke-shire, Wales. He was on board of a man of war, cruising on the American coasts in the late war: The ship was wrecked on the coast, and being on deck at the time, he was thrown on the sand, wherein he remained buried near a quarter of an hour. Since the accident, he never could hear at all. I looked in the meatus, and found it filled up to the very orifice. I extracted with plain warm water the extraneous

bodies that it contained, and when that was done, the man heard no better. Several days elapsed without any alteration. He called again, and complained of a prodigious ringing in his ears. I desired him to blow in his ears as hard as ever he could; this he repeated several times in the course of two days, when he came to acquaint me that his hearing was returned, but imperfectly. Business calling me some where else, I left the place, and I do not know how it turned out, but I suppose from other observations, that his hearing could but improve, in case that he continued to blow now and then in his ears.

Remarks. It is more than probable, that the meatus auditorius having been clogged for more than four years, the muscles and ossicula had lost their action, and, in consequence of that, the cavities of the labyrinth being too full of the limpid serosity, the nervous ramifications in the cochlea were pressed without injury done to the nerves, and that the ossicula did not help the exudation of the limpid serosity through the aqueducts. When I desired him to blow in his ears, the air forced the ossicula to act, and of course the hearing returned. I have often met with cases of deafness, wherein the meatus auditorius was not clogged, and cured by simple blowing in the ears. If such a method proves of no use, it cannot do any harm, unless the breaking of the membrana tympani, if blowing should be used with violence, the membrane being thinner than usual.

About January 1787, a servant maid applied to me for a running in her ears. She was very dull in her hearing, and the matter that issued out of the meatus had a very offensive smell. There was no excrescence whatever; the membrana tympani was inflamed, together with the coat of the meatus, but more towards the posterior inside. I injected both ears with emollients. It
cleaned

cleaned the meatus, and augmented the running. I mixt some spirit of wine with the injection, and strengthened it by degrees. In two months time the running subsided, and the patient was restored to her hearing. A month after she applied again; she was dressed as before, and I rubbed the meatus with some *balsamum traumaticum* for a few days; she took a purgative, and has had no return since, to my knowledge.

Remarks. I think that the seat of the running arose from the membrana tympani; for whenever I pushed the injection somewhat harder than usual, the blood tinged the injection, and she complained of great pains in her ears. It appeared that the blood vessels which ramify over the membrana tympani are real arteriols without corresponding veins, for they generate very fast, and seem to be of the varicous kind. This idea will be supported by another case which is very common.

In June 1787, a young man, by business a wright, applied to me for a dulness in his left ear, and a running in the right. The matter which flowed from this ear had a very offensive smell. This complaint had its origin after a severe fever, three years previous to the time he applied for relief. The meatus of the left ear was clogged with a great deal of ceruminous matter, which I removed cautiously; this duct being cleared, his hearing was considerably improved, and when I desired him to blow gently in his ears, the air came through the membrana tympani. I left the ear in that state, and examined the other, which offered me a considerable excrescence to remove. I touched it with a silver probe, and observed it was of the glandulous kind. I scarified it, and desired the patient to come next day, if it should happen to be sun-shine. Accordingly he came, and on looking in the left ear, I observed that the membrana tympani

was

was closed, as the wind could not pass as before. In that state the hearing of that ear had increased. I scarified again the excrescence of the right ear; it bled profusely, and I washed it with spirit of wine and water, half and half. This I continued for a fortnight, but the running continued much the same; at last being tired of such tedious operations, I incised it towards its basis, and extracted whatever I could, but I left a good part of it behind. A week after, the remaining part disappeared of itself, and the patient was perfectly cured of the running. This ear was by far the best of the two.

Remarks. It was easy to account for the defect of hearing in the left ear, because, when the meatus is clogged with some cerumen, and the membrana tympani broke, the ossicula cannot perform their function; so that the dulness of hearing was more owing to the disease of the membrane, than to the cerumen on it; and it was probable that some extraneous bodies had slipped into the tympanum, since, when the ear was cleaned, there remained some dulness even when the membrana tympani had healed. But what mischief these extraneous bodies had done within the tympanum may only be guessed. The glandulous excrescence of the right ear was occasioned by an erosion of the skin which lines the meatus, and the ceruminous glands being no longer kept within bounds, they enlarged on account of the blood varicous vessels which penetrate into them. What remained of the excrescence unextirpated, contracted, after profuse bleeding in the part, and the membrane of the meatus uniting, kept the rest sufficiently secured.

In the month of June 1779, an old man applied to me for a dulness of hearing. On my examining the meatus auditorius of both ears, I found an excrescence placed at the anterior lateral inside of the meatus of the
left

left ear, and another at the external orifice of the right. They were both very hard, and I mistook them for an exostosis, but on a closer examination, I discovered that they were hard fleshy excrescences; but as the last did not appear to be any obstruction to the sounds, I only incised that of the left ear, as its situation and size filled up almost the meatus. After its total extirpation with a pair of crooked scissars, and the healing of the part, the patient received no benefit in his hearing, for which reason it was let alone.

Remarks. This case shows plainly, that sounds cannot be easily intercepted, since the patient could hear perfectly well before, although the excrescence did exist at the time of his hearing, and it was after a closer enquiry, that I attributed the cause of the dulness to the relaxation of the membrana tympani. To ascertain my suspicion, I desired him to blow in his ears, and at that time it being sun shine, kept a watchful eye on the membrana tympani, which at every blowing moved very freely upwards and downwards without any air going through it; therefore, after various useless trials to strengthen the membrana, I gave up the case. There was a great singing and hissing noise in his ears, what made me conjecture that the ossicula had lost their action, or the malleus perhaps detached from its adhesion to the membrana tympani, or loose within the tympanum. It would appear from this observation, that the relaxation of the membrana tympani, is a symptom of the inaction of the ossicula or their dislocation.

A gentleman was under my care in the month of July 1787, for a dulness of hearing. He attributed the complaint to several colds that he experienced for several years in attending his farm, especially at night. On looking at the meatus of each ear, I observed but little
ceruminous

ceruminous matter on the insides of the meatus, and that the membrana tympani was very dry. Both had the appearance of a dry bladder's skin, presenting several white longitudinal marks. I syringed both ears with lukewarm emollients, and for two or three days he found great benefit from them; but in time he experienced that his relief was only temporary; for which reason, I dropped a little oil of almonds in each ear, and this kept them moist for three months. Since that, his hearing returned and has continued so during two or three months with it, which he repeats whenever he thinks proper.

Remarks. This case evidently proves, that the natural state of the membrana tympani is moist and not dry, as many modern anatomists and physiologists have advanced.

About the month of July 1786, Mrs Abercrombie, who lives in Halkerston's-wynd, Edinburgh, brought me a little girl about seven years of age. I looked in the meatus auditorius of the left ear, and found it clogged with ceruminous matter, which I removed. The meatus of the right ear was obstructed with a thin pellicle, situated very near the membrana tympani, which I tore with a blunt silver probe, and afterwards cleaned the meatus as usual. After the opening of the pellicle, she could hear much better with that ear than with the other.

Remarks. I have observed that when the meatus auditorius has been clogged with a great quantity of ceruminous matter for some time, the membrana tympani becomes relaxed, and to nothing else could I attribute the defect of the left ear. When I had opened the pellicle above mentioned, I found some mucilaginous matter between it and the membrana tympani, which made me believe that she was born with it.

OF THE
INTERNAL DISORDERS

OF THE
HUMAN EAR.

I HAVE thought it needless to mention more cases on the external diseases of the ear. Practitioners will find a variety of them which will differ very little from the above, either to inforce or object to my physiological principles. I am perfectly sensible that many external, simple, and complicated anomalous cases, would produce or furnish objections to them; but, at the same time, I am sufficiently convinced, that, in general, they will hold good against some. It is now time to investigate the internal diseases of the ear. Many of the internals may have their original cause in the external disorders, or be independent of them. For example, an abscess on, or in the membrana tympani, may, in destroying this membrane, injure the tympanum and its contained parts; the membranes of the fenestra ovalis and rotunda may be broke or destroyed by inflammations and suppurations, tho' the membrana tympani be in a sound state; the nervous ramifications of the labyrinth may lose their sensibility, without, or with injury in the membrane of the cochlea, or the portio mollis in its principal
N n branch.

branch. All these different accidents may be properly distinguished from each other. If the nervous filaments of the cochlea are affected without any injury in the other parts, I would call this disease a *paralysis of the cochlea*; if the portio mollis be disordered with these nervous filament, I would call the disease *gutta auricula*. These different alterations in the internal part of the ear should be classed with some degree of propriety; it would enable the practitioner to distinguish every particular affection, and indicate rational means of cure. This task will be filled up by observations.

In the year, 1778 a common labouring man applied to me on account of a complete deafness on both ears, and as, from the appearance of his case, I gave him little or no encouragement, he expressed a wish to try what I should think proper, either for his benefit, or that of the public good. The reader may easily apprehend that I did not let such a fine opportunity escape, as he entertained a thorough confidence in me. The eustachian tube of both ears were perfectly pervious; the membrana tympani quite relaxed, almost transparent, and excessively thin. In such a case, the malleus might have been seen through the membrane, but I could discern nothing of it. I removed the membrana tympani of the left ear, and the tympanum being uncovered, I saw none of the ossicula; not even a single trace of them. The membranes of the fenestra ovalis and rotunda were open, and most of the cavities visible by the help of the rays of the sun introduced in the meatus auditorius; in short every part appeared in a dry state. The patient suffered very little from the extraction of the membrana tympani, and the blood, which amounted to about the quantity of a tea spoonful, did not run through the eustachian tube. The injection, which I threw in to wash off the blood, did not get at the mouth, but the wind, on blowing in
his

his ears, came out through the meatus. A few days after, I probed the fenestra ovalis and rotunda, but the probe, in going through the last, produced such smart pains that he would not suffer another trial. I placed an acoustic machine in the bottom of the meatus and spoke very loud; he heard the noise pretty well, but he could not make sense of the words. I incised the membrana tympani of the right ear with a sharp, long, but small lancet. I left the patient in that state for some time, and afterwards observed that it had reunited. I stopped the left ear with some cotton, desired him to blow in his ears, and observed that the air did not get through as before. I freed the left ear from the cotton, and tried the hearing with the acoustic machine, but as he could not hear at all, I never attempted any thing more towards the disease. I incised again the membrana tympani of the right ear, but crucially; and on removing the parts of the membrane incised, I discovered some of the ossicula which I brought out, and on examining them with the microscope, they proved a part of the incus and stapes, but excessively reduced in size. The patient and myself being tired by that time, the case was let alone for a considerable time. When he called for the last time, there was no material alteration, nor had he experienced any pains; and as our correspondence was only by signs, and of course very much contracted, we parted.

Remarks. This case shows that the ossicula may be dislocated and disunited from their adherences; and when reduced to a certain degree, evacuate through the eustachian tube.

I have read the observations on deafness from the affections of the eustachian tube, by Dr James Sims, published in 1787, in the first volume of the Memoirs of the

Medical Society of London. Page 95, he says, “ many
“ uses have been ascribed to this *tube*; yet, I am apprehensive,
“ one of the principal ones has not as yet been pointed out. From several circumstances, I am of
“ opinion, that it conveys the sound of our own voice to the organ of hearing, in the same manner as the
“ meatus auditorius conveys to it all other sounds whatever; on which account, it is the principal regulator of our own voice.” If the Doctor had any real knowledge of the tube and its functions, he never would have advanced such an absurdity, much less if he understood by what mechanism our voice takes place, and the sound carried to the organ of hearing. In the first instance, I ought to put him in mind, that the *velum pendulum palati* is always over the eustachian tube, when the larynx emits sounds, and that in many cases it is rather difficult to blow thro’ it, though one might hear perfectly well,—what indicates that this tube cannot admit sounds. In the second, that deafness, produced by a pellicle in the meatus, could not happen, if the tube admitted sounds. In the third, that when he will be pleased to stop close his meatus auditorius, the sounds will not be conveyed to the immediate organ of hearing, through the tube. In the fourth, that slow hissing sounds, raised by the application of the extremity of our tongue near the teeth, cannot have a sufficient force to dilate the tube, and be admitted through it, since forced air can hardly find its way within the tympanum. In short, he was at a loss how to discover whether the tube was open or shut, and entertained many doubts concerning the consequence. Let the Doctor desire his patients to blow in their ears, in stopping both nose and mouth, the air going in the tympanum through the eustachian tube will remove all doubts at once. The cases of deafness he alludes to

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were certainly not an obstruction in the tube, but a dislocation of the ossicula. I have cured this disease, in the year 1775, for the first time, when the present Dr Petit had taught me the method to blow through the tube. I have often observed that the tube may be closed, and the organ suffer nothing by it, till along time afterwards.

In the same work, page 114. he says, “The last method of cure which I shall mention is, by injections into the tube, either from the mouth or nose. The injecting from the mouth seems rather impracticable, —from the nose it has, beyond a doubt, sometimes succeeded; and whoever would wish to know more of this method, may consult Mr Wathen’s very ingenious paper on the subject, in the 49th volume of the Philosophical Transactions.” I have no patience with people who publish such nonsensical quotations. It appears plain, that the aim of that paragraph is either ironical or justifies a common saying: *C’est un barbier qui rase un autre.* But, as I think proper to recommend this work to the medical world, I find myself indispensably obliged to refute the above absurdity. In a work intitled “*Traité des Instrumens de Chirurgie, par Monsieur Garengéot,*” we find the description of the instrument to inject from the mouth, through the eustachian tube, with an observation of a gentleman who injected himself; but the complaint he was cured by it, was, in my opinion a dislocation of the ossicula, which could not be reduced by blowing in the ear. I have the instrument, and I make a frequent use of it; but I only place it, and the patient injects himself; because I have found by experience, that the water pouring towards the throat, was better managed by the patient than by me. In placing the end of the instrument in the orifice of the eustachian tube, I carefully convey it close and behind the upper part of the *uvula*, and endeavour to hook with it

the velum pendulum palati to bring it forward; and when I am sure, by groping, that the instrument is in the opening of the tube, I push it in a little externally; this done, I give the whole into the hands of the patient who pushes the injection, his head low, and facing the ground. Let the Doctor and Mr Wathen introduce the extremity of a long and crooked hollow probe at the end of a syringe, through their nostrils, up to the eustachian tube; they shall soon find, that pains, sneezing, and snuffing, must baffle their attempt. I am morally certain, that if such a groping and injecting has ever been practised through the nose, it must undoubtedly have been tried on a dead body; for as to the living, I am physically certain of the impossibility of it, or the person was senseless. This practice brings into my recollection a saying of Monsieur Moreau, who was without doubt the first practical surgeon in Paris. Let surgeons perform four hundred operations upon the dead body, it will not be equivalent to the fourth part of a single operation on the living. I really think that many writers should behave more cautiously, both in praises and recommendations.

In February 1784, a young woman applied to me for relief in her deafness. She had been troubled with a continual ear-ach for two months together; her menses had never appeared but once, and that two years before the disorder took place. By her account, the pains were periodical. When I first saw her, there was a tension and swelling at the *membrana tympani*, attended with inflammation. She complained of a hissing noise in her head, and violent pains in her ears. She was bled at the arm, lost thirty-two ounces of blood in three days, and took some purgatives, which operated powerfully. Six days after, she took, for the first time, 25 drops of laudanum in two ounces of water at bed time.

The second night 26 drops in the same quantity of water; and the dose was increased of one drop more every night, till it amounted to 46, when her hearing returned in some degree. She was desired to blow in her ears several times a day; and, in the course of a month, she became able to distinguish words of usual conversation. Being pleased with that degree of hearing, I discontinued my attendance.

Remarks. The above case was not occasioned by the occlusion of the eustachian tube, because, from the beginning, the air could pass from the mouth into the tympanum. It was neither a dislocation of the ossicula, nor the relaxation of the membrana tympani, since the hissing noise was about the upper part of the temporal region: But an inflammation of the containing and contained parts of the tympanum, and likely a dilatation of the aqueducts, which poured in the cranium more limpid serosity than could be absorbed; and the inflammation of the membrana tympani, together with the above symptoms, were sufficient ground for my conjecture.

A gentleman was under my care in the year 1778 for a similar complaint. He had been deaf one year and a half, and had applied various watery and oily fluids at different times, in the meatus auditorius, without any sensible benefit. The symptoms were very much like those of the above case, except that the hissing noise, instead of being in the head, was in the labyrinth. I treated him upon the same plan as the above case, but he did not obtain a cure.

Remarks. I am pretty certain that the complaint had its origin in the labyrinth, and from comparison with many cases, it occurred to me that it was a paralysis of the nervous filaments, and an obstruction or occlusion of the
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the aqueducts of the labyrinth, as the deafness came on by degrees. I had occasion to see him three years ago, labouring under a complete deafness, which I think was the *gutta auricula*.

I recollect having read in a German book, intitled, "*Remarks on anomalous disorders,*" the following paragraph: "One of my acquaintance sleeping in the open field, was suddenly awoke by a great snap or noise in his right ear; he immediately started up, and felt some insect groping in his ear, shook his head, in order to get rid of it, but perceived nothing. He felt no pain except tickling, which ended as soon as he had shook his head. On inspecting the membrane of the drum, I observed a large opening, which seemed to have been made by what is vulgarly called an *ear-borer*, a well known insect. The air came out from the throat very freely, if the nose and mouth were closed, so that I really think he might have breathed that way; there was at the time no pains whatever, and the loss of hearing came on by degrees, without any other inconvenience," &c. &c. The above case, together with many others coincide in proving that the *membrana tympani* is of great use to preserve the inside of the *tympanum*, and the mechanism, or functions of the *ossicula* in the ear.

In the month of July 1783, when I travelled through the west of England, I had many opportunities of being consulted for children who were born deaf and dumb, as I cured two children who were afflicted with that complaint. Among those who came to me for relief, there was a girl aged about seven years, who had no *tympanum*, and, I firmly believe, that no accident had happened from the appearance of the *meatus auditorius*. The cavities of the *tympanum* were all smooth and uniformly covered with the common *periosteum*. I could distinguish the

the trace of the fenestra rotunda and ovalis ; but, as the child would not allow me to probe, I could get no further information.

About the beginning of October 1786, a young boy, born deaf and dumb, was brought to me. The meatus auditorius of both ears, and the concha in particular, were so soft, that it was no difficult matter to apprehend a deficiency of some of the cartillaginous parts. It appeared, that most part of the meatus was improperly ossified, and the membrana tympani thicker than common. I removed from each meatus a great quantity of ceruminous matter and thick pellicles, which were adherent to the membrana tympani. After these operations, the boy gave indications of hearing, and I left the case alone to take its chance, perceiving no further defect in the organs. Sometime after I met with the mother, who informed me, that the boy attempted to speak with his father and sister ; with the latter, he used to speak a particular language which is incomprehensible to every body but themselves. They are both very young, so that it is rather difficult to determine whether the boy's hearing be perfect or not ; but, it is evident, that if the membrane was reduced to a thinner state than it is at present, I make no doubt that the boy would receive great benefit from it.

Remarks. This case, which was not new to me, shows that practitioners should pay particular attention to the state of the membrana tympani, because its strength occasions the same defect as its thinness. I wished to proceed further in the case, but interested considerations were an obstacle ; and, I must acknowledge, that in tedious cases, patients think that we want to take advantage of them, consequently, it is proper sometimes to stop.

In August 1786, a young man applied to me for a great dulness of hearing. He was formerly a servant, which situation he could no longer fulfil on account of his complaint. The disorder took place after a cold, or a fever, but as both afflicted him at once, he could not be sure to which it might be attributed. He had asked advice, and what had been done proving of no service, the disease was left to take its chance for two years, before he applied to me. When I looked in the meatus auditorius of each ear, I found very little ceruminous matter, the membrana tympani was very white, and covered with a mucous substance. I scraped the membrana tympani with a slender silver probe, shaped at one end like a shovel; it bled, and became extremely painful, but a few days after, every symptom subsided, and the hearing improved. He had blown in his ears very often, and one day that he did it stronger than usual, he heard a great snap within the right ear; and, in a little time after, his hearing became perfect. The blowing hard being recommended, produced the same effect in the left ear about a fortnight after, when all things considered, my attendance was no longer required.

Remarks. It appears that the above case was a complicated one, but whether it was to the dislocation of the ossicula, or to the thickness of the membrana tympani, dependent or independent of each other, that the complaint took place, I shall not take upon me to ascertain; however, I am almost sure that the membrana tympani, in that state, was sufficient to occasion dulness, as well as the dislocation of the ossicula.

I had under my care, very lately, three young women at the same time, who were afflicted with periodical deafness. All three were also labouring under violent inflammations in their eyes. One of them, the daughter
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of John Johnstone, a farmer near Borrowstowness, was quite blind; the other, the daughter of a miller near Dalkeith, was perfectly blind of the left eye; as to the third, the symptoms were not so aggravated, having had better attendance than the other two. The first patient was bled several times for the above complaints, and, on account of her menses, which had never appeared. I cured her eyes in the course of a month, and, when I dismissed her, she was not able to hear the report of a gun. It not being convenient for the family to stay any longer in town, I cleaned both ears, and desired her to blow in them every now and then. Since that time, six months have elapsed, I have heard that she had recovered her hearing. The other two patients came to their hearing by the same means; their menses appeared, and have continued every month since the first bleeding. When the menses have never run, I always bleed in the full moon; whether it is prejudicial, or grounded on reason, I will not take upon me to determine.

Remarks. I am firmly of opinion, that these cases of deafness are occasioned by plenitude of blood in the lymphatic arteries, which ramificate within the cavities of the labyrinth, or an inflammation of the parts contained in the tympanum, which preclude the ossicula to perform their functions. The symptoms are generally an inflammation of the membrana tympani and its environs, the inflammation of the eyes, and a great hissing noise within the ears.

In July 1786, two boys, born deaf and dumb, were brought to me by their mother from the county of Fife, who informed me that she had two more at home in the same situation, but on account of their youth, she did not think proper to take them along with her.

The oldest was about thirteen years of age. He had in each ear a thick pellicle almost close to the membrana tympani, that I extracted; the loss of blood did not exceed a tea spoonful, and, in the course of a week, he gave indications of imperfect hearing. The other was eight years old; the membrana tympani was excessively thick. I attempted to make it thinner by the same means indicated in one of the cases above mentioned. During the operation, I had occasion to use a sharp pointed steel instrument, and, as it was close to the membrane, the boy happening to cough unexpectedly, the instrument went through the membrana tympani, and being conscious of the consequence, proceeded no further. The other ear offered neither difficulty in the same operation, nor accident of the kind. Some days after, I looked at the wounded membrana tympani, that had been accidentally incised, and found it perfectly closed.— This boy did not appear to hear as well as the other, but on account of being unable to get information from children in their situation, I desired the mother to go home, and bring them back again two or three months after. Accordingly she did so, and informed me, that she was perfectly sure they did hear the singing of psalms at church time, but they had not yet attempted to speak, except unintelligible sounds. I really think that these children being always kept together, and used to converse by signs that nobody understand but themselves, it is difficult to judge whether they are, in their present situation, enabled to speak, or if it be owing to any defect in their organ of speech. I have attended many of these cases, and found in general that they become able to speak a sort of language in the space of about two years after. The mother brought me a little girl about four years old, and on looking in the meatus of each ear, I found but a loose thin pellicle on
each

each membrana tympani, that I extracted; but the child is so young, and so little time has elapsed, that I cannot form a just idea of these three cases. All I am able to say of them at present is, that I presume there is little or no articulation of the ossicula in the two boys ears, and the girl a defect in the organ of speech, because she utters different sounds than the others do, and upon the whole seems to hear better.

Remarks. The membrana tympani were excessively tense and thick in the three above cases, and as I suspected, the eustachian tube closed, (because I never was able to make them blow in their ears,) I put a hollow tube on the membrane, and sucked up the air, in order to reduce the ossicula in case of a dislocation, but whether it answered I could not guess. I tried the injection of the tube by the mouth, but the boys opposed every artful means employed to bring it about; so that the reader may well imagine what trouble, time, difficulty, and patience such cases require, considering such obstacles to put in practice every necessary method. Upon the whole, the eldest was able to obey my commands by sounds; he knew the motions of my lips, for which reason I placed myself behind his back. I was well aware of the method to convey uniform ideas by a regular practice of uttering the very same sounds, for, whenever I deviated in the least, tho' he heard, he was in suspense whether he should execute my orders, which were to raise from his seat at the loud sound of A, and to sit down at that of O. All these hints indicate how hard it is to learn the distinction of sounds, and acquire ideas uniform to their meaning, in supposing their organs fit for the purpose. I am almost convinced from the knowledge of every circumstance relating to these children, that if they were separated from each other for a while, they would be able to
speak

speak in a short time; but it has not been convenient for the family to do it.

A young woman has been under my care for a considerable time on account of deafness. Previous to her application to me, she had laboured under the complaint about eight or nine years; and, she informed me, it came on by degrees after a violent fever. The meatus auditorius of the left ear contained little or no ceruminous matter, and what there was of it had a whitish look; the membrana tympani of that ear was ruptured, but, on account of the depth and crookedness of the meatus with a narrow diameter, I could not distinguish how the tympanum stood. The meatus auditorius and membrana tympani of the right ear were wider, and the membrane very much relaxed; the eustachian tubes were open, because, on blowing in her ears, the air from the throat came through the ear. In that state, she could hear the sound of a pitch-fork when applied to her teeth or the upper part of her head; she could also hear any tune played on the violin, if the head of the instrument touched her teeth, or any part of her head. With the right ear, she was even able to hear, when the mouth of the speaker was close to that ear, but excessively loud. I tried various methods to render the membrana tympani more tense, and to reduce the dislocation of the ossicula, in case it should have been the case, but all my efforts were of no use. She complained at first of a hissing noise in both ears, but it subsided by the forced injections and other methods then used; at last, I gave the case up, and she is still to my knowledge in the same situation, without any alteration whatever.

Remarks. It would appear by the above case, that there was a complication of more disorders than the situation of the parts would admit to investigate on a clear principle.

principle. I have often lamented, that, with the practice which has fallen to my share, I never was able to ascertain the symptoms of the *gutta auricula*, which I take to be an affection of the *nervi auditorii*. Sometime before, a gentleman applied to me, in consequence of a similar case, but the *membrana tympani* being stretched, the *eustachian tubes* open, and his organs deprived of hearing, I took the case for the *gutta auricula*, considering every circumstance together.

I communicate to the medical world this Treatise on the Ear, in order that some more light may be thrown upon a subject so intricate, and too long neglected. The reader will please to recollect, that the *gutta serena* and *gutta auricula* are common cases, and very little understood; the symptoms of the first may be ascertained by observations and informations from the patient, whereas the last may be only guessed with great difficulty and doubts. I have advanced in several places, that I have often cured the *gutta serena*, and in others said that it is incurable. This contradiction does not arise from my mistake for in the case that I read at the Royal Academy of Surgery at Paris, (quoted p. 202). I prove, that the case was mistaken for such, which made me mention it in that light, as well as the others. I have been successful in disorders of this kind, and yet I must freely acknowledge, that it has been without the use of electricity, which I reject in diseases of the Human Eye and Ear as useless. It would, perhaps, be to the honour of the medical world in general, if entirely laid aside.

Before dismissing these two Treatises, I ought, as a man of feeling, to open my mind more freely than I have on medical electricity, in addition to what I said before. If one had the presumption to ask the promoters of it, what they expect from that stimulant fire, this would be
undoubtedly

undoubtedly the answer: " We know the great and
 " wonderful achievements of the *Rosy Goddess of Health*
 " when in the Adelphi, and at the *Hymen Temple*, Pall-
 " mall, London; her travels through different parts of
 " Great Britain. Who knows, if she has not visited the
 " Moon, and made her appearance again here under the
 " disguise of a tall-man clothed in white, or some
 " other odd dress! strenuously recommending sweet ef-
 " fluvia, electrical, celestial fire, &c. &c. earthen or sand
 " baths, water drinking, and plenty of air, or other
 " strange *recipe*; curing such disorders as other medical
 " men cannot manage or palliate. We are told by
 " Doctors Cavallo, and Katterfelto assisted by his black
 " cat, that they cure every disease by electricity, of
 " course we are anxious to tread upon their steps, altho'
 " we have no great opinion of either, by our own un-
 " successful imitations."

Who has been cured by electricity? Those pati-
 ents who were assisted by nature. What are these cu-
 rative observations of medical electricity, recorded by its
 promoters? Mere tales. What people recommend for
 medical purposes this well known fire? Enthusiasts, in-
 terested men, Quacks, &c. &c. The same might also
 be said of sea-bathing, advised by physicians and sur-
 geons, when they are *sur le banc des ignorants*, or willing
 to get rid of their patients in a genteel manner.

I once paid a visit to Dr Gray in the British Museum
 of London, accompanied with Mr John Sheldon, Pro-
 fessor of Anatomy, who was then labouring under a dif-
 fusion in his knees, on purpose of being electrified for it.
 The Doctor showed us his electrical apparatus, which is
 the most complete I ever saw. Two electrometers of
 his invention produced the most surprising effects.
 He was at that time electrifying a young man who was
 afflicted with a slight ophthalmia. The cornea was ex-
 tremely

tremely tarnished, on account of some varicous vessels whose extremities ramified externally over the cornea. The Doctor was electrifying the eye by gentle streams, and, having darkened the room, showed them to us, striking on a receiver, conspicuously seen behind the head. In short, they had a beautiful appearance, many of them reflecting the prismatic colours admirably well. This patient had been under his care for a considerable time for the complaint; and, upon my telling him that such a disease might be removed in three days, with the use of No. xxxi. applied every other day under the lids for three times only, he seemed surprised. Indeed, I believe, I convinced him that nature operated more than the electrical fire, which I looked upon as an ineffectual stimulus to destroy the varicous vessels.

In the first edition of my Treatise on the Human Eye, I was blamed by some, for publishing the *formulae medicamentorum*; but the number of those who approve of them, being more numerous, I will run the risk of displeasing the first, to oblige the second, reflecting that it is more easy to pass them over than be wanting. I know likewise by experience that many practitioners have made use of them without success in cases indicated for their use, where I have effected a cure with the same on the same patient; consequently, it was not the fault of the *recipe*, but the improper method to employ and conduct it, or the defect of its ingredients.

THE HISTORY OF THE

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FORMULÆ MEDICAMENTORUM.

No. I.

PTISANA COMMUNIS.

R.	Radic. Gramin. mundatar. contuf. & incil.	ʒ iv.
	Coq. in Aq. comm.	lb. xij.
	Ad.	lb. x.
	Infund. Glycyrrh. raf. & contuf.	ʒ j.
	F. S. A. Ptifana.	

This diluent is of fuch a nature, that it opens the pores by the means of its fharp particles, attenuates thick and viscous humors, either in blood or lymphatic arteries ; infomuch, that they eafily circulate through them, after the ufe of it. Its dofe, for a common conftitution, is two quarts *per* day, drank every other hour by a gill ; but, in order the patient be able to digeft well his meals, let two hours diftance before and after them,

No. II.

No. II.

PTISANA SEU AQUA HORDEI.

R.	Hordei confr. & loti.	℥ iv.
	Coq. ad tertiæ partis confumpt. in Aq. comm.	℔. xij.
	Infund. Glycyrrh. raf. & contuf.	℥ j.
	Cola & F. Ptif.	

This diluent cleanses the body from viscous humors. It is more deterfive than the foregoing; its dose and manner of drinking is just the same as the above; besides, it is exceeding good for the affections in the thorax.

No. III.

PTISANA SEU AQUA ORISÆ.

R.	Orisæ mund. & lotæ.	℥ ij.
	Bull. per femi hor. in Aq. comm.	℔. xvj.
	Adde, si lubet, Rafur. C. C. in nodulo includ.	℥ j ℥.
	Vel ex præscripto Rad. Consolid. major.	℥ iij.
	F. Ptif.	

This diluent, for common drink, as the above. It is very useful in hemorrhagiæ and disenteric affections.

No. IV.

PTISANA LAPATHI.

R. Rad. Lapathi acuti mundat. & incif.	℥ iv.
Coq. ad tertiæ partis consumpt. in Aq. comm.	℔. xij.
Infund. Glycyrrh. raf. & contuf.	℥ j.
F. Ptif.	

This diluent is of a great benefit for removing the jaundice and obstructions in the liver. Its dose is a quart *per* day, drank at equal times.

No. V.

PTISANA LAXANS SEU REGIA.

R. Rad. Lapathi acut.	℥ j ℥.
Polyp. Quern.	
Chichor. Sylvestr. ana	℥ j.
Fol. Orient. mund.	℥ vj.
Sal. Cathart. amar.	℥ j.
Bull. in Aq. comm.	℔. iv. ad ℔. iij.
Sub finem Adde Anisi,	℥ j.
Liquir. raf. & contuf.	℥ iij.
Malum Citreum in talleol. sect.	No. i.
Colet. Liquor.	

This diluent is a gentle purgative, very effective and convenient. Its dose is three gills, each to be taken in a morning at half an hour distance from one another, after which the patient may drink and eat moderately at his meals as usual.

No. VI.

DECOCTUM CEPHALICUM.

<i>R.</i> Herb. Meliff.	
Beton. ana	M. iv.
Summit. Florid. Galli luteii,	
Stæchad. ana	M. ij.
Coq. léviter in Aq. comm. S. Q. ad	℔. xij.

This decoction is very effective for removing headaches and numbnesses of the senses; it fortifies the nerves and refreshes the animal spirit. Its dose is four gills *per* day, at proper and equal intervals.

No. VII.

DECOCTUM DIURETICUM.

<i>R.</i> Rad. Brusfc.	
Asparag.	
Rubiæ Tinct. ana	̄ iv.
Fol. Pariet.	
Chritmi,	
Herniar.	
Raphan.	
Summit. Lupul. ana	M. ij.
Coq. in Aq. comm.	℔. xvi. ad xij.

This decoction is attenuating, incisive, and works powerfully by the urine, especially when the reins and bladder

bladder are lined with gluish humors. It is also made use of with success in several kinds of hydrophies, to carry off the thinner part of the mass of the blood through the urine. Its dose is six gills *per* day, taken separately, as circumstance requires it.

No. VIII.

DECOCTUM OPHTHALMICUM.

R. Fol. Euphras.	
Plantag.	
Fænicul. ana.	M. iv.
Chelid. maj.	M. ij.
Flor. Rosar.	
Cyani, ana.	Pug. iv.
Coq. in Aq. comm.	℥. xv. ad. xij.

This decoction is made use of with success in the inflammation of the eye-lids and conjunctiva. The use of it is to wet softly the outward parts of the globe of the eye, when covered with its eye-lids, with a small hair pencil dipt in the decoction. But I shall observe here, that the patient ought to keep his eyes shut till the eye-lids be quite dry of themselves, in order the lotion may infiltrate through the pores of the skin. This lotion may be made use of as often as the case requires it, without any bad consequences.

No. IX.

DECOCTUM CASSIÆ.

R. Siliq. Ægyptiacar. contract.	℥. ℥ss.
Coq. in Aq. comm. vel feri Lactis Q. S. ad	℥ xij.
Colat. Solv. ex Præscript. vel Tart.	
Solub. vel Salis Polychr. Rupell	℥ ij.

This decoction softens and opens the belly in a gentle manner. Its use, continued for several days together, removes costiveness. The patient divides the above dose in two potions, and drinks them in a morning at one hour distance; he may even divide it into three, if he likes it better, always keeping a due regulation of time.

No. X.

DECOCTUM SENNÆ.

R. Fol. Senn. mund.	℥ ℥ss.
Salis Veget. vel Sal. Rupell.	℥ ij.
Bull. leviter in Aq. comm. S. Q. ad	℥ xij.
Infund. Semin. Anisi,	
Fœnicul. ana	℥ j.
Liquirit. cont.	℥ ij.
Colet liq.	

This decoction is a strong and powerful evacuative for carrying off all kinds of humors. The dose of this prescription ought to be divided into two potions, and drunk in a morning at two hours distance from each other.

No. XI.

POTIO CATHARTICA EMOLLIENS.

R. Decoct. Cassiæ,	ʒ vj.
Solv. Mann.	ʒ ij.
Sal. Vegetab.	ʒ j.
vel Salis Cathart. amar. vel Polychrest. Solub.	ʒ ij.
Addi potest, ex Præscript. Syrup. de Cichor. compof. vel de Pomis vel de Rosis Solut.	ʒ j.
vel Q. S.	

This potion is purgative, and carries away the foul humors in a gentle manner, if the patient has been prepared to it by the use of some diluent drink. It ought to be preferred as a first purgation in acute and inflammatory disorders. The whole may be taken at one time.

No. XII.

POTIO HYDRAGOGA.

R. Decoct. Senn.	ʒ vi.
Solv. Mann.	ʒ jʒ.
Colat. Adde Pulv. Jalapp. vel Cornachin.	ʒʒ.
Dilue Syrup. de Rhamno Cathartic.	ʒ jʒ.

This potion evacuates powerfully the ferocities. It ought chiefly to be made use of in hydropical cases, and œdematous affections. This dose may be taken at one time as the above.

No. XIII.

PULVIS STERNUTATORIUS.

R.	Radic. Ireos,	3 j.
	Fol. Majoranæ ficc.	
	Florum Lili convall. ana.	3 ſs.
	Helleb. alb.	ʒ j.
	F. Pulv.	

This sternutatory powder is very beneficial for removing habitual and inveterate head-achs, apoplexy, and soporous affections; it produces frequent sneezing, and sometimes a bleeding at the nose, what very often relieves the patient from these complaints. Its dose is one pinch, taken by the nose, the repetition of which depends on the strength of the patient, and the effect of the sternutatory.

No. XIV.

COLLYRIUM TEMPERANS.

R.	Aq. stillat. Sperniol.	
	Solani, ana	ʒ iij.
	Trochisc. alb. Rhafis,	3 j.
	Sacchar Saturni,	Gr. x.
	M. F. Collyrium,	

This collyrium is generally made use of for the inflammation in the eye-lids. Its use is to wet them with a soft rag dipt in it, three times a-day, as long as the inflammation subsists.

No. XV.

COLLYRIUM IN VARIOLIS.

R.	Aq. stillat. Rosar.	
	Plantag. ana	ʒ iij.
	Croci pulver.	Gr. xv.
	M. F. Collyr.	

This collyrium is of very great service when the eyes are too watery, as it assuages the acrimonious humors, which, in this state, bath continually the exterior parts of the globe. Its use as the above.

No. XVI.

COLLYRIUM RESOLVENS.

R.	Decoct. vel Aq. stillat. Ophthalm.	ʒ vj.
	Ireos pulv.	ʒ j.
	Caphuræ,	
	Croci pulver. ana	Gr. viij.
	Spirit. Vini,	ʒ j.
	Sacchar. Candi,	ʒ j.
	M. F. Collyr.	

This collyrium ought to be particularly made use of when the ophthalmia come from the obstruction in the ciliary glands, as it is very successful in these cases. If the globe of the eye be not affected, some very fine compresses, lightly wet in it, may be applied over the eye-lids, and fixed up with as little compression as possible.

No. XVII.

COLLYRIUM ASTRINGENS.

R.	Aq. stillat. Rosar. rubr.	
	Plantag. ana	ʒ vj.
	Tuthiæ præparat.	ʒ j.
	Vitriol. alb.	Gr. x.
	Alumin.	Gr. vj.
	Misce.	

This collyrium strengthens the membranes which make up the outward parts of the eye. It is used as the above.

No. XVIII.

COLLYRIUM VULNERARIUM.

R.	Decoct. vel Aq. stillat. Ophthalm.	ʒ vj.
	Radicis Aristoloch.	
	Ireos pulver. ana	ʒ j.
	Elixir Propriet.	Gutt. xv.
	Aq. Vulnerariæ,	ʒ j.
	Misce.	

This collyrium is used as the above ; its propriety is to dispel inflammations when produced by extraneous bodies, wounds, or contusions in the eye.

No. XIX.

COLLYRIUM IN INFLAMMATIONIBUS.

R.	Vitriol. alb.	ʒ j.
	Camphor.	ʒ ſ.
	Ireos Florent.	ʒ j.
	Inde in Ovi Albumine indurato, ex quo prius Vitellus exempt. fuerit.	
	Macera, per 4 hor. in Aq. Plantag.	
	Rofar. ana	ʒ vj.
	Contere Totum ad totius Solutionem, & Cola.	

The habitual inflammations, and what the vulgar call continual red eyes, can only be removed but by the re-establishment of the tone in the blood vessels which ramificate the conjunctiva over the globe, and spread by degrees over the cornea, nay, on the internal surfaces of the eye-lids; therefore, as this liquid has a propriety of cooling with that of deterging, it is recommended in such cases.

No. XX.

ENEMA SIMPLEX.

R. Aq. comm. vel Decoct. Furfuris, vel
Semin. Lini Q. S.
Fiat Enema.

This clyster ought generally to be given in the beginning of any chronical disorders, to facilitate the evacuation

ation of the excrements in the *primæ viæ*, when patients are costive; besides this, it is also useful to cool the humors during the course of the disorder.

No. XXI.

ENEMA EMOLLIENS.

R. Decoct. Emollient. Q. S.
 Adde Olei Olivar. $\bar{3}$ iij.
 F. Enema.

Cum doloribus excruciantur Intestina, aut Inflammatione laborant abdominis Viscera Enematis Emollientibus demulcentur.

Decoct. vero Emolliens fit ex fol. Malvæ, Altea, Betæ, Violar. Mercurial. Senecion. ana Q. S.

No. XXII.

ENEMA EMOLLIENS LAXANS.

R. Decoct. Emoll. Q. S.
 Dilue, ex Præscrip. vel Mell. Mercurial. vel Nymphææ, vel Violar. ad $\bar{3}$ iv.
 vel Electuar. Lenitivi, $\bar{3}$ j.
 vel Pulpæ Cassiæ, ad $\bar{3}$ ij.
 vel Siliquar. Ægyptiacar cum Nucl. confract. ad $\bar{3}$ viij.
 Fiat Enema.

This medicine injected into the bowels by the fundament, is of great help to a slow purgative, or very commendable to dispose patients for copious evacuations, when other methods fail.

No. XXIII.

INJECTIO VULNERARIA.

R. Decoct. Herbar. Traumatic. comm.	℔. j.
Mellis Rosat.	℥ ij.
M. F. Injct.	

This injection is made use of to clean deep and fistulous wounds; it deterges also the *faccus lacrymalis*, and re-establishes it to its natural state. It may be injected, either luke-warm or cold, through the *puncta lacrymalia*, or the inferior orifice of the *ductus ad nasum*; but it operates more powerfully, when employed warm.

No. XXIV.

INJECTIO VULNERARIA COMPOSITA.

R. Radic. Ireos Florent.	
Aristoloch.	
Gentian. ana.	℥ i ℥ss.
Coq. in Aq. comm.	℔. viij. ad. ℔. vj.
Adde Summit. Hyperic.	
Absinth.	
Centaur. min.	
Fol. Agrimon.	
Scordii,	
Hederæ terrestr. ana.	M. j.
Coq. iterum ad	℔. v.
Colaturæ singulis ℔. Adde, ex Præscripto,	
Vini alb. vel Spirit. Vin. vel Aq. Vulne-	
rariæ, vel Tinctur Myrrhæ aut Aloes	
Q. Conven.	
F. Injct.	

This injection is made use of as the above, and in the same cases; but it is a great deal more deterfive, and resists to the putrefactive humors till it carries them off along with it.

No. XXV.

INJECTIO ASTRINGENS.

R. Decoct. vel Aq. still. Astringent. vel Aq.
 Plantag. lb. j.
 Mellis Rosac ʒ ij.
 Lapid. Medicamentosi; ʒ ʒs.
 Misce.

This injection is deterfive; its use as above. It is also recommended as a lotion when the sacculus lacrymalis is so far disordered as to be fistulous in the cellular texture.

No. XXVI.

FOTUS AD ERYSIPELAS.

R. Fol. & Flor. Sambuc M. v.
 Coq. ad tertiæ partis consumpt. in Aq. comm. lb. v.
 Colat Add. ex Præscript. Aq. Vitæ, vel Spiritus Vini Camphor. Q. Conv.

This fomentation is of great benefit for removing the erysipelatous disorders. Its use consists by wetting the parts several times a day; and in case it cannot be practised, a fumigation of the same fluid ought to take place,

place, as it does not so much excoriate the epidermis. This operation of fumigating requires that the fluid should be boiling hot, and that the patient should expose the disordered parts over the steam, till a sufficient infiltration be operated, to dilate the parts as the case require.

No. XXVII.

CATAPLASMA EMOLLIENS.

R. Radic. Lilior. albor.
 Alth. ana ℥ ij.
 Fol. Malvæ,
 Altheæ,
 Acanthi,
 Senecion. ana M. j.
 Flor. Verbasc.
 Chamæmel.
 Melilot. ana ʒ iij.
 Coq. in Aq. comm. S. Q. ad Putrilaginem. Magna
 Contunde, & per setaceum Trajice.

This cataplasm softens the tumors which arise from inflammations; they must be applied as warm as possible. But I will observe here, that in case the globe be inflamed, the emollient fumigation is preferable, as it answers both ways without any bad consequence.

No. XXVIII.

CATAPLASMA RESOLVENS.

R.	Fol. Alth.	
	Perficar. urentis,	
	Parietariæ,	
	Scordii,	
	Abfinth. ana	M. j.
	Flor. Chamæm.	
	Melilot,	
	Sambuc. ana	Pug. iij.
	Semin. Carvi,	
	Anethi,	
	Fœnu græci. ana	ʒ j.
	Cumini,	ʒ ʒ.
	Bulliant, ad Putrilaginem, in Oxymell.	
	Pulpæ trajectæ adde Farin. Orob.	
	Fabar. ana	ʒ ij.
	Coq. cum Decocto ejusd. Cataplasmat. ad debitam consistentiam.	
	Adde Camphoræ in Spirit. Vini Solut.	ʒ j.
	Fiat S. Art. Cataplasma.	

This cataplasm is made use of in case of cold tumors; its activity divides, attenuates, and dissolves, very powerfully, the thick and gluish humors which occasion those kinds of tumors.

No. XXIX.

CATAPLASMA EX QUATUOR FARINIS.

R.	Quator Farin. Resolvent.	lb. j.
	Coq. ad debitam Consistentiam in Vini S. Q.	
		This

This cataplasm is not so active as the above; its propriety is to re-establish the motion of the eye-lids when suspended. Its use as the former.

No. XXX.

FOTUS AD ERYSIPELAS.

R. Flor. Sambuc.	
Chamæmel.	
Melilot. ana	Pug. j.
Infunde in Aq. bull.	℔. j.
In Colatur. Dissolve Sapon. alb.	ʒ ij.
Adde Spirit. Vin.	ʒ ij.

This fomentation is warmly recommended in erysipelatous cases; but I observe here, that the spirit of wine must be suppressed in the beginning of the inflammations, as it increases them instead of dispelling the disorder. The principal aim for removing them, is to avoid all kinds of heat in the parts, and relax the whole to a certain degree.

No. XXXI.

POMMATUM DETERSIVUM.

R. Adeps vipera,	
Tutia preparat. ana	ʒ j.
Albus precipit.	ʒ ij.
Misce ut fiat pommatum, dein adde bals. com-	
mend.	Gutt. xij.

This pommatum is a powerful deterfive in inflammations of the conjunctiva; that is to say, when the blood vessels, which ramificate this membrane, are too dilated and consequently filled. Its dose is a grain introduced under the eye-lid.

No. XXXII.

POMMATUM DETERSIVUM.

R.	Axunguiæ Suillæ non Salitæ	3 ij.
	Bolus armen. Rub.	
	Tutia preparat.	
	Albus precipit. ana	3 j.
	Misce ut fiat pomm. S. A ; dein add.	
	balf. commendato.	℞ j.

This pommatum does not operate so powerfully as the above ; its dose and use the same.

No. XXXIII.

FLUIDUS ELECTRI VIM HABENS.

R.	Balf. Fioraventi,	3 iv.
	Aq. Colog.	
	Meliss. ana	5 j.
	Lucis,	3 ij.
	Spirit. Vol. aromat. oleof.	3 ij.
	Oleum cinnamo.	Gutt. vj.
	Oleum myrrh.	Gutt. xij.
	Misce & in flaguncula pone.	
		This

This fluid is excellent to promote circulation in the humors of the globe of the eye, and strengthen, at the same time, all its exterior membranes. Its use is to fetch up through the nose, by means of respiration, the volatile parts of this fluid, and avoid, as much as possible, its evaporation out of the bottle during the operation, which may be repeated six times; then the patient wets the palm of his hands, and presents them to his eyes, in order the evaporation be effected over the globe of the eye. When the volatile parts of the fluid are out, two other drachms of aqua lucis ought to be entered into the bottle, to avoid a recomposition of the whole.

No. XXXIV.

PILULÆ ANTI-SYPHILES.

R. Mercur. sublim. corrosiv.	ʒ ʒ.
dulcis,	ʒ j ʒ.
Tere & Misce; dein adde	
Gummi Ammoniacum,	
Guayacum. ana	ʒ j.
Pul. Sennæ,	
Pyreth. ana	ʒ ij.
M. cum S. Q. Syrup. de rhamo ca-	
tharico F. massa. Pilulæ sunt	Gr. vj.

These pills are recommended by the most famous physicians, in all inveterate and desperate venereal cases; they are only used when the constitution of the patient baffles all other methods, or when an infinity of mercurial remedies have been applied without order. But I must observe, after many others, that they are sometimes productive

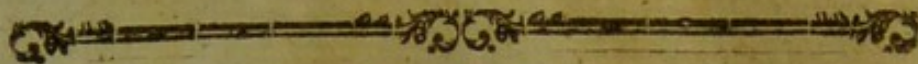
productive of bad consequences, when used in common. Their dose is three pills taken every morning, and three before bed-time; a number that ought to be diminished according to circumstances. They may be continued for nine or ten days.

No. XXXV.

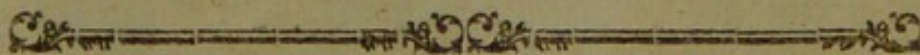
ANIMATED DIGESTIVE.

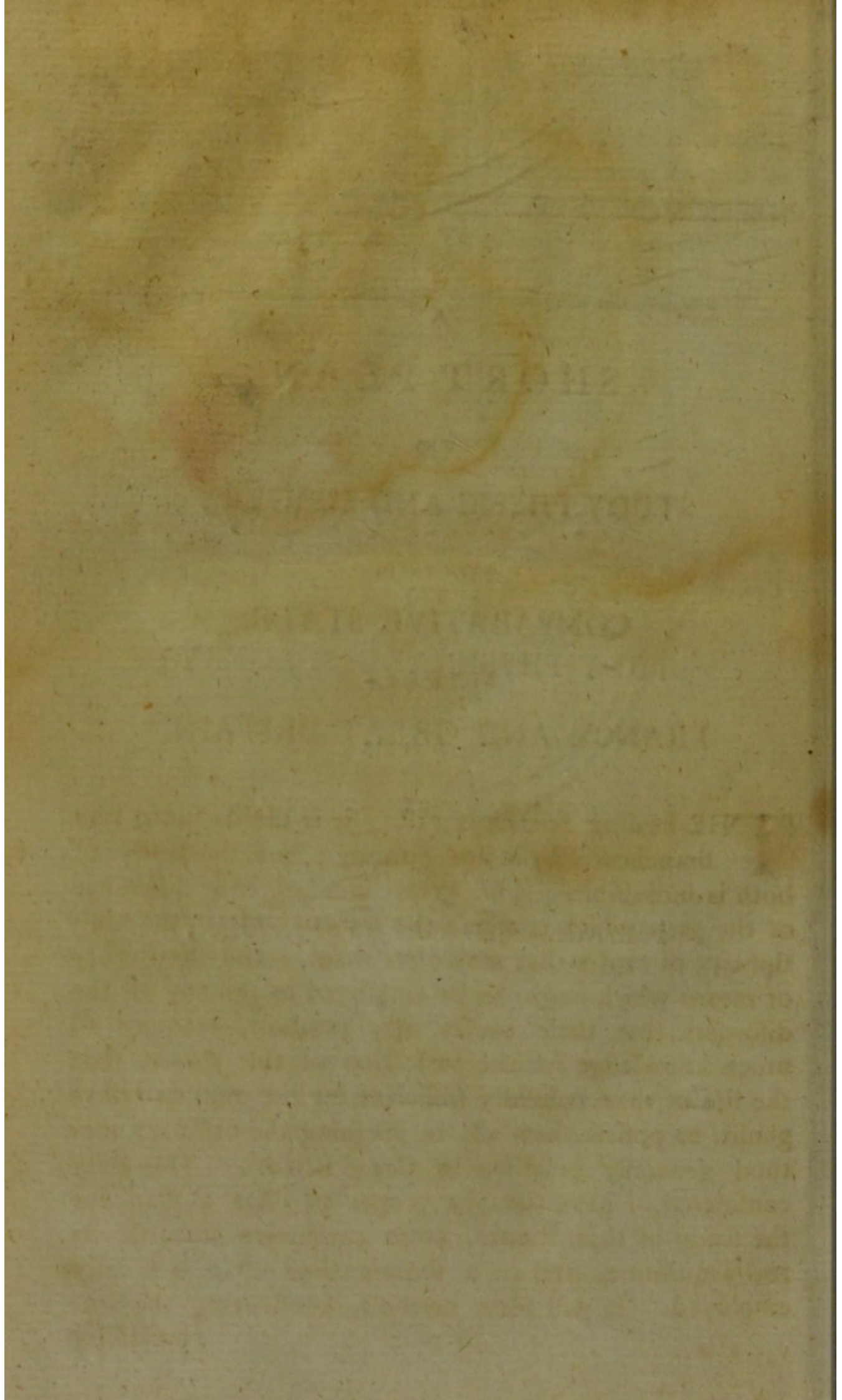
Take two ounces of turpentine, beat it well with an ounce of brandy; when it is mixed, add half an ounce of ointment of storax, the yolk of two eggs, an ounce of oil of St. John's wort, two drachms of aloes in powder, and as much myrrh.

A SHORT



A
SHORT PLAN
TO
STUDY PHYSIC AND SURGERY;
WITH THEIR
COMPARATIVE STATE
BETWEEN
FRANCE AND GREAT BRITAIN.





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THE healing science is vast. It is divided into two branches, Physic and Surgery; but the study of both is indivisible. The great number and difference of the parts which compose the human body, — the multiplicity of causes that may alter them, — and the variety of means which ought to be employed to remedy all the disorders that these causes may produce, — require so much knowledge for the perfection of this *science*, that the life of man is hardly sufficient for the most extensive genius to possess them all, in pursuing the ordinary method generally practised in Great Britain. This duly considered, I have thought proper to offer a Plan for the study of that science, more conducive towards its real acquisition, and in a shorter time than is usually employed. It will seem needless, considering the impossibility

S s

possibility to reform the abuses of education, and an old established custom of teaching; but, when the reader understands that my advice extends only to the pursuits of the different branches separately, *in statu quo*, he will think otherwise.

The study of Physic and Surgery should be preceded by that of the Mathematics and the Languages. These points obtained, I recommend as absolutely necessary Parkinson's System of Mechanics. The human body is an animated machine,—a knowledge of this science will help very much the student to conceive the motions executed by it, when well regulated, and those which are the effects of its changes. The study of Anatomy ought to be the next pursuit. Previous to entering in a Class of Anatomy, Physiology, and Surgery, as it is taught in Great Britain, it will be of use to consult Albinus's large Anatomical Tables of the Human Skeleton, Muscles, Blood-Vessels, and Nerves. Then a sight of the human bones, their eminences, cavities, foramens, and connections will become so familiar, that the progress, assisted by simple explanations from a friend or private teacher, shall be astonishingly rapid. The muscles, blood-vessels, and nerves, ought to be learned or studied in the same manner.

After a cursory study, and view of these parts of the human body, it will be proper to read the System of Anatomy compiled by Mr Fyffe, from Winslow, Monro, Innes, Hewson, and the living authors. This work is the best on Anatomy in the English language. It contains three volumes *octavo*, including comparative Anatomy. The Anatomy of the Absorbing Vessels of the Human Body, by William Cruickshank, ought to become the next serious study. This work contains more clear principles of physiology and pathology than all the other medical works put together.

When

When the student has gone so far in his private study, he is capable to benefit in an Anatomical Class, to which I advise him to enter, and particularly to shut his ears to every thing else but descriptive Anatomy, the professors, in general, being extremely fond to begin by physiological explanations, or mix them with anatomical descriptions. Such an irregular plan perplexes and confuses the memory, on the ill-grounded notion, that anatomy, by itself, becomes too insipid and difficult. He ought only to take notice of descriptive osteology, myology, splanchnology, angiology, nevrology, and adenology, as the teacher chuses to order them. Every thing else will be more solidly and shortly learned by reading authors than by attending classes.

Physiology consists in the knowledge of the different elements which constitute the human body: It teaches the formation of the parts, their connections, and, at the same time, explains their functions. The student who is conversant in anatomy, will make more progress in reading than in hearing at the classes of physiology. Here I am sorry to inform my readers, that we have no work on physiology which I would wish to recommend as a sure and short guide towards this part of the science; but till some author presumes to favour the medical world with one consistent with the absorbing vessels, their valves, the new discoveries of anatomy, and the pathology of the human body, the perusal of Haller's First Lines of Physiology will supply his wants, in some degree, together with the medical works below recommended,

Therapeutics instruct in the knowledge of the general rules, and means which ought to be observed and employed in the cure of disorders. This part of the science is scattered in physical and chirurgical works, and so nearly connected with the other branches, that it be-

comes difficult to indicate what author would sooner assist than another; for which reason, I think proper to recommend Dr George Fordyce's elements of the practice of physic as the first step in pathological informations. Gaubius's institutes of medicinal pathology will convey an idea of the subject, but I must acknowledge the work inferior to expectation.

Le Dran and Sharpe's treatises on the operations of surgery; Pott's chirurgical works; Le Dran's observations and consultations in surgery; Broomfield, Warner, Whytt, Gooche's cases, ought to be studied with great attention, in the order mentioned. The medical observations and enquiries by a Society of Physicians in London; the London Medical Transactions; the London Medical Journal, are works which ought to be the property of medical and chirurgical practitioners, as they contain cases which may be depended upon. This pursuit will take up one twelve month to an active young man.

The student being supposed to have properly acquired so much of the science, it will be time to attend one course of chirurgical operations, by a practical surgeon only. Next to it, a course of practical midwifery, during which I recommend to him the study of Smellie's treatise on the theory and practice of midwifery, to which is added, his set of anatomical tables, exhibiting the various cases that occur in practice, by Thomas Young. The two last courses that I would propose to the student, are chemistry and botany; during the first, he is to peruse Macquer's Dictionary of Chemistry, as a great help in such a complicated study, and during the last *Linnaei philosophia botanica, cum figuris*. I think it highly improper to learn many branches, and attend several courses at once; such a method, although encouraged by saving, will produce and multiply blockheads, and disgrace physic or surgery.

Having

Having gone so far in pursuit of medical and surgical science, the student will be able to determine within his own mind, whether he is fit for the practice of surgery or not. This part of the science requires bodily qualities, which are not necessary for the practice of physic, *viz.* genius, keen sight, firmness of mind, and above all dexterity. The two first of these qualities depend on nature, and the two last will improve with study and practice. Besides these qualifications, it is necessary to possess humanity and sympathy; for, in the practice of surgery, one ought to spare pains to the patient as much as possible; however, it would be dangerous to have too much feelings, this might disturb during operations, but the firmness of mind, already required, knows how to check them.

If the student thinks that nature has qualified him for the practice of surgery, he ought to embrace that part of the healing science as the most noble and most useful; if, on the contrary, his bodily faculties forbid him to fulfil such an arduous task, he ought to decline it in due time. I firmly and ardently wish that all practical surgeons may be informed of whatever the practical physicians can possibly be acquainted with, and when that shall take place, the dignity of surgeon will be considered above that of Physician, as it should be.

The reader may be astonished at my silence concerning the visiting of hospitals. This, in my opinion, ought to be the student's last pursuit. All hospitals do not offer the same opportunity of real information; there is consequently a choice, and this may be determined by the success of the practitioner at the head of them. We daily observe, that physicians and surgeons bring such charitable houses in repute, and these but too often make the practitioner's reputation. It was once asked in St. Bartholomew's hospital, London; What difference is there

there between Pott and Crane? a humorist answered; The first makes the house, and the house makes the second!—Might not this sarcasm be applied to many?

Considering the state and variation in hospitals, I leave it as the student's business to enquire where is the most extensive hospital, attended by the best practical surgeon, and consider whether his fortune will allow him to go and learn under him. He who intends to practise physic, will not meet with the same difficulty; for if we compare the state of the first practical surgeons with that of physicians, we shall certainly find that the last are fifty to one. Before I draw a parallel of the state of physic and surgery between France and Great Britain, in indicating where are the most numerous and best attended hospitals for proper instruction, it will not be unacceptable to my readers, to take a view of the method of studying it in France.

In Paris, the metropolis of France, there are two colleges, one for the study of Physic, and the other for that of Surgery. All the members of the Royal College of Physicians take the title of Professors, because each in turn delivers lectures in Latin on Anatomy, Physiology, Hygiene, and Therapeutics, separately, and without fee. The members of the Royal College of Surgery are all members of the Royal Academy of Surgery, but these do not deliver lectures by turns, as the Physicians do in their college. The King appoints permanent Professors on Osteology, Sarcology, Physiology, Hygiene, Therapeutics, Operations, Midwifery, and Diseases of the Eye, who deliver separately their lectures in French, at the theatres of the Surgery School, free of all expenses. These Professors take the title of *Royal*, because the King allows each of them a salary. Besides these Professors, there are several others appointed by the King, with a salary, to deliver lectures on Anatomy, Physiology,

logy, Surgery, Chemistry, and Botany, at the Royal Garden of Plants. These also have no fees from students.

Such students as wish to attend the different courses, previously enter their names (the Swiss of the College indicates who keeps the book) else they could not obtain certificates of attendance. It is customary before, and at the end of each lecture, to call the names of the students; if absent at the time of calling, the professor marks the absentees a certain number of times, and, when they call for their certificates of attendance, they are either refused, or granted as their name stands marked. There are likewise private professors who teach separately or jointly all these branches of the science for a moderate fee; they grant certificates of attendance, but if these private professors are not members of the Royal College of Physicians or Surgeons, their certificates must be also signed by a member of either College, as a sanction that they are able to teach properly, or they would be of no manner of use. Monsieur Deffaulx's certificates were signed by him and Monsieur Louis, before he was admitted member of the Royal College of Surgery.

The only public school not free to every student is, *L'école pratique*. It is generally composed of such as have been remarked to be attentive and industrious in the courses. A place in that school is not easily obtained. Those who offer themselves candidates for it undergo several close examinations, and when found capable, they must be recommended by some members to be of good morals. Here they have a great advantage over the other students, which is that of practice under the direction of the greatest masters in the school, who are all professors, and repeat the courses with more precision, attended with all the *minutiæ*. Every year, gold and silver medals are distributed among such of the students as produce the best paper, the best injection, and
dissection,

dissection, or the best answer to a difficult question proposed by the professors, who support and attend the school.

With these advantages, known throughout Europe, Paris has the advantage over every University in the world for medical and chirurgical information. The Courts of Europe, at their respective expences, send students to Paris on purpose to study and practise surgery. Every year Russia sends six, Vienna four, Holland four, Dresden two, Rome four, Denmark two, Berlin four, Poland two, Sardinia four, Spain eight. These are presented by the ambassadors of their Court, and maintained in Paris during the time of their studies.

When a young man has a mind to learn surgery, and cannot afford to maintain himself during his studies, he learns to dress hair and shave, then he enters in a barber's shop, under the title of *Major*, in which capacity he receives, for the work of the shop, five shillings *per* month, besides his board and lodging, and obtains leave twice a week, during the courses, to attend the public lectures above mentioned and the hospitals. When he has attended each course, he obtains certificates of attendance, and retires into the country to practise; so that a young man, destitute of support, acquires as much of the science in five years, as another might in one year for seven or eight hundred livres, which is about L. 30 Sterling. There are innumerable instances of these *majors* becoming very great Surgeons; and one particularly is at present first surgeon to the king. Monsieur de la Martiniere is said to have put a check to that kind of education; but whenever the *majors* enter their name, they take lodgings at a private house, which they indicate as a guarantee, that they do not follow the shop business. They particularly take care to dress genteely to avoid

avoid suspicion at lectures; and, on returning to the shop's work, they put on *l'habit de poudre*.

After students have received their education, the manner of granting *diplomas*, and becoming members of the colleges, will not be unwelcome to my readers. The college of physicians requires of the candidate, his extract of baptism, his diploma of *magister artium en l'université des quatre nations*, his certificates of lectures; and, on paying about 600 livres of different fees, the first *thesis* is admitted, and a day appointed to determine on its merit, and that of the author. If the candidate is 24 years of age and one day, a Roman Catholic, provided with the above diploma and certificates, and found capable by his *thesis*, leave is granted to bring on the next month his second, supported with fees as the first, and so on, till he has gone through 15 *theses*, and paid about 5000 livres. Then a diploma is given him, which entitles him to practise in Paris, or any place in the kingdom. If the fortune of the candidate should not allow him to pay all these fees, in course of every month appointed for each *thesis*, leave is granted to bring in the second, when it may suit his pocket, which may be protracted one year or more; and, after his first *thesis*, he is allowed to practise as candidate, provided he promises to support 14 more with the same fees at each.

The college of surgery, and the Royal Academy of surgery, are very different from each other. The college of surgery is just as expensive in its fees to the candidates as that of physic; but no member can belong to both at the same time, it being even required of a candidate to free himself of any other body, previous to be admitted a candidate to either; for example, *un maitre en chirurgie de Paris* cannot be *maitre en chirurgie* of any other college in the kingdom, but he may belong to a college of physic, except that of Paris. *Les docteurs*

en medecine du college de Paris observe the same rules. The intention of this plan is, to excite emulation, and keep one another in countenance.

The exorbitant fees of the College of Physic and Surgery in Paris has particularly divided the practice of Surgery into two branches; *la petite et la grande chirurgie*. The practice of physic being indivisible, has suffered no material change. The College of Surgery grants 100 places, which are almost unconnected with it. Such surgeons as obtain them, are called *chirurgiens privilégiés*. Before they are entitled to practise, they undergo an examination by the Royal Professors of the College, who either refuse or admit them. These *chirurgiens privilégiés* practise only *la petite chirurgie*, that is to say, they cannot perform great operations unless one of the members of the college be present, or else the operator stands a chance of losing his place, or severely fined. It must be observed, that the Princes of the blood, and people of the first rank, have a power to grant a place of surgeon, who takes the title of the donor. They can only practise *la petite chirurgie*, except the surgeon of the Princes of the blood; but in general, they are members of the College of Surgery; for the public have little or no opinion of all the others.

Monsieur Petit, belonging to neither of these Colleges, made a great push to oblige them to admit candidates without fees, provided that such as would offer themselves upon that plan, should be examined *ex tempore* by the Professors, and, as an instance, presented himself to the College of Surgery. The College informed of his intention, refused to admit him a candidate on that score, of course it was dropt on both sides. Sometime after, Monsieur Petit offered himself a candidate to the College of Physicians, on the same terms as he had formerly done to the College of Surgery; these, less actuated

ated by interest, embraced the opportunity of incorporating in their body a man of reputed abilities, both in the medical and chirurgical line.

Much about that time, there was a contest between the two Colleges, which consisted in ascertaining who should have the precedence in point of superiority of rank at Court, and whether Surgeons should be allowed to practise Physic, and Physicians Surgery. After a long process at law, the King's first Physician and first Surgeon settled amicably the dispute in the following manner: Physicians should be allowed to practise Surgery, and Surgeons to practise Physic, under the restriction, that the latter should not sign their *recipe*, and that four physicians should be present at the reception of a candidate in surgery, and that no surgeon should be required at that of a physician. Thus ended a dispute, on the concession of the surgeons, and began a rivalry, which has induced, and still induces, both bodies to surpass each other, in a science so useful to humanity. From the emulation of these two bodies, who continually struggle which shall be more deserving of public esteem, the science has made rapid and considerable progress.

The hospitals that are free to every visitor are not, however, free for practice to every physician and surgeon; they are each attended by a Chief Surgeon, with a salary, and Physicians without salaries. The first is assisted by two, three, or more Assistant-Surgeons, without salary, according to the size of the hospital. In the Hotel-dieu there are four Assistant-Surgeons for a certain time, deputed by the College of Surgery, after which they become free of the business of the hospital, and are afterwards admitted members of the College of Surgery, without paying fees. They are called *Chirurgiens gagnant maitrise*, and, in general, serve three years. These assistants can do nothing without the consent of

the principal surgeon, who may indeed call a consultation; but, when it happens, it may be looked upon as a condescension on his part.

It has been particularly a reproach to the Hotel-dieu of Paris, that the method of crowding several patients in one bed, was absurd and disgraceful to humanity. I think it will not be improper to clear the administration of that house of such an ill-grounded charge. It should be understood, that there is necessity for a political conduct in the management of the largest hospital in the world; which is to disgust the public's eye, in order to keep away as many as possible, without refusing assistance to any one. This is exactly the case with that house; for, whenever there are several patients in one bed, it is always managed according as the cases will suit. Some people have been found still living among others half-dead, and others entirely deprived of life, all in the same bed; but it has never been observed, that a patient was so mixt, when there was the least chance; therefore, every objection, above mentioned, ought to appear trifling to a man who knows how liberally that hospital extends its charity.

There are in Paris six large hospitals, the smallest of which is considerably bigger than the largest in London. These houses are open to every medical student, free of expence, and each has a particular hour for dressing patients; so that a young man who should be active and diligent, might, in Paris, be employed in dressing from six in the morning till six at night, without it should be necessary for that to be residing in either of these hospitals. In every hospital there is a permanent Principal Surgeon, the *Gagnans Maitrises*, and the Dressers. If a student be observed to attend close as a looker-on, the first surgeon, or the first dresser, commonly takes notice of him, and, on his asking the *tablier* of the principal surgeon,

surgeon, it will chearfully be granted him. I must observe here, that certificates of attendance in hospitals as dressers, are absolutely required to become candidates for, or obtain places in the Army and Navy, or even to buy *un privilege pour exercer la Chirurgie dans Paris*.

Many of the principal towns of France have also colleges of physic and surgery upon the same plan as those of Paris. Montpellier, Rheims, Toulouse, Rouen, Angers, Orleans, Lyon, Nancy, Dijon, are places where a student may live remarkably cheaper than in Paris. When all these opportunities are considered, together with the freedom of the public libraries, without the expence of a single farthing, it will be no difficult task to account for the progress of physic and surgery in France. In Paris, *la bibliotheque du Roy* is open twice a week to every body. There the reader will meet with all the writers of Europe in their respective languages, and that without the smallest objection and the least trouble. *La bibliotheque de St. Germain* is open every day, morning and evening, except Saturday evening. There are likewise several public libraries, that any body will soon know on the first enquiry of any of the visitors, who generally are the poor *literati*.

It is needless to inform the reader of the method pursued in Great Britain to learn the science, and obtain diplomas to practise it; the student being made acquainted which Universities and Hospitals will most probably turn to his advantage will be quite sufficient, if he adopts the plan above mentioned. London, the metropolis of England, has no university; but on account of several reputed teachers of anatomy, and the largest hospitals permanently attended by the best practical surgeons, it is become the most eligible place for general information both in the medical and chirurgical line: *Mais tout se fait à force d'argent, l'humanité y est comptée pour peu de chose,*

chose, la preuve de cette assertion se trouve dans la conduite de tout le monde ; chacun commence par demander : combien me coutera cela ? combien me donneres vous ? In London charity extends ^{way}beyond the imagination, and those employed to administer it, are wholly taken up and actuated either by their own interest or that of their friends. If a student enters as a dresser at St. Bartholomew's Hospital, he must pay 50 l. Sterling for his ticket of admission during a year ; if only for six months, he pays 25 l. or else he cannot walk the Hospital as a looker on. Such a practice, in Royal Hospitals, however supported by reasons, is a disgrace to government, and the practitioners themselves ; to the first, because what belongs to government belongs to the public ; to the second, as they often act in a parsimonious manner, they are sheltered from public censure.

Edinburgh, the principal city of Scotland, has an University and a Royal Infirmary. Many abuses in the first might be shown ; but considering that it would produce no alteration, I shall confine myself about the management of the Royal Infirmary, as the most essential part of the student's education. This charitable house is poor, has no permanent surgeon, and being attended by the members of the Royal College of Surgery in turn, it will be for ever a scene of unaccountable trials at the expence of humanity, the discredit of the chirurgical practitioners, and perplexing to students. Many instances might be brought to prove this assertion beyond a doubt, and I must confess that it cannot be otherwise. There should be a principal surgeon with a salary, and four assistants, who should serve each three years at least, before they could be admitted members of the Royal College of Surgery, and the Hospital free to every student at any time, except when a physician or surgeon delivers clinical lectures.

Dublin, the metropolis of Ireland, is extremely deficient in point of medical and chirurgical education. It is worse still as a place of information, having neither hospitals nor teachers who have deserved a public fame. Trinity College, Cambridge, Oxford, Glasgow, Aberdeen, St. Andrews, all grant diplomas!

There is a kind of imposition every day laid on the student, which he ought to be informed of; I mean, compilations in the medical and chirurgical line. We have but too often observed that writers publish with two views, the first to be known, and the second to get money by it. The authors I have mentioned, may have wrote also from interest; but as they convey information, it will make amends for the purchase of their works. We are daily smothered with new works, which in fact are old books. Read Baglivi, Boerhaave, and Haller, you will find nothing new in Cullen's works. Read Storck on hemlock, and put it in practice, you shall undoubtedly be convinced, that it has committed more murders since its publication, than all the armies of the late King of Prussia, &c. &c.

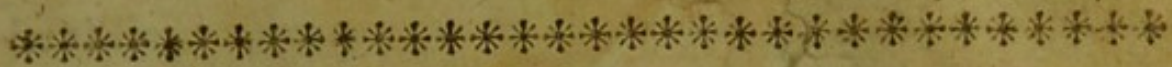
When two Doctors of Physic differ in points of practice, the student may safely conclude, that they are both in the wrong. This axiom may properly be extended to the dispute between Doctors Brown and Cullen, and yet the last needs only say one word at lectures; an army of Doctors Brown will be like the straw before the wind, it being extremely difficult to overthrow *fame* of whatever nature she may be.

After what has been said concerning the education and the practice of Physic and Surgery, both by Colleges and Hospitals in France and Great Britain, it will be the student's interest to learn the French language, particularly if he has a mind to become a practical Surgeon.— On one side, he knows that the French government opens
Colleges,

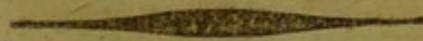
Colleges, and pays le^{tt}ed Professors to teach and practise, free of expences, before who has a mind to learn ; on the other, he is informed that the education of one of the most complicated science in human life is left in the hands of interest^{ed}, and too often ignorant Professors. On these considerations and informations, he is now enabled to benefit by the above intelligence.

From that source of liberality in the French government, the progress of the science must have been rapid and conspicuous to every one, without it be possible to bring a decent comparison between the two kingdoms. Physic and Surgery are two sciences very near connected ; the study of both is hard and disgusting at first, but when either advanced or understood, the most pleasing and most necessary to a rational being.

EXPLICATIO



EXPLICATIO FIGURARUM.



T A B. I.

NERVI BULBI & MUSCULORUM OCULI.

- | | |
|----|---|
| A. | Bulbus oculi. |
| B. | Glandula lacrymalis. |
| C. | Musculus abducens. |
| D. | Musculus attollens. |
| E. | Levator palpebræ. |
| F. | Musculus deprimens. |
| G. | Musculus adducens. |
| H. | Obliquus superior. |
| I. | Trochlea. |
| K. | Pars musculi obliqui inferioris. |
| L. | Carotidis decursus in receptaculo. |
| M. | Carotis in cavitatem cranii penetrans. |
| N. | Arteria ophthalmica ex carotide orta. |
| a. | Nervus opticus foramen suum transiens. |
| b. | Nervus quinti paris in cavitate cranii. |
| c. | Nervi quinti paris ramus tertius. |
| d. | Ejusdem ramus secundus. |
| e. | Ramus primus. |

- f.* Primi rami *e.* ramus frontalis in duos ramos iterum divisus.
- g.* Primi rami *e.* ramus nasalis.
- b. b.* Rami *g.* ramuli ciliares super nervum incedentes.
- i.* Rami *e.* ramus lacrymalis.
- k.* Nervus quarti paris.
- l.* Nervus sexti paris duplex in receptaculo.
- m.* Radix duplex nervi intercostalis a sexto pari.
- n.* Sexti paris insertio in muscolum abducentem.
- o.* Truncus nervi tertii paris.
- p.* Tertii paris ramus superior, minor.
- q.* Rami *p.* ramuli ad attollentem muscolum.
- r.* Rami *p.* ramulus ad levatorem palpebræ.
- s.* Tertii paris ramus inferior major.
- t.* Rami *s.* ramus ad muscolum adducentem.
- u.* Rami *s.* ramus ad muscolum deprimentem.
- x.* Rami *s.* ramus ad obliquum inferiorem.
- y.* Ganglion ophthalmicum, nexu cum nervo optico solutum, & ad exteriora revolutum, ut divisio nervi paris tertii pateat.
- z.* Radix brevior ganglii ophthalmici, a nervo obliqui inferioris.
1. Ganglii radix longior a ramo nasali quinti paris.
2. Nervorum ciliarium fasciculus superior, quem quatuor hic nervuli faciunt.
3. Fasciculus inferior.
4. Fasciculi inferioris ramulus extrorsum a reliquis secedens.
5. Ramulus alterutri furculo *b. b.* ex nervo nasali orto insertus, ad latus externum nervi optici infra fasciculum superiorem adscendens.

6. Fasciculi inferioris nervus ciliaris inferior interior.

T A B. II.

Arteriæ & venæ oculi: *Vide pag. 25.*

- a b c* Arteriolas ciliares longas ad venæ vorticose iridis
abeuntes.
d e Arteriæ ciliares breves ad venæ vorticose choro-
ides abeuntes.
f Nervus opticus.
g Infertio arteria centralis in nervo optico.
b i k l m } Infertio arteriolæ visuales in nervo optico.
n o p }
q Sclerotica.
r Cornea.

T A B. III.

Vide pag. 49.

T A B. IV.

Vide pag. 240.

Fig. 1.

Demonstrat hæc figuræ integrum tympanum cum of-
ficula & labyrinthum cum cotunnii aqueductibus auris
humanæ internæ.

Fig. 2.

Representat partem ossis petrosi sinistri hominis adulti,
a quo vestibulum, & canales ablati sunt, solus vero gy-
rus cochleæ primus patefactus est relictus, & a parte an-

teriori ita derafum est os, ut progressus aquæductus cochleæ, et venæ vestibuli apertissime conspiciatur.

- a a* Gyros cochleæ primus per longitudinem patefactus.
- b b* Aquæductus cochleæ per totam sui longitudinem apertus.
- c* Semicanalis osseus inferiori aquæductus orificio continuus, pariter in longitudinem divisus.
- d d* Decursus venæ cochleæ.
- e* Locus in quo intra semicanalem terminat canalis osseus venam ducens.
- f* Orificium aquæductus cochleæ superius vicinissimum insertioni venæ.
- g* Rami duo venæ cochleæ, qui a trunco emergunt, et per primum cochleæ gyrum incipiunt progredi.
- b* Ramus alter ejusdem venæ ad vestibulum pertinens.

Fig. 3.

Ostendit apicem cochleæ dextræ, qualis apparet cupula detracta, ut infundibulum, gyri albi laminæ spiralis rostrum, terminus et rostrum zonæ cochleæ naturali in positu conspicerentur. Actus autem ad decuplum vitro, pictus est.

- a a* Semigyros ultimus cochleæ.
- b* Extremitas secundi gyri.
- c* Centrum infundibuli, five orificium tubi, circa quem secundi cochleæ gyri postrema medietas, et ultimus semigyros sunt declives.
- d* Margo liber, in quo definit ultimus semigyros.
- e* Rostrum gyri albi laminæ spinalis in quo.

Margo

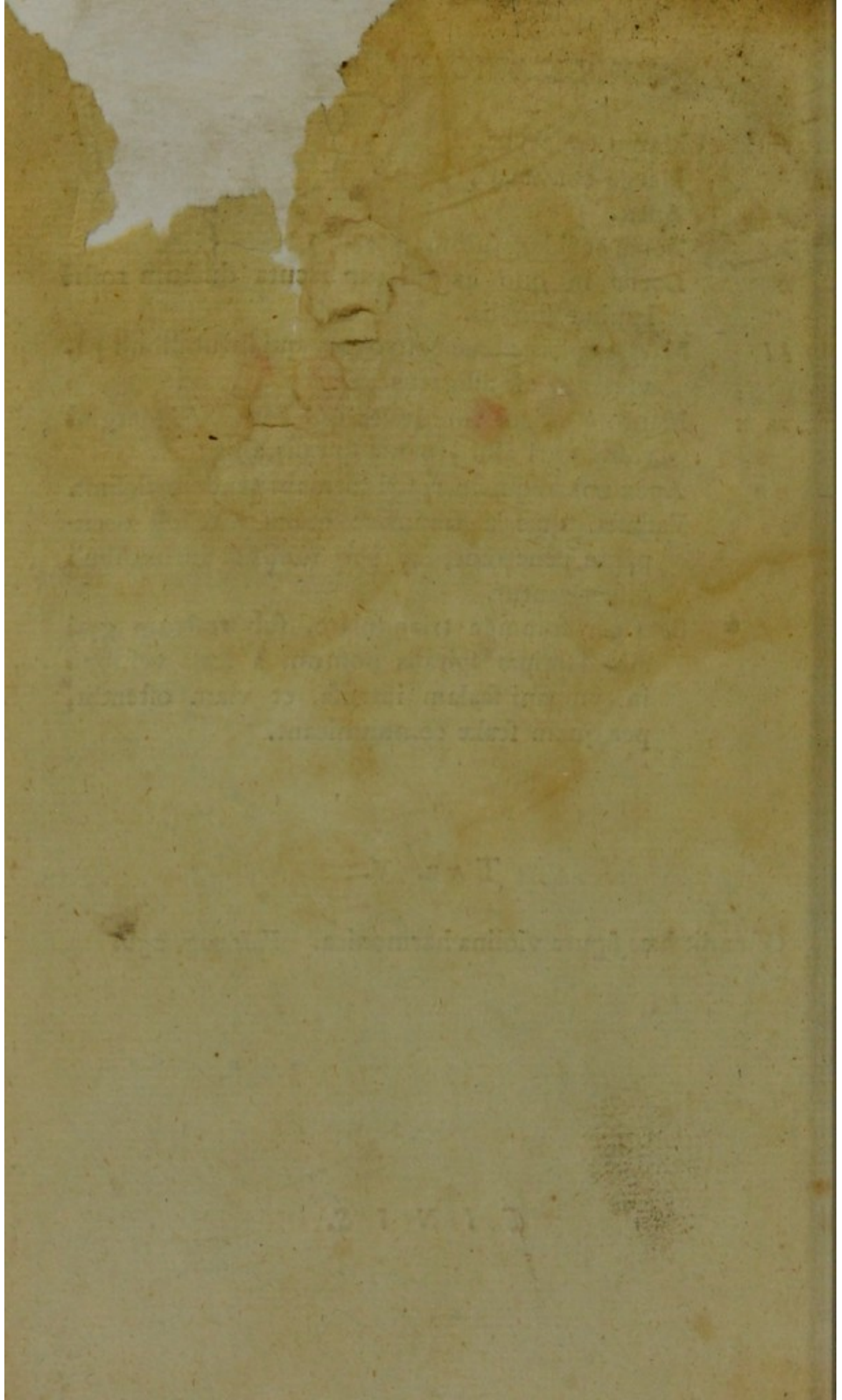
EXPLICATIO FIGURÆ

- f* Margo concavus,
g Margo convexus,
h Apex.
i Zonæ cochleæ summa pars.
k Locus in quo angustatur secuta ductum rostri
 laminæ spiralis.
ll Margo apicis zonæ convexus, qui infundibuli pa-
 vimento est alligatus.
m, m Margo ejusdem concavus, qui convexo margini
 rostri gyri albi laminæ spiralis alligatur.
nn Apex zonæ, qui in rostri formam tandem desinit.
oo Vascula, quæ a foramine axem modioli occu-
 pante penetrant, et per fundum infundibuli
 disperguntur.
 Seta per foramen triangulare, sub rostrum gyri
 albi laminæ spiralis positum a scala vestibuli
 in tympani scalam intrusa, et viam ostendit,
 per quam scalæ communicant.

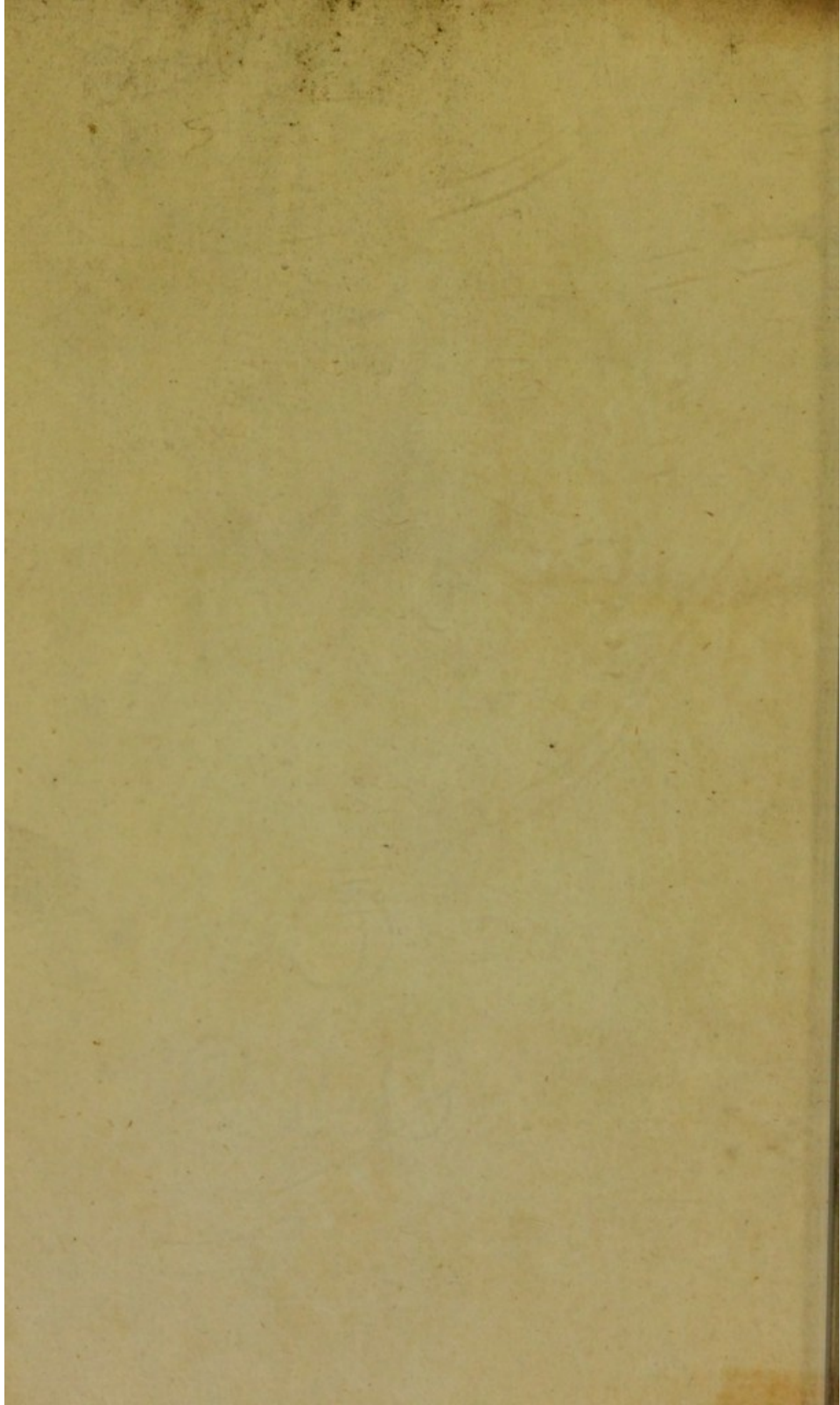
T A B. V.

Ostendit hæc figura violina harmonica. *Vide pag. 256.*

F I N I S.







12.

