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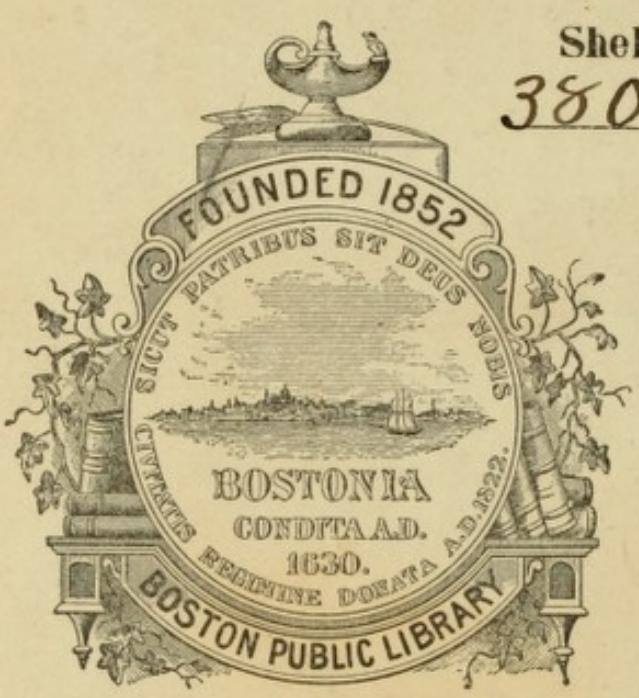

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OPHTHALMOSCOPIC EXAMINATION.

(AFTER FOLLIN.)

A PRACTICAL GUIDE

TO THE STUDY OF THE

DISEASES OF THE EYE:

THEIR MEDICAL AND SURGICAL TREATMENT.

BY

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PREFACE.

We are not unprovided with works on the diseases of the eye; but they are either so elaborately complete as to require a high degree of education, and large experience in ophthalmic practice, to enable the reader to appreciate the nice distinctions laid down; or they attempt too much within narrow limits, and, from want of space and confused arrangement, sacrifice that clearness of description which should be regarded as all-important in a work intended for instruction.

In offering this treatise to the profession, and to those who are about to enter it, the author does not assume to set forth all which is known in respect to diseases of the eye. He has endeavored to supply a want which his relations with junior practitioners and students have shown him to exist, and to prepare a work which shall afford, in a form

as simple and concise as possible, a practical and serviceable knowledge of these diseases, and of their treatment, to those whose opportunities for special study have been less extensive than they could have desired. It is only in a few cities, in America, that students find even limited facilities for clinical observation of these affections; and a very large number yearly begin their career as practitioners, without having enjoyed the privilege of any instruction whatever in this important branch of medical education.

It has been the aim of the author to avoid encumbering his work, and confusing the reader, by the introduction of merely exceptional details, — by an account of every proposed but exploded mode of treatment, or by more than the most sparing use of the too learned technical designations which abound in ophthalmic literature; but he has endeavored to give clear and explicit descriptions of the usual forms of disease, so that the physician may be able to recognize, at once, their distinctive features, — and to define the course of treatment best adapted, in a majority of cases, to remove the morbid con-

dition. Some affections, and certain phases of disease, of rare occurrence and trivial importance, will be merely alluded to; enough being said, however, to enable the reader to detect their character, as exceptional cases, and to allow him to consult other works, at his leisure, should he wish for complete information regarding them.

It is impossible for the author of a medical work to avoid availing himself of the rich treasures accumulated as the result of the labors of his predecessors. To all of them the writer acknowledges his indebtedness. But he would not have assumed his task, except from a desire to fulfil the duty which he believes to be incumbent on every physician, of adding something, if possible, to the stock of knowledge which it is the glory of our profession to regard as the common property of all its members. He has hoped to do this, by promulgating new and original views, which he deems highly important, upon certain of the subjects considered in this treatise, — and by facilitating, by simplified classification, the study of what at first sight seem to be the intricate and compli-

cated phenomena of diseases of the organ of vision.

The descriptions given, the conclusions announced, and the treatment recommended, are such as the author's own observation and experience have led him to consider accurate and useful.

15 Arlington Street, Boston,
1st June, 1862.

PREFACE

TO THE SECOND EDITION.

Grateful for the welcome which his work has received from the Profession, the author has endeavored to make this second edition yet more acceptable and useful.

With this view, he has embodied in it, or added in the Appendix, a large portion of his Essay on Recent Advances in Ophthalmic Science, — at the same time revising the whole work, — in order to set forth, as concisely and clearly as possible, the many new facts and principles regarding the optical powers and functions of the eye, of which the demonstration, by Professors Donders, Graefe, Helmholtz, and others, has conferred fresh lustre upon Ophthalmology, and entitled it to a high place among the departments of Medical Science.

It may be justly said that never, perhaps, in the same period of time, have so many and so brilliant advances been made, in any depart-

ment of Medicine, as have been attained within half a generation in the knowledge and treatment of diseases of the eye.

He is indebted to the accurate scientific knowledge and artistic skill of his friend, Dr. John Green, of St. Louis, for drawings of the plates which so greatly enhance the value of the work; and he thinks it will be admitted that these illustrations, especially those explaining the Ophthalmoscope, and those relating to the refractive and accommodative functions, afford to the novice in these studies a more perfect demonstration of the principles involved, and of their application, than can be found in any work which has hitherto appeared.

Arlington Street,
1st May, 1867.

PREFACE

TO THE THIRD EDITION.

The author trusts that the generous commendation awarded to the improved second edition may be his warrant for hoping that this third impression will be received with similar favor.

15 Arlington Street,
1st Jan., 1869.

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DISEASES OF THE EYE.

We shall derive the greatest advantage, in our study of the pathology of the eye, from such a classification of its diseases as may not only aid us in forming a prompt diagnosis, but assist in determining, at once, the general plan of treatment to be adopted. The most simple and rational arrangement, and one which includes a very large proportion of the numerous diseases of the eye, is that which ranks them, as far as may be, according to the structure which they primarily affect. A further subdivision is required, to designate those peculiar phases of disease denoting the existence of any constitutional condition or other circumstance capable of modifying the course of the malady or its results.

Many of the inflammatory as well as other affections of the eye are distinctly limited, at the outset, to certain of its tissues, — as the iris or the conjunctiva, — and may disappear without involving contiguous parts; but even these, if left to themselves, tend to produce new conditions, affecting

other structures, and complicating or even masking the original disease. As an instance of this latter tendency, we may refer to the effect produced upon the cornea by long-continued friction of granulated lids upon its surface. For a considerable time, especially if the granulations are flabby rather than hard, the cornea continues clear; but at length vessels become developed upon its surface, it loses its transparency, and, if the original disease remain unchecked, it becomes ulcerated, and perforation very probably ensues. When these changes have occurred, attended, perhaps, with much circum-orbital pain, serving still further to disguise the case, it is difficult for an inexperienced observer to recognize, as the cause of all this mischief, a condition of the mucous membrane lining the upper lid, towards which, if he hope for success, his remedial measures must be primarily and almost solely directed.

In order to unmask these complications, and discover the true features they conceal, — or, when they have themselves become, *de facto*, new diseases, to determine where and how to direct his treatment, — it is essential that the observer should accustom himself to close and careful examination of the eye, overlooking no morbid change, however apparently trivial. This being of so much consequence, I shall endeavor to point out the mode of making an accurate and methodical examination, that the student may have a guide as to what he should look for, and how he is to find it.

CHAPTER I.

METHOD OF EXAMINING THE EYE.

So far as it goes, information obtained by the physician's own senses is of more value than that derived from the patient. As a general rule, therefore, a personal inspection should precede any inquiries as to the history or symptoms of the case. Thus relying on his own observation, the physician learns to note every deviation from a normal condition, — he avoids, in a measure, the chance of being misled by preconceived theory in the mind of his patient, — and he may often gain, at once, the patient's confidence, by showing, in his first question or remark, that he thoroughly comprehends the disease.

The examination of the patient may commence from the moment he enters the room. The skilful observer will distinguish, in his very bearing, the patient with cataract, who, with shaded eyes, appears as if searching his way, from him who has the bold gait and wandering eyeballs marking the loss of all perception of light. The half-closed lids of the short-sighted, the spasmodic contraction attendant on intolerance of light, the deviation from

harmonious action in the eyes of those affected with strabismus, may all be observed at a glance.

The patient should be seated near a window, with the light falling obliquely on his eye. For examinations requiring much delicacy, a window having a north aspect is best.

The appendages of the eye, the brow and lids, should receive an instant's attention before we turn to the globe itself. Recent wounds or contusions of the eyebrows, or the cicatrices resulting from former injury, are worthy of note, as such accidents now and then, through the supra-orbital branch of the fifth pair, seriously affect the power of vision.

In the lids, we should observe if there is any loss of the natural freedom of motion, whether from muscular paralysis, or from thickening of their structure, or from photophobia. We should note any inversion or eversion of their edges, or the existence of wounds, ecchymosis, œdema or tumors. The tarsal borders may be thickened; or covered more or less with crusts, indicating disease of the Meibomian glands; or infested with pediculi. The absence of a portion of the eyelashes, or their misdirection, constitutes another important change. In cases where the cilia are thus misdirected, growing towards the eyeball, they are often so pale, from constant immersion in the secretions of the eye, that it is difficult to detect them, and they may be best discovered by the fact that the tears are drawn slightly around them by simple attraction.

Any alteration of the position of the globe, or other evidence of tumors in the orbit, should be at once noted.

All the appendages of the eye having been scrutinized at a rapid glance, we turn our attention to the globe itself. Its anterior surface should be carefully passed in review, to detect the presence of any foreign body, ulceration of the cornea, vascularity or cloudiness resulting from friction of granulated lids, or lingering traces of former disease of the cornea; or any abnormal conditions of the conjunctiva, such as the olive stain produced by long-continued applications of solutions of the nitrate of silver, chemosis, small papulæ, pterygium, or any increase of vascularity. If abnormal vascularity of the eye exists, we are to observe its character and seat, whether it affects the superficial and inosculating conjunctival vessels, or the radiating zone of those of the sclerotica, and whether accompanied or not by augmented secretion. We should also detect any alteration of the form of the globe, from conicity of the cornea, staphyloma, hydrophthalmia, or atrophy.

If there is reason to suppose that an extraneous substance has become lodged under the lids, or to suspect the existence of granulations, the lids should next be everted. (In nine cases in ten, a foreign body which may have intruded is found at the centre and near the edge of the upper lid.)

As we proceed to explore the internal parts of the eye, the clearness or haziness of the field of the pupil, its size, irregularities in its outline, or any unusual appearances in the iris, are to be noted. The contractility of the pupils must be tested in each eye separately. To do this the fingers of one hand are placed upon the brow and the thumb upon the upper lid of one eye, the other hand being similarly placed as regards the other; and the lid of one eye is to be raised by the thumb, without pressure, while the other is kept closed. Unless this is done, we may be deceived, as the light falling on one eye causes sympathetic contraction of the other pupil, though that eye may have lost all sensibility to light. This alternate closing and opening of the eyes also aids us in detecting cataract or other changes behind the iris; as, by covering the eye for a moment, we obtain such dilatation of the pupil as permits of a quick glance over a larger field. By pressure of the thumb upon the globe, we are also enabled to judge as to any increase or lessening of the normal degree of hardness, indicating tension on the one hand or on the other commencing atrophy of the eye.

Should it be desired to dilate the pupil for the purpose of obtaining a better view of the deep-seated parts, this may best be done by touching the inner surface of the lower lid with a small camel's-hair pencil dipped in a solution of the sul-

phate of atropia, of about two grains to the ounce. This application will be painless, and produces considerable dilatation in fifteen or twenty minutes. The lens, the vitreous mass, and the whole of the posterior portion of the interior of the globe, may now be examined to great advantage. Should the physician be unprovided with atropia, the object may be accomplished by using the fresh juice, or a solution of the extract of belladonna or stramonium, which may be smeared upon the eyebrows and lids, or dropped into the eye.

Various pathological changes may be discerned in the deeper parts of the eye, especially after having dilated the pupil, without the aid of the ophthalmoscope, — as, for instance, opacities of the lens, constituting cataract; or those more profoundly situated, in the vitreous body; or the formation of purulent collections or commencement of cancerous disease at the posterior part of the globe. With the ophthalmoscope, we may detect the minutest differences of vascularity or exceedingly delicate changes of structure in the retina itself, as well as the incipient stages of the above-named affections.

If we are satisfied that the lining of the lids is in a healthy condition, the upper lid need not be everted. But in very many cases, including a large share of those where the conjunctiva is affected, the source of mischief is to be found in this very situation. Almost invariably the upper is much more diseased than the

lower lid. This is principally due to its anatomical configuration, — the upper lid being broader than the lower, — and to its position, rendering its vessels more liable to become and remain engorged, from the influence of gravitation; whereas the circulation in the lower lid more readily recovers from any temporary congestion. As in these cases eversion of the lid must be performed, perhaps daily, for a considerable time, for the purpose of applying remedies directly to the affected parts, it is of great consequence to the patient's comfort and the surgeon's success that adroitness and delicacy in executing this little manœuvre should be acquired. The eyelashes and edge of the lid are to be taken hold of with the thumb and finger of the left hand, and drawn gently forward and then upward, while at the same moment pressure is made against the lid, at about the upper edge of the tarsal cartilage, with a probe, a small pencil, or some similar object, held in the other hand, — the upper edge of the cartilage being thus tilted backward while the lower edge is brought forward. The patient is to look down, thus making the reversal of the lid more easy.

METHOD OF EXAMINATION IN CHILDREN.

With small children, especially those suffering from photophobia, or who have been long diseased, we must use a different method in our examination. It is important to avoid terrifying them, as any future

inspections, or even the application of necessary remedies, are thus rendered more difficult; and, moreover, we can often obtain a better view by patience and stratagem than we can by force. By calling the child's attention to something else, and not appearing to care for the eye, we may often see it to good advantage; and, if we can gain but a momentary glance in cases of photophobia, this may suffice to assure us that the cornea is not seriously threatened, which, for the moment, is all we need to know. But if the child is unwilling or unable to allow us this assuring glance, — or where, in other cases, the swollen state of the lids prevents their being easily raised, — we must often feel compelled, at least at a first examination, to ascertain the exact condition of things by the employment of gentle force. The child should be held on the knees of another person, his feet turned from the surgeon, who sits at right angles to the individual holding the child. His head should then be lowered between the surgeon's knees and firmly grasped by them, and, his hands being held by the attendant, he can make no resistance. Both hands of the surgeon are free, and he can depress the lower lid with one hand, while with the other he raises the upper lid. Should the resistance offered by the orbicularis muscle be too strong, or the lid be greatly swollen, it may be necessary to use an elevator to raise the upper lid, so as to obtain the requisite view of the cornea.

Any remedial measures may be applied, if necessary, while the child is in this position.

VARIETIES OF INJECTION AS A MEANS OF DIAGNOSIS.

I have alluded to the distinct characters of the injection of the external vessels, and those more intimately connected with the internal parts. The vessels of the conjunctiva run tortuously upon its surface, inosculating in all directions, and may be readily moved over the surface of the sclerotica by friction exercised through the eyelid. They have a bright scarlet color, and are largest at the point where the conjunctiva is reflected from the lid upon the globe. Even though the injection should be sufficient almost to hide the sclerotica, it may still be distinguished by these features. Injection of the sclerotica is characterized by the presence of minute vessels, largest next to the margin of the cornea, and tapering to an invisible fineness as they radiate upon the globe. They form a distinct circum-corneal zone, of a purplish or lake tint, and cannot be displaced by friction. They are evidently deeper seated than the conjunctival vessels.

DIFFERENCES IN THE SECRETIONS.

A similar marked difference is exhibited in the nature of the secretions. Those poured out by an inflamed conjunctiva have a more or less viscid mucous or purulent consistence; while those which flow when the internal parts are implicated, or when ulceration

of the cornea exists, seem to be derived, to a large extent, from the lachrymal gland, and have the character of acrid tears.

DIFFERENCES IN PAIN COMPLAINED OF.

The kind of pain complained of by the patient is also very characteristic of the diseases it accompanies. In conjunctivitis, the sensation is one of smarting, or as if sand or sticks were in the eye, and is generally evidently superficial; while in inflammations of internal parts of the eye, and sometimes in cases of ulceration of the cornea, the pain has an aching character, extends deeply through the organ, and frequently affects also the circum-orbital branches of the fifth pair.

The difference in the characteristics of affections as indicated by these three symptoms — the injection, the secretion, and the pain — should never be forgotten, as a due appreciation of these is of the greatest assistance in making a diagnosis, and of the greatest value as regards treatment. We may feel little anxiety and give a favorable prognosis in a case of severe conjunctivitis, where the amount of redness renders the disease formidable to the eyes of the patient's friends; whilst we watch with far more solicitude an eye which seems to others only slightly affected, but where we find deep-seated pain and development of radiating vessels, denoting, to our experienced estimation of their value, implication of important internal parts.

LATERAL ILLUMINATION.

Another mode of exploring the anterior and central portions of the globe, which offers many advantages and great facility, is that by lateral or oblique illumination.

The patient is placed with the light near his temple, and this is concentrated, by means of a lens, upon the cornea, iris, crystalline, or vitreous, wherever morbid changes may be perceived or suspected. The observer's eye may be placed directly in front of the eye examined, or, still better, at the point where he will receive the reflected rays at the same angle as that of their incidence. He may magnify and give greater clearness to the appearances inspected by employing a second lens if necessary.

In this manner we may readily detect even the slightest opacities or irregularities in the cornea, the faintest traces of commencing cataract, foreign bodies in the anterior chamber or lodged in the iris, as well as many alterations in the vitreous, hemorrhagic or other effusions, and, sometimes, bulging folds of a separated retina.

The ease and rapidity with which this means may be employed is not a slight recommendation.

In many instances no enlargement of the pupil is necessary; but in cases of doubt as to the condition of the parts posterior to the iris, atropia should be used,

to produce such dilatation as may allow of their more complete exploration.

In the Appendix will be found a description of the modes of exploring the interior of the eye, and an account of the methods of determining limitations of the field of vision, and of ascertaining any deviations from the normal conditions of refraction or of acuteness of sight.

CHAPTER II.

USE OF THE OPHTHALMOSCOPE.

Previous to the success of Helmholtz in devising means for a satisfactory illumination of the deeper parts of the eye, nearly the whole of that portion lying behind the crystalline lens was veiled to our observation; it being difficult to place our own eyes in a position to receive rays which are reflected from another retina in the direction in which they reach it, — any attempt to do so intercepting the luminous rays themselves. His invention has made a large addition to our means of diagnosis of the deep-seated diseases of the eye.

For a full description of the ophthalmoscope and the methods of employing it, the reader is referred to the Appendix.

CHAPTER III.

REMEDIES, AND THEIR APPLICATION.

Before proceeding to a description of particular affections, we may properly devote a little space to a few of the principles which should guide us in the treatment of ophthalmic diseases. A certain share of them, among which are most of those of the conjunctiva, may be regarded as almost wholly local, and amenable to local remedies, little attention to the general condition being required. In others, no local treatment is called for, but certain conditions of the system demand our exclusive attention; as, for instance, in the loss of vision which sometimes accompanies excessive lactation. In another large class, as in the rheumatic and syphilitic forms of iritis, and in strumous affections of the cornea, it is important to combine the judicious administration of remedies with a proper application of local means.

Of the various methods of local treatment, the use of collyria, more or less astringent, stimulant, or sedative, is of most extensive application. Solutions are preferable to any other vehicle for our remedies, as we are able to graduate them to a uniform strength, and no mechanical violence is requisite to their intro-

duction. No ointments, of any description, should ever be used inside the eyelids. They are liable to vary in strength, to become rancid or decomposed, and their fatty substance forms, at best, a vehicle far inferior to water for distributing the medicinal agent over the whole of the affected surface. Under no circumstances do they offer any advantages which are not afforded by judiciously adapted aqueous solutions. I have seen most serious results from incautious use of nitrate of silver ointment, in the hands of physicians themselves, as well as when employed by patients at the suggestion of well-meaning friends.

Solutions of the acetate of lead, sugar of lead as it is popularly called, formerly had a prominent place among collyria, and are even now extensively employed by some physicians, and especially by the common people. They should be banished from the list of ophthalmic remedies. In cases where they seem to be of service, the object can be better accomplished by other means which are not dangerous to the eye, as are all the preparations containing lead. Where ulceration of the cornea exists, the solution of lead is liable to be decomposed and deposited in the texture of the cornea, forming an indelible opacity. I have several times removed crusts from the anterior surface of the cornea which have been proved by analysis to contain lead. While, therefore, we have excellent substitutes in other astringents, it is not justifiable to make use of lead as an ingredient in a

collyrium; as we can seldom be certain that the cornea may not become implicated in the inflammations for which it is ordinarily prescribed, or that the same collyrium may not be employed at a future time for another member of the family who may happen to be attacked with ophthalmic disease. But, aside from the danger of employing it, lead does not deserve the reputation it has enjoyed, and is certainly inferior in value to other mineral astringents, for ophthalmic purposes.

The abuse of strong solutions of the nitrate of silver is another evil to which I feel bound to call attention. It is apparently considered, by some, a specific for all the ills which eyes are heir to, — and is so lavishly employed that we not only observe, as results, a disagreeable olive stain of the conjunctiva, but, in some instances, destruction of the folds of this membrane and adhesions between the lid and the globe, where solutions approaching to saturation have been incautiously applied. It frequently aggravates the symptoms, and I can assert, as the result of many comparative trials, where the nitrate, in solutions of different strength, has been used for one eye, and solutions of the sulphate of zinc, with perhaps the crayon of sulphate of copper for the other equally diseased eye of the same individual, that I have always found recovery slower in the eye to which the nitrate of silver was applied, and have often been compelled to abandon its use and substitute the treat-

ment under which the other eye had already recovered. I do not say that the use of the nitrate of silver should be abandoned. It may be resorted to with good effect in certain cases; but entire abstinence from its use, as an application inside the lids, for a long period in my own practice, has proved that it may be dispensed with without its want being felt, and I am glad to find the more recent authorities restricting its use within far narrower bounds than formerly. My desire is, only, to caution the young practitioner against too frequent use of this powerful stimulant, in cases where a mild astringent would better serve his purpose. It would be a gain for ophthalmic therapeutics if its use should become far less general; as, even in cases where its application may be followed by recovery, the same result would equally have been attained had milder means been employed.

The crayon of sulphate of copper is capable of replacing, with great advantage, the nitrate of silver, in most of the cases where this has been in favor; especially in the treatment of conjunctival inflammation and granulated lids. It does not, like the nitrate in substance or in strong solutions, act as a caustic, destroying the surface of the conjunctiva, but as a powerful astringent. To obtain good crayons, which is exceedingly important, it is almost essential to procure crystals from a laboratory or to recrystallize a quantity of the sulphate; as, when sent to market, the crystals are so much broken that it is difficult to

find suitable pieces. The part to be selected is the hard portion, free from water of crystallization, near the apex of the crystal. This is to be carefully cut with a pocket-knife, or sawn, into the desired shape, which should be that of an ordinary crayon of large diameter. It may then be rendered as smooth as a piece of glass by rubbing with a wet rag, and fitted in a porte caustique. If the selection has been well made, the crayon will wear perfectly smooth, and, if carefully wiped after each application, may be used a great number of times, and for various patients, without danger; though, of course, as a precaution, the physician should be provided with several if he has to employ them upon those whose diseases are highly contagious. It should usually be very lightly applied, over the whole surface of the conjunctiva of the everted upper lid. Too heavy a touch should be avoided, as, if clumsily used, it causes much more pain, and acts as an over-stimulus. Where the inflammation is intense, the pain from the first applications is sometimes considerable, but it is less than that produced by an equivalent strength of the solution of nitrate of silver; and as the patient becomes habituated to the remedy and the symptoms diminish in severity, the pain becomes trivial, even children disregarding it after the first few moments from its application, though they may have seemed to suffer very much when it is used for the first few times.

Collyria may be dropped into the eye from a tea-

spoon, or a quill, — or a bit of rag or fine sponge may be moistened with the fluid, which is then to be squeezed into the eye; or any other means most convenient to the patient may be employed in their introduction; it being desirable to instil a few drops at each application, that the whole of the affected surface may be reached by the remedy.

This is not the place to introduce a full list of remedies which are useful for external applications to the eye. Suffice it to say, that among them the mineral astringents hold a prominent and deserved place. Theoretically, the vegetable astringents would seem adapted to do good service; but practically I have been disappointed in their effects. As to the strength of the solution to be employed, the best general rule is, that it should not cause smarting for more than a few minutes. As a rule, a collyrium should be so mild as to allow of its frequent use, that its influence on the eye may be kept up. If more active remedies are required, other means should generally be resorted to, rather than to increase the strength of the collyrium. If its effects continue a long time, I usually direct the patient to reduce a portion of the collyrium till it causes pain for not more than five minutes, and to continue to use it thus diluted till the eye becomes able to bear the full strength.

Local depletion by means of leeches is often of signal service in the acute stages of inflammation, but

their influence is scarcely felt in affections which have become chronic. When prescribed, they should generally be applied on the temple, at some distance behind the eye and on a level with it. If applied on or above or too near the lids, much swelling is liable to ensue, from infiltration of the loose sub-cutaneous cellular tissue. Depletion by scarification of the conjunctiva, or division of vessels on the surface of the globe, has been much recommended by some authorities; but, though scarification is often followed by a sense of relief, the effect is but transitory, — the reparative process for the healing of the small incisions renewing the vascular congestion to fully its original degree, — so that on the second day the condition is usually the same as before the operation was performed. Vessels should not be divided with the hope of cutting off a supply from a diseased cornea; such an expedient could only have been devised by a superficial observer; as in this case their development is the effect and not the cause of the disease, and, if certain branches are obliterated after incision, others are immediately developed in their place; whereas they all disappear after, but not before, the state of the cornea is improved by proper treatment.

Local depletion, to a moderate extent, is by no means incompatible with a general tonic treatment. Unloading the neighboring vessels may relieve a passive congestion, the return of which may best be prevented by giving vigor to the general circulation.

Poultices, whether made *secundum artem*, or composed of the disgusting ingredients so much in favor with the vulgar, are very rarely allowable in disease of the eye itself. If applied in conjunctivitis, or disease of the cornea, they tend to augment the discharge and to soften the corneal tissue, favoring the formation of ulcers and perforation by the relaxation produced by the constant application of heat and moisture.

When deep-seated, aching pain, with injection of the zone of vessels radiating outwards from the margin of the cornea, indicates inflammation of the iris or other internal part of the eye, — the collyria and other outward applications, of so much service in affections of the external tissues, become valueless. They cannot reach the diseased portion of the organ, and, far from being able to control any secondary injunction of the conjunctiva which arises from contiguity to the inflamed parts, they tend to aggravate it. This injection will subside with the diminution of the primary disease, — and our use of local remedies must often be restricted to such sedatives as may control the pain, and to agents capable of effecting enlargement of the pupil.

In traumatic injuries of the globe, we should be very sparing of our resort to active treatment. Non-interference should be the rule, except where positive indications are manifest. This point cannot be too strongly insisted on.

In specifying the treatment of the various affections, I shall not attempt to mention all the remedies which may be of service. My design is rather to mark out a safe, and, as far as possible, the best course to be followed, without confusing the reader by a multiplicity of details. General principles being thus established, the practitioner will have no difficulty in selecting other remedies of similar action to those recommended as a first choice, whenever in his judgment they may seem to be indicated.

Our means of acting on the iris, to produce dilatation or contraction of the pupil, and thus to effect important therapeutic results, have been most advantageously increased by the use of atropia as a substitute for belladonna, and by the discovery of the properties of the Calabar bean, the only article of the materia medica which can be relied on as a local application to contract the pupil.

Gelatine wafers, which have been saturated with a solution of these substances, are convenient where the patient is timid, or when the application is to be made by himself or his friends. They readily dissolve when placed inside the lower lid. An account of the Calabar bean is included in the Appendix.

It has been the good fortune of the younger men of the present generation of physicians to receive the boon conferred on surgery by the introduction of anæsthetics.

In their application to operations on the eye these

agents have been of incalculable benefit. Many of these operations, as, for instance, excision of staphyloma, or removal of a part or the whole of the globe itself, are exceedingly painful; many, which involve less actual suffering, appear formidable to the patient, because he thinks the eye so sensitive.

In many other operations, delicate rather than painful, — such as those for iridectomy, separation of adhesions of the margin of the pupil, and some of those for cataract, — it is a great advantage to have the motor muscles of the globe, which are but slightly under the control of the will, rendered passive by anæsthetics; that we may have nothing to fear from spasmodic pressure of the muscles upon the eyeball, or sudden involuntary movements. If the subject be a child, even the slightest operation could formerly be done only under forcible restraint, not only controlling the movements of the body, but of the eye itself. Now, in operations for congenital cataract, strabismus, &c., half the objections to surgical interference are removed by the fact of the unconsciousness of the patient.

The ability to insure complete repose of the eye gives yet further advantages: it allows of seizing of the conjunctiva with forceps and turning the globe in any direction, to give convenient access with instruments to certain parts, and it permits of so much deliberation that the intended manœuvres may be more nicely executed.

CHAPTER IV.

AFFECTIONS OF THE CONJUNCTIVA.

SIMPLE CONJUNCTIVITIS.

THE slight and transient irritation of the conjunctiva, caused by the presence of a foreign body, scarcely deserves to be regarded as one of its diseases; yet it is a source of annoyance often requiring relief, and if improperly treated may lead to more serious symptoms.

It is characterized by slight injection, increased lachrymation, and a sensation of having something in the eye, with more or less sensitiveness to light. If a foreign body is still present, its removal is to be at once effected. A large proportion of such bodies are particles of sand, cinders, or other similar objects, which have been blown into the eye, or minute particles of iron, &c., which have been projected into it from lathes in machine-shops, or in the use of various tools in stone-cutting and other occupations. Nearly all the former which are not readily washed out by the increased flow of tears, become lodged beneath the upper lid and near its edge, at the centre of the tarsal cartilage. The adroit eversion of the lid and removal of the offending substance with a

probe, a small brush, the point of a pencil, or anything at hand, is but the work of an instant. Usually the patient is at once relieved from the sensation of scratching caused by the sharp particle; but at times the feeling of having something in the eye is not immediately removed, owing to the vessels having become injected. This sensation will soon subside, if the eye is left to itself or bathed a few times with tepid or cold water or milk and water. Where a particle of iron, cinder, or other hard substance has become imbedded in the cornea, it is usually detected with little difficulty; but, if it happen to be near the centre, in front of the black field of the pupil, it may escape notice unless carefully looked for. If only slightly imbedded, it may be removed by a brush or small stick, such as are used for toothpicks. When it has been driven with force into the cornea, and is firmly held in its elastic tissue as a nail is fastened in a board, a small instrument having a round, slightly-blunted extremity, or an instrument shaped like a cataract-needle, but having a shorter shaft that it may have less spring, is very serviceable. When the particle has been but a short time in the eye it may usually be readily removed; but, where unsuccessful attempts have been made by fellow-workmen and others, the sensitiveness becomes extreme, and it is difficult for the patient to control his eye long enough for the surgeon to effect the object. The use of ether to induce anæsthesia may

be required in a few cases under such circumstances. The patient may stand near a window, his head resting against the frame of the window and the wall, or may be seated in a high-backed chair, and the surgeon, separating the lids with the fingers of his left hand, endeavors, by quick manœuvres with his instrument, to lift the foreign body from its position; keeping on his guard against sudden movements of the globe, that the instrument may neither scratch the cornea nor be thrust through it.

A similar form of conjunctivitis to that caused by a foreign body, is often occasioned by exposure to draughts of air or sudden changes of temperature, not sufficiently prolonged or violent in their action to bring on the catarrhal form of inflammation. If treated by strong stimulants or astringents the symptoms are aggravated, but they are easily removed by the frequent use of mild applications. Lotions with tepid water, milk and water, rose-water, or infusion of tea, are often all which is needed. When these have proved insufficient, I have found great advantage from the use of a collyrium containing from eight to twelve grains of borax to an ounce of the aqua camphoræ of the U. S. Pharmacopœia. A little of this solution, dropped into the eye three or four times a day, appears to have a gently stimulant and at the same time sedative effect, and answers the purpose far better than the strong solutions so often indiscreetly recommended.

ERUPTIVE CONJUNCTIVITIS.

Another variety of disease of the conjunctiva is characterized by the appearance of one or several small papular elevations upon its surface; each papule being surrounded by a slight injection. Sometimes their summits are white, but they have no true pustular character. Their most frequent seat is at or near the margin of the cornea. Children near the age of puberty, and young females whose menstruation is irregular, are the subjects in whom we oftenest observe this form of disease. The treatment should consist in the use of mild means only, as any severe applications tend to aggravate symptoms which would generally spontaneously disappear in a few days. A very weak astringent, dropped into the eye three or four times a day, seems not only to favor the resolution of the papulæ, but to fortify the conjunctiva against their recurrence. Nothing more active than very weak solutions of borax, alum, or sulphate of zinc is to be advised. This tendency to recur is one of the features of the disease; to obviate which, the general health should be maintained by tonics and nutritious food.

Another form of this eruptive affection is more chronic in its tendency. It exhibits a flattened elevation of much larger size than the papules just spoken of, sometimes having a diameter of two lines or more. Save in its tendency to persist, it resem-

bles the disease already described, — its causes, prognosis, and treatment being similar. A solution of borax, ten grains to the ounce, may be dropped into the eye, and lotions of an emollient nature (as infusions of sassafras pith, althea root, or quince seeds), may sometimes be advantageously used. If other collyria are required, solutions of alum, one or two grains to the ounce, or wine of opium largely diluted with water, are sufficiently active. A nearly expectant treatment is better than too much interference. More attention to the general condition seems to be required in this chronic form of the disease, most of its subjects being in a state of health below the normal standard; otherwise the morbid changes may remain for weeks notwithstanding judicious local treatment. Occasionally a change of air seems to be very beneficial, the symptoms quickly subsiding after a sojourn at the seaside, if the patient has resided in the country, or *vice versa*.

MUCO-PURULENT CONJUNCTIVITIS.

By far the most important class of affections of the conjunctiva is made up of several diseases of which a common and peculiar feature is the occurrence of a muco-purulent discharge from this membrane. Their importance claims for each a separate description.

CATARRHAL CONJUNCTIVITIS.

The sensations experienced at the outset are scarcely more severe than those complained of in simple conjunctivitis. The patient has a sensation of itching, smarting, or dryness of the lid, usually, though not invariably, increased towards evening, sometimes most felt on awaking in the morning. Frequently the access is so sudden, that he feels sure that some foreign body is beneath the lids, and I have often found it difficult to convince my friends of the profession who have consulted me, that such was not the case with them when seen in the early stages of this disease. But the appearance of the conjunctiva, on everting the upper lid, shows a marked difference in the two cases. Where a foreign body is or has been lodged beneath the lid, there is simply injection of the palpebral conjunctiva, usually over a limited extent, — while in commencing catarrhal inflammation the conjunctival surface is more universally injected, and shows a velvety thickening of the mucous membrane, quite different from the smooth though congested surface which has been merely irritated by some intruding substance.

At this stage it is easily arrested, in healthy and cleanly subjects, by the use of a mild astringent collyrium. A solution of sulphate of zinc, from one to three grains to the ounce, has seemed to me most certain to insure prompt recovery. Sometimes, a

collyrium of borax, ten grains to the ounce, will serve the purpose, — and now and then, frequent lotions with tepid water, milk and water, infusion of rose-leaves carefully strained, or strong tea, are all which is needed. Tepid are better than cold lotions in these affections; as, though the latter sometimes seem more grateful at the moment of application, they appear to cause a reaction which is unfavorable to recovery. The majority of patients also find more relief from the use of lotions at a warm temperature.

But it is seldom that the disease is brought to our notice till it has made further advances. The sensation of sand or sticks in the eye becomes more marked, and the edges of the lids are often agglutinated in the morning by the abundant secretion which has accumulated during the night. Examination shows a great increase of the injection and thickness of the membrane, and a more or less villous, or, as it is termed, granular condition of its surface. The enlarged vessels, which before were confined to the palpebral, now extend to the ocular portion of the conjunctiva. Instead of a disposition to spontaneous recovery, or a ready yielding to mild remedies, we now find a tendency in the disease to persist indefinitely, and to occasion yet further morbid structural change.

As the affection becomes confirmed, the granulations are more and more prominent, the conjunctiva

of the upper lid having a surface as irregular as that of a raspberry. Now and then the enlarged follicles become pedunculated and seem almost detached from the surface.

Two forms of roughness of the mucous surface are met with; — one, a mere hypertrophy of the conjunctival follicles; the other, far more chronic in its tendencies, consisting in a deposit of fibrinous material in the conjunctiva and its subjacent cellular tissue. The latter variety of granulations is termed *trachoma*, and shows itself in the form of small roundish or oval deposits, resembling grains of tapioca, which have a harder consistence, and therefore cause more injury to the cornea from friction, than the enlarged follicles. The treatment to be pursued is the same in both forms of disease; but in trachoma it must often be continued through a very long period, until the fibrinous masses have become reabsorbed.

Recovery from the trachomatous condition is often, in long neglected cases, far less perfect than where we have to deal with the mere villous hypertrophy resulting from follicular enlargement. The absorption of the dense plastic exsudation is followed by structural changes and contraction of the conjunctival tissue, and the inner surface of the lid assumes almost a puckered aspect; the cartilage at the same time becoming incurvated, and causing troublesome friction of the tarsal margin or of inverted cilia upon the cornea, thus keeping up the haziness and vascularity to which the granulations had given rise.

These secondary pathological alterations require careful attention, to avert, or mitigate as far as possible, the ill consequences towards which they tend.

According to the condition assumed by these granulations, we may expect more or less serious changes in the globe itself. If they remain soft and flabby the disease may be almost limited to the lids, and may continue for years without affecting the cornea; but, even in these more favorable cases, the cornea at length yields, and, though the symptoms have long pursued a mild course, they are liable to sudden aggravation. Where, on the contrary, the granulations become hard and almost horny, the constant friction of the rough lid over the surface of the transparent cornea brings on vascularity, cloudiness, and at length ulceration, ending, if allowed to take its course, in perforation of the cornea, and perhaps destruction of the eye.

The lining of the upper is almost invariably more affected than that of the lower lid. Consequently the upper part of the cornea, which is most of the time covered by this lid, is usually the first to become cloudy, every movement of the eye or lid bringing the roughened surface in contact with the delicate transparent structure. So marked is the effect thus produced, that the upper half of the cornea is sometimes deeply ulcerated while the lower part remains clear, and a glance at the eyeball is sufficient to show what must be the condition of the upper lid.

The character of the pain, and form of injection proper to all the varieties of conjunctivitis, are of themselves, as I have elsewhere shown, sufficient to establish the diagnosis between the affections of this tissue and those of the internal parts of the globe. The pain is a smarting or itching, with a sensation of having some substance inside the lids, — and is wholly different from the severe aching, deep-seated pain, often extending along the supra-orbital or other branches of the fifth pair of nerves, which accompanies inflammation of the internal parts. There is no pain, of consequence, when the eye is moved or gently pressed upon. The injection of the globe commences at the line of reflection of the conjunctiva from the lids upon the eyeball, and the vessels diminish in size as they approach the cornea. They are tortuous and irregular, crossing and inosculating in all directions, and have a bright scarlet or vermilion color. They may also be moved freely over the surface of the sclerotica by rubbing the lid to and fro upon the globe.

In internal inflammations, as for example in iritis, the pain, as I have said, is deeper-seated and often circum-orbital. The injection is evidently in the sclerotica, radiating from the margin of the cornea, the vessels growing less and disappearing at a distance of a few lines from its edge. They do not cross each other, and have a straight, instead of a tortuous course. They cannot be made to glide, by

movements of the lid. The color is a pink or purplish hue, quite different from the florid tint of the congested conjunctival vessels.

When, however, conjunctivitis has involved the cornea, the character of the pain changes, — and it has a nature and severity resembling that attendant on inflammation of deeper-seated parts.

Causes. — The causes of catarrhal conjunctivitis are, principally, exposure to cold and to atmospheric changes, and the irritation occasioned by fine particles of dust, especially if the patient is afterwards exposed to cold, damp winds, or night air. In California, and upon our western prairies, these influences are largely felt, and affect great numbers of persons.

Inoculation of a healthy eye with the secretion from one affected with the disease, is liable to induce a similar condition, and is in fact one of its most frequent causes. It is not uncommon for whole families to be attacked, from the indiscriminate use of towels which have served for individuals suffering from the affection. In these instances, the symptoms are not unfrequently more severe in the cases secondarily affected, than in that from which they were derived.

Prognosis. — Scarcely any disease is more amenable to treatment, — and we may be almost certain of perfect restoration of the normal condition, if the disease has not already produced irreparable changes.

But to secure this result, constant and patient care is requisite in all but the mildest cases. The disease must be driven from its last hiding-place beneath the upper lid, as, if allowed to linger there, it is liable to be re-extended to the eyeball, upon any imprudent exposure. The patient often requires to be detained, when he thinks himself almost entirely recovered, till the normal condition of the conjunctiva is fully restored in all its parts; otherwise he is liable to relapse, and may have to submit to even more tediously prolonged treatment before he can recover lost ground.

Ever where the cornea has become obscured, by the development of vessels and the cloudiness which results from their presence, or where considerable ulceration has taken place, we may yet obtain complete restoration of its transparency, notwithstanding the disease may have been in progress for years. In one instance in which I was consulted, the patient had been known as a blind man for sixteen years, but was restored to vision by assiduous treatment continued for months. It was amusing to witness his sur prise that his friends had grown so much older since he last saw them. But, when ulceration is followed by perforation of the cornea, closure of the pupil is likely to occur, the iris becoming cemented to the cornea by the lymph effused to close the perforation. Where the aperture is but small, adhesions of the iris to the cornea may sometimes be prevented, and the

pupil preserved, by the prompt use of atropia ; large dilatation of the pupil keeping its edge at a distance from the point where reparation of the cornea is going on. But, unless the original disease is at the same time arrested, the ulceration is likely to extend, and the entire cornea becomes softened and gives way, allowing the iris to protrude, and forming with it a staphylomatous projection.

When no deep ulceration of the cornea has occurred, we may promise, as I have said, complete restoration, notwithstanding the great amount or long duration of obscurity resulting from thickening and vascularity of the epithelial layer of the cornea. We are not to allow the patient to be discouraged because he perceives very little improvement even after treatment has been continued for a considerable period. The fact is, the cornea has become so altered from its normal state, that even a small amount of friction from the lid suffices to keep up its morbid condition, and it is only after the roughness of the lids has been very much reduced that a gain in the transparency of the cornea, and improvement in vision, may be expected. The patient must be satisfied, at first, with our assurances, — and with a diminution of the secretion and increased power of opening the lids, — without obtaining the pleasing evidence of progress which is afforded by returning sight. After the prominence of the granulations has been considerably reduced, and the condition of the whole conjunctival surface at

the same time improved, the patient gains more rapidly, and soon observes an amendment from one week to another, if not from day to day. When the pathological changes have existed a long time, or when the epithelial layer of the cornea, in common with the rest of the conjunctiva, has been stained by the excessive use of solutions of the nitrate of silver, recovery of perfect vision for small objects is often tediously slow. A slightly hazy look of the cornea, as if the anterior chamber were filled with smoke, continues for some time after large objects can be distinctly perceived. Time, however, with or without the aid of mild stimulating or astringent collyria, will gradually dissipate all obstacles to perfect vision.

Where ulceration of the cornea has occurred, the cicatrix, even if very extensive, may disappear after a time, if the ulcer has not penetrated too far. If very deep, the cicatrix persists ; and when it occupies the centre of the cornea, interferes more or less with perfect sight; but it frequently diminishes to a small fraction of its original size, and allows of much more vision than was at first expected. Where only a portion of the edge of the pupil has been involved, in cases of perforation, this diminution of the cicatrix often affords happy results. But when the pupil is entirely closed, an operation for artificial pupil is the sole resource for recovery of vision. This means should not be resorted to while good vision remains in the other eye, as the want of harmony in the two

eyes would probably cause the result to be more annoying than useful to the patient.

Treatment. — Our first care should be, to guard against contagion. If but one eye is affected, precautions should be taken against contact of the secretion with the other eye. The patient's friends should also be warned against making use of towels, wash-basins, or handkerchiefs which may have become contaminated.

As regards general treatment, I must protest against a course which is exceedingly common, — the placing a patient upon strict diet, subjecting him to active general or local depletion, and administering remedies which reduce the general health below the previously existing standard. A large proportion of the worst cases are conjoined with a strumous diathesis, or occur in those who are already enfeebled by the privations which poverty brings in its train, and which are only too quickly increased when disability to labor cuts off the usual resources. In these conditions, a resort to depressing measures only aggravates the symptoms. The disease, in the stage at which we generally see it, is essentially chronic in its character, and is not to be thrown off by any heroic treatment; but it is far more readily subdued when we can give tone to the circulation and vigor to the general system.

In acute cases, advantage may now and then be derived from a purgative, which has a derivative

effect on the circulation, and sometimes from two or three leeches applied to the temple, unloading the vessels in the vicinity of the eye, and giving the conjunctiva an opportunity to recover itself. But when the affection has become chronic, little if any good results from these remedies of transient influence, and no general treatment is required, except to keep the patient as nearly as may be at the standard of health. We should allow the usual diet if the food is well digested, even making it more substantial where the state of the system is below par. Gruel and frequent laxatives are by no means adapted to keep up the health or spirits of a patient who is already sufficiently depressed by the prospect of blindness, — and their use could only be justified by the results of experience, which, far from favoring, forbid them. On the other hand, abstinence from stimulants should be insisted on, unless when prescribed to obviate some low condition of the system. Exposure to cold and damp, to high winds, or sudden variations of temperature, should be guarded against. In cases where the granulation is of long standing and the cornea much involved, it is desirable that the patient should be rather quiet than otherwise, taking only so much exercise as is necessary to his health, and keeping the eyes much of the time in repose, that there may be less of the friction upon the globe which must always take place while the patient is looking about as he walks.

But the disease is so eminently a local affection, that the principal treatment must consist in local remedies. If these are judiciously employed, we have the satisfaction of an almost invariable success, — if they are ill chosen or unskilfully applied, we shall often fail, for the languid efforts of nature are of slight avail to arrest the destructive tendency.

Cleanliness should be insisted on, — as the frequent removal of the secretion takes away one source of irritation. The eyes may be bathed several times a day, if necessary, with tepid water or milk and water, and a little of some simple ointment should be applied along the edge of the lids at bedtime, to prevent their becoming agglutinated, and to allow of a free escape of the secretion during the night.

The choice of a collyrium is one of the most important points of treatment, in this affection of the eye. By this means, which should be so mild that it may be frequently introduced by the patient without exciting excessive irritation, we keep up an influence on the disease which can be exerted in no other way. The occasional and even daily application of remedies by the physician himself, even when most judiciously made, will often fail of success because nothing has been given to the patient to act as an auxiliary to the means used, and keep up a constant mild action on the diseased tissues. In both the acute and chronic stages of this affection, a solution of sulphate of zinc in the proportion of

from two to four grains to the ounce of water or rose-water, answers admirably in a large proportion of cases. This should be employed from two to four times a day, the lower lid being drawn down, and a few drops poured from a spoon, or squeezed from a bit of rag or fine sponge into the eye. It is carried to all parts of the conjunctiva by the movements of the lids. Unless a child, the patient can apply this without assistance. The best rule in regard to the collyrium, is to have it of such strength as will cause smarting for a few minutes only, after which the eye should have a sense of more or less relief. Should the patient complain of pain prolonged beyond this time, he should reduce the strength of the solution. In the acute stage, many cases require nothing more than the use of tepid lotions, with such a collyrium as I have described.

Solutions of alum, acetate of zinc, or sulphate of copper may also be employed in this affection, if a change is considered desirable, the alum being used stronger and the sulphate of copper weaker than the solution of sulphate or acetate of zinc. Probably many more remedies than we have been in the habit of employing might be added to the list; but our present ophthalmic pharmacopœia needs to be curtailed of certain of its preparations, and it should be enlarged only after sufficient experimental trial.

In more obstinate or chronic cases, the same plan is to be pursued by the patient, but other additional local

applications should be made by the physician himself. Of these, by far the best is the crayon of sulphate of copper, prepared as I have described in the chapter on "Remedies, and their Mode of Application," and *lightly* passed over the inner surface of the upper lid; which, as I have explained, is the original seat of the disease. This touch with the crayon should be repeated every day or once in two or three days, according to circumstances. The more frequently the better, as a rule, in chronic cases; yet, if the patient is unable to attend so often, once in two or three days may answer the purpose, especially after the symptoms are considerably ameliorated. The crayon should be gently passed, once only, over the surface of the lid; repeating it several times gives too strong a stimulus, and what should have been a remedy becomes an irritant. When the physician, especially if young or of limited experience in these diseases, has charge of one of the sluggish cases I have described, — where the disease has existed for years, and must continue for months, even under the most skilful management, his position is a difficult one. It is hard to satisfy himself or his patient that he is doing the best which can be done, in following an almost unvarying treatment week after week, whilst little progress seems to be made towards the wished for end. It is still more difficult to persist when the patient appears to lose ground, as will now and then be the case after some imprudent exposure,

which causes a relapse from which recovery is even more slow than before. The temptation to try other remedies is nearly irresistible; some other course seems imperatively called for. But I am satisfied, from careful and long observation, that it is better in these instances to persevere in a course which experience has justified, as, we may say, invariably successful; particularly if, in some respects, its effects have seemed beneficial, and the patient has for a time improved; rather than to try one remedy after another, in a hopeless attempt to effect a *rapid* recovery. This need not prevent our substituting, temporarily, other collyria, or the use of lotions or other applications of little potency, with a view to keep the attention of the patient occupied, and lead him to feel that the physician is using every means he thinks likely to be of service.

In preferring the crayon of the sulphate of copper to solutions of nitrate of silver, I am far from wishing to undervalue the latter, or to advocate any merely routine treatment. But comparative experiments have proved, for me, that the sulphate of copper will accomplish everything which can be effected with the stronger remedy; and as it does not destroy the tissues, as is sometimes done by the nitrate to such an extent as to cause adhesion of the entire lid to the globe; or produce indelible stains, which often ensue when lunar-caustic is employed for a considerable time; it certainly seems advisable to prefer a reliable and less

dangerous agent than the nitrate must be admitted to be. Having charge, at one time, of a large number of ophthalmic patients in one of our public institutions, comprising many cases of chronic granulation of the lids, — I repeatedly experimented, comparatively, with the two remedies, applying the crayon of sulph. cupri to one eye, and solutions of argent. nit. of various strength, to the other eye of the same patient. Of course no differences of constitution or habits could influence the result; but I believe in every instance recovery was more rapid in the eye to which the crayon had been applied, and in some instances it was necessary to substitute the crayon of copper for the nitrate of silver before any improvement could be effected.

PURULENT CONJUNCTIVITIS.

This variety of the same class of inflammations of the conjunctiva, known also under the name of Egyptian Ophthalmia, Ophthalmia of Armies, &c., differs from the catarrhal form rather in the virulence of its contagion and the extreme rapidity of its course, than in any radical dissimilarity of nature.

Causes. — It is caused by direct contagion, by exposure to glare of light, to winds charged with fine sand, and especially by the influence of cold at night after such exposure and great fatigue during the day. Perhaps, also, the crowding together of large numbers of men in ill-ventilated barracks, or of children

in foundling or other hospitals, may induce the disease, where others who are affected occupy the same apartments, even without direct contact. This last supposition finds some support in recent experiments which are said to have detected the presence of pus in the air of such localities where the disease existed.

Some military authorities, especially in Belgium, where the disease is endemic in certain garrisons, have denied the virulent properties of the secretion, even going so far as to introduce it into their own eyes; but the evidence in support of the doctrine of its contagiousness is too strong to be set aside by a few negative facts.

Symptoms. — In a very short time, even a few hours after its invasion, the lids become enormously swollen, and often livid, the disease not only causing great thickening of the conjunctiva, but implicating other tissues of the lid. The upper lid is sometimes so much enlarged as to cover the lower lid and rest upon the cheek. Chemosis, or infiltration of the sub-conjunctival cellular tissue covering the globe, is usually present, — at first serous in its character, but afterward becoming phlegmonous, as the cellular tissue becomes itself inflamed. The secretion is very copious, and has more of a purulent character than in the catarrhal form of conjunctivitis. Being confined by the swollen lid, it gushes out in large quantity when this is raised. The sensation of having

sand in the eye is intensely acute, and is often accompanied with circum-orbital pain, from the extreme distension of the tissues, and, perhaps, from commencement of disease of the cornea.

Prognosis. — The disease requires prompt interference; otherwise there is danger that sloughing of the cornea may occur from strangulation, its proper nutrient supply being cut off; or that more or less extensive ulceration, with its consequences, may take place.

Treatment. — Cleanliness is a cardinal point in all the muco-purulent affections of the conjunctiva. The secretion should not be allowed to accumulate within the lids, — as it is highly irritating in its character, and appears to macerate and soften the cornea. If it does not freely escape upon opening the lids, the nozzle of a syringe should be introduced beneath the swollen lid, and the orbital cavity cleansed, alternately with pure water and with a suitable collyrium. In doing this, the operator should take care that no drop of liquid is thrown into his own eye. Collyria, of somewhat greater strength than those required in catarrhal inflammation, should be frequently used, and, if necessary, as is generally the case, should be injected by means of a syringe, that they may come in contact with the whole of the diseased surface; but they should not be so strong as to cause smarting for more than a few minutes after their application. The other eye should be carefully protected, if only one is attacked.

The crayon of sulphate of copper may be applied twice in twenty-four hours, introducing it beneath the swollen upper lid, which it is almost impossible to evert. If perforation of the cornea is threatened, the iris should be put under the influence of atropia, except when the ulceration is near the edge of the cornea. Local depletion, by leeches applied to the temple, or, in patients who cannot afford the cost of leeches, by cupping, and derivation by means of an active cathartic and hot pediluvia, are proper; but these measures should be pursued to only a moderate extent.

The application of the crayon of nitrate of silver, or of a strong solution of the same, has been recommended by authors, with a view to change the character of the inflammation, and substitute a simply traumatic for a virulent form. But I have not seen the expected advantages follow this plan of treatment, nor do the published results speak very strongly in its favor. The same is true as regards extensive scarifications or excisions of the chemosed conjunctiva. If absolutely required, to relieve the cornea from commencing strangulation, the scarifications should radiate from the cornea outward, and should not be so numerous as to involve excessive subsequent congestion of the conjunctiva for the accomplishment of their own repair.

Observations of the course of catarrhal conjunctivitis, and of that form which affects new-born in-

fants, do not encourage the use of extreme measures in the disease we are now considering; and I have obtained better results from the plan recommended for the catarrhal form, more closely followed up, — combined with the greatest precautions as to cleanliness, — than I ever saw from treatment intended to exterminate the disease by substituting another train of symptoms of an assumed traumatic form.

The subsidence of the more active phenomena often leaves behind an extremely granular condition of the lids. This, as also any other pathological change which may have ensued, is to be treated according to the rules given for similar conditions following catarrhal inflammation. The granulations should be actively followed up with the crayon of sulphate of copper and a mild collyrium, that they may be removed before they have time to injure the transparent cornea.

This form of disease has fortunately been of very rare occurrence with us; but, as in other countries, when it makes its appearance in institutions where large numbers of soldiers, children, or paupers are congregated, it is rapidly communicated from one to another, and often causes the loss of many eyes before its ravages are checked.

GONORRHŒAL CONJUNCTIVITIS.

The affection resulting from inoculation with gonorrhœal matter is even more violent than idiopathic

purulent conjunctivitis. It comes upon the eye with terrible suddenness, a few hours after infection, and the cornea may be totally destroyed and vision hopelessly lost in a few hours more. I have myself seen a patient who had lost both eyes, from sloughing of the cornea, within less than forty-eight hours from the time of inoculation, which was distinctly traced; and instances are recorded where even a less time has been sufficient for this irreparable mischief.

It is more frequent in males than in females, the pestilent secretion being much more likely in them to be conveyed from the genitals to the fingers and thence to the eyes. It is usually confined to one eye, at the outset; and subsequently, unless the discharge from this is carelessly allowed to enter the other eye.

The swelling of the conjunctiva, sub-conjunctival tissue, and all the textures of the lids, proceeds with great rapidity, the skin of the lids becoming livid from distension. This is accompanied by a copious thin secretion, of a straw color, or sometimes a slightly greenish tint. The chemosis is phlegmonous, and its effect on the vessels supplying the cornea, with the retention in contact with it of the morbid secretion, causes a loss of vitality in that tissue, showing itself in ulceration or in the formation of a slough, involving a part or the whole of its extent, and penetrating more or less deeply. In some instances, this process of disorganization occurs

in the whole circumference of the cornea, and it is thrown off in one mass. When ulceration or sloughing is taking place, we observe a dirty, sanious discharge mingled with the purulent conjunctival secretion.

Prognosis.—Notwithstanding the formidable nature of the disease, there is still hope of recovery so long as extensive perforation of the cornea has not taken place. Even hernia of the iris, through a perforation of limited extent, is not necessarily fatal to vision, or even to the good appearance of the globe. The cloudiness attending a partial loss of vitality may be resolved, and the scar resulting from ulceration is after a time nearly or quite absorbed. But where the whole cornea has perished, there can be no hope of vision; and, as a general rule, protrusion of the iris and lens ensues, forming staphyloma.

Treatment.—The means to be adopted are, first, to keep the other eye from danger of receiving any of the poisonous secretion; next, to insure absolute cleanliness in the diseased eye by frequent removal of the accumulated discharge. To effect this, water may be injected from a small syringe, its nozzle being passed well up beneath the overlapping lid. These injections may be alternated with others containing mild astringents; of which borax, sulphate of zinc, or alum are to be preferred. The application of a crayon of sulphate of copper may be combined with the use of these means, if the symptoms are violent. Should

haziness of the cornea be observed, it will be well to maintain dilatation of the pupil by the use of a solution of atropia or of extract of belladonna, that hernia of the iris may, if possible, be prevented from occurring, should perforation take place.

Leeches may sometimes be of service, as also the use of cathartics; but we have seldom time for obtaining the effect of other internal remedies, even were they indicated, during the acute stage of the disease.

After the extinction of the severer symptoms, a collyrium of borax may sometimes be usefully alternated with the more astringent solutions. The granulations, always exuberant in and subsequent to this disease, should be removed by a continued use of some of these collyria, especially a solution of sulphate of zinc; aided by daily touches with the crayon of sulphate of copper.

Should hernia of the iris occur through an aperture in the cornea, while the disease is yet at its height, or during the decline of the symptoms, it is often good practice to snip off the small protruding portion, close to the cornea, with curved scissors; in order to prevent an increase of the ulceration and hernia from constant traction of the lid upon the portion of iris already projecting.

CONJUNCTIVITIS OF NEW-BORN CHILDREN.

The symptoms are usually observed within four or five days after birth, though they may declare them-

selves at a later period. A slight red line along the centre of the upper lid is often the first indication of disease. This is followed by the discharge of a little mucous secretion, and if the inside of the lids is then examined, their conjunctival lining is seen to be red and swollen. If the disease is allowed to go on, the tumefaction rapidly gains ground, the upper lid swelling to such an extent as to cover the lower and rest upon the malar prominence. The amount of secretion is astonishing, — and as it is retained by the occlusion of the lids, it gushes out in large quantity whenever these are opened, even if at short intervals. Half a teaspoonful or more accumulates within a few minutes in some aggravated cases.

In these young and delicate subjects there is great danger of partial or total destruction of the cornea, and constant vigilance is required to avert this misfortune. It should also be borne in mind, that haziness and even perforation of the cornea may come on at a late period of the disease, and even after great improvement has taken place in the other symptoms, — the cornea having resisted to a certain point the pernicious influences which threatened it, but at last having given way.

Causes. — The presence of a leucorrhœal, still more of a gonorrhœal, discharge in the mother, seems to be one of the causes of this affection ; some of the secretion finding its way into the eyes during the transit of the child through the vagina, or upon its

first opening them after birth. Other irritants, such as soap or alcohol, used in cleansing the child, may also perhaps excite the disease if they come in contact with the eye. Cold is apparently a frequent cause, especially if acting conjointly with those first mentioned. Exposure to bright light has been supposed to induce the disease, but this is doubtful.

Prognosis. — Scarcely any disease has a greater tendency to an unfortunate termination, if neglected, or even if over-treated. When left to itself, the accumulating secretion seems to soften the cornea and hasten its destruction, and if harsh means are used there is equally danger of an unhappy result, the inflammation of the lids being kept up by the excessive irritation thus created, till the cornea gives way. But a mild treatment, especially if commenced early and pursued with vigilance, is almost certain to be effectual. Even if haziness of the cornea has begun to show itself, we need feel no uneasiness, if the other symptoms are assuming a favorable aspect, as the transparency will be restored within a short time. If perforation, with hernia of the iris, has actually happened, our prognosis must be guarded ; but cases occur where even this condition is recovered from, — the only remaining traces of disease being adhesion of a portion of the edge of the pupil to a small cicatrix of the cornea, — the rest of the margin of the pupil remaining free.

Treatment. — The most watchful and constant at-

tention is required, from the outset, in this disease. If attacked early, it may be extinguished with little difficulty, and the physician himself, as well as the friends of the patient, escape the anxiety attendant upon the progress of so grave a malady. No apparent mildness of the symptoms should throw the physician off his guard and lead him to neglect such an examination of the eyes as may satisfy him of the integrity of the cornea. Practitioners of experience, particularly those who had never met with other than mild cases of this affection, have been deceived by a certain amount of decrease of the severer symptoms, — to discover, too late, that insidious mischief had destroyed the cornea whilst they flattered themselves that all danger was past.

The swollen state of the lids renders it difficult to obtain a view of the cornea without the assistance of an elevator. This may be employed without risk of injury. If the physician is not provided with this instrument, he may make one by bending half an inch of the handle of an old-fashioned thin teaspoon to a suitable curve, or a common probe may be doubled to the shape of a hair-pin and the rounded end then bent flatwise, to form an elevator. Either of these will generally raise the lid to a sufficient extent to permit a view of the cornea, but the first is the better of the two, as the bent probe allows the tumefied conjunctiva to prolapse between the sides of the impromptu elevator, whereas the other draws all the tissues before it.

As before remarked, many cases are ruined by undue activity in treatment. Strong irritants, of whatever kind, are almost invariably hurtful. On the other hand, the consequences of ignorance or neglect on the part of parents and nurses present themselves with melancholy frequency. Reliance on inefficient remedies, such as breast-milk, or the application of poultices; or want of proper attention to cleanliness, have brought a pang to many a mother's heart, who finds her child doomed to hopeless blindness.

The eyes should be kept clean. However often attention may be called for, it must be rendered. As a general rule, a syringe is requisite, in severe cases, to insure thorough removal of the discharge. Its nozzle is to be carefully insinuated beneath the lid, and the injection may then be made with gentle force. Care must be used by the operator, that the ejected fluid, mixed with the virulent secretion, does not touch his own eye, as instances are known where the accidental spirting of a drop into the eye of the physician or nurse has given rise to purulent conjunctivitis and occasioned the loss of vision.

We may employ conjointly, as injections, lukewarm water, and a solution of alum of five grains to the ounce. They should be used, alternately, as often as required to keep the eyes free from any accumulated discharge; once in two hours, hourly, or even every half-hour during the daytime,—according to the

severity of the case. Two or three times during the night will generally suffice. A little simple ointment or rose-water ointment may be applied along the edges of the lids, to prevent adhesion during the night and allow the discharges to come away more freely. The injections may be replaced by the dropping of a little of the collyrium into the eyes, whenever the lids are, or become, so little swollen as to permit this to be done. Its use should still be frequently repeated, that a constant effect may be kept up on the conjunctiva, and it should not be entirely given up till the lids have for some time had a healthy appearance, and the discharge has ceased.

Other mild astringents may be substituted for the alum solution, if the physician sees indications for so doing; but this should not be hastily or inconsiderately done because immediate amelioration of the symptoms is not observed under the treatment already advised. Improvement must take place gradually, and is not to be hastened by frequent changes of remedies. If the physician decides that a different collyrium is desirable, he may employ the sulphate or acetate of zinc, the solution being of the strength of from one to three grains to the ounce. In sluggish cases, a gentle application of the crayon of sulphate of copper to the inner surface of the upper lid may be very serviceable; but this is to be regarded as only exceptional, and very rarely called for.

The nitrate of silver, whether in substance, solution, or ointment, should be avoided, as being less safe and less frequently useful than the means I have described. It and other very stimulating applications have done vast mischief in cases of this affection. The use of lead, in any form, is not to be thought of. Solutions containing bi-chloride of mercury, formerly recommended by good authority, but not now approved of, and all the mercurial ointments, should not be made use of, as they are likely to prove too irritating.

When the cornea is implicated, even to the extent of only a slight haziness, it is best, as a precaution, to instil into the eye, once a day, a drop of a solution of sulphate of atropia, one or two grains to the ounce, as we thus diminish the risk of extensive adhesion of the iris and closure of the pupil, in case perforation of the cornea should unfortunately occur. Should the child be feeble when the disease declares itself, it is important to inquire as to the quantity and quality of its nutrition ; as, if its nurse is unable to give it a proper supply, another should be obtained without delay.

PTERYGIUM.

This disease consists in a morbid growth, situated in the conjunctiva and the subjacent cellular tissue, having its origin most frequently at the inner angle of the eye, and gradually extending itself towards and

upon the cornea. Sometimes a second pterygium extends from the outer canthus; and in a few cases other growths have been met with over the situation of the superior and inferior recti muscles. Both eyes are frequently, but by no means invariably, affected.

The disease is very rare in landsmen, but is extremely common in mariners who have been much in hot latitudes.

At first it seems scarcely more than a fasciculus of vessels, but finally becomes a broad wing or wedge-shaped band, of fleshy or even fibrous appearance. Its progress is usually very slow, and, having reached the edge of the cornea, it is usually arrested for a period more or less long, before beginning its march upon the closely investing epithelial layer of the cornea. After advancing a little distance upon this tissue, however, it goes on more rapidly, and I have seen it (though very seldom) extend so far as to partially cover the pupil and interfere with vision.

In some patients the disease causes scarcely any inconvenience; others are liable, when exposed to cold or wind, to inflammation of the morbid growth and the surrounding portion of the conjunctiva.

Mere fasciculi of vessels, terminating in a small aphthous papule, — or an unusual development of the vessels of the inner canthus in some persons, — or small, round, yellowish deposits termed Pinguecula, often seen beneath the conjunctiva, near the inner

margin of the cornea, must not be mistaken for pterygium, as these are harmless, or at most require but the mildest local remedies.

Treatment. — The morbid growth is to be divided, and the half next the cornea carefully removed; taking care that every connecting fibre, throughout the whole breadth of the band, is cut off. The surface of the sclerotica should be exposed, clear of diseased tissue. It is not necessary to remove that portion of the growth which is towards the caruncule, as this seems to disappear after a part has been excised. If the disease has invaded the cornea, it is to be carefully dissected off with fine instruments; removing all trace of the pterygium, but impinging as little as possible upon the corneal substance.

Cauterization does not accomplish the extirpation of pterygia, unless a more active caustic is employed than can be used without endangering the eye. Weaker applications of this nature are more likely to stimulate than to arrest the morbid growth, and their repeated use, from which alone any success could be expected, would prove far more painful and troublesome than the operation as above advised, which effects a radical cure. The disease scarcely ever returns after having been thoroughly excised.

ECCHYMOSIS OF THE CONJUNCTIVA.

Extravasation of blood, from a ruptured conjunctival vessel, is a not infrequent consequence of slight

blows, exposure to high wind, or such trifling exertions as coughing, sneezing, &c. The effusion may be small in amount, or may be sufficient to extend completely around the cornea, spreading itself between the conjunctiva and sclerotica. The accident is unimportant, except from the disagreeable aspect it gives to the patient; as it spontaneously disappears in a short time. But as the person is naturally anxious for a prompt recovery, we may endeavor to aid the absorption of the blood by a mild astringent collyrium, or by lotions with infusion or diluted tincture of arnica. If the hemorrhage is still going on, we should check it by laying cold wet compresses over the eye. As the effusion is removed, the color becomes lighter, and a yellowish appearance takes the place of the bright red hue in the ecchymosed patches, to be exchanged for the natural white of the sclerotica as absorption is completed.

ŒDEMA OF THE CONJUNCTIVA.

Watery effusion beneath the conjunctiva often occurs where the lids are the seat of erysipelatous inflammation, small abscesses, or boils. In these circumstances it is unimportant, but subsides with the decrease of the primary disease. It is also observed in a marked degree, often very early, in cases of phlegmonous inflammation of the eyeball, and is a symptom of very unfavorable import when thus occurring accompanied by severe pain. The same phenomenon,

under the name of serous chemosis, is also attendant on some cases of conjunctivitis, though it is not to be mistaken for the graver symptom termed phlegmonous chemosis which supervenes in purulent forms of that disease. But it seldom requires attention, *per se;* our efforts being directed to the removal of the disease on which it depends, with full confidence that the œdema will vanish as the other symptoms subside.

MORBID GROWTHS FROM THE CONJUNCTIVA, CYSTICERCI.

Small warty or fungous growths are now and then developed from the conjunctiva, and cysticerci have, very rarely, been seen lodged beneath it. Excision may in all these cases be safely and readily performed.

DIPHTHERITIC INFLAMMATION OF THE CONJUNCTIVA.

Though happily this disease is rare among us, and seems to be common only at Berlin and in Holland, whilst almost unknown in England and France, yet it does occur here, and may become more frequent.

It prevails at the cold and damp seasons of the year, and oftenest affects children of from two to eight years of age, though adults may be attacked. Its invasion is rapid, a few hours sometimes sufficing to produce enormous tumefaction of the lids. They become hard and stiff, and can be everted with difficulty, owing

to the infiltration of the conjunctiva and sub-mucous tissue with a fibrinous exudation. Chemosis exists beneath the conjunctiva of the globe, which shows here and there dots of extravasated blood. This chemosis is not serous, but is made up of the same fibrinous material which gives hardness to the lids, and its pressure upon the vessels interferes with the free circulation of blood.

The secretions are at first dirty grayish and watery; afterwards they are mixed with pus globules and fibrinous fragments; differing widely from the discharges in muco-purulent conjunctivitis.

On everting the lids, they are found lined with a firm, fibrinous mass, which is, perhaps, separated at its edges while still adhering firmly to the central portion of the lid. If detached with forceps or otherwise, slight hemorrhage follows. This false membrane is very rapidly reproduced, and may acquire a thickness of two or three lines in twenty-four hours.

The principal danger arises from the liability to extensive and intractable ulceration of the cornea, — produced by interruption of its nutrition and by the action of the acrid secretions.

Very frequent use of slight astringents, with continuous cold external applications, and cleansing the eye with mild fluids injected from a syringe, has proved more serviceable than active cauterization with nitrate of silver or other powerful remedies.

Contraction of the conjunctiva and tarsal cartilage,

and consequent entropion, is liable to ensue from the degeneration caused by this disease.

A constitutional predisposition to this rare affection seems to exist in some families, and I have seen several children successively attacked on reaching a certain age.

After convalescence, more than usual precautions should be taken against too early and long-continued use of the eyes, lest symptoms of asthenopia from loss of accommodative power should manifest themselves, as is often observed among the sequelæ of diphtheria.

CHAPTER V.

AFFECTIONS OF THE LACHRYMAL ORGANS.

These diseases are assigned a place next to those of the conjunctiva, because the parts affected have an intimate connection with it, as well as a similar anatomical structure and analogous diseases to those of this membrane.

Obstruction to the free conveyance from the eye of the tears and other secretions may occur at various points of the lachrymal passages. I commence the description of these affections with those departures from the normal condition which have their seat nearest the eye.

The puncta lachrymalia, or minute openings of the canals by which the secretions are conveyed to the lachrymal sac, are sometimes everted, in consequence of a thickened or of a relaxed state of the conjunctiva. In this position the tears can no longer be taken up by capillary action, and, if the eversion continues for any length of time, the orifices are liable to become closed. In some instances we may keep these open by occasional dilatation with a probe having a fine point but slightly increasing in size at a short distance from the extremity, for such time

as will enable us to correct the abnormal condition of the conjunctiva and bring the edge of the lid and the lachrymal orifice once more into a proper position in regard to the globe. If permanent elongation of the lid, or ectropium, has caused the eversion, the lachrymal punctum and canal may be slit up to such a distance as will allow of the absorption of the tears; this little operation causing only slight pain, and giving rise to no inconvenience; or, if required by the extremely relaxed state of the parts, a V-shaped portion of the centre of the lid, including its whole thickness, may be excised.

The same causes which induce catarrhal inflammation of the conjunctiva, similarly affect the lining of the lachrymal sac and of the duct leading from it to the nostril. Even a slight degree of thickening of the lining of these passages diminishes their calibre, to such a degree that the patient cannot walk or ride in a cold wind without being annoyed by the trickling of tears upon the cheek. Further progress of these changes causes the secretions to accumulate in the sac, giving rise to discomfort from distension; but the contents may still be pressed downwards into the nose by placing a finger upon the tumor and using some force. If the morbid process advances a step further, the duct becomes yet more obstructed, and the sac begins to pour forth a thickened secretion which offers another obstacle to free evacuation downward through the duct. This condition of things may remain

chronic, the patient being still able to discharge the contents of the sac upwards through the puncta, by pressure with the finger, even when he can no longer cause it to pass downwards. Relief of the sac in this manner may require to be repeated several times a day, yet the patient may have no great discomfort from the existence of his infirmity.

But acuter symptoms are liable to supervene upon slight exposure, and the case is transformed suddenly into one of active inflammation of the sac. The distention becomes excessive, accompained by intense pain arising from the unyielding fibrous structure of the sac. The swelling extends to the neighboring parts, causing so much tumefaction of the lids and cheek, with chemosis or œdema of the conjunctiva, that the case is often mistaken, by the inexperienced, for an erysipelatous attack. The history of the commencement of the swelling, and its great prominence and hardness in the region of the sac, are sufficient guides to a right diagnosis. The eye is often closed from infiltration of the lids, and the patient cannot obtain an instant's repose on account of the agonizing pain.

If the inflammation is allowed to take its course, the sac gives way, the accumulated pus is diffused beneath the skin, and finally makes its way to the surface, forming true fistula lachrymalis.

The severe symptoms subside when the abscess has been opened, either spontaneously or by the lancet,

and in some instances the fistula spontaneously diminishes to a minute orifice, through which, now and then, a drop of secretion is discharged; the sac returning in other respects to its healthy condition. In other cases the opening closes, and the sac continuing in a morbid state, renewed acute attacks occur, followed by the same train of symptoms.

Treatment. — The treatment of affections of the lachrymal passages must be as varied as their different degrees. In the outset, little difficulty is experienced in their management, if gentle measures are perseveringly employed. When we are uncertain as to the perviousness of the duct, or wish to ascertain the probable amount of thickening of its lining, it is desirable to make an exploratory injection, by throwing a little warm water from Anel's syringe through the lower punctum into the sac, whence, if there be no obstruction, it will pass readily through the duct and be felt in the nostril or throat. If we find little impediment to the free passage of this injection we may hope to remove the symptoms, even when they have become quite annoying to the patient, by the use of remedies adapted to improve the condition of the conjunctiva and the lachrymal passages. The conjunctiva is most frequently affected to a certain extent, and it is important to restore its healthy character simultaneously with that of the lachrymal organs themselves. A mild collyrium should be dropped into the eye three or four times a day, and

the inside of the upper lid may be touched, if thought desirable, with a crayon of alum every day or two. If the edges of the lids are thickened, and the Meibomian glands diseased, about the size of the head of a pin of an ointment composed of one part of the citrine ointment and five parts of simple or spermaceti ointment may be melted on the end of the finger and applied along the edge of the *closed* lids at bedtime. Such a collyrium and ointment, thus used, are often sufficient to effect a cure, the remedies being carried by the tears into contact with the lining of the sac, thus acting directly upon it, while the fact that the internal membrane of the sac and duct is continuous, as we may say, with the conjunctiva, causes it to participate indirectly in any improvement which is brought about in the condition of that tissue. Of course the patient should be careful to avoid exposure to vicissitudes of weather, and should be prudent even as to long-continued use of the eyes.

If the morbid process has advanced so far that a tumor is formed from accumulations within the sac, it should be reduced by emptying the sac by gentle pressure; especially previous to the application of remedies. The pressure should be made downward, that the passage of the collected tears and mucus may assist in maintaining the perviousness of the duct. If an occasional stoppage should occur it may often be overcome after the parts have been relaxed by the application of warm fomentations for two or three hours.

When the sac can no longer be emptied downwards, our chance of restoring the natural condition of the duct by gentle measures is materially lessened. But, if we are able to bring the conjunctiva and the lining of the sac into such a state that no unhealthy secretion shall be formed, the patient is rendered comfortable, and may go on with his pursuits for years, if he chooses so to do, with no worse infirmity than the being compelled to press upward the fluid contents of the sac, perhaps two or three times a day. But if it is considered expedient or desirable to attempt a radical cure, it can only be accomplished, in this stage of the disease, by mechanical means. We are able, however, to resort to measures much more effectual, and less barbarous, than those formerly in vogue. No excuse now exists for the insertion of canulæ or styles, nor for a resort to the introduction of Gensoul's sound from the nostril into the lower extremity of the duct. The tubes and styles were occasionally a temporary relief, seldom a lasting benefit. If the canula was inserted and the skin allowed to close over it, it frequently caused abscess and caries of the bone, after having been worn for some time in comfort, and I have repeatedly had occasion to remove them on this account. If the style was worn with its head exposed, it was disagreeably conspicuous, — the relief while worn was often very slight, — and if taken out at the end of a year or two, there was no certainty that fresh attacks of inflamma-

tion might not declare themselves. The passage of a sound from the nose involved the necessity of submitting to its presence for a considerable time at each repetition, in the hope of effecting dilatation; it was quite painful, and has long since been condemned by the authorities of most experience, as practically ineffectual, though theoretically it seemed to promise good results.

Formerly, the only other means employed for removing obstructions of the duct, were the fine probes of Anel, which were often too delicate to effect a passage; or, if successful in this, made an opening so small that it became speedily reclosed. The plan proposed by Mr. Bowman of London, of enlarging the punctum, so as to admit of the use of even a common-sized surgical dressing-probe, has superseded all other methods in the majority of cases. He observed that the lachrymal canals were of sufficient size to admit of the passage of a large instrument, provided this could be passed through the punctum. Experiment proved that the punctum might be divided and the canal slit open, even as far as the sac, if required, without subsequent inconvenience. Generally, the orifice only, needs to be enlarged, and this may best be done by inserting the point of a fine pair of scissors to the distance of about a line, and dividing the ring surrounding the opening by a quick stroke. The surgeon should be provided with various-sized probes, and if he finds difficulty in intro-

ducing one of large diameter he may begin with a smaller, gradually increasing the size till he arrives at the dimensions he desires. The only point at which he is like to encounter difficulty is at the junction of the canal with the sac, and, if he finds it impossible to overcome this stricture, it may be divided by a minute knife intended for the purpose, or may even be laid open, with the entire length of the canal. Having entered the sac, the extremity of the probe is to be directed downwards, and pushed, with gentle force, through the duct into the nose. It is well that the probe should not be too inflexible, and it should be slightly curved from a straight line, near the point, that the orifice of the duct may be readily found and its direction conformed to. Some hemorrhage may occur at the time the probe is first passed, and even at subsequent repetitions; but it is only of importance as enforcing the necessity of gentleness in manipulation, as it does not seem materially to retard the cure, if not too copious. It probably arises from slight laceration of the mucous membrane lining the sac or duct, by the extremity of the probe.

It is well to repeat the introduction of the probe, after two or three days' interval, that the passage may not have time to close. The same manœuvre will need to be several times performed, in order to insure permanent good results; perviousness of the duct being maintained by these artificial means, until we judge that its lining has had time to regain a

healthy condition. The probe is passed with more and more facility each time it is introduced.

When an acute attack declares itself, either in those who have long been subjects of chronic inflammation of the sac, or in others, we are to lose no time, if we hope to obtain resolution of the symptoms without the formation of abscess. Formerly, if the application of a leech and warm fomentations did not afford relief, no other resource was believed to be left but to puncture the abscess, and end the patient's sufferings by giving exit to the distending fluids. I have pursued another course with great advantage. If the application of warm fomentations does not soon diminish the sensitiveness, and relax the parts sufficiently to allow of evacuation of the sac by pressure, I introduce a fine probe through the punctum into the sac, which, by bringing the canal into one straight line, generally allows the pus to escape along the side of the probe, or immediately upon its withdrawal, especially if gentle pressure is at the same time made. The discharge of even a small portion of the accumulated matter gives immense relief, by taking off the tension of the parieties of the sac, and the probe may often be inserted a second time, and the evacuation completed with little pain. Where the parts have become so exquisitely tender that the slightest touch cannot be borne, it is desirable to produce insensibility by the administration of ether by inhalation, before proceeding to the intro-

duction of the probe. It is but rarely, however, that ether is required. Should it be impossible to find the opening and introduce the probe, the punctum and canal may be laid open, or the sac itself entered from this direction, with a very narrow knife, rather than to allow the abscess to take its own course, or to relieve it by puncture through the skin.

Having afforded relief to the urgent symptoms, we may wait for the subsidence of the exalted sensibility of the parts before attempting measures looking to a radical cure. We should then pursue the plan already indicated for restoring the pervious condition of the duct.

When fistula lachrymalis has already formed, previous to our seeing the patient, it is well to take advantage of the abnormal opening through the skin for the dilatation of the duct. A large probe may generally be passed into the sac, though in some cases only after patient endeavors to find the internal fistulous aperture. It is then to be carried through the duct. The fistula should be kept open, while required for the purpose of dilatation, by inserting a tent formed of a strip of muslin or fine cotton, not more than a line in width; which is to be moistened, pushed through the whole extent of the fistula upon the point of a probe, and left in place until the next day, when the duct is to be again explored, and another tent introduced. After a few days the tent may be discontinued, and the fistula left to itself. Should it

close entirely, we may treat the case as if it had not existed; passing the probe, if required, through the punctum; but not renewing operative proceedings till the sac has had a short time to recover itself from the inflammation it has undergone. Should a minute fistulous opening persist, it is better to leave it, for a while at least, as a sort of safety-valve; as, if the duct is in a normal state, the tears will seldom escape through the fistula, and, in case of any tendency to a fresh attack, it affords a vent for the secretions, and obviates the dangers which arise from distention. But its almost capillary orifice may at any time be closed by refreshing its edges with an actual cautery in the shape of a hot needle, when the proper moment for its obliteration appears to have arrived.

I have recently devised what I have found a very useful modification of Bowman's probes. Instead of being throughout of the same calibre, I have them made with bulbous extremities of the six sizes of Bowman's scale, but with the third of the probe nearest the end much more slender than the remaining portion. This gives a flexibility which enables the probe to conform itself to the direction of the lachrymal duct, and obviates to a great extent the tearing of the mucous membrane, which is almost unavoidable where the ordinary probes are used, even where an attempt has been made, by bending, to adapt them to the supposed direction of the passages. The probes should be of alloyed silver, not too pure, that they may have an elastic flexibility without being liable to bend too readily.

CHAPTER VI.

TRAUMATIC INJURIES OF THE EYE.

The management of the various accidents of which the eye may be the subject is of great importance to the general practitioner, especially if established in the country, as cases will come under his notice in which the responsibility of treatment must rest with him, — the patient being unable to go elsewhere for advice. The preservation or loss of vision will depend, in numerous instances, on the course pursued immediately subsequent to the injury.

The error of over activity in treatment is far more common and fatal than its opposite. For instance, in case of an extensive wound of the cornea, — repeated examinations, frequent application of a collyrium, or anything which disturbs the absolute repose in which the cut edges should be left, will tend to prevent union, excite inflammation, and cause loss of the eye, when, if intrusted to Nature, immediate adhesion might have taken place, and all unfortunate results have been averted.

It is only in the rarest cases that any other than local treatment can be employed with benefit. There is in fact, until inflammation and pain shall

have ensued, no more disturbance of the general system than would follow a cut finger, for the cure of which there would be no propriety in employing active measures.

INJURIES OF THE CORNEA AND CONJUNCTIVA.

In treating of simple conjunctivitis, I have already described the mode of disposing of those small particles of iron, cinders, husks of seeds, &c., which so often become impacted in the cornea. Another and far more dangerous injury frequently occurs among reapers, who, in cutting handfuls of grain with the sickle, sometimes brush the heads against the eye, lodging in the cornea a minute particle of the beard of the grain. The serrated edge of this particle of beard rankles in the wound, and induces, if the offending substance is not removed, rapidly destructive ulceration and sloughing of the cornea; so that many eyes are annually lost from this cause. The treatment consists in removal of the source of irritation, and the use of soothing lotions of tepid water or milk and water. Local depletion, by leeches to the temple, and the administration of a purgative, together with stimulating pediluvia, may also be resorted to if the symptoms assume a grave aspect from the lateness of the period at which the patient applies for advice.

It is extraordinary how much suffering may result from the slightest abrasions of the cornea by a scratch

from an infant's finger-nail, the corner of a sheet of paper, or any such trivial cause. This often continues for two or three days, and sometimes, during pregnancy or nursing, for weeks and months. The pain is circum-orbital, as if from connection of the injured part with branches of the fifth pair of nerves, but is attended with, at most, slight injection of the eye.

In the acute stage, mucilaginous lotions, as infusions of sassafras-pith or althea-root, or a collyrium of borax, seem to sheath over the abraded surface and give relief, while the healing process goes on. Long persistence of pain after such accidents is oftenest met with in women who are nursing, and whose system is in a low condition. No trace of disease is visible in the cornea, the slight abrasion of its surface having long since healed. The treatment must here be general rather than local. Tonics, antispasmodics, and good diet are required, and it is sometimes necessary that the child should be removed from the breast if the mother does not find relief after they have been administered for a sufficient period.

Chemical injuries, or burns, are serious in proportion to the extent of their action on the parts. Lime, potash, or strong acids may so far decompose the cornea, that sloughing or an indelible opacity may result; or destroy the mucous surfaces of the conjunctiva of the lids and the globe to such an extent that unmanageable cicatrices are formed, with cohesion of the apposed surfaces.

It is seldom that the case is seen in time for the advantageous employment of any antidote; the mischief is instantaneously accomplished. The eye should be bathed with tepid water, to remove any irritating particles which may remain, and such lotions should be subsequently continued. Should unhealthy ulceration threaten to perforate the cornea, atropia should be used, to prevent hernia of the iris. Where this has actually occurred, but is of small size, and is acted on as a foreign body at each movement of the lids, it should be excised by a quick stroke of fine scissors, on a level with the cornea, thus getting rid of the mechanical irritation caused by friction against it. It is surprising how quickly perforation of the cornea will often heal, when relieved of the constant irritation caused by the presence of hernia iridis. If the lesion of the cornea is not too extensive, vision is often preserved, the iris adhering at some point only to the cicatrix of the ulcer, and the pupil remaining unobstructed. Even where the ulceration resulting from the injury is very extensive, our prognosis must not be too unfavorable if the loss of substance is superficial, and no perforation has occurred; as the cornea has great power of regaining its transparency.

When the mucous surfaces of the lid and the globe nave both been destroyed to any considerable extent, it is important to prevent adhesion, if possible, by bringing together some portions of the wound by

suture, so that two surfaces denuded of their mucous membrane may not be in contact and become united, as they are almost sure to do unless prevented by suitable precautions.

Wounds of the eyelids should also be brought carefully together by suture, that we may not only avoid deformity but prevent any displacement of the eyelashes or the formation of ridges to irritate the surface of the globe.

The cornea is not unfrequently cleanly cut, more or less largely, by explosion of glass bottles or retorts, or the sudden slipping of a knife; or lacerated by a blow from some jagged object; or burst by coming forcibly in collision with some hard body. If the wound is merely an incision, it may be very extensive without of necessity involving any danger to vision; as, for instance, in the operation for extraction of cataract, where one half of the circumference of the cornea is divided. But where an accidental wound involves a large extent of the cornea, it is accompanied by a loss of the aqueous humor, and frequently with hernia of the iris. When no hernia is present, the treatment required is absolute rest of the organ, the patient being placed on his back and directed to keep both eyes closed and as quiet as possible. The eyes may be lightly covered with a bandage, as an additional precaution, and if there is reason to fear that the patient will not follow our injunction to keep his eyes closed, the lids may be

kept shut by confining them with narrow strips of isinglass or court-plaster. The aqueous humor is thus retained in the eye, as a fresh secretion takes place, and the wound rapidly unites. If hernia has formed, efforts should be made to reduce it by gentle friction of the lid upon the globe, or by careful attempts with a probe, and, if the hernia be central, by the use of atropia. If the iris still continue to protrude, like a small sac, between the lips of the wound, it may be punctured with a cataract needle, and, if this does not lead to permanent collapse, a small portion of iris should be excised at the centre of the prominence, with fine curved scissors. This allows the edges of the wound to come into contact and unite. Among my notes of such cases of accident, I find two where the incision (caused in one instance by a broken carriage window, in the other by a fragment of glass bottle) extended across the cornea at its lower third, and some distance into the sclerotica, more than half an inch in all; yet only the lower portion of the iris was involved in the hernia which occurred, and, upon the excision of a small bit of iris, the wound promptly healed, and vision was perfectly restored.

When the wound has more of a contused or lacerated character the prognosis is less favorable; but where the internal parts of the eye have not been too much injured by the accident, we often obtain a good result, or at least preserve the eye in such a con-

dition as would admit of an operation for artificial pupil in case loss of vision should befall the other eye. When the entire globe is involved in the injury, and suppuration ensues, its progress should be favored by fomentations or poultices.

Wounds of the sclerotica are to be treated on similar principles of non-interference. Even if a small portion of the vitreous body protrude, it may be left to itself. But if the protruding mass is so large as to give rise to much friction against the lid, it is better to excise it with sharp scissors than to incur the risk of the dragging out of a still larger portion of the vitreous and retard the union of the sclerotic wound.

Punctured wounds of the cornea and sclerotica are more serious than small incisions; but we often observe great tolerance of these injuries. I have seen a case where the point of scissors, thrown at a young lady, entered the globe at the junction of the cornea and sclerotica, and nearly passed again through the sclerotica at a point half an inch distant, near the inner canthus, pushing the tunics of the globe before it so as to form a small projection instead of a counter puncture; yet the iris and lens escaped serious injury and vision was preserved.

Wounds of the crystalline lens or capsule result in opacity of the lens. If the capsule has been largely divided or ruptured there may be much swelling of the lenticular substance, making it necessary to put

the pupil under the influence of atropia to prevent inflammation of the iris. Where the capsule is thus extensively lacerated, complete absorption of the crystalline may take place, and the opacity disappear from the field of the pupil, without operation. But where only a small opening has been made in the capsule, the wound often closes without giving opportunity for absorption, and the resulting cataract can only be removed by surgical means. The question of operation will be considered under the head of traumatic cataract. Opacity of the lens may also be occasioned by blows upon the eye, producing no obvious external injury, but probably rupturing more or less of the suspensory ligament or preventing in some way the proper nutrition of the lens. I have seen two cases from the same small town, where this result followed a blow from the knot at the end of a whip-lash, received on cracking the whip. Generally, opacity of the crystalline is to be observed within a few weeks from the reception of the blow, and in cases of such injury, the prognosis given should be guarded, the patient being notified of the possibility of such a consequence. In one instance, however, I have seen the appearance of cloudiness delayed for eight years from the time the eye was injured by a stone playfully thrown. The girl was under my care at the time the blow was received, and the chance of the formation of cataract was explained to her parents; but she soon recovered from the immediate effects of the in-

jury, and after many months I considered the danger past. Eight years after, however, cataract made its appearance, and interfered so seriously with her good looks that I removed it by operation, and restored vision as well as comeliness.

Dislocation of the lens may also occur, when the eye is struck by a stick of wood or other heavy body. In these circumstances, the capsule and lens may remain transparent, or opacity may ensue. Instances are now within my observation where this displacement has occurred, and the crystalline, still transparent, changes its place with the position of the head. The patients are able to see on stooping forward, with tolerable clearness; but as the head is brought to an erect position, I can observe the falling back of the crystalline, at the same moment that the patient finds his sight obscured, and vision only becomes good by the aid of a cataract-glass. I shall describe elsewhere a very remarkable case of *spontaneous* dislocation of the lens in both eyes.

When the dislocated lens is thrown into the anterior chamber, lodged in the pupil, or situated so as to press upon the iris, it often creates so much irritation that its extraction becomes imperative. The general rules for the operation of extraction should be followed, so far as practicable; but the relations of the parts are so altered by the violence which has been suffered, that the surgeon must use his judgment in deciding on the method of executing it. The

results of extraction in such circumstances must, of course, be less favorable than in ordinary cases of cataract.

Injuries of the iris, when uncomplicated by the presence of any foreign body, rarely give rise to inflammation. We are able, in our operations for artificial pupil, to lacerate the iris, and even to draw from the eye and excise large portions of its tissue, almost with impunity. But wounds of the iris seldom reunite, and the effect upon vision will depend on their situation and extent; a large fissure in certain parts causing much less visual disturbance than a smaller one in other situations.

Among the most dangerous injuries of the eye are those caused by the penetration of fragments of percussion caps or other projectiles. So very common is the loss of an eye from the entrance of a bit of copper cap, that children should never be allowed to amuse themselves by placing them upon a post or window-sill and striking them with a hammer or stone, or by exploding them in any other way. Small fragments of a cold chisel or other tool are sometimes struck off, and projected with great force into the eye, by a blow from another tool in the hands of stone-cutters or machinists.

The mischief in these cases results from the fact, that whatever is propelled with sufficient force to pass through the cornea, has almost always sufficient momentum to carry it onward to the iris or lens,

and, too frequently, to the very posterior part of the globe; where it excites suppuration and destroys the organ.

Intense pain is often felt at the instant the injury is received; but this soon subsides, and for a day or two — sometimes for several days — the patient has no uneasiness, or next to none. But the practised observer is not deceived by this tranquillity. On examining the eye, he can generally detect the wound of the cornea, already cicatrized; — but beyond this he traces the course of the fatal missile, in perhaps another perforation of the iris behind the slight opacity of the cornea, or in commencing haziness of the lens. Should the foreign body be arrested by the iris, and remain lodged in its tissue, it usually excites so much irritation as to require its removal; but this may generally be accomplished, if undertaken in due season, without material injury to vision. If lodged in the lens, the immediate effect is loss of vision, from the formation of traumatic cataract; but if the wound of the capsule is sufficiently large to permit the aqueous humor to come freely in contact with the lenticular substance, this is frequently dissolved, leaving only the capsule, in which the bit of extraneous substance has become enveloped by a deposit of lymph.

The foreign body may enter through the sclerotica, thus depriving us of the opportunity of tracing its course. But, in the absence of other indications, the

loss of vision is an important sign, in these circumstances, of its presence within the globe.

The course of events varies where projectiles have become thus deeply lodged; — sometimes injection of the circum-corneal zone of vessels, with much deep-seated orbital and frontal pain, will manifest itself within a few days; — in other cases months elapse before these symptoms declare themselves. Now and then these phenomena subside, and the foreign body ceases to be an offending substance, — probably becoming surrounded by an effusion of lymph. Such a favorable termination is, however, exceedingly rare. In most instances, the observer sooner or later perceives an opacity behind the pupil, far back in the eye, — which he recognizes as a deep-seated purulent collection. This has sometimes been mistaken for cataract. It generally comes slowly forward, in accordance with the tendency of matter to make its way to the surface, and at length points, usually at some part of the cornea, bringing with it the foreign body, the cause of all the disturbance.

In most cases we can employ only palliative means; as, however certain the surgeon may be that a metallic fragment is deposited in the eye, he will scarcely feel justified in operating for its removal till sure that it is within easy reach, unless sympathetic inflammation of the other eye is threatened. The patient and his friends cling to hope till the last moment, and can scarcely believe that an eye, which still looks but

slightly affected, can be hopelessly diseased and require an operation by which it must be disfigured. Furthermore, the expulsive process, as accomplished by the efforts of nature, results in less subsequent deformity than is often occasioned by an operation to remove a fragment, the precise situation of which is not known. The use of the ophthalmoscope may, perhaps, place it in our power, in a few instances, to discover the foreign body soon after its entrance, and, after etherization of the patient, remove it by delicate canula instruments, and thus spare him the long period of suspense and uneasiness preceding its spontaneous expulsion, even if we are unable to preserve his vision.

Whilst the deposit of pus is slowly coming forward we may relieve pain by fomentations and lotions, and, if necessary, by the internal administration of anodynes. Whenever the foreign body can be perceived, it is well to operate for its removal, and hasten the final result.

The globe is generally somewhat diminished in size, and the cornea may be more or less changed in aspect, after the throwing off or removal of the intruding substance. If the deformity is slight, no concealment should be attempted; but should it be considerable, it may be masked by wearing an artificial eye.

Among traumatic injuries of the eye we also rank the consequences of a blow in the supra-orbital re-

gion, which is sometimes followed by blindness when the eyeball does not appear to have sustained any harm. Formerly it was supposed that the result was due to injury of the fifth pair; but in many instances examination with the ophthalmoscope, after the accident, reveals some deep-seated lesion of the retina or choroid.

A melancholy consequence often following grave traumatic injury of one eye is the subsequent development of a peculiar form of inflammation of the other globe, which we term sympathetic ophthalmia. Of this I shall treat elsewhere in this work, and will only say here, that this liability forms an urgent reason for watching cases of traumatic injury with scrupulous care, in order that, if mischief cannot be prevented in the injured organ, the symptoms may be palliated, and morbid irritability lessened as much as possible, in the hope of averting the danger of future destruction of the other and healthy eye.

CHAPTER VII.

AFFECTIONS OF THE CORNEA.

The affections of the cornea are some of them less distinctly limited to this single tissue than are those of the conjunctiva. But I shall endeavor to describe several conditions in which, however much it may be complicated with symptoms extending to contiguous structures, the state of the cornea constitutes the primary and essential morbid affection.

The cornea is a tissue of low organization, and its diseases proper have a tendency to slow recovery; much time being requisite for the repair of any loss of substance or of transparency. On the other hand, this same low vitality favors rapid disorganization when acted on by destructive agencies arising from disease of other parts, — as, for example, the virulent secretion poured out in some forms of conjunctivitis, or the continual friction of granulated lids. Several of the diseases of the cornea depend intimately, moreover, on conditions of the general system, and can only be removed by attention to the morbid diatheses which give rise to them. Nearly all these conditions of the system have an asthenic type, — an important fact to be remembered in connection with the struc-

ture of the tissue itself. All of these circumstances require to be taken into account, in determining the question of treatment. If the physician expect to be able to afford the same speedy relief he has often been able to confer in other affections of the eye, — where, perhaps, the symptoms were seemingly much more formidable, — he will often be disappointed; — if he act as a mere specialist, and attempt to gain his object by local remedies alone, his best endeavors will be baffled and the symptoms will persist or increase; — if he resort too readily and freely to antiphlogistics and alteratives, which might be appropriate for subduing an active inflammation, he will often hasten the disorganization already favored by an impoverished state of the circulating fluid and a generally depressed mental and physical condition.

ULCERATION OF THE CORNEA.

Under this head I do not propose to include those ulcerations which are sequelæ of other disease, as, for example, the sloughing ulcer so frequently a result of purulent conjunctivitis, or the destructive ulceration consequent on neglected granulation of the lids. Two series of phenomena occur, where the ulceration deserves to be regarded as the characteristic and only important local feature of disease. These are, the simple ulceration mostly observed in children, and the dotted ulceration now and then met with in children or adults.

SIMPLE ULCERATION OF THE CORNEA.

This disease, with its concomitant symptoms, which form an ensemble frequently described under the name of *scrofulous ophthalmia*, is exceedingly common in children aged from two to twelve years, especially in those of a strumous diathesis, and who are ill nourished, scantily clothed, and exposed to vicissitudes of temperature. Other and more healthy children, not habitually subject to these unfavorable influences, may be attacked, if exposed to cold and damp weather with insufficient protection, — especially during the period of teething.

Ulceration may occur after a small papule on the epithelial covering of the cornea; but it oftener makes its appearance without any such precursory alteration, no other phenomena being observed than very slight injection and lachrymation. No sooner, however, is the ulcerative process established, than we have, in most cases, an accession of more marked symptoms. The child becomes peevish and fretful, refuses food, declines play, exhibits more or less of febrile disturbance, and, if old enough, often complains of severe pain in and around the eye. The intolerance of light frequently becomes so intense that the patient will remain for days and even weeks in a darkened room, covering his eyes closely by day and burying his face in the pillow at night. Even his physiognomy is peculiar, — every muscle on that

side of his face seeming to concur in a strong effort to keep the lids closed, so as to exclude every ray of light. Both eyes are rarely simultaneously affected, but morbid symptoms often alternate, first in one, then in the other.

Much tact and patience are frequently necessary to enable the physician to examine the eye. The child's attention should be engaged, if possible, without his being allowed to suspect that any effort is made to inspect the eye. So doing, after a few minutes we may usually, in a moderate light, obtain a glimpse of the cornea. In mild cases, and when the physician does not intend to make any application to the eye with his own hand, it is a great advantage to accomplish this inspection thus quietly and without a struggle; as, if the child's confidence be thus gained, he will allow any future exploration or treatment with much more willingness, whereas he will be constantly on his defence if violence is used at the first interview. A mere glance is sufficient to allow us to determine whether or not serious changes are going on in the cornea, and this, in connection with the other obvious symptoms, will guide us in adapting our treatment. If the photophobia prevents the child from opening his eyes, the physician may often, by playing with the child and touching other parts of his face, succeed at last in raising the lid, by a quick movement, sufficiently to assure himself as to the state of the cornea. But if the child, from peevish-

ness, previous harsh treatment, or extreme photophobia, resist every attempt to examine his eyes, it is best at once to employ gentle force, if we deem it important to ascertain the exact pathological condition. Where we are confident that the cornea cannot have become profoundly affected, this forcible examination need not be insisted on; at least at the first visit. No danger would be incurred by delay, and we sometimes gain in the good opinion of the child and its parents by not appearing too ready to resort to extreme measures. The mode of proceeding, as I have already explained, is, to have the child held upon the lap of another person, its back towards the surgeon. Its head is then to be lowered between his knees and firmly grasped by them, and the hands of the child being held by the other person, the surgeon has his own at liberty, for raising and depressing the lids. If the cornea is rolled so far upwards that it cannot be seen, the upper lid may be raised still more by means of an elevator. When the resistance of the child has been from wilfulness, he often submits readily enough to future examinations, without a resort to force, after having once experienced the futility of opposition. But, when the intolerance of light is excessive, he cannot exercise sufficient control to permit an inspection of his eyes, however well disposed, — and we are sometimes compelled to repeat the forcible exploration, which, though disagreeable, is not otherwise painful. The amount of pathologi-

cal lesion is often very small compared with the severity of the symptoms.

Examination shows, perhaps, merely a small spot of cloudy effusion in the cornea; or, if the symptoms have advanced a degree further, a smaller or larger excavation of the corneal surface, surrounded or not by effusion gradually shading off in density as the distance from the ulcer increases. There is injection of the circum-corneal zone of vessels; but those of the conjunctiva proper may be only slightly congested. The pupil is often contracted; but the iris exhibits no trace of morbid alteration, and the disease is not to be confounded with iritis, as it often is, on account of the pain, photophobia, or circum-corneal injection, or of the contraction of the pupil. The intolerance of light does not depend on any alteration affecting the integrity of the retina; for the child sees well at evening or in a darkened room, provided the ulceration has not become so extensive as to hinder the free transmission of the rays of light. The photophobia is subject to exacerbations and remissions, and is generally greatest in the morning. In many cases the child is able to open his eyes in the afternoon or evening, but suffers a return of all his symptoms the next morning, to be again relieved as before.

The flow of tears is greatly increased, and their abnormal acridity not only irritates the lining of the nose, but causes disease of the Meibomian glands, and

produces excoriation of the skin of the lids and cheek, often leading to the formation of thick crusts, and constituting one of the pathognomonic features of the disease. No increased mucous secretion, such as accompanies conjunctivitis, is observed.

Inter-laminar effusions of lymph or pus are sometimes formed in the cornea, and these may either be reabsorbed, or may open outwards, forming new ulcerating cavities, or inward, giving rise to hypopion or a collection of matter in the anterior chamber.

After the excavated ulcer has for some time had a perfectly transparent appearance, it is not an unfavorable sign to see its surface become covered with a slight cloudiness, as this is evidence of an attempt of nature to fill and heal the ulcer by an exudation of lymph. This deposit, if it occur, should not be meddled with. But the process of healing may take place without this exudation, — the cornea afterwards exhibiting a slight transparent depression upon its surface at the point where the ulcer had existed. These small saucer-like excavations or facettes are not to be mistaken for actual ulcerations; as they may exist long after all injection or other symptom of ulceration has passed away.

When simple ulcer occurs in adults, its characters are nearly the same as in children. Sloughing ulcer may occur in patients of any age, as a result of chemical decomposition, purulent conjunctivitis, extreme debility, or tension of the globe from inflam-

mation of the entire eyeball. The cornea then takes on an appearance resembling a tough, leathery membrane, and the gangrenous part shrivels and separates from the surrounding tissue.

In two cases, in adults, I have seen the central part of the cornea isolated from the sclerotica by a ring of ulceration, the middle portion continuing almost clear until its nutrition had been entirely cut off, but finally yielding to the morbid process and breaking down into a disorganized mass. The cause, in these cases, was the introduction beneath the lids of an ointment sold by an itinerant vender of quack medicines as a specific for sore eyes. The cases when first seen were beyond the reach of remedial measures.

Prognosis. — Ulcers of the cornea have an unfortunate proclivity towards its central portion; yet, even if of formidable size, they may leave no trace of their having existed, if they do not penetrate too deeply; any temporary opacity disappearing, and integrity of the structure being fully restored. But if neglected, they are likely to affect the laminæ more profoundly, and a cicatrix results which may never be wholly removed by absorption. Even in these cases, however, the opacity diminishes, both in density and extent, as the child becomes older, and, though occupying the centre of the cornea, may interfere but very slightly with vision. Perforation rarely occurs in these cases of simple ulceration,

unless the disease is wholly neglected; and if it take place, the pupil, under skilful management, may be implicated to only a small extent, or all adhesion of the edge of the pupil to the cornea may even be prevented.

Treatment. — Constitutional remedies are of quite as much importance as any local applications. Preparations of iron, of which the solution of the iodide is one of the best, iodide of potassium, cod-liver oil, quinia, and other medicines of similar tonic properties, may be administered, whilst at the same time we enforce the necessity of good, nutritious diet and warm clothing. A laxative may be given with benefit at the outset; but the popular plan of giving frequent purgatives "to cleanse the blood" is often a source of serious mischief; as is also the keeping a child on low diet, or on the unsuitable food which is often the sole nutriment provided for their children by the poorer class of our foreign population. Fresh meat, once a day at least, and bread and milk, are to be substituted if possible for such indigestible articles. Sea-bathing is often of great service, especially to children from the country, and a change to the interior appears to be sometimes advantageous to a child residing near the coast. In fine weather the child should go or be taken out, if the photophobia will allow of this. His eyes should not be covered with thick bandages, but kept cool by exposure to the air; but a large shade may be worn

with advantage, to protect his eyes from bright light. When photophobia exists, the room should be darkened to a considerable extent, and the child encouraged to open his eyes in this subdued light. He must not be allowed to bury his face in the pillow at night, but if asleep in this position he should be carefully turned over, and if his sleep be disturbed by this action, recourse must be had to local or even general anodyne treatment for the relief of the photophobic symptoms, and the increased nervous sensibility, so that he may be able to endure sleeping in a proper position.

As local means, if the child is manageable, we may direct the use of a mild collyrium, of two grains sulphate of zinc, or six grains of borax to an ounce of water, three times a day. But, if a struggle takes place every time an attempt is made to instil this, its introduction becomes so difficult, and its benefits are so far counteracted by the resistance and tears of the child, that its utility is doubtful, and it is better to dispense with any and all collyria. Its place may be supplied by a light touch, once a day, or once in two days, with a smooth crayon of sulphate of copper. This can be introduced beneath the upper lid with little difficulty, notwithstanding the spasmodic contraction of the orbicularis, — the head of the child being held between the knees of the surgeon in the same manner as when making an examination. As one application of this crayon is more

than equivalent in efficiency to several of any collyrium which might be employed, — and as a few days generally suffice for the removal of the extreme intolerance, and for placing the eye out of danger, its application is in reality the mildest course which can be pursued. A light touch of the crayon over the inside of the lid is all that is necessary, the remedy reaching the ulcer as the lid returns to its contact with the globe. After two or three repetitions, the child usually makes less complaint, especially after the urgent symptoms have yielded, and if resistance is still made to the introduction of collyria, and sometimes in any event, the application of the crayon should be continued till convalescence is assured. It is to be considered, in estimating the amount of pain occasioned by the crayon, that the child is in a condition of heightened nervous irritability, — querulous and fretful, and will make great complaint at even a small degree of suffering. That the application is much milder than would appear from the child's behavior will be evident as the disease subsides, as he at length complains for only a few moments after the crayon has been employed, instead of perhaps for several hours as at first. The earlier applications are doubtless more painful than those subsequently made; but at that time, when the disease is at its height, every remedy, even the mildest, causes severe symptoms.

When the photophobia is excessive, a solution of

atropia (gr. i. to the ounce), or of ext. of belladonna, is of great service in mitigating this symptom, and seems to have a happy influence on the general course of the disease. A drop may be put into the eye by means of a camel's-hair pencil, after the crayon has been applied; or once a day where this has not been required. Its introduction after the crayon has been applied evidently relieves the pain caused by its use, or shortens its duration.

In many cases, instead of the method of treatment above described, solutions of atropia may be alone employed, and are an effectual means of relief. This sedative plan is to be preferred to the other in cases where the conjunctiva is only slightly implicated; but should it not be effectual, or should there be much conjunctival injection or mucous secretion, it is best to combine with it an occasional application of the crayon of the sulphate of copper, to which, however, it is seldom necessary to have recourse more than a few times before alleviation of the severer symptoms.

All preparations of lead should be most scrupulously avoided, for the reason, as I have before explained, that they are almost certain to be decomposed, and the lead incorporated with the corneal tissue, forming an opaque deposit.

Counter-irritation, by means of blisters and issues, has formerly been much in vogue, both among the profession and the people. But more recently, the best authorities unite in regarding their value as having

been over-estimated. They are certainly ill adapted to the strumous diathesis belonging to most of the subjects of this affection, and are a great annoyance to children, increasing the irritability already present in a large degree.

I regret that it should be necessary to refer with condemnation to the practice of blowing powders of finely ground sugar, calomel, glass, or even more objectionable substances into the eye, for the cure of strumous ophthalmia. This is still kept up; but can only be regarded as a mode of treatment worthy of veterinary surgery, — to be banished beyond the pale of toleration as regards human therapeutics.

The injection of the conjunctiva does not require special attention. It disappears with the severer affection of the cornea which gave rise to it.

The lids and cheek should be protected from the action of the augmented flow of scalding tears, by smearing a little simple ointment or spermaceti ointment upon the exposed surfaces. Ointment or cerate is better than liquid oily substances, or glycerine, as it is not so readily absorbed into, but retains its place upon, the skin, thus protecting it for a longer time.

Disease of the Meibomian glands often coexists with this affection of the cornea. If much crusting occurs along their orifices, the crusts should be softened with warm water and carefully removed, every morning. The spots most affected along the edge

of the lid, especially if ulcers have formed beneath the crusts, may be touched, at intervals of a day or two, with a pointed crayon of nitrate of silver. About the size of the head of a pin of a suitable ointment is to be carefully applied, with a feather or small brush, along the edge of the lid, after the child is asleep, the ointment being first melted near the flame of a lamp. An excellent prescription for this purpose is the ung. hydrar. nitratis one part, simple or rose-water ointment five or six parts. Two grains of the red oxide of mercury to a drachm of simple ointment or lard is another excellent combination. Only a very small quantity is to be used; as it is better that it should not find its way into the eye. If the crusts are not troublesome, this treatment may be postponed till the more serious symptoms have been disposed of; but the affection of these glands and the roots of the cilia should receive attention at a proper moment; as it is important that all morbid conditions of the eye or its appendages should be removed, as a security against relapses.

As the lining of the nose is frequently made very sore by the constant flow of tears, it may be necessary to soften and remove the hardened crusts which obstruct it, and to apply either simple ointment or a preparation composed by adding to almond-oil enough of a saturated solution of borax to form an emulsion. In some instances, the medicated oint-

ments recommended for the ciliary edges of the lids may be used a few times in the nose with advantage.

Should perforation of the cornea be threatened, the pupil must be placed and kept under the influence of atropia, — that, if this event should occur, hernia of the iris may be prevented. Even a small hernia is not incompatible with a fair recovery. If efforts to reduce it should not be successful, it may be left to itself, if not too prominent; but in case it project so far as to be irritated by every movement of the lid, it should be snipped off close to the cornea with fine curved scissors, as I have already advised.

When perforation of the cornea has resulted from ulceration caused by granular lids or purulent ophthalmia, atropia may be used if the aperture is near the centre of the cornea; but if near the margin, it should generally be omitted, lest it cause further protrusion of the iris.

DOTTED OPACITY OF THE CORNEA.

Another, but rare form of disease of the cornea exhibits itself in the development of numerous minute ulcerations, which give to the surface an appearance like that of ice on which salt has been sprinkled. There is also a resemblance to ground glass; but the variety of disease now spoken of is to be distinguished, I think, from syphilitic disease of the cornea as it

occurs in children and young adults, where a similar appearance is presented, which will be described in another chapter. If examined with a lens of moderate power, a great number of distinct dots of ulceration are observed. These most often occupy the central portion, but they may increase in number till a large part of the cornea becomes nebulous. They do not penetrate deeply. Sometimes the minute excavations seem to be filled with accumulations of foreign matter, giving them a black appearance.

This affection is most frequently met with in persons who are strumous or anæmic, or who are suffering from exhaustion or from disordered menstruation. It is more likely than the simple ulcer to affect both eyes, sometimes coming on in the second when the first has nearly recovered.

Little or no pain is complained of, and the conjunctiva is but slightly injected. There is scarcely any increased lachrymation or intolerance of light.

Prognosis. — The result is generally favorable, but it is not uncommon for the symptoms to increase for a time, until the constitutional condition can be modified, — and they often linger for weeks, and occasionally for months, before the full effect of remedies can be obtained. Patients must not be allowed to despond because they observe a temporary diminution of vision.

Treatment. — Local means bear but a subordinate

part to the general treatment. This should be of a tonic character, with such alteratives as the iod. potass., or with some preparation of iron or other remedy adapted to the indications in each case.

More stimulating applications than those employed in treatment of simple ulcer may be sometimes made use of. Collyria containing wine of opium or acetic acid may be applied, if they do not greatly increase the injection of the conjunctiva. In other instances, the mild astringent collyria advised for simple ulceration prove more advantageous.

Atropia may be employed, if the central cloudiness is so dense that vision is nearly lost, — in order that dilatation of the pupil may allow of the perception of objects, — and the eyes may be kept under its influence until moderate transparency of the cornea is regained.

CORNEITIS OR KERATITIS.

Interstitial inflammation of the cornea leaves the surface intact, but gives rise to deposits among the laminæ. These are apparently effusions of lymph. They seem to be capable of being completely reabsorbed, — of undergoing a purulent transformation, forming small abscesses, which may discharge externally or into the anterior chamber, — or of becoming organized and acquiring a permanent character. The opacity assumes different forms, — the cloudiness being in some cases disseminated, or, as it were,

infiltrated through the tissue, giving it the dull appearance of ground glass; in others, accumulated in distinct masses. In rare instances the cornea assumes a slight reddish tinge, as if everywhere permeated by an abnormal vascularity, and there is sometimes evident bulging, as if from softening of the corneal substance. These appearances are readily distinguished from that thickening of the conjunctival layer of the cornea sometimes termed pannus, where the front of the globe has been for a long time irritated by granular lids.

The vessels of the sclerotica are congested, exhibiting the purplish tint peculiar to them, whilst the conjunctiva remains nearly free from injection. At times, when the opacity is concentrated in a single mass, the sclerotic vessels are enlarged only in the vicinity of the cloudy deposit. This vascularity, as well as the orbital and supra-orbital pain, are similar to the injection and pain observed in iritis; but, though the two structures, the cornea and iris, are very frequently implicated in the same attack, such is not necessarily the case. The absence of evidence of congestion in the iris, and the presence of corneal symptoms, will enable us to form our diagnosis. The pain, too, is less intense than in iritis, though wearisome and annoying to the patient.

Causes. — This form of inflammation of the cornea may occur spontaneously, but it is often conjoined with, or a sequel of, iritis. It is generally met with

under peculiar circumstances; first, where iritis has existed in persons of rheumatic diathesis, who have become debilitated or anæmic; secondly, and most frequently, in conjunction with syphilitic iritis, either as it occurs in adults as a tertiary symptom, or in the constitutional inherited syphilis of children or young persons. In adults it generally supervenes during the decline of the iritis, and is often far more troublesome than the precursory affection.

Prognosis. — This disease is often subdued without leaving behind it any morbid changes of structure; but where the opacity has been considerable, it sometimes degenerates to a chalky deposit; or, if mostly absorbed, appears to cause so much disturbance of the arrangement of the corneal fibres that the normal transparency of this structure and perfection of its refractive function are never restored.

Treatment. — Much of the treatment must be general rather than local. The iod. potass. is an excellent alterative in some circumstances. Where the affection of the cornea follows syphilitic iritis in adults, a similar plan is to be pursued; the physician being careful not to employ too active measures where the system is already in a very low condition from the effects of the primary constitutional affection. When the inflammation of the cornea is met with in adults in whom there is no reason to suspect any other cause than a strumous diathesis, or after rheumatic iritis, the state of the system usually indicates the

employment of tonics, or such alteratives as may improve the quality of the blood and antagonize any morbid peculiarities of constitution.

The frequent complication with iritis calls for attention to the state of the pupil, and the use of atropia is important, not only to prevent contraction and synechia, but as having also a sedative effect where pain is complained of in or around the eye. A few leeches may be applied to the temple, if indicated by any increased urgency of symptoms. Anodyne lotions, composed of simple infusions of opium or poppy capsules, may be of service.

SYPHILITIC KERATITIS.

Unlike the disease of the iris resulting from intrauterine contamination, the affection of the cornea attributable to the same origin rarely makes its appearance till the period of second dentition. It had been regarded as a manifestation of strumous diathesis, and its symptoms described as such by authors who had well observed its characteristic features; but there seems to be no doubt as to its affiliation with other unquestionable evidences of syphilitic saturation. At the outset, as in infantile syphilitic iritis, there is little pain, and scarcely any injection of the vessels of the eye. But much dimness of vision is complained of, and on examination the cornea is observed to be more or less thickly sprinkled with minute dotted opacities. These are evidently not upon its anterior surface, but

diffused interstitially through its substance. If examined with a lens they are seen to be infinitely multiplied. As the disease advances, not only the central portion, but even the entire cornea may become obscured, and acquire a cloudiness resembling the opacity of ground glass; but there is little tendency to ulceration. Sometimes, at this stage of the disease, the globe is much softened, so as to be even flaccid when pressed with the finger. Accompanying this increased cloudiness of the cornea there is often considerable injection of the vessels of the circumcorneal zone, and sometimes iritis complicates the affection, or traces of its having occurred during infancy can be detected if sought for.

It is the rule that the disease affects in turn the two eyes, — the second being perhaps attacked whilst the first is recovering.

All cases of sluggish keratitis of this diffused character, occurring in subjects from six to eighteen years of age and unattended by ulceration or by much pain or photophobia, should be viewed with suspicion, and inquiry made, if possible, as to the antecedents of the parents, and the family history. If the child had, during its infancy, any syphilitic symptoms, in the eye or elsewhere, — if the mother has had still-born children or such as had but a puny and brief existence, — if others of the brothers and sisters have suffered from similar affections, — it would be desirable to ascertain if either parent has had symptoms of constitutional syphilis.

But we are not compelled to rely solely on this knowledge for corroborative evidence, however satisfactory it may be thus to obtain it. In most instances, we find in the patient other diagnostic marks, which serve as so many manifestations of a pervading infection. The most distinctive of these are found in the condition of the teeth and the skin. As Mr. Hutchinson has well pointed out, the central incisors of the second dentition have a peculiar crescentic notch at their lower margins, and the lateral incisors and canines, as well as the molars, are often small, peg-shaped, and with tubercular prominences upon their surface. They are perhaps also irregularly set in the jaw, and of bad color or prematurely decayed.

The following plates show these abnormal appearances as exhibited in three cases now under my observation.

Fig. 1.

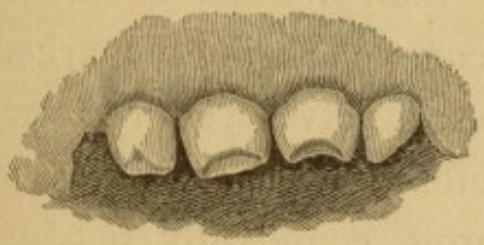
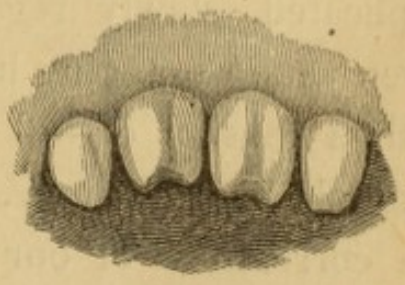
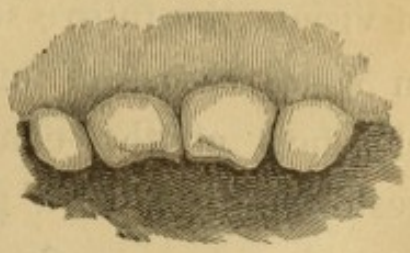


Fig. 2.



Figures 1 and 2 show the condition of the teeth in a boy and girl aged about twelve and fourteen. In figure 3, from a girl of seventeen, the notched appearance has already become lessened by wear of the teeth.

Fig. 3.



The skin is coarse and sallow, often pitted in a singular manner, — the bridge of the nose usually broad and sunken, — there are cicatrices of fissures at the angles of the mouth, — and the lips are thick and misshapen.

As in the acquired syphilis of adults, the choroid and retina, as well as the iris, are sometimes implicated, generally simultaneously with the corneal affection, and effusions occur in those parts, especially in the choroid. This fact should be borne in mind when treating this affection, as the opacity of the cornea frequently makes it impossible to examine the fundus of the eye with the ophthalmoscope.

Mr. Hutchinson has advised, — and in this he is sustained by other authorities, — a combination of tonic with mild mercurial treatment, — the patient being usually in a cachectic condition. The prognosis is generally favorable, — the tissues, if not too deeply implicated, slowly regaining their normal condition. Even where softening had become exceedingly marked, with a tension of —3 degrees, I have seen recovery take place. We may, therefore, if well satisfied of the correctness of our diagnosis, confidently reassure the patient, even when, from the increasing dimness of vision, the future seems to him very hopeless. But in some cases, of more than average severity, the clearness of the central part of the cornea is not restored till after a period of years.

OPACITIES OF THE CORNEA.

We are so often consulted on account of opacities of the cornea, that it is very important to be able to decide at once as to their nature and prognosis. The physician should know how to distinguish the cloudiness accompanying actual disease from the opacity resulting from affections which have passed away, leaving these effects behind them; and should know what amount of change is to be expected in the future, either from the processes of nature or the results of treatment.

The appearances of the cornea when actually the seat of morbid processes, have been already described. After these processes have terminated, we may still perceive some blood-vessels on or near any opaque spot which may remain; but these are not to be regarded as detrimental, — on the contrary, they are essential to the absorption of the cloudy effusion, — and when this is accomplished they disappear. In recent cases, especially in children, if ulceration has not perforated the cornea, we may predict that the opacity will nearly or quite disappear as the child grows older. Strabismus sometimes comes on as a consequence of central opacity, and disappears after its absorption. These slighter opacities are termed nebulæ. The more extensive and dense opacities resulting from very large ulcers, especially the perforating ulcers resulting from neglected conjunctivitis

(to which the term leucoma is applied), may lessen in diameter, so as to allow of more or less vision where it had been wholly abolished, or to admit of a successful operation for artificial pupil; but they can neither be absorbed nor removed by operation. Deposits of decomposed acetate of lead may be scraped off if they do not extend below the epithelial layer, and perfect transparency restored; but if they have become incorporated with the proper substance of the cornea, interference is almost useless. These deposits are generally slightly raised above the surface, and of a dead white color. In eyes where the epithelial layer had been detached, and raised in the form of a blister, I have removed the clouded epithelium over the whole extent of the cornea, and had the satisfaction of finding a transparent surface beneath. The cornea continued clear, and vision sufficiently good to allow the patient to read a fair, ordinary type. Much pain was complained of after the operation, as is the case where the cornea is accidentally abraded.

If perforating ulcer has been followed by anterior synechia or adhesion of the iris to the cornea, there must always be a considerable cloudiness at this point; but the halo which surrounds it narrows and fades, and great improvement in vision may result, as the cloudiness disappears from all but the central spot where adhesion has formed.

Treatment. — Various astringent or stimulating collyria have been lauded as efficient for the removal of

opacities of the cornea. It is well, perhaps, to prescribe some mild and grateful application, since it prevents the patient or his friends from resorting to the thousand infallible specifics which are constantly pressed upon their notice. But we must not claim too much for our remedy. It is best to say that the removal of the cloud must take place very gradually, and that the means we advise will do as much as can be done to promote its disappearance. The absorption will go on more rapidly in young persons, or after an acute ulceration of short duration; but the process is little hastened by the use of local or general remedies if the subject is healthy. The fact that reparation goes on whilst various means are used by the patient, has given reputation to numerous empirical applications; but it would have gone on equally rapidly, so far as my experience has enabled me to judge, had the case been left to nature. Therefore let our interference be at least harmless. Opaque deposits of lead, or altered epithelium, may be dissected off carefully with cataract-knives, minute toothed forceps, and fine scissors.

ARCUS SENILIS.

A cloudy ring near the margin of the cornea, sometimes complete, at others only extending partly around it, is often observed in old, and now and then in young persons. It is regarded by some authors as an indication of fatty degeneration of the heart:

but, as far as the eye is concerned, is not to be considered a disease deserving attention. The fears of the patient may be allayed by assurances that the change will be limited to the border of the cornea, and will not affect the field of the pupil or interfere with vision. Charlatans are in the habit of terrifying patients by predictions that "the sight will become covered" unless their services are retained, but these predictions are utterly groundless.

CONICAL CORNEA.

The cornea is now and then observed to undergo a change of curvature, the central portion giving way and forming a cone. The change comes on insidiously, the patient finding his vision less distinct, yet experiencing no pain, nor perceiving any injection of the eye. At the outset, the physician perceives a peculiarity in the reflection of light from the cornea, even when close inspection detects only a very slight departure from its normal curvature. As the disease advances, the change becomes more and more marked; the conical form being very apparent, and vision more imperfect. The apex of the cone may remain transparent; but in marked cases of the disease it most frequently becomes slightly clouded, without the occurrence of ulceration. Notwithstanding the extreme thinning which seems to exist in these instances, I have never known rupture of conical cornea to occur; though in hydrophthalmia this misfortune is extremely common.

Vision is imperfect from the excessive refraction of the rays as they enter the eye; and concave glasses, though of service in mild cases of the disease, are scarcely a palliative where the alteration has reached an advanced degree. Frequently the pupil is large, the iris tremulous in the superabundant aqueous humor, and the entire globe slightly softer to the touch than natural. The disease usually declares itself in both eyes; but seldom begins in both at the same time.

Causes. — It generally commences in youth or early adult life, and though most likely to attack those of feeble constitution, it is by no means confined to such. I have seen marked specimens of the disease in young men of vigorous health. Excessive use of the eyes does not seem to have any agency as a remote or proximate cause; nor does the affection appear to be induced by any peculiarities of habits or food.

Prognosis. — In healthy persons we may hope for an arrest of the disease; which, after reaching a certain point, sometimes comes to a stand, and does not afterward either recede or advance. Observation of this fact leads us to endeavor by tonic treatment to obtain a similar result in individuals of lymphatic or delicate constitution. Any absolute restoration of the natural form of the cornea, by pressure, puncture, evacuation of the aqueous humor, extraction of the lens, or other means, seems to be

impossible. But though, as a rule, I have opposed puncture and evacuation of the aqueous, yet I have seen very great benefit follow it in one aggravated instance, where vision was almost completely gone, and was restored to a very useful degree even for reading, after an operation. The improvement continued for some two or three years, at the end of which periods I repeated the operation a second, and again a third time, with like good results.

The change for the worse is often so gradual that the patient observes a lessening of vision when we are unable to detect any alteration from one month to another in the apparent condition of the cornea.

Treatment. — Palliatives rather than restoratives afford our sole resource, except from surgical interference. We may essay to arrest the further advance of the organic changes by tonic general treatment, and by prudent use of the eyes, so that no vascular congestion may be occasioned by strong efforts to distinguish objects.

Concave glasses are sometimes an auxiliary to vision, in slight degrees of the affection. Disks of buffalo-horn, perforated by a small slit, have been of use, by virtually lessening the diameter of the pupil, and cutting off lateral pencils of rays. Reasoning on these facts, Mr. Bowman, of London, was led to devise a method of operation by which the edge of the pupil is drawn through and allowed to form adhesions with a small puncture of the cornea.

He advises performing the operation at both the upper and lower edges of the pupil, so that its form may be changed to a vertical slit. The operation is to be done by puncturing the cornea near its lower margin, drawing out the iris by means of a short, blunt hook, with which the edge of the pupil is seized, and securing it outside the corneal wound by a very fine ligature. This gives the pupil a balloon-shape. If considered desirable to perform a second operation, the puncture is to be made at the upper edge of the cornea, and the iris drawn out in the same manner, thus giving the pupil a slit-like form. If the first operation results in a fair amount of vision, a second is not indispensable, as the gain from a second operation is much less in proportion than that derived from the first.

Should puncture of the cornea for the evacuation of the aqueous humor be resorted to, the operation may be done at any convenient point near the edge of the cornea.

FOREIGN BODIES IN THE CORNEA.

From its exposed position, the cornea is liable to be struck by small, flying particles, which are often driven deeply into its substance, and are difficult of removal on account of the extreme mobility of the eye, which has become irritated by their presence and exceedingly sensitive. If not removed, they continue for a long time a source of annoyance,

and may give rise to serious symptoms, though they are eventually thrown off by ulceration. Soft substances, grains of gunpowder, &c., may remain imbedded without causing irritation; becoming incorporated, as it were, with the corneal tissue.

The mode of removing these particles is the same as already described for those lodged in the conjunctival layer of the cornea; but should they have penetrated so far as to be partially within the anterior chamber, it is sometimes necessary to make pressure against them from behind, with a fine needle passed through the cornea, whilst their extraction is being attempted.

STAPHYLOMA OF THE CORNEA.

When nearly the entire cornea has been destroyed by extensive ulceration, the action of the recti muscles frequently pushes forward the lens and iris; or the iris alone is displaced. A cicatrix results, made up of a new tissue taking the place of the disorganized structures, and forming a projection beyond the normal curvature of the front of the globe. When this is not very prominent, it causes little irritation, and though unsightly, need not be removed unless the patient desires to wear an artificial eye. When the the bulging is excessive, it is frequently necessary to excise a portion of the mass, that the patient may be relieved from the irritation occasioned by its friction against the lids, and from the repulsive de-

formity. Excision may be performed by transfixing it and forming a flap with a cataract-knife or thin bistoury, and clipping off the flap with scissors. Care should be taken not to carry the instruments so far back as to impinge upon the lens or vitreous, if these are still healthy. In some cases we may simply remove an oval portion of the centre of the staphyloma, allowing the edges to fall together, or even uniting them by a single fine suture. The globe is thus restored to about its natural size, and where a patient cannot afford an artificial eye, has a better look than when merely the stump of an eyeball remains, as is the case where suppuration follows too extensive excision, as well as in cases where the vitreous had already undergone a process of softening previous to the operation. Ether should always be administered unless the patient's steadiness can be relied on, and always in cases of children; as the operation is sometimes attended with no little pain.

CHAPTER VIII.

AFFECTIONS OF THE SCLEROTICA.

NOTWITHSTANDING the elaborate endeavors of authors to define simple inflammation of the sclerotica, I believe that it rarely, perhaps never, occurs as a distinct or primary disease. Complicated forms of disease, sometimes described as rheumatic ophthalmia, &c., involving more than one of the tissues of the globe, are certainly not unfrequent; but the sclerotica seems peculiarly free from tendency to become inflamed. Injection of its vessels takes place whenever the cornea or iris are seriously affected, or when the entire globe is attacked or an abscess forms within it; its structure may become thinned from disease of the choroid; but in all these circumstances the alterations in other parts precede those of the sclerotica, and are the important objects of our attention. Certainly the sclerotica never calls for special care, in any of these affections, but the treatment of its symptoms merges in that of other parts which are simultaneously disordered.

WOUNDS OF THE SCLEROTICA.

Incised wounds of the sclerotica implicate, of course, the conjunctiva, and generally extend to the choroid, retina, and vitreous mass. Should any considerable protrusion of the vitreous or other internal parts of the globe exist, it may be necessary to excise this by a quick cut with fine curved scissors; but should the protrusion be slight, it is better to leave it undisturbed till we can observe if it act as a source of much irritation. In this case it must be excised; otherwise the only treatment required is entire rest. The lids in many instances should be kept closed by strips of court-plaster. We should carefully abstain from the use of collyria or lotions, as any such disturbance of the reparative process can only do harm.

Rupture of the sclerotica may be caused by a blow, and may exist without lesion of the conjunctiva. The same rules, as to quiet and non-interference, apply to the treatment of this injury; but the prognosis is less favorable than in cases of incised wounds, as all the important parts of the eye have probably been injured by the shock.

In rare cases, the lens is forced through the wound, and remains between the sclerotica and conjunctiva. It is to be carefully extracted, — the incision of the conjunctiva being made at a distance from the rupture of the sclerotica, that the valvular flap thus

created may form an obstacle to prolapsus of the vitreous humor.

THINNING OF THE SCLEROTICA.

This is sometimes observed where the choroid has long been affected in strumous subjects, and seems to be accompanied by tension of the globe from increased secretion of its contained humors. A certain degree of this alteration is not incompatible with vision, and it now and then yields to the use of the iodide potassii and tonic treatment; but it is oftener concomitant with serious organic alterations of internal parts and is little amenable to remedies.

STAPHYLOMA OF THE SCLEROTICA.

One or more protrusions of the choroid or corpus ciliare through the thinned sclerotica are not unfrequently observed in patients of strumous constitution. They are situated for the most part between the edge of the cornea and the attachments of the recti muscles, though they sometimes form posteriorly, where the sclerotica is firmer. These small tumors have a bluish-black color, and vary in size and form, sometimes being a single rounded elevation, sometimes a cluster of such elevations, and again an elongated ridge partially or wholly surrounding the cornea. They bear a certain resemblance to melanotic tumors of the globe, but may be readily distinguished by gently touching them with a probe, when their fluid

contents will allow them to yield to the pressure; or by puncture. They sometimes enlarge to such an extent as to prevent the lids from closing.

Staphyloma in a slight degree may be amenable to treatment; but where extensive, it involves so many more important changes that vision is usually lost, even if complete disorganization of the globe do not occur. Puncture of the projecting point and even excision may now and then be admissible when the tumor is small; but as in these cases little inconvenience is felt from its presence, it is best in most instances to leave it untouched. When the staphyloma is so large as to be hideous, or annoying to the patient, the anterior part of the globe may be removed, or the globe may be excised within the orbital capsule, the patient being placed under the influence of ether.

Removal of the globe subjects the patient to various inconveniences, which, though of no weight where the preservation of the other eye is in question, as in cases of sympathetic inflammation, are yet of importance in the circumstances we are now considering. If done, the deformity is considerable, and even though care may have been taken to leave the recti muscles and the cellular tissue of the orbit, as far as possible, intact, an artificial eye has not the amount of support requisite to its proper movements. Should no factitious eye be worn, the lids fall in and the eyelashes come into contact with the conjunctiva, keeping up

disagreeable amount of secretion from its irritated surface. In most cases, instead of resorting to this extreme measure, ablation of the staphyloma may be advantageously substituted.

Mr. Critchett has proposed an excellent method of operating. The patient being etherized, four or five curved needles armed with sutures are passed through the globe from above downwards, just behind the ciliary region, thus including in front of them the whole of the staphyloma.

These are thus placed to steady the globe and prevent the possible escape of the vitreous during the operation, and to allow of the sutures being tied immediately on the completion of the excision. The staphyloma is now excised with a sharp, narrow bistoury, the needles are drawn through, the sutures tied, and the edges of the wound thus brought together. Speedy closure of the wound being desirable, it is well to have the silk or thread in each needle of a different color, that the sutures may be easily distinguished from each other.

The wound often closes by primary adhesion, or so much of it becomes united as to insure the healing of the remainder by granulation, without loss of the contents of the globe. Simple water dressings are to be used. Recovery is rapid, and the stump obtained is not very unsightly, even if not covered by an artificial eye; or, should one be worn, it affords a good support.

In a few instances the attempt to preserve the ful-

ness of the globe fails, inflammation coming on and causing suppuration of its contents; but should this occur, little pain is usually felt, as the wound allows of the free escape of matter, and the resulting stump is much more comfortable to the patient, and gives better support and movement to an artificial eye, than when the globe has been removed.

Where the staphylomatous tissue has considerable firmness, only an oval portion from its central part may be excised, without previous insertion of needles, — the edges of the wound being brought together by sutures. Nearly the natural dimensions of the globe may thus be preserved.

POSTERIOR STAPHYLOMA.

Thinning and giving way of the tunics of the eyeball may occur at any part of its surface, as a result of disease. But we are indebted to modern researches, in aid of which the ophthalmoscope and post-mortem examinations have borne a prominent part, for a knowledge of the fact, that such a condition is extremely common around the entrance of the optic nerve, — that it may commence and increase without a suspicion of its existence being for some time excited, — and that it is very frequently both a consequence of myopia and a cause of its increase.

The protrusion backwards of this portion of the eyeball (regarded by some writers as the result of inflammatory action, and termed by them sclero-choroiditis)

begins, so far as we can perceive by observation, by an attenuation of all the tissues, especially of the sclerotica and choroid. As shown by the ophthalmoscope, it has the form of a whitish or grayish-white crescent, its concave edge towards the optic disc and its convexity in the direction of the macula lutea. As the affection progresses, the crescent becomes wider and more prolonged, sometimes completely encircling the disc, but expanding principally towards the yellow spot; its outline at the same time becoming more irregular. The reflection from its surface grows whiter as attenuation and atrophy of the choroid and retina goes on and the sclerotica becomes more and more exposed; though its surface may be studded with grayish spots, remains of the choroid, or with black pigment accumulations. The retina is thinned and expanded; but its nerve fibres are for a long time unaltered, so that impressions made upon other parts of the retina are still conveyed across this space, though no clear images can be formed upon the implicated surface. As the sclerotica yields more and more, the devious course of the retinal vessels shows that they run over a concave surface. Other spots of atrophy of the choroid often make their appearance near the margin of the crescent or in the vicinity of the macula lutea, and coalesce with the extending staphyloma, giving it an irregular instead of a crescentic form. The disc seems oval instead of round, as the side of the optic nerve next the staphyloma becomes involved in it. As the disease begins to affect

the region of the yellow spot, or the optic nerve itself, vision becomes more impaired.

With the increased bulging of the sclerotica the danger arises that the retina may not accommodate its surface to that of the outer tunic, and that effusion may be formed between the two structures, giving rise to the condition known as separation of the retina.

That such abnormal elongation of the eyeball should be a cause of myopia may be readily seen, — the lengthening of the optic axis giving rise to excess of refraction, so that the focus is formed in front of its normal position. But the affection, itself a cause of myopia, may be yet further increased in consequence of it. Any long-continued convergence of the optic axes, in accommodation for near objects, causes greater external pressure upon the globe from the action of the recti muscles, and at the same time the stooping position of the head assumed in reading and writing favors congestion of the vessels and increases the intra-ocular pressure. Both these influences promote the further yielding of the already weakened tissues, and thus lead to an increase of the staphylomatous bulging.

An examination of the fundus oculi with the ophthalmoscope should therefore be made in all cases of short-sightedness, particularly in young subjects; as it is important to detect the existence of staphyloma, if present, that precautions may be taken against its increase with the advancing age of the patient.

During the period of youth there is a strong predisposition to an augmentation of this morbid change, and, unless counteracted, it attains such a degree that the eye becomes incompetent to oppose its steady march, and before middle age the patient has the misfortune to perceive, not only an increased myopia, but a constantly failing vision. But if the period of youth can be safely passed without the development of progressive staphyloma, these results are less to be apprehended. It therefore becomes exceedingly important to direct the patient to avoid everything which might favor the advance of this lurking enemy. Long-continued close application of the eyes, especially with the head bent forward, should be interdicted, — glasses should be properly selected to avoid the necessity for accommodative efforts, — and every care taken, by derivative measures if necessary, to avoid cerebral or ocular congestion.

CHAPTER IX.

AFFECTIONS OF THE IRIS.

The iris appears to be only slightly susceptible to become inflamed after traumatic injury, unless a foreign body is lodged in its tissue or continuous pressure is made upon it. Large fissures may extend across it or around its margin, or a segment may be excised, in operations for artificial pupil or for relief of glaucoma, without the appearance of a single morbid symptom. I have never seen iritis ensue, in any instance, in patients on whom I have performed or witnessed these operations. But where the iris is pressed upon by a swollen or dislocated lens, or when a fragment of percussion cap or other foreign body is imbedded in it, a form of inflammation is induced which can rarely be controlled until the exciting cause has first been removed.

Except under such circumstances of continued irritation as I have described, I shall recognize two varieties only of iritis; viz. the rheumatic and the syphilitic; the form sometimes described as strumous iritis being apparently an affection dependent on inherited venereal taint, though differing wholly from syphilitic iritis appearing after direct infection.

RHEUMATIC IRITIS.

Exposure to unfavorable atmospheric influences — as, for instance, to cold or damp winds, which, in another person, would cause at most an attack of catarrhal conjunctivitis — will frequently induce iritis in an individual of rheumatic diathesis. The liability is greater when the exposure occurs after the eyes have been stimulated by use or by bright light.

Symptoms. — A slight soreness when the globe is moved or pressed upon, apparently seated at the points of insertion of the recti muscles, is sometimes complained of as the earliest symptom, — before any congestion of the iris or injection of the circumcorneal zone of vessels can be perceived. These last-named phenomena are soon superadded, while, at the same time, the patient begins to notice that his sight is less perfect than usual.

The characters of the disease are broadly distinct from those of inflammation of the external membranes, as seen in conjunctivitis. The pain, instead of being a smarting or itching, evidently situated on the surface of the globe or lids, is of an aching character and deep-seated when the iris is involved, often severe, sometimes agonizing; described by the patient as if tension of the eye even to bursting were taking place. It frequently extends to the supra-orbital or other branches of the fifth pair of nerves, often causing great tenderness of the scalp over the

whole of the affected side. Usually it is remittent, returning with increased severity at evening, or in the night, after a comparatively tranquil day. Very large anodynes are often ineffectual to procure sleep.

The injection affects a different set of vessels from those which become enlarged in conjunctivitis. It is not now a scarlet network, covering the whole anterior portion of the sclerotica and nearly concealing it, especially marked at the line where the conjunctiva is reflected from the lids upon the globe; but consists in the development of hitherto unseen straight filiform vessels, having their largest calibre close to the margin of the cornea, and fading to invisibility as they extend upon the sclerotica, leaving most of the globe, at the outset of the attack, free from injection. If, later in the course of the disease, the conjunctiva becomes more or less involved, the zone of purplish or lake-colored vessels may still be detected beneath the conjunctival network. The condition of the external membrane requires little attention, as it spontaneously improves upon the subsidence of the internal inflammation on which it depends.

The muco-purulent secretion proper to conjunctivitis is wanting, or nearly so, in attacks of iritis, and is replaced by a copious lachrymal flow. There is also, as a rule, great intolerance of light, which rarely exists, in any degree, in conjunctival affections, unless the cornea becomes involved.

Now and then the disease comes on insidiously, no severe pain or considerable injection giving the patient warning of the advent of serious disease: and permanent mischief may have been accomplished before he applies for advice.

On inspection of the eye, in addition to the appearances above described, marked changes can be perceived in the iris. It has a turgid, swollen aspect; often projecting beyond its natural plane towards the anterior chamber. Its brilliant lustre and striated appearance are lost, and its tissue seems infiltrated. These changes result from the congestion of its vessels or the extravasation of lymph into its substance. This effusion, blending with the natural color of the iris, changes this to a darker shade; a blue iris acquiring a greenish, and a brown iris a reddish tint. Tubercles, or small masses of lymph, are sometimes formed in the substance of the iris, or upon its free edge.

The intolerance of light tends strongly to contract the pupil, and this contraction is favored and kept up by the congestion of the iris or effusion into its substance. This tendency constitutes the only formidable danger to be apprehended from the disease; as, unless means are used in the early stages to dilate the pupil, it cannot afterward be fully acted on by mydriatics, and the edge of the pupil forms adhesions to the capsule of the lens, constituting what is termed posterior synechia, — or its area becomes

even blocked up by deposits of lymph, thus abolishing vision. Adhesions of limited extent may not seriously interfere with the recovery of excellent vision; but they place the eye in a less favorable condition for resisting future attacks should any such occur, — and of this there is, unfortunately, always more or less chance where an individual has once been affected.

Prognosis. — If early and properly treated, the result is almost always, if not invariably, favorable. The severe symptoms yield, the pain and injection gradually subside, the photophobia disappears, and the normal movements of the pupil are restored. The dimness of vision, however, often continues for several weeks after the injection has vanished; but, if the physician detects no traces of organic change in the iris or pupil, he may confidently assure his patient that vision will be completely restored after a short time.

If reasonably prudent, the patient may enjoy immunity from a second attack; but he should be cautious, at least for some months, in regard to exposure to glare of light from the snow or from light surfaces, or to cold or damp winds. If residing at a distance, it is well that he should be provided with a solution of atropia, by means of which he can secure prompt dilatation of the pupil at the outset of any fresh attack, and maintain this enlargement till he can have suitable professional advice.

When the disease is not seen till a later period, and has been allowed to take its own course, the prognosis will depend on the extent of the pathological changes which have taken place. If the adhesions are but slight, or if they can be detached by dilatation of the pupil, very good vision may be preserved. But where they implicate the entire circumference of the pupil, and its area is covered with lymph, vision is likely to be nearly or wholly lost. Moreover, a new danger arises; the aqueous fluid secreted behind the iris, no longer finding access through the pupil to the anterior chamber, sometimes distends the iris to such a degree as to cause disorganization, which extends to other internal parts of the eye, and annihilates all hope of a restoration of sight by the performance of an operation for artificial pupil, which would otherwise have been practicable.

Treatment. — I believe this disease to belong to the class known as self-limited, having a tendency to recovery in about three weeks, provided the morbid processes do not reach the point of producing extensive adhesions of the pupil; but having also a tendency to produce serious organic alterations, and to have a longer duration, where these processes are excessively violent and are permitted to go on unchecked. If this opinion be well founded, one important point in treatment has a high precedence above all others, — the maintenance of dilata

tion of the pupil. In fact, without undervaluing other remedies, indicated at times by the general condition, I am confident that atropia and opium — the former to enlarge the pupil, the latter to control the pain attending the disease — are the essentials in the management of this affection. It follows that I attach little value to mercury in the treatment of this affection, though it has formerly been regarded as almost a specific, and has been often cited as an instance of the power of remedies in arresting morbid processes.

Such dissent from the doctrine of all the authorities demands a full explanation. From the time when iritis was described by Schmidt, of Vienna, as a distinct disease, the precept has been strongly inculcated that mercury must be given in the early stages, otherwise the golden opportunity for bringing the patient under its influence would be lost, and success could scarcely be hoped for. The authorities having thus insisted on the importance of an early resort to this remedy, each practitioner has been afraid to take the responsibility of deviating, in the treatment of so grave an affection, from the course declared to be the only path of safety. Thus very few opportunities occurred for observing the natural course of the disease, — as the milder cases, which did not require treatment by medical men, recovered, and never presented themselves to their notice, — whilst the severer cases, in which, the pupil having

been left to itself, occlusion had resulted and vision was destroyed, were brought forward as examples of the ravages of the affection when uninfluenced by mercury. But the authorities also advised the free local use of belladonna at the same time that mercury was administered internally. Whenever, therefore, a patient who had been thus treated, *secundum artem*, fully recovered, the credit was given, not where as I believe it belonged, to the belladonna or stramonium, under the influence of which the pupil had been kept widely expanded, — but to the mercury, which had been canonically given, even to the extent of producing ptyalism. When the result was less happy, it was ascribed, not to the neglect or the too tardy use of belladonna (which was too often the case), but to the supposed fact that mercury was not given as soon or as freely as it should have been, or to a want of susceptibility to its influence on the part of the patient. The remark often made, that the symptoms did not begin to yield till the gums were touched, proves nothing under these circumstances; as after a certain period they would equally have given way had the supposed specific been withheld. The want of any absolute specific power has been admitted, of late years, in the attempts made to provide substitutes, as turpentine, &c., in cases where mercury seemed inefficacious or evidently disagreed.

Observation of many cases which came under my

notice where the patient had been treated with mercury to the fullest extent, but nothing had been done to dilate the pupil, and where the result was most disastrous; and reflection on the mode of action of the constitutional and local remedies, induced me to vary from the treatment I had always previously pursued according to the approved method, in certain cases which came under my care, where the patients were in such a condition as contra-indicated the use of mercury unless as an imperative necessity. These were treated by anodynes and tonics, and the pupil kept fully under the influence of belladonna, and they terminated far more favorably than the severity of the attack and the state of the patient had allowed me to expect. Encouraged by excellent results in these cases, I was led to try a similar plan in other instances; and I am confident that I never saw better results ensue, in the hands of others or myself, from the old method. If it be in our power, then, to spare the patient the infliction of the grave inconveniences and protracted convalescence often occasioned by the free use of mercury, and to relieve him as well and as quickly by other remedies, we may gladly accept the alternative.

A few words as to the anatomical reasons which give so much importance to the action of belladonna and its kindred remedies. Referring to the construction and relations of the parts, we observe that the lens is largely convex, and the iris suspended, a plane

surface, a short distance in front of it. In a normal condition of the eye, the edge of the iris, when the pupil is contracted, probably touches and glides over the convex surface of the crystalline. Much more close must be the contact when the pupil is strongly contracted by photophobia and the iris turgid and thickened from inflammation. If, in these conditions, plastic lymph is effused, the formation of adhesions, and even of a deposit covering the whole field of the diminished pupil, is a most probable occurrence. But if we can effect even moderate enlargement of the pupil, the relations of the parts are greatly modified. The edge of the pupil is now at some distance from the retreating convex surface of the lens, and their cohesion has become impossible so long as these relative positions are maintained.

With these brief arguments in support of a plan which I have followed for years in every form of iritis, and of which I am constantly receiving fresh sanction from *confrêres* in Europe and at home, I pass to the details of treatment.

The most important indication, the securing ample dilatation of the pupil, is best fulfilled by the use of a solution of atropia. Formerly, the extract of belladonna or stramonium, moistened with water or combined with ointment, was freely and frequently smeared around the orbit; or a filtered solution of the same was dropped into the eye. But the nauseous odor of the extract, its variable

strength, its liability to become decomposed if prescribed in solution, and the discomfort attending its use, were strong reasons for substituting atropia. The sulphate of atropia, readily soluble in water, can now be procured at a moderate price. If, however, the physician does not have this at hand when needed, the extract of belladonna or stramonium, well rubbed up with water, in the proportion of from twenty to forty grains to the ounce, and filtered, is an efficient substitute. It may be dropped into the eye once or twice a day, and causes only slight irritation if freshly prepared; as it should be every few days, at least in warm weather. The application of the extract around the orbit, in the form of paste or ointment, is disagreeable to the patient, and, unless portions of it are rubbed into the eye, it acts very slowly and inefficiently. It is but a clumsy way of accomplishing the object desired.

When the eye is uninflamed, and we wish merely to dilate the pupil, a solution of no greater strength than half a grain of the neutral sulphate of atropia in an ounce of water is sufficient for the purpose, — acting in from fifteen to thirty minutes. But in cases where the iris has already become more or less congested it is necessary to employ a stronger solution. Five grains to the ounce is nearly certain to act efficiently; but if adhesions are already formed, or if the congestion and thickening of the

iris are excessive, the strength of the solution may be doubled. A drop may be put into the eye once, or even several times, in twenty-four hours, by means of a camel's-hair pencil. The lower lid is to be drawn down for an instant, the brush introduced into the palpebral sinus, and the lid allowed to return to its place, thus squeezing a drop of liquid from the brush by pressure between the lid and the globe.

Atropia seems also to have a secondary influence, in lessening the amount of pain; perhaps by diminishing the congestion of the iris.

Some caution is necessary in the use of very strong solutions of atropia, as they are not required for effecting the object, and several instances are recorded where serious cerebral symptoms have followed the instillation of a drop or two of a strong solution (of thirty grains to the ounce), into the eyes of aged persons and children.

As the severity of the symptoms subsides, atropia may be less often applied; but the iris should be kept under its influence till we have assurance, from the improved condition of this membrane, that adhesion is no longer to be apprehended. No ill consequences result from its use, even for a long period, the pupil ordinarily resuming its contractile functions within a short time after the applications are discontinued.

Another important indication is to control the pain, as the severe nocturnal paroxysms seem to have an effect to increase the effusion of lymph. We may

sometimes attain this object by relieving the circulation in and around the eye by the application of three or four leeches to the temple, at the same time prescribing a hot foot-bath before the patient retires. The leeches should be placed on a level with the eye, and some distance from it, as, if applied above the eyebrow or too near the lids, swelling of the palpebræ is apt to ensue, producing painful pressure on the globe. Bleeding from the bites should be encouraged for an hour after the leeches fall off, by the application of poultices or of cloths wrung out of hot water. In most severe attacks these means are insufficient to do more than mitigate the pain, and we must resort to opiates for its complete relief. These should be given in sufficient quantity, however much this may be; a dose, judged to be a suitable one, being prescribed, and, if requisite, repeated hourly, till the patient is relieved. Very large amounts of opium or morphia are sometimes required to subdue the agonizing pain, and procure sleep.

Warm fomentations, especially with an infusion of opium or poppy capsules, are sometimes soothing. In other cases, lotions with tepid water or milk and water, are preferred by the patient. Infusions of chamomile flowers, rose-leaves, or other simple remedies may be used, if desired by the patient; but they have probably no other efficacy than that derived from the lukewarm temperature at which they should be applied. Hot pediluvia seem to be often useful from their derivative action.

Very severe pain and tension may sometimes be relieved by puncturing the cornea, and permitting the escape of the aqueous humor. The best instrument for this little operation is one devised by M. Desmarres for the purpose, and is shaped like a broad cataract-needle, but with a guard at a short distance from the point to prevent it from plunging into the eye, if the patient should make a sudden movement. The puncture may be made with a cataract-needle, or even with the point of a clean lancet, if the patient is steady, — if the above-named instrument is not at hand. The humor should be allowed to escape a second time, a few moments after the puncture, the edges of the wound being slightly separated to allow of the discharge of the reaccumulated fluid. After a second evacuation the secretion takes place more slowly, and the vessels of the eye appear to be in some degree unloaded. The operation is unattended with the slightest risk if skilfully performed, and the little wound heals at once. The puncture should be made near the margin of the cornea, that there may be no chance of any impediment to vision by the slight cicatrix.

These means are sufficient, in most cases, for securing a fortunate termination of the disease, and as speedy a recovery as the nature of the affection and severity of the attack will admit of; without the employment of any remedies having a claim to specific action through the constitution of the patient.

But as this form of iritis seems to be but a manifestation of the rheumatic diathesis pervading the whole system, it is well, in many instances, to give the patient the benefit of any means which may seem adapted to have a favorable influence on his general condition. Among these the physician will select such as in his judgment will suit each particular case.

For promoting the absorption of any deposit of lymph which may have been effused, the iodide of potassium appears to have as much influence as is possessed by any remedy; the use of atropia being at the same time continued to exert traction on the bands of adhesion.

As regards the effect of mercury as a resolvent of effused lymph, I have seen so many cases where the pupil has become and remained obliterated by deposits, where mercury had been most lavishly, and, as would be thought, judiciously administered; and, on the other hand, have so often seen the lymph absorbed, and the congestion of the iris resolved where only tonics had been given; that I cannot coincide in a belief in the specific properties of this as surpassing those of any other remedy. A large proportion of the cases of both rheumatic and syphilitic iritis can be safely, quickly, and pleasantly relieved without it, and with a more rapid recovery of perfect health than where it is given. Many a case will perhaps be cited in the reader's mind, which seemed

to go on more favorably, when, after a trial of other remedies, this was resorted to; but here the attack had already lasted a considerable time, and had probably reached its acme. As I have before stated, experience justifies us in believing, that from a certain point, varying in different cases, there is an evident tendency towards recovery, provided the deposit of adhesive lymph has not been so considerable as to fill the pupil and cement its edge to the surface of the lens. Given at this turning-point of the disease, when even an expectant treatment would have been followed by a favorable result, mercury has obtained credit which belonged to the *vis medicatrix naturæ*, or to other means employed conjointly with it.

Where adhesions have actually formed between the edge of the pupil and the capsule of the crystalline lens, they may frequently be detached by means of atropia; or, if they cannot thus be entirely separated, they may be so far elongated as to allow free play of the iris, and lessen the danger of the formation of further adhesions in the event of another attack.

Where adhesion has taken place to such an extent that the movements of the iris are interfered with and an irritable condition of this structure is kept up, the bands of lymph may be detached by means of an extremely minute hook designed for this purpose, blunted at its extremity so as not to endanger the lens. It is dexterously introduced through a small puncture

of the cornea, without evacuating the aqueous humor, and is then carefully passed between the edge of the pupil and the lens, dividing or tearing away the adhesions. The patient should be under the influence of ether, that immobility of his eye may be secured. After the operation, the pupil should be dilated by atropia, to prevent reformation of adhesions.

SYPHILITIC IRITIS.

The iris is the seat of one of the manifestations of constitutional syphilitic infection.

Symptoms. — In most cases the symptoms differ from those of rheumatic iritis, to such an extent as to render diagnosis easy, without reference to other specific phenomena which may be present; but instances occur where the appearances, though suspicious, will not warrant our regarding the disease as positively of this character, unless other facts concur to establish our opinion.

The change of color in the iris, loss of its natural brilliancy and striated appearance, and its evident congestion, are usually more marked than in the rheumatic form of the affection. There is also a greater tendency to effusion, and well-defined deposits or tubercles of lymph are more frequently seen in the substance or along the pupillary edge of the iris. These deposits were once regarded as characteristic of the syphilitic variety of the disease; but they may occur, though more rarely, in rheumatic attacks.

The pupil is generally irregular, and it has more apparent turbidity than in rheumatic cases.

It is by no means uncommon, as the phenomena proper to the iris begin to subside, and even when they have nearly disappeared, to encounter an accession of new symptoms, in the form of interstitial inflammation of the cornea. This complication is not only dangerous, as being liable to cause structural changes of the cornea resulting in an opaque cicatrix, but also as tending to keep up the original iritic affection.

Prognosis. — The subjects of this disease are so frequently cachectic, that more than ordinary difficulty may be anticipated in arresting its course. Yet, if the pupil has been well dilated early in the attack, and no large tubercles are developed along its edge, there is little danger of a bad result. When the use of atropia has been neglected in the first stages, the puffy iris is often beyond its power at a later period, the swollen tissue being capable of no change of position. In these circumstances some of the unfortunate sequelæ already described in speaking of rheumatic iritis are likely to occur.

Treatment. — As in rheumatic iritis, the use of atropia, or some agent of similar effect, is of the first importance. Other local remedies of a soothing tendency and the internal administration of anodynes should also be had recourse to, as recommended for the treatment of the rheumatic form of the disease. Local depletion should be cautiously advised, if at all,

and the general treatment should have a tonic character, as is often indicated by the condition of the patient. Where interstitial corneitis exists as a complication, the use of mercurials may be admissible, and of these the iodide is one of the best preparations in its effects on these cases.

IRIDECTOMY FOR RELIEF OF CLOSURE OF THE PUPIL.

Whatever may be thought of the propriety of doing iridectomy, as a precautionary measure, to avert future attacks of iritis, in cases of partial synechia, — where the adhesions are limited and a large portion of the pupil remains clear, — as has been proposed by some authors, — there can be no question of its propriety and necessity in instances where the aperture has become closed. Where complete obliteration of the pupil has been established, the aqueous humor secreted in the posterior chamber, no longer passing freely into the anterior part of the globe, distends the iris and pushes it forward, till the vitality of its texture is destroyed, and it becomes a mere pouch, as it were, lying nearly or quite in contact with the cornea.

At the same time pressure also takes place backward towards the important structures in the posterior part of the eye, and a slow process of disorganization is there set up, resulting, if interference be too long delayed, in utter extinction of vision.

But if an artificial pupil be seasonably made, or the natural pupil re-established by corelysis, — thus re-

opening communication between the two aqueous chambers, these morbid changes are arrested, and excellent vision is oftentimes restored.

In these instances, the surgeon should not refuse or delay to interfere because the patient has one sound eye, — as he can do, without detriment, in cases of cataract. To postpone relief is to sacrifice the eye; and, apart from the possibility, the probability in fact, that a patient whose one eye has suffered from iritis may at some time have the other invaded by the same disease, or the chance that it might be destroyed by accident, it is too desirable to give him, if possible, the benefit of binocular vision, to allow of hesitation in doing an operation from which he incurs no risk, and is likely to have little inconvenience. As a rule, the loss of substance should, in these cases, be below the natural pupil, — that being the position admitting of most usefulness for an artificial pupil, — and it should fall short of rather than exceed the average dimensions of the natural aperture.

IRIDDESIS IN CASES OF CLOSED PUPIL.

Where the pupil has been for some time nearly or quite closed, and we judge from the aspect of the iris that its fibres have become so flaccid, and their contractile power so diminished, that the operation of co relysis, detaching the adhesions from the capsule of the lens, would be insufficent to secure a permanent opening, a small portion of the iris may be drawn out

through a minute opening in the sclerotica, at the edge of the cornea, and an additional safeguard thus obtained for the patency of the pupil, while less deformity is produced, and the eye can better protect itself against a flood of light, than where iridectomy has been done. In nearly all these cases iriddesis should be downwards.

CONGENITAL SYPHILITIC IRITIS.

The iris is, in a few rare instances, attacked with inflammation, evidently of syphilitic origin, within a few months, or even years, after birth. The symptoms are less intense, so far as regards injection or pain, than in the disease as it occurs in adults; but the iris itself often exhibits extensive deposits of lymph and marked changes of color and structure. The patient is generally puny, and other symptoms of congenital syphilis are to be observed on different parts of its body. Any disease of the iris in very young children may be suspected to arise from constitutional infection.

Treatment.— Atropia is not to be neglected. With this local means we combine remedies for the improvement of the general condition. The administration of hydrar. cum cretâ, associated with tonics, seems to have a most happy effect.

CHAPTER X.

AFFECTIONS OF THE CRYSTALLINE LENS.

DISLOCATION OF THE CRYSTALLINE.

Though most frequently occasioned by a blow upon the eyeball, displacement of the lens may occur spontaneously. Some years since, an interesting example of this very unusual condition came under my observation, which is worthy of being recorded. The patient had a feeble constitution, and had always had weak sight, as she expressed it, since having measles, scarlatina, and variola, in quick succession, in childhood. A few days before I saw her, her age being at this time about thirty-five, in stooping to raise a tub, she became conscious of some change in her right eye, which was followed by circum-orbital pain and by nausea. She afterward noticed a transparent mass in the anterior chamber. After lying on her back at night this appearance was no longer seen, but her sight was less good than before. The same phenomena occurred on again stooping about her work, and when I saw her, the transparent lens of the right eye was lying in the anterior chamber. Its weight caused the iris to form a pouch, so that the lower margin of the lens was a line or more below

the cornea, its upper edge extending rather above the middle of the pupil. The edge of the lens was sharply defined, as much so as the edge of a smoothly-ground cataract-glass of one inch focus. No attachments could be seen, and it was evident that none passed through the pupil, which was somewhat contracted. There was no injection of the eye, but she had a constant sense of nausea and discomfort. Vision was indistinct; but on trial with cataract-glasses, I found she could read with a lens of two inches focus.

As the sight of the other eye was imperfect, I examined this also, and observed marked tremulousness of the iris, as seen after the lens has been removed by an operation for cataract. I at once suspected that displacement of the lens had occurred in this eye also, — as, although I could not see it floating in the posterior chamber, there was an appearance at the lower part of the iris as if some body were lying there, and were impelled against it as the globe moved in various directions. On testing this eye with cataract-glasses, she saw perfectly.

Causing her to lie down on her back upon a couch, with the eyes closed, the right lens soon slipped back through the pupil, and became invisible in the posterior chamber. She now saw distinctly with a glass of half an inch less focus than that which suited the left eye, using for reading two inches, and for distant vision four inches radius.

I repeatedly saw this patient when the lens had slipped into the anterior chamber of the right eye; and in December, 1854, I exhibited her in this condition to the Boston Society for Medical Improvement. On one occasion, the presence of the lens in the anterior chamber caused so much irritation that the pupil contracted strongly, and the lens could not recede till atropia had been employed to dilate it.

Quite recently another case of double spontaneous dislocation has been reported, as observed by Professor Arlt, of Vienna; where he found it necessary to extract the lens from one eye.

I have also seen the lens displaced by a blow upon the eye, without losing its transparency, the patient seeing tolerably well when stooping forward or when lying on his back; but losing all distinct vision as he brought his head to an upright position, when the lens could be observed to fall backward with a hinge-like motion, as if its suspensory attachments remained unsevered at the lower edge.

Most often, however, the lens becomes opaque after these accidents; either from interruption of its nutrition or from rupture of the capsule.

If no irritation is caused by the displaced mass, it may be left to itself, and, in cases where the capsule has been torn, will become absorbed; but if it excites inflammatory action, especially when it has been thrown into the anterior chamber or fixed in the

distended pupil, it should be extracted. When pressing on the iris from behind, and thus causing serious symptoms, relief may often be given and absorption hastened, by division with a cataract needle.

When protruded through a rupture of the sclerotica, and lying beneath the conjunctiva, it should be extracted, the incision for its removal being at a distance from the wound of the sclerotic coat.

CATARACT.

This term should be limited to opacity of the crystalline lens or its capsule, — excluding all those deposits of lymph occupying the field of the pupil which were formerly designated false cataract, and all opacities having their seat in the vitreous mass or the posterior parts of the eye. This affection assumes a variety of forms under different circumstances, and should be described under several heads.

CONGENITAL CATARACT.

This form of cataract, although most frequently existing from birth, is sometimes developed at a later period, even after the age of puberty. But whether existing in infancy or observed afterward, the appearances are the same, and are quite different from those characterizing the cataracts of elderly persons. The lens shows a grayish or bluish-white opacity, sometimes perfectly uniform, like milk diluted with water,

in other cases mottled with specks of a chalky white. Radii are rarely seen; but a more dense nucleus is sometimes observed, through translucent cortical layers of the lens. In a certain number of cases, the opacity occupies at first only the centre of the lens, and allows of fairly distinct vision when the pupil is dilated, appearing in these instances as if the lens were but imperfectly developed. This appearance is, however, deceptive, and the entire lens usually becomes cloudy as the child approaches puberty.

Where blindness has existed from birth, it is usually accompanied with much oscillation of the globe, in irregular movements, — the patient never having learned to control the direction of the eyes, from having been unable to fix them upon objects.

Causes. — Hereditary predisposition is a not unfrequent cause of this form of cataract, — which may affect several members of the same family. I have seen an instance where seven individuals of one family had cataract; — at another time I operated in one day upon the six eyes of three children in a family where yet another child and the mother were also affected, — two other children remaining thus far exempt. The result was perfectly successful in all the eyes operated on. The cases of the mother and youngest child are equally favorable, but the operation has been postponed, for their convenience. I have operated in a number of other instances on two or three cases in the same family. But, though fre-

quently hereditary, the disease is by no means necessarily so.

Prognosis. — As in all other forms of cataract, the removal of the lens is the only radical cure; though in a few cases, where the opacity is central only, atropia will greatly increase the amount of vision. In such cases it may be used as a temporary palliative; or, if the amount of vision conferred by its aid is sufficient for the patient's purposes, it may be employed for an indefinite period instead of resorting to an operation. The operation is, however, far from formidable, and almost invariably successful. I have never, except in two instances, seen more than very transient irritation as a consequence of this operation, and in those the symptoms subsided without bad results.

Operation. — The pupil should be previously dilated by the use of atropia, and if the patient is a young child, ether should be administered to secure immobility of the eye. He may then be laid upon a table near a window, and supported by pillows, in such a position that the light may fall favorably upon the eye. The surgeon should stand behind the patient's head, and elevate the upper lid with the forefinger of one hand, while the other hand holds the instrument. An assistant may depress the lower lid with one finger; but the operator does not absolutely need the services of an aid. Should the eye oscillate to a troublesome degree, it may be controlled by seizing the conjunc-

tiva with fine forceps, which may be held by the same hand which raises the lid.

The operation may be performed through the cornea or sclerotica.

Operation through the Cornea. — A very fine needle is introduced through the cornea, at a point midway between its edge and centre, and the anterior capsule is then incised or freely lacerated, and the lenticular substance divided to a greater or less extent, according to the judgment of the operator. If but a small opening be made in the capsule, and the centre of the lens broken up by a drilling movement, the risk of irritation of the iris by pressure of fragments of the lens against it is much less than when the whole mass of the lens is at once divided. Even should the operation require to be repeated, this may be done with little danger, as the bulk of the lens will have become diminished by partial absorption.

The division of the capsule allowing the aqueous humor to act on the lenticular substance, the first effect is the expansion of the latter, as it imbibes the fluid. Until absorption can have made some progress, the swollen fragments may exert dangerous pressure upon the iris; a fact which should be borne in mind by the surgeon during the performance of the operation. Some authorities advise that no attempt should be made to completely divide the lens or its capsule, so as to obtain absorption as the result of a single operation; but prefer to repeat it several times if

necessary. It is seldom, however, that this is convenient for the friends of the patient, who often come from a distance to obtain skilful advice. In such cases we may often resort to a method of operating which is more certain to effect complete removal of the lens, without requiring to be repeated, than the method by division through the cornea; though it is not to be denied that the risk of at least temporary irritation is somewhat enhanced.

Operation through the Sclerotica. — As in the operation through the cornea, a very fine needle is to be employed. It is to be introduced through the sclerotica, about a line from the margin of the cornea, and its point carried over the upper edge of the lens and brought to the centre of the pupil. The needle is then to be carried backward, so as to divide the lens and capsule. This movement may be repeated, so as to separate the lens into smaller fragments, and these should be placed in such a position that the iris shall not be pressed upon, or some of them may even be pushed with the point of the needle into the anterior chamber.

Iriddesis in Congenital Cataract. — In some forms of congenital cataract there exists opacity of the central portion only of the lens, without the usual tendency to increase of the cloudiness to such an extent as to involve the whole crystalline. In these instances the patients see tolerably well in a moderate light, or after artificial mydriasis.

Great advantages may be gained, under these circumstances, from displacing the pupil so as to bring it in apposition with a transparent portion of the lens, towards its margin, — while at the same time the opposite portion of the iris is drawn over, so as to mask to some extent the central opacity. By proceeding thus, instead of operating for the removal of the lens itself, we retain for the eye the power of vision without cataract glasses, and of accommodation to different distances, — both of which functions would be abolished were the crystalline removed. Furthermore, this operation involves less risk than that of division of the lens, or than linear extraction or removal by suction.

The unusual position and balloon-shape of the pupil creates a slight deformity on close inspection ; but this is of no importance compared with the advantage of being able to dispense with glasses, and attracts less attention than the wearing of these.

Treatment after Operation. — After either operation the room should be somewhat darkened, and the eyes kept under the influence of atropia. No bandage or covering for the eyes is necessary, the exclusion of light from the room being a sufficient precaution against inflammatory action. Compresses wet with cold water may be laid over the eye if much pain is complained of. As in other soft cataracts, nausea and vomiting are sometimes felt, for a few hours only.

Where the patient has attained a reasonable age, ether may be dispensed with, — as the actual pain

attending the operation is insignificant. The patient may sit or recline. If sitting, the surgeon may stand behind him, supporting his head, and raising the upper lid with the hand not required for the operation, — or the lid may be raised by an assistant standing behind the patient, whilst the surgeon sits in front, and depresses the lower lid with one hand, while he operates with the other. The surgeon should acquire the requisite skill to enable him to operate with either the right or left hand. He may thus conveniently operate on one eye with his right and on the other with his left hand, without changing his position.

Time requisite for Absorption. — The time required for absorption varies from a few days to as many months, in proportion to the vigor of the patient, the softness of the lens, and the extent to which it is broken up. The process goes on slowly at first, but afterward, when softening and disintegration of the masses has commenced, more and more rapidly. Congenital cataracts are softer than those met with in advanced life, except when these latter have resulted from traumatic injury.

TRAUMATIC CATARACT.

This may be occasioned by any wound of the capsule of the lens, allowing the aqueous to penetrate to its substance; or by smart blows upon the eye, rupturing the capsule or separating its suspensory attachments. As I have already stated, I met with two instances from one small town, where a blow from the knot at the end of a whip-lash, received in cracking a whip, had caused traumatic opacity of the lens. When following puncture or rupture of the capsule, lenticular cloudiness soon begins to exhibit itself; but when occasioned by detachment of the suspensory ligament, and the probable interruption of perfect nutrition of the lens, it may come on at a much later period, often several months, and even years, after the injury. The most remarkable instance I have known of tardy manifestation of this pathological change, I have mentioned in speaking of traumatic injuries of the eye. It occurred in a girl who was accidentally hit in the eye with a stone thrown by a boy. I found but a small wound of the conjunctiva; but from the direction in which the blow was received, I felt sure that severe concussion of the eyeball must have attended it, and stated to her parents my apprehensions that cataract might subsequently result. But, as many months passed by with no appearance of morbid change, I told her friends that I regarded the danger as past. Eight years

after, nothing having happened to the eye in the mean time, cataract exhibited itself, and after waiting some two years longer it was successfully removed.

Traumatic cataract has a uniform slightly bluish-white tint, like that of milk largely diluted with water, — so long as the lens remains undissolved; but, when this has become absorbed, the capsule, if it remain suspended behind the pupil, may have the appearance of a thin gauze merely, or it may form a dense yellowish mass, or even undergo cretaceous degeneration. Often it is so extremely thin that it is only to be detected on most careful examination, — the pupil, at first sight, appearing to be perfectly clear.

Treatment. — When the capsule has been extensively torn by a sharp body or by concussion, the lens is often absorbed by the aqueous humor, without a necessity for any operation; and it is well to delay interference if we have reason to think this may be the case, keeping the pupil dilated if the iris seems to be pressed upon injuriously.

Operation. — The pupil should be dilated by means of atropia, before the operation. Ether may be given if the patient is a child, or is very timid.

As traumatic cataract is invariably quite soft (except in cases where the lens has already been absorbed, and only the toughened capsule remains), we may generally operate with safety for its complete removal at a single sitting. This may be done through the

cornea or sclerotica. If done through the cornea, care must be taken to divide the posterior as well as the anterior capsule; otherwise there is danger that the masses of lenticular substance, confined between the posterior capsule and the iris, may make destructive pressure on the latter membrane. When done through the sclerotica, thorough division of the entire lens and capsule may be accomplished, and the pieces disposed of in such a manner that no harm shall result from their expansion. The pupil is to be kept fully dilated by atropia until the fragments of lens are so far absorbed as not to press upon the iris. The operative manœuvres are the same as directed for congenital cataract, and their description need not be repeated here.

Removal of Portions of Capsule. — Should a portion of capsule be the only remaining obstruction to vision, it may often be sufficiently torn by a fine needle introduced through the sclerotica or cornea. When this is difficult, from its toughness and elasticity, two fine needles may be inserted at different places in the cornea, and their points being passed through the centre of the capsule, are then to be separated so as to tear it. The minute canula forceps of recent invention also offers an excellent means for removing these elastic and other more dense obstructions from the field of the pupil. A puncture is made in the cornea, near its outer margin, with a broad cataract needle; or, if required, a larger opening may be

made with a cornea-knife. Through this the forceps is inserted, being kept closed by pressure of the thumb on the trigger, till it reaches the capsule. Pressure is then relaxed, the capsule seized between the toothed branches of the instrument, which are again closed together by a movement of the thumb, and the opaque membrane is withdrawn in its grasp. After this operation a fresh secretion of aqueous humor refills the anterior chamber, and the wound of the cornea readily heals. As no very sensitive parts are touched, we seldom have an unpleasant symptom subsequently to the operation. It is necessary to be careful, however, that no shred of capsule is left entangled in the lips of the wound and at the same time undetached from its posterior adhesions, as in such case it would press upon the edge of the pupil as soon as the influence of the atropia was suspended. Nor should any minute portion, even if detached posteriorly, be left in the corneal wound; as union is thereby prevented. The patient should be secluded from light, and kept quiet; but no applications to the eye are necessary unless pain should supervene.

COMMON LENTICULAR CATARACT.

Except when resulting from traumatic injury, or having the form which has been described under the head of Congenital Cataract, opacity of the lens is generally met with in persons who have passed the

middle period of life. The morbid change is usually in the lens only, the capsule not being implicated, as was formerly believed to be frequently the case. Both eyes are sooner or later affected, and usually within a few months, or at most a few years, of each other, though I have seen an instance where more than twenty years intervened between the formation of cataract in the first and the second eye.

Hard or Nuclear, and Soft or Cortical Forms of Cataract. — Two important divisions are recognized, — hard and soft cataract. In the former, the opacity begins in the nucleus of the lens, and gradually diffuses itself through its whole substance; in soft cataract, the cortical layers are first affected, generally in radiating lines, by which the lens is divided into segments which may retain transparency for a considerable time. These divisions are not merely interesting as regards diagnosis; but, as we shall see, they have an importance as regards treatment.

Causes. — On referring to my notes of several hundreds of cases in which I have operated, I find that in nearly half, the patients were aware that cataract had appeared in one or more members of their family, on either the father's or mother's side. Beyond this hereditary predisposition, I am not aware that any cause can be named as especially active in producing the disease. Persons of every condition, temperament, and occupation seem alike liable to it. Diabetes is often accompanied by cataract; and the

fact that opacity of the lens may be produced, as a temporary condition, in frogs and some other animals, by injection of a solution of sugar into the cellular tissue beneath the skin, — and that this opacity may disappear again, — in connection with the frequent presence of cataract in diabetic patients, is well worthy of attention; as it affords a glimpse of hope that careful research and inquiry may some day further elucidate the pathology of cataract, and possibly enable us to employ other than surgical means for its removal.

The precise nature of the changes which constitute this disease of the lens is imperfectly understood. Perhaps some interference with the nutrition of the lens, occasioning alterations of its structure analogous to atheromatous degeneration of the blood-vessels in other parts of the body, is the most probable explanation.

Symptoms.— Patients afflicted with cataract have a different bearing from those suffering from blindness from other causes. They have still, except in the advanced stages, a degree of vision in a subdued light, — and we see them shading the eyes by bending the head, or by a visor or some similar protection, and endeavoring to find their way and to discern objects; whilst those totally blind from other disease usually carry the body and head erect, and have little of the groping aspect of those attempting to see.

The loss of vision is generally gradual, the patient complaining that objects seem enveloped in fog, or,

especially while the opacity is still limited to some cortical radii, that objects are multiplied or distorted. Where the opacity is nuclear, the patient generally sees much better at twilight or in a cloudy day, and in such cases we may employ atropia with great advantage, as a palliative, to increase the amount of vision, while we await a proper or convenient time for the performance of an operation. In fact, belladonna is frequently used by charlatans to impose upon patients, — who are assured that a radical cure has been effected, when, in fact, the pupil has merely been dilated. The influence of the belladonna is continued, by repeated applications, till the itinerant charlatan has time to open the patient's purse and to take his own departure; after which the eye is perhaps left to itself, or, if dilatation of the pupil is kept up, the gradual extension of the opacity towards the circumference of the lens renders this dilatation no longer a benefit to vision.

No pain attends the formation of cataract; any sensations which may be felt being due to other causes.

On examining the eye, we find various degrees of opacity of the pupil. Now and then, even when vision has become materially diminished, the cloudiness of the lens is so slight that it can scarcely be perceived even after dilatation of the pupil. In such cases a magnifying lens will sometimes disclose it, or it may be detected by concentrating an increased amount of light upon the field of the pupil by means

of a lens of moderate power. The ophthalmoscope affords another and very efficient means of detecting slight opacities. Ordinarily, however, when the disease has made such progress as to lead the patient to apply for advice, we can perceive the opacity, on close inspection, without artificial aid, especially if we dilate the pupil.

By means of the ophthalmoscope, and by oblique illumination, we are able to detect the presence of minute opacities of the lens at a much earlier stage of the disease than that at which it was possible to do so by the former methods of investigation.

With the ophthalmoscope these are seen as shadows thrown upon the fundus of the eye, and with a little practice are readily distinguished from dusky appearances having their seat in the vitreous or in the cornea. By lateral illumination they give a grayish reflection as light is thrown upon them, and are evidently situated but a little posterior to the iris.

In the harder forms of cataract the opacity shows itself as a uniform grayish or amber cloudiness of the nucleus of the lens, gradually shading off towards the circumference, and without distinct radii. The space between the edge of the pupil and the opacity seems considerable, and a shadow is thrown by the iris upon the clouded lens. The pupil dilates and contracts as in a healthy eye.

When the disease assumes the character of what we term soft cataract, the cloudiness commences, as

a rule, at the periphery of the lens, or in its anterior or posterior cortical layers, extending in radiating lines, and leaving the intervening spaces nearly or wholly free from obscurity. In the incipient stages we often see only small dots of opacity, which are afterward to extend themselves to lines converging to the centre. Convex radii on the anterior, and concave in the posterior cortical portions may frequently be seen, the central nucleus remaining for a time transparent. In these instances patients may have tolerable vision, even for years from the time of the evident commencement of the pathological change. These appearances were once erroneously supposed to have their seat in the anterior and posterior capsule. As the disease progresses, the portions between the radii become altered, and the lens acquires a cream-colored or grayish, and sometimes pearly aspect, with or without a persistence of the radiating lines. A very uniform light color, with occasionally an irregularly turbid appearance, sometimes marks a fluid cataract, so thin in consistence that I have seen it flow into the anterior chamber in a milky jet upon opening the capsule. A mottled appearance is sometimes exhibited in other forms of soft cataract, certain spots showing a clearer white than the rest of the mass.

Prognosis. — In cases of cataract having other than a traumatic origin we must regard the disease as likely to be developed sooner or later in both eyes.

How soon after the failure of one eye the other may become affected, we cannot certainly predict; nor are we able, on a single inspection, to pronounce on the probable rapidity of the morbid change, after the disease has declared itself. It is common to observe a very slow development during the earlier stages, with a comparatively sudden failure of sight and rapidly increased opacity after the affection has reached a certain point.

As cataract may also occur as a secondary morbid condition, in cases of glaucoma, Bright's disease, and extreme myopia, care should be taken to ascertain that the retina retains good perceptive power, at least as to lights and shadows, before making a prognosis as to the result of an operation.

So far as the results of operation are concerned, the prognosis is very favorable; failure, in skilful hands, being an exception to the general rule.

Treatment. — I have referred to the palliative use of atropia in certain cases of cataract. Where the patient derives increased sight from enlargement of the pupil he may be supplied with a solution of sulphate of atropia of from two to five grains to the ounce of water, of which he may have a drop applied every day to the inside of the lower lid with a small camel's-hair pencil. This may be continued until, with the advance of the disease, relief is no longer derived from its use.

Convex, and in some rare instances concave, glasses are of material service in a proportion of

cases of incipient cataract. The temporary advantage derived by the patient from such auxiliaries is at times quite a matter of surprise; and there is no objection to their use during the short time that they continue to be of service.

But all these means of transient relief have no influence in retarding or removing the disease; — for a radical cure an operation is our sole resource. Charlatans have always assumed to be able to rid patients of their infirmity by other treatment; but, at the Ophthalmic Congress held some years since at Brussels, the testimony was unanimous that not a single instance of successful cure other than by surgical interference had been authenticated. Cases have occurred, to be sure, where cataract has fallen from its suspensory attachments or been displaced by a blow; but these events are beyond the limits of expectation, and, so far as they go, confirm the propriety of operation.

Season for Operating. — As regards the proper time for operating, and the maturity the disease should be allowed to reach, our practice must vary with circumstances. In America, any season of the year, except during the extreme heats of summer, seems equally favorable, though it is well to avoid operating when a long storm is present, or seems to be impending. Much more stress than its importance deserved was formerly laid upon the ripeness, as it was termed, of cataract. But it is desirable that the disease should

be well advanced before an operation is performed, as the patient then becomes satisfied of the hopelessness of his condition unless relieved by skilful treatment, and is likely to be more tractable and to follow any instructions laid down for him with implicit care. As a rule, one eye should not be operated on so long as the other exhibits no sign of disease; but, as the development of cataract in the second eye within a brief period may be considered inevitable, we are justified in operating without waiting for its appearance in this eye, provided the patient is about to go to a great distance, where he will not at a future time be within reach of skilful aid.

When both eyes are evidently affected, the operation may be delayed till vision is almost entirely lost, — and may then be performed on both at the same time, — if judged expedient. But generally the convenience or necessities of the patient will require that one eye should be operated on while the other is but partially obscured. If, in this case, some time should be required for the removal of the lens by absorption after an operation by division, the individual has in the mean time the use of the other eye, and, if the result of the first operation is success, he is relieved from his infirmity, and restored to usefulness without having undergone the penance of watching the slow approach of total blindness while waiting for the disease to reach its climax in the second eye.

Preparation for the Operation. — The nearer the

condition of the patient approaches the standard of health, the better is his chance of a successful result from the operation. If previously well, he should continue in his usual habits, without being subjected to any special preparation. If debilitated, or if exceedingly plethoric, it may be desirable to fortify or to reduce his general system previous to operating.

Choice of Method. — Several modes of operation are adapted to the different forms of cataract. If the lens is so soft as to allow of its being readily absorbed after division, this operation — or that which is termed linear extraction, i. e. extraction through a small opening in the cornea — is by far the safest method. If harder, it may be displaced by reclination, or extracted from the eye. The latter is the most scientific mode of procedure, and in the hands of skilful operators gives the best result; for, though unquestionably more difficult of execution than mere reclination, yet the flap of the cornea reunited, all danger is at an end; whereas, after reclination, or, as it is also termed, couching, there is for a considerable time a chance of reascension of the lens, or of its causing serious inflammation by pressure on the parts to the vicinity of which it has been displaced. As a general rule, then, we should prefer extraction in cases of nuclear cataract, — resorting to the operation by couching only in exceptional cases, or where some special contra indication for extraction is observed in the patient.

Position during Operation. — Operators are not agreed as to the best position for the patient in operations for cataract. English surgeons, in many instances, prefer the recumbent position, while on the Continent the sitting posture is more in favor. In public institutions, where everything can be arranged so as to afford the most favorable light, and the utmost convenience to the operator, the recumbent position is perhaps the most desirable. In private practice, where arrangements must be made extempore, it is easier to place a patient in a good light when seated, than if upon a couch. This position also seems less formidable to the patient.

If seated, the chair occupied by the patient should be so low that his head may be nearly on a level with the breast of the surgeon. His hands should clasp the sides of his chair, that he may the better resist any impulse to raise them. His head should be supported by the assistant, who stands behind him with one foot thrown backward so as to give a firm support in case the patient should start. One hand of the assistant should be placed under the patient's chin, and with the first and second fingers of the other he is to raise the upper lid of the eye to be operated on. If the right eye, the left hand should be employed to raise the lid; if the left eye, the right hand should be made use of; as thus the other fingers of the hand are less in the surgeon's way. When the patient still enjoys vision with the other

eye, it should be bandaged previous to the operation, that its movements may not involve motion of the eye to be operated on. The pupil should have been previously enlarged by atropia.

Operation by Division through the Cornea. — When tolerable sight remains in the other eye, we may operate by simple division of the capsule, allowing the lens to be slowly dissolved by the action of the aqueous humor; without incurring the risk of too great swelling of the fragments, which sometimes attends free division of the entire lens. In this method, a very fine needle, held in the same position as a writing-pen, between the thumb and fingers, is passed through the cornea, midway between its centre and edge, and the capsule is to be opened by one or two small scratches with the point of the needle. If thought prudent, the lens may also be divided to a certain extent, and its absorption thus facilitated. Where the lens proves to be very soft, and therefore likely to swell upon imbibition of the aqueous humor, the needle may be carefully passed through the lens to lacerate the posterior capsule, so as to allow of expansion in this direction, and avoid the danger arising from confinement of the swollen lens between the posterior capsule and the iris. After the bulk of the crystalline has been reduced by the absorption resulting from this operation, a second and more complete division of both lens and capsule may be made, through the cornea or scle-

rotica; provided the process of absorption seems to be suspended, or goes on too slowly for the patient's convenience, thus rendering a second operation advisable.

Division through the Sclerotica. — When division is performed through the sclerotica, the needle, held as before directed, is to be introduced about a line from the margin of the cornea, and brought over the lens into the field of the pupil, taking care to pass it between the iris and the anterior capsule, and not inside the capsule. Its cutting edge is then to be used for free division of the lens and its enveloping membrane. The larger fragments are to be carried away from contact with the iris; and if convenient some of them may be pushed into the anterior chamber. The operation through the cornea is absolutely painless, and that through the sclerotica is usually no more painful than the prick of a needle upon the skin.

Treatment after Operation. — The eyes should be kept closed, and generally a bandage should be worn after the operation. So long as any danger of pressure upon the iris may be thought to exist, the pupil should be kept under the influence of atropia. The light in the apartment should be moderated.

After free division of the lens, the patient is often scarcely conscious that any change has been effected in the condition of his eye. In other exactly similar cases, and from no apparent cause, severe pain in the

eye and head, with excessive nausea and vomiting, comes on in a few hours after the operation. This seems little amenable to treatment; large opiates or other remedies having scarcely any influence in relieving it; but it seldom continues more than twenty-four or thirty hours. The patient should be told, after the operation, that this may possibly happen, and assured that it need not cause any anxiety as to the favorable progress of his eye, and will be but a temporary suffering. Without this forewarning, he might become much alarmed should the symptoms occur.

Operation by Linear Extraction. — This operation is, in fact, a combination of division and extraction. The lens is first divided with a fine needle, introduced through the cornea. The corneal wound is then enlarged with a broad needle, or a cornea-knife, and the lenticular fragments are removed through this opening, which should not exceed two lines in length, by means of a small scoop or curette. The posterior capsule should not be disturbed and often retains its transparency. When it does not continue clear, it may be subsequently removed by the aid of canula forceps. This is an excellent mode of removing very soft cataracts.

Operations for Hard Cataract. — When the lens has such a degree of hardness that its division could not be easily effected, — or, if accomplished, a long time would be required for absorption of the fragments, —

operations by extraction or reclination are to be preferred.

Operation by Reclination or Couching. — The pupil should be well dilated by atropia before the operation. A slightly-curved, lance-headed needle, somewhat larger than that used for division, is best adapted for this method. In all operations with the needle, the instrument is to be held like a pen between the thumb and the first and second fingers, and should not be tightly grasped. The third and fourth fingers, or the fourth alone, should, if the patient is in a sitting posture, be fixed on the malar prominence, and give support to the hand, which, resting thus on the cheek of the patient, follows any slight movement of his head. The surgeon should never support his hand by resting his elbow upon his own or the patient's knee. All lightness of touch would thus be sacrificed, and a slight motion might have fatal consequences to the eye. It should be passed through the sclerotica, its convex surface upward, at the distance of a line from the cornea; its point being directed towards the centre of the globe, that the iris may not be wounded should the patient suddenly move his eye. The posterior capsule may now be lacerated to facilitate the displacement. The needle is then to be turned one quarter on its axis, so as to bring the convex surface of its head parallel with the iris. In this position it is to be brought over and in front of the lens, taking care that it shall pass

before and not within the anterior capsule. Instead of turning the edge of the needle towards the crystalline, as when we propose to divide the cataract, pressure is made against the lens at about its centre, with the slightly concave surface of the head of the needle, and it is thus carried downward and backward towards the lower and outer part of the globe. The needle should retain its position for a few seconds, till the lens has become sufficiently covered by portions of the vitreous to prevent its reascension. It is then to be disengaged by a slight rotatory movement, and withdrawn from the eye in the same position as that in which it was introduced, i. e. with its convex face upward. The dots on the handle of the instrument indicate the position of its head when this cannot be seen within the globe. Care should be taken that the needle is not placed so much above or below the horizontal diameter of the lens that this shall be tilted forward into the anterior chamber. We should also be sure that the lens is carried so far from the iris and ciliary processes that pressure shall not be made upon them in case expansion of the crystalline should take place. Nor, on the other hand, must it be pressed hard upon the retina, as serious injury of this delicate structure must ensue.

If the patient has been seated during the operation, it is well for him to remain so for some hours, if he is comfortable. When he lies down he must

not stoop in undressing, but should be carefully assisted. He should sit upon the edge of the bed and lie down backward, the hand of a friend or nurse supporting his shoulder, without turning his face downward; as it is important to avoid incurring the possible chance of reascension of the lens.

The lids do not require to be confined by strips of plaster; but the patient should be directed to keep his eyes closed, and they should be covered with a dry compress and light bandage. The room should be darkened, and the pupil kept under the influence of atropia. After a few days, if all goes on well, the patient may be allowed more liberty; but he should remain in a subdued light, and wear a shade for some little time after all injection and sensitiveness have disappeared. Should severe pain come on at any time after the operation, cold wet compresses, frequently changed, may be laid upon the lid, a purgative given, and a few leeches applied to the temple.

The operation of couching is most applicable to those cases where the eyes are so deep set that extraction is difficult of execution, and to those where we have reason to suspect, from the tremulousness of the iris, that the vitreous is abnormally fluid and might escape from the eye should the cornea be opened. The first of these difficulties may, however, be surmounted by seizing the conjunctiva, including the sub-conjunctival cellular tis-

sue, with forceps, and holding the globe in a position which allows section of the cornea to be made with more facility.

This operation often gives a very flattering immediate result, — the patient at once recovering vision; and were it not for the after effects sometimes ensuing, it would be the sole method employed, as being most easy of execution. But the presence of so large a mass, acting almost as a foreign body, in a part of the globe where slight displacement may bring it into contact with most sensitive structures and excite destructive inflammation, constitutes a source of so much danger, that this method is seldom employed by skilful operators. But in unpractised hands, I believe this method, with all its defects, will result in fewer failures than the operation by extraction, which requires a nicer delicacy of manipulation. Where, therefore, a patient is not able to leave his home, but must place himself under the care of surgeons of small experience, this operation may be selected, and when carefully performed, offers a very good chance of a fortunate result.

Operation by Extraction. — The position of the patient may be either sitting or lying, as the surgeon may prefer. If sitting, the same rules are to be observed, as regards the position of the patient and the surgeon's assistant, as have been given for the operation by reclination. The assistant should raise the lid by alternate traction with the first and

second fingers, so as to include all the folds of skin ; otherwise, if only the edge of the lid is secured, there may be inversion of the tarsal cartilage, as the patient contracts the orbicularis muscle, which will bring the everted lid into contact with the knife. The eyelashes should be brought to the supra-orbital ridge, where being retained by the finger, they assist in securing the lid in a proper position. The aid should be careful to make no pressure on the globe, unless at the express desire of the surgeon.

Seated in front of his patient, the surgeon depresses the lower lid with a finger of one hand, and holds the instrument as he would a writing-pen, between the thumb and two fingers of the other. The other fingers rest upon the malar prominence, and give support to the hand. These should remain fixed, all movements of the knife being executed by extension and flexion of the other fingers. It is desirable that the surgeon should be ambidexter, capable of operating with his right hand on the left and his left hand on the right eye.

Should the patient be unsteady, so that he cannot keep his eye fixedly in the direction required by the surgeon, — or in case he has been deprived of voluntary control of it by the influence of anæsthetics, — it should be held in a proper position by seizing a fold of conjunctiva and the subjacent tissue with artery forceps. By their means, the aid may keep the globe perfectly steady, very greatly facilitating

the section of the cornea. He should be ready instantly to relax his hold on a signal or request from the surgeon. The knife should be held parallel to the cornea, and before inserting its point it should be carried across in front of the eye, that the operator may be sure that his fingers are so placed as to allow of the completion of the incision of the cornea by a movement of simple extension of those fingers, without moving from the support on the cheek. The knife has a triangular form, adapting it for cutting when merely pushed forwards.

The cornea may be divided upwards or downwards. The lower section has the advantage of being more easy of execution, — as the natural tendency of the eye to roll upwards favors the accomplishment of the incision. Its disadvantages are, that after the operation the edge of the lower lid is more likely to insinuate itself beneath the flap of the wound and disturb the healing process, — and that hernia of the iris can more readily occur. The incision upwards is more difficult; but when effected, the wound is covered by the upper lid, which by a slight pressure tends to keep its edges in apposition. The lid is not in a position to disturb the wound, and there is somewhat less risk of prolapse of the iris or vitreous humor.

The instrument is to penetrate the cornea near its edge, and in the line of its horizontal diameter; its point being turned slightly towards the iris till the

anterior chamber is entered, that it may not glide between the corneal laminæ. It is then to be pushed quickly but very steadily forward, the blade parallel with the iris, and counter puncture made at the opposite point of the diameter. The incision is to be completed by continuing to push forward the knife; but the last fibres of the upper edge of the cornea should be very cautiously divided, especially in case any spasmodic contraction of the muscles should be perceived by the operator; otherwise there is danger that not only the lens but a large portion of the vitreous may be expelled from the eye. Should the spasmodic action be excessive, the knife may be withdrawn previous to division of these fibres, and the lids allowed to close for a few moments, after which the incision may be finished with a narrow, probe-pointed knife.

In making the incision, great steadiness is required to prevent the escape of the aqueous humor by the side of the knife, as, if this occurs, the iris falls in front of the edge of the instrument. Should this happen, efforts must be made to disengage the knife; but if these fail, and but a small portion of iris is implicated, the section of the cornea may be completed, even should the iris be wounded or excised to a limited extent. If too much of the iris is involved, it is better to withdraw the triangular knife, and substitute a narrow, probe-pointed one for finishing the flap. If the patient is agitated, he may be allowed a

brief repose before proceeding to the second part of the operation.

A cataract-needle, or a small hook designed for this purpose, is to be placed with its shaft across the wound, and slid in this position till it reaches the diameter of the pupil. It is then to be slightly withdrawn, its point carried through the pupil, and the anterior capsule freely divided by crucial incision. This second step accomplished, the lens often slips through the pupil, and presents itself at the corneal wound, without any pressure having been employed. If it does not, gentle pressure may be made on the globe, below or above the cornea, by the finger or a curette. Should the lens be arrested in its transit through the pupil or the corneal incision, it may be assisted by the curette, or by the needle which usually is placed at the other end of the same handle, — all haste being avoided, and every movement of the operation executed with the greatest delicacy. The aid now closes the lid, taking care to lift it as it were over the flap of the cornea. The patient should be told to keep the lids quietly shut, as if asleep. After a few moments, if all has gone on favorably, he may be turned away from the light and allowed to open his eye and distinguish some object. This is for him an assurance of success, and renders him more content during the days when the eyes must be kept under restraint. The lids are then to be secured, in both eyes, by narrow strips of court-

plaster extending across the lids in oblique directions.

If no pain or swelling of the lid comes on, it is proper not to disturb these strips for four or five days, at the end of which time the wound has generally united. But even when we find this to be the case, it is well to reapply them for two or three days longer. Should any severe circum-orbital pain be complained of, or much swelling of the globe or increased secretion be observed, — it is best to remove the adhesive strips and examine the condition of the wound at an earlier period than when we have reason to believe that all is going on well.

Should any of the vitreous humor escape during the operation, the surgeon and his assistant must not allow themselves to be disconcerted and act precipitately; but the lids should be carefully closed, and remain thus till all spasmodic action has subsided. If any portion of vitreous then protrudes between the lips of the wound of the cornea, no effort should be made to return it, but it should be excised with sharp scissors, without seizing it with forceps or employing the curette, as, if these are made use of, there is danger that a still larger portion may be dragged forth. This accident should be carefully guarded against, as the presence of vitreous humor in the field of the pupil or the corneal wound is liable to interfere with the all-important process of immediate union. But though in appearance so hopeless a mis-

fortune, the loss of a large amount, — even as much as one third of the vitreous mass, — may occur, without seriously affecting the amount of vision.

If the patient can sleep on his back, with his head somewhat raised, this is the best position. He should have been divested of some of his clothing previously to the operation, and in being undressed must have the aid of others. He must not stoop forward on any account. A dry compress and light bandage may be placed over his eyes, and his room should be darkened. An opiate may often be given at night with advantage. Should there be reason to fear that he may touch or rub his eyes during sleep, he should be watched by an attendant, or if this cannot be done, his wrists should be confined by a towel or other easy bandage, which is to be fastened at the sides of the bed, so loosely that he may be able to move his arms, but not to reach his eyes.

The after treatment should consist of a continuance of the above-described means, unless urgent symptoms declare themselves. In this case, compresses constantly wet with cold water should be laid over the eyes, and a few leeches may be applied to the temple, but not too near the eye. When there is reason to fear that hernia of the iris has occurred, the eye should be at once examined, and if present, the hernia should, if possible, be replaced by a probe or curette. When this cannot be done, the protruding portion should be excised by a clip with fine scissors.

Opiates may be given when required for the relief of pain. Purgatives are not desirable, as it is important that the patient should be disturbed as little as possible. He may have a moderate diet of articles requiring little mastication. After we have reason to think union of the corneal wound has taken place, the patient may be allowed to sit up, and even to walk about with the assistance of another person. In a few days more the eyes may be opened; but little light should be admitted for some time longer.

Should the surgeon prefer to place the patient to be operated on in the recumbent position, the positions are the same as previously directed for the operation on children affected with congenital cataract. The incision and other steps of the operation are to be executed as just described.

Out-scooping of Cataract. — The out-scooping of cataract, by means of spoons devised for that purpose by Dr. Waldau (formerly Dr. Schuft) of Berlin, or by these spoons as modified by Mr. Critchett, is a *modus operandi* adapted to some cases of semi-hard cataract.

In doing this operation a very broad, lance-shaped, bent knife is substituted for the ordinary extraction knife. The lids being separated by a spring elevator, and the eyeball turned downwards by means of forceps held by the operator or assistant, the knife is inserted near the upper edge of the cornea and pushed onwards, parallel with the iris, to the full breadth of the

instrument. A portion of the upper part of the iris is now excised, in the usual mode of doing iridectomy; but it is not important, as when operating for the relief of glaucoma, that an entire segment of iris should be removed as far as the ciliary margin. All that is now needed is, that an enlargement of the pupil should be made, so as to afford more room for the extraction of the lens without exposing the iris to danger of contusion from the scoop.

The third step of the operation consists in very free division of the anterior capsule of the crystalline, with one of the small instruments designed for this purpose. The thin scoop or spoon as modified by Mr. Critchett, or as in another model which I have devised and prefer, is then passed behind the lens, gliding along its convexity, if possible between it and the posterior capsule, care being taken not to rupture the hyaloid membrane, and is carried as far as the lower margin of the crystalline. The spoon is then pressed slightly towards the cornea, and withdrawn, bringing with it the nucleus or a considerable portion of the lenticular substance. It is to be again introduced and withdrawn, till all fragments of crystalline, so far as seen, have been removed and the field of the pupil is clear. Care should be taken that fragments are not pushed behind the iris, to cause subsequent irritation, and that pressure is not made against that membrane.

This operation offers the advantages of a straight and small incision, well disposed to immediate union;

it lessens also the risk of prolapsus iridis, and we thus avoid two of the principal dangers of ordinary extraction. The recovery, in favorable cases, is more rapid, and the after treatment requires less strict care. These are strong arguments in its favor. On the other hand, the objections to this method are, that inflammation of the iris and capsule, arising either from contusion or from the presence of some unremoved fragments of the lens, are unhappily frequent, and that secondary operations for the removal of opaque capsule are often required. Its true relative value remains to be determined.

Iridectomy previous to extraction of Cataract. — The operation of iridectomy as preliminary, and some weeks previous to extraction of the lens, has been recommended by Mooren and others, as calculated to increase the chances of success. Only a narrow strip or segment need be removed, — the design being to enlarge the natural pupil and thus obtain more room for easy exit of the lens, and also to lessen the chances of prolapsus iridis through the wound of the cornea.

If this auxiliary operation be resorted to, iridectomy and the subsequent extraction should be done upwards.

Iridectomy may also be combined with extraction, — as proposed by Jacobson, — the two operations being done at the same time. There are many reasons for preferring this plan to that of leaving an interval be-

tween the two operations; and almost the sole objection, — the difficulty of keeping the patient quiet during the slightly longer time required for the double operation, — may be obviated by the use of anæsthetics. In this case, moreover, the operator has it in his power to decide, after section of the cornea, according to the indications he meets with, whether or not he will resort to iridectomy.

Removal of Soft Cataract by Suction. — An ancient mode of extracting a lens of soft consistence by suction has recently been revived by Mr. Teale, and advocated by him in the Royal London Ophthalmic Hospital Reports. I have obtained excellent results from his operation, performed with slight modifications. I use a broad needle for puncturing the cornea and make free division of the anterior capsule with the same instrument. A silver suction tube, of the size of the canula of a small exploring trocar, is connected by a short, flexible rubber tube with a glass bulb, and to this bulb is attached another longer tube which is held in the mouth of the operator. The silver tube is inserted through the wound made by the needle, and carried through the pupil, which has previously been dilated by atropia, to the centre of the lens. Gentle aspirative efforts are now made, and the lenticular substance is drawn through the tube into the glass bulb. The mouth of the tube is slightly moved from one point to another within the capsule, so as to bring within its reach any fragments of the crystalline which may be

observed to remain. If the lens be quite soft, every portion of it may be drawn into the instrument, leaving the pupil clear. Should it have more tenacity, it may not be possible to remove the whole, and the fragments are left to dissolve, as after an ordinary operation for solution or a linear extraction, or they might perhaps be removed, after having become softened by the aqueous humor, by a subsequent suction operation. It is best to maintain dilatation of the pupil, as a precautionary measure, during the first days after the operation, and until we are satisfied that no danger is to be feared from pressure of unremoved flakes of lens against the iris.

SUTURE OF THE CORNEA AFTER EXTRACTION OF CATARACT.

So far as I know, the insertion of sutures in the cornea, after extraction of the lens, to facilitate primary union of the flap, has never been performed or suggested, until lately by myself. I have done this in a considerable number of instances, and thus far with excellent results; and after careful observation of the results obtained, can advocate this method as possessing numerous and important advantages. I prefer a straight needle, or one slightly curved near its point, only a quarter of an inch long, and having its point flattened to a cutting edge and carefully sharpened. The needle is held and passed through the cornea by means

of a pair of firm forceps, and the suture, formed by a single strand of silk or the finest thread, is tied, not too tightly. This is allowed to remain until it cuts itself out, which is sometimes not for several days, or even weeks; or it may be removed after the wound has become consolidated, say at the end of a week or ten days. From the usual intolerance of the cornea of the presence of foreign bodies, we might expect that the suture would give rise to much irritation, but such has not been the fact, as I have known it to remain *in situ* seven weeks without causing inconvenience.

Every one will appreciate the immense advantages to be gained by employing such a means of insuring immediate union of the corneal wound, — if the question of tolerance be once determined in its favor. Non-union of the edges of the flap is of itself one of the great dangers following the operation; but we have thus placed it in conditions where its displacement will be prevented, its union by primary adhesion promoted, and swelling and suppuration of its border rendered most unlikely to occur. Prolapsus of the iris, another of the sequelæ we have most to fear, is rendered almost impossible. By accomplishing a more speedy restoration of the anterior chamber and retention of the aqueous humor, we escape or greatly lessen the chances of inflammation of the iris, the crystalline capsule, and the choroid. We are able to maintain dilatation of the pupil by the free use of atropia, without fearing that hernia iridis may be thereby induced, — and we thus

obviate the dangers resulting from pressure of fragments of cortical lenticular substance, or of capsule, against the pupillary margin of the iris. Lastly, we are able sooner to examine the eye with safety, and satisfy ourselves as to its condition, and, if necessary, to institute measures to combat any threatening symtom in its incipient stage.

ANÆSTHETICS IN OPERATIONS FOR CATARACT.

The use of chloroform or ether, till complete insensibility is induced, greatly increases the chances of success in the operations for extraction of hard cataract and in the removal of soft cataract by suction.

In extraction of cataract by the ordinary flap operation, anæsthesia allows of fixation of the globe in any desired position, — so that the upward section of the cornea, which offers most advantages, may be made with nearly as much ease as the lower. It renders prolapsus of the iris or loss of vitreous during the operation less probable, by preventing all compression from spasmodic contraction of the recti muscles, and it allows of the careful removal of any fragments of cortical substance which may remain after the exit of the mass of the lens. Should a suture be employed, as I have already proposed, its introduction will be facilitated by the passiveness of the eye.

Almost the sole objection to the use of ether in extraction is found in the possibility of loss of the vitre-

ous or of intra-ocular hemorrhage during efforts of emesis induced by the anæsthetic. This accident may be avoided, in great part, if care be taken to have the stomach nearly empty at the time of administration, and its dangers may be obviated by hastening the application of the compressive bandages, which retain the edges of the corneal wound in proper apposition. The use of chloroform does not involve this objection in the same degree; but it is less safe than ether, though unquestionably very slight risk attends its careful employment. Should the extraction be combined with iridectomy, as proposed by Jacobson and Mooren, or effected by means of out-scooping with a spoon through a small corneal wound and after iridectomy, as practised by Waldau, the induction of anæsthesia becomes yet more important. It allows of the upper section being made, which, though somewhat more difficult than the lower, is the only one properly admissible in these methods, — obviates all danger of too great separation of the iris by any sudden rotation of the globe, — and, if out-scooping be resorted to, renders the iris less liable to be contused by the spoon.

The operation by suction is also much facilitated by previously rendering the patient unconscious and his eye passive by etherization, the danger of contusing the iris or penetrating the vitreous being thus avoided.

CATARACT-GLASSES.

After the loss of the crystalline lens, it is nearly always necessary to compensate for its absence by a cataract-glass of proper focal power. Some persons see large objects with tolerable distinctness without such extraneous aid, but generally, even for them, objects are much more clearly defined on employing a glass of suitable strength. The majority of patients select a lens of four, four and a quarter, or four and a half inches focus, for looking at large objects. Some see very well with a lower number, and some require as high as three and a half or even three inches radius.

Another glass is necessary for reading and seeing minute objects, generally from two and a half to two inches focus. Very rarely we meet with an individual who, having previously been very short-sighted, can see, even to read, without assistance from a glass, after extraction of the crystalline.

The glasses for distant objects may be worn at all times. Those for reading or work must never be kept on after these occupations are finished, as eyes may be fatally injured by imprudent use of lenses of very high power, — as, for instance, where these are worn for sewing or knitting, and at the same time the eyes are frequently turned to other objects in the room.

As the thickness of these glasses of short focus renders them heavy, and sometimes brings on head-

ache when they are continuously worn, it is well, where only one eye requires a cataract-glass, to insert a plane glass, or one of slight convexity, in the other half of the spectacles.

Cataract-glasses should not be given to the patient till the operation has been fully recovered from, and the eye has had time to conform itself to its new condition. The patient's vision is then to be carefully tested with glasses of different foci, and that number selected which appears to give him what most nearly approaches natural vision. Too strong a glass should not be allowed, as it frequently causes a sensation of giddiness, and is less agreeable and useful than one of lower power. After a time, if a shorter focus is evidently more serviceable and more grateful to the eye than that first selected, the patient may be permitted to exchange the lower for a higher number. If, on the contrary, the eye gains strength, and is able to see equally well with a less power, the change should certainly be made in this direction.

SECONDARY OPERATIONS FOR CATARACT.

The capsule of the lens being nearly always transparent at the time of an operation for cataract, it sometimes happens that it is not so extensively divided or separated from its suspensory attachments as to allow of its absorption, or of its shrinking upon itself to a degree which leaves the pupil free from obstruction. Now and then, in these cases, we must

make a most critical examination before we are able to detect the slight, gauzy veil which prevents perfect vision. More frequently, the relics of the capsule may be seen with tolerable readiness in the form of a bluish-white membrane or fine whitish filaments. If these cover but certain portions of the pupil, vision may sometimes be rendered sufficient for all purposes by the use of atropia. If not, they may be removed with slight inconvenience or risk. In some instances, their elasticity and toughness render it almost impossible to detach or divide them with a cataract-needle, and they require to be torn by the simultaneous use of two needles, or extracted with canula forceps. In many cases, however, a fine needle introduced through the sclerotica readily detaches or cuts these obstacles, and excellent vision is at once regained. After such an operation, the patient should be careful to avoid too much light, or use of his eyes, for a few days; but no very strict confinement to the house is usually necessary after the first or second day.

Where two needles are employed, they are to be directed upon the capsule from different points of the cornea, and the membrane is then to be torn by moving them in opposite directions. Should the canula forceps be preferred, a puncture is made near the outer edge of the cornea with a very broad needle. Through this aperture the canula forceps is introduced, closed, and the blades being allowed to separate by relaxing the spring of the instrument, the

membrane is seized. The blades are then brought together by pressure upon the spring, and the capsule is withdrawn in their grasp. Vision is thus often instantaneously improved.

GLAUCOMATOUS CATARACT.

A variety of cataract, sometimes mistaken for cataracta simplex, often accompanies advanced stages of glaucoma. It may be distinguished by its dirty greenish-white or sea-green color, its apparently large size, pressing forward against a widely-expanded pupil, — and by the evidences of disorganization in other parts of the eye; such as a diseased aspect of the iris, enlarged, tortuous veins of the sclerotica, stony hardness of the globe, and the absence of perception of light. Its true character is also shown by the history of the case, — in most instances comprising severe pain, which does not attend the formation of ordinary cataract.

It is needless to say that an operation for cataract can be of no avail when fatal changes have taken place in all the contiguous parts, as in the condition in question.

CHAPTER XI.

AFFECTIONS OF THE VITREOUS HUMOR.

SYNCHISIS, OR SOFTENING OF THE VITREOUS.

THIS condition may exist without serious alteration of vision. It is to be suspected when the iris has a marked tremulous motion to and fro, as if suspended in a considerable amount of fluid. In this case it might be a reason for performing some other operation, rather than extraction, for cataract. The ophthalmoscope discloses, in some of these instances, large numbers of minute spots, apparently of organized fibrine, interspersed or not with crystals of cholesterine. These may be visible to the patient, giving rise to one form of "muscæ volitantes," on his moving the eye. In other cases, softening of the vitreous is accompanied by other changes in the eye and loss of sight; the eyeball feeling soft when pressed upon.

SPARKLING SYNCHISIS.

Crystals of cholesterine are sometimes seen in considerable quantity in the vitreous, especially where this has been more or less disturbed in operations for cataract with the needle. They float upward as the

person moves the eye, and fall to the bottom of the posterior chamber like a shower of gold rain, when the eye is in repose. They can be readily seen without the ophthalmoscope. This phenomenon involves a fluid condition of a part at least of the vitreous.

No treatment has any effect, so far as I know, to restore an altered vitreous to its natural condition, but the cholesterine crystals sometimes seem to diminish or disappear after a time.

CHAPTER XII.

OPERATIONS FOR ARTIFICIAL PUPIL.

This operation is called for when the natural pupil has become closed in consequence of disease or accident, or when it is rendered useless by being covered by large and incurable opacity of the cornea. It is not to be advised, usually, when the other eye is still healthy; as more embarrassment would arise from the want of harmony in the two eyes, than benefit from the amount of vision obtained in the eye operated on.

As necessary conditions to success, the eye must have recovered from any inflammation which may have created the necessity for operation, the cornea must be transparent in a sufficiently large space, and the anterior chamber not entirely obliterated. It is desirable also that the eye should be free from evidences of disease in other of its parts. The operation should not be too hastily resorted to in cases of opacity of the cornea, for this often improves to a surprising extent, if time be allowed for absorption of the cloudy effusion.

It is useless to describe all the operative procedures which have been imagined; but I shall give

the details of three principal methods, which include provision for almost every circumstance which can arise.

The sitting position is preferable, as the patient can be brought near a window so that the light may fall very favorably, and the surgeon has a rather more delicate command of his own hand and arm than when standing. The surgeon should never, however, support his arm by resting the elbow on his knee, as if he cannot otherwise command perfect steadiness of hand he should not operate. The patient should, in most cases, be fully under the influence of some anæsthetic.

In addition to the aid who is to stand behind the patient and raise the lid, it is well to have one or two other assistants. The lid should be carefully held, and as a precaution it is well, in all operations on the eye, to have the skin of the lid and the fingers of the aid perfectly dry, that no slipping may occur. The other aids should be ready to render any service which may be asked of them, and, if a portion of iris is to be excised, one of them should be prepared with fine scissors to clip off the amount drawn out, instantly, on a signal from the surgeon.

The same general rules as to positions are to be followed as have been laid down for operations for cataract.

Where the pupil has become closed by a deposit

of lymph or adhesion of capsule, after an operation for cataract, the obstruction may often be removed, and the natural pupil restored, by seizing and withdrawing the foreign substance with canula forceps, or by dividing the adhesions with a cataract-needle. Where this cannot be done without involving risk of a new attack of inflammation, and where the fibres of the iris are put upon the stretch, either by adhesion to the foreign deposit or capsule, or to the cornea, an incision across these fibres gives a very fair result. A very minute knife may be introduced through the cornea or sclerotica, and the iris divided to the required extent by a slight sawing motion. But, unless the tension of the iris has been considerable, its fibres do not retract sufficiently, and the aperture heals. In most cases where an operation is called for, excision of a portion of iris is necessary to secure a permanent opening of the requisite dimensions for vision.

In a majority of cases requiring the formation of an artificial pupil the cornea is cloudy over a large extent. We are, therefore, sometimes compelled to make our new aperture wherever the healthy condition of the cornea and iris will permit. But where we can elect, the situation to be preferred is towards the lower, or lower and inner part of the cornea; the rays of light thus falling most favorably upon the retina. The inner side of the cornea is next to be chosen, and the outer or upper side to

be resorted to only when no other alternative exists. If possible, the new opening should be formed near the natural situation of the pupil. When this is the aim of the operator, an incision is made near the edge of the cornea with a lancet-shaped knife or a cataract-knife, and an exceedingly fine-toothed forceps or the canula forceps being introduced, the iris is seized at a point as central as the circumstances will admit of, and, being torn from its adhesions, is drawn through the wound of the cornea to a sufficient extent. It is then to be quickly excised, close to the cornea, by the assistant who has been charged with this duty. He should hold the scissors in readiness for instant use, near the eye, and should, if possible, have as steady a hand as the operator himself. The portion excised will give the size of the new pupil, and it is better that this should be too small rather than too large; the patient's vision being more distinct and less dazzled than when a very large aperture is formed. Another excellent mode of obtaining the result, to be preferred in many cases to the method above described, is the plan proposed by Mr. Critchett, of London, for placing a very fine ligature around the iris, close to the cornea, instead of excising it.

When the centre of the cornea is entirely opaque but the pupil is in its natural condition, we may displace the pupil by a similar method of operating, using sometimes a blunt hook, which is to engage the

edge of the pupil, instead of the forceps. Ligature rather than excision of the iris offers most advantages in this operation, — the edge of the pupil being retained in contact with the cornea till it becomes adherent, — enabling us to limit the extent of the displacement as we may desire, with more accuracy than when excision is performed.

When, in addition to extensive opacity of the centre of the cornea, the edge of the pupil has become completely adherent to it, forming what is termed anterior synechia, the opening in the cornea must be made at or near its centre, perhaps through a spot already opaque, to spare as much as possible the small space remaining transparent. The iris is seized as before, but in this case near its ciliary attachments, that the artificial pupil may be situated at its edge, and is to be withdrawn and excised rather than ligatured.

Considerable hemorrhage takes place into the anterior chamber from the torn vessels of the iris, and it is often impossible to judge at the moment of operation as to its precise result, all the parts becoming obscured and hidden by the effused blood; but the effusion is absorbed in a few days, and the patient begins to see. In all these operations, the greatest care must be had not to wound the capsule of the lens, when it remains in place and transparent, as in doing so we should occasion traumatic cataract.

The eye having always been extensively injured

by accident or disease in cases requiring an operation for artificial pupil, the patient has reason to be grateful if he recovers even a small degree of useful vision, so as to be able to find his way without a guide; but, when the mischief has not gone too far, we often gain far more brilliant results, the patient being even able to read with facility. I have at this moment under my notice an old man of seventy-six, previously entirely blind, who can read a newspaper, without glasses, through a pupil which I made for him two years since.

As we know that the iris is very susceptible to take on morbid processes when pressed upon or injured, we might fear the consequences of any violence so great as that inflicted by tearing or cutting away a considerable portion of its tissue. But in all the instances where I witnessed or performed the operation, I do not recollect ever to have seen inflammation result. The after-treatment, therefore, is of the mildest. The patient should remain in a darkened room and keep the eyes for the most part closed. At first they may be covered with a compress and bandage. His diet should be moderate, but not closely restricted. After three or four days the eyes may be uncovered, and every precaution dispensed with, except the avoidance of strong light and draughts of air. Glasses are to be employed after the operation, if required by the conditions of the eye.

CHAPTER XIII.

AFFECTIONS INVOLVING THE ENTIRE GLOBE.

GLAUCOMA.

Since the invention of the ophthalmoscope all the phenomena of this disease have been examined *de novo*, and we now know that the appearances, especially the sea-green opacity of the pupil, which formerly constituted a principal means of recognizing and gave a name to the affection, are but symptoms of a far advanced stage of the malady.

Those attacked are usually beyond middle age, and a large proportion are females who have passed the critical period of life.

Deterioration of the general health, especially when combined with the depressing influences of fatigue from watching with sick friends or grief at their loss, appears to be frequently a predisposing cause. But the disease may exceptionally occur in those whose health is unimpaired and who have endured no mental anxiety. It is also in some cases hereditary.

Both eyes are usually attacked, at an interval which varies from a few days to as many years. The friends of a patient in whom one eye has been affected should therefore be warned to lose no time before applying

for aid, should any symptoms, however slight, declare themselves in the other eye. But this warning should not be expressed to the patient, as it would but serve to fix the attention upon the eye and possibly might predispose to an attack. Even a necessity for a rapid increase in the power of spectacles, if such are worn, should not be allowed to pass unquestioned, as this is one of the premonitory symptoms. If accompanied by appearances of rainbow colors around a lamp, or flashes of light within the eye, and, especially, if the patient complain of occasional transient attacks of indistinctness of sight, it should induce further inquiry, to ascertain if tension of the globe, in any abnormal degree, is present, — or if limitation has taken place in the field of vision.

Should these symptoms be overlooked or undervalued, the patient's vision may, in chronic cases, be gradually lost, if only one eye be affected, without the occurrence of any severe pain, or injection of the external vessels, to call attention to the eye. If, on examination by the touch, the eye gives to the finger a sensation of increased resistance, indicating abnormal tension, it should be examined with the ophthalmoscope, to determine if further evidence of intra-ocular pressure is to be found in a cupped condition of the optic nerve.

The fact that in some internal diseases of the eye its tension is augmented by the increase of its contained fluids, is one of the most important of the recent obser-

vations in ophthalmic science. It had long been known that in advanced stages of glaucoma the eye felt hard to the touch; but it is only lately that we have learned to recognize increase of tension as an early symptom, and to mark this condition as an important indication for prompt treatment.

The degree of tension may be estimated by placing the forefinger or the first and second fingers upon the closed upper lid, and making gentle pressure upon the globe. One eye may thus be compared with the other, and the surgeon makes a mental estimate of comparison with the normal standard as felt in a healthy eye. Or the first finger of each hand may be placed upon the lid at different points, and pressure made from one finger towards the other. Practice will soon teach the surgeon to recognize at once, by either of these methods, any abnormal increase or diminution of tension.

Mr. Bowman has advised the adoption of a scale of three degrees of plus (+) tension, where the eye is harder than in a healthy condition, and three degrees of minus (—) tension, where it is softer than the normal standard.

The advantages of iridectomy are not, it is true, as marked in the chronic as in the acute form of glaucoma, — and frequently, especially if the symptoms have been of any considerable duration, the most which can be hoped for is to prevent further lessening of the patient's vision; but if, with this result, he

can hope for greater security from attack in the other eye, as there is some reason for believing, the surgeon is fully justified in advising an operation which involves almost no risk, pain, or loss of time.

After a longer or shorter duration of the more passive morbid processes, a sudden explosion of violent symptoms may occur, and the case assumes the characters of acute glaucoma. Here the performance of iridectomy is urgently demanded, not only to preserve if possible any visual power which may yet remain, but to relieve the intense suffering.

The onset of acute glaucoma is as overpowering as the invasion of its chronic form is insidious. Instantly, in some cases, severe pain is felt in the eye, which augments till it becomes agony. It extends to the supra-orbital region, and even affects the brain. Frequently it causes sympathetic disturbance of the stomach, with intense nausea and vomiting. Examination of the eye shows a varicose turgescence of the subconjunctival vessels, with perhaps more or less circumcorneal injection, a bluish tint in the sclerotica, and a certain amount of chemosis. The cornea has a dull aspect, and has lost its sensibility, so that it may be touched without giving pain. The iris is evidently crowded forward, rendering the anterior chamber shallow, and the pupil is expanded, by pressure of the lens. The pupil does not contract under the influence of light, and its field is muddy, allowing a less distinct view of the fundus than can be had in a healthy eye

Often the fundus cannot be made out with the ophthalmoscope. If seen, the optic disc is observed to be pushed backwards by the distending fluids of the globe, and the retinal vessels follow this altered direction of its surface, emerging from it as if passing over the edge of a cup; their continuity appearing broken.

Pulsation of the retinal arteries and a beaded varicose enlargement of the veins, may in some instances be observed, showing the obstruction which exists to a free circulation within them.

Greater or less changes in the choroid or retina may also be present. The eyeball is of almost stony hardness to the touch, especially after the symptoms have been of some little duration.

If objects continue to be perceived, they appear white or as if seen through a fog.

Unhappily there are too many cases where the disease is not at first recognized; the severe pain and loss of vision being attributed to neuralgia, and the other evidences of disease in the eyeball being quite overlooked, since they are not so marked as to attract attention unless carefully observed. It is thus only at an advanced period of the disease, when hopelessly irreparable transformations have taken place, that it is discovered that something is wrong in the appearance of the eye, and the case is referred for consultation to a practitioner of experience in ocular diseases. The cornea is now still more dim, and its epithelial layer is sometimes raised as if vesicated. The pupil has be-

come so widely dilated that the iris, atrophied and disorganized, forms merely a thin and narrow ring. The lens presses so far forwards as nearly to obliterate the anterior chamber, and has become opaque and acquired a dirty sea-green color. The deeper parts of the eye can no longer be explored with the ophthalmoscope. Externally, the sclerotica has a thinned bluish look, and several large vessels run between it and the conjunctiva, anastamosing around the cornea. The excessive hardness of the globe, as if a marble were under the eyelid, continues in most cases; but the intense suffering accompanying the period of active distension is now, perhaps, abated, — the nerves having as it were adapted themselves to their altered conditions of tension.

In some instances, however, pain still lingers to such a degree that iridectomy and extraction of the lens are demanded for the patient's comfort; though of course without hope of restoring vision where all perception of light has been for some time lost.

The best explanation hitherto given of the origin and course of this mysterious disease, is that of Professor Donders of Utrecht, who believes it to have its source in an irritation of the ciliary nerves, which preside over the secretion of the vitreous humor. In consequence of this neurosis the vitreous becomes increased, and this augmentation, by producing general distension of the globe, presses upon the nervous filaments and adds to the already existing derangement of

their functions. The morbid phenomena thus act and react upon each other, and the disease goes on from bad to worse. This theory also well explains the mode in which relief may be afforded by the operation of iridectomy. Excision of a portion of the iris as far as its ciliary attachments, attended as it necessarily is by evacuation of the aqueous humor and a certain amount of depletion from the torn vessels, may act in two ways: by directly reducing the intra-ocular pressure, and by lessening the tension and irritability of the ciliary nerves and favoring a restoration of their normal action. That the last of these effects is that of chief remedial importance is proved by the fact that mere evacuation of the aqueous, though several times repeated, seems to be almost without influence on the course of the symptoms. But, whatever theory may be entertained as to the cause of the disease, or the *modus operandi* of the operation which relieves it, we have the gratifying assurance of possessing in iridectomy a safe and effectual cure, the value of which has become so rapidly and so generally acknowledged, as, within a few years of its first performance, to have nearly superseded all other treatment, medical or surgical, of this disease. The means formerly employed were conceded to be powerless to control this formidable affection; and another proposed operation, section of fibres of the ciliary muscle, has failed of acceptance, to any extent beyond the immediate circle of its origin.

If the surgeon undertakes this operation without an

assistant, he should be provided with a spring elevator, by which the lids are held apart, leaving both his hands free, and also with a bent triangular knife, a very delicate curved, toothed forceps, and fine scissors slightly rounded at their points. Should he have an assistant who can be relied on, the latter may assume the charge of one of the eyelids, and, if desired by the surgeon, may also control the eyeball and turn it in any direction by seizing a fold of the conjunctiva with another forceps. Etherization is not imperatively necessary, unless the patient is young or very timid, as the pain of the operation is not of any great severity; but the pain is of such a character, from the tearing of the ciliary nerves, that there is danger of a sudden movement of the globe, causing a too large separation of the iris, if the eye be not firmly held. The induction of anæsthesia is therefore oftentimes advisable, as it allows of the operation being done with greater deliberation and delicacy, and of the portion of iris removed being accurately calculated.

When this operation is done for the relief of glaucoma, or in cases where no special reason exists for the selection of some other part of the iris, it should be performed upwards, in order that the space thus added to the natural pupil may be covered by the upper lid in the ordinary positions of the eye. This is important for cosmetic reasons, as well as to avoid the dazzling caused by an excessive influx of light into the eye, — and has been too little regarded.

An incision, three or four lines in length, is made with the bent lance-shaped knife, through the sclerotica, just beyond the margin of the cornea and close to the insertion of the iris, thus entering the anterior chamber at its extreme border. The knife makes its incision by being simply pushed onward, and should the iris and crystalline have been crowded forward by pressure of the vitreous, care will be necessary to keep the point of the knife well towards the inner surface of the cornea, to avoid wounding the capsule of the lens and causing traumatic cataract. As the knife is withdrawn, the iris, if free from adhesions, frequently follows it as the aqueous humor flows out, and forms a slight hernia through the wound. If this occur, the iris may be immediately seized by the forceps, but should it not prolapse the forceps must be carefully introduced through the wound and the iris taken hold of near the margin of the pupil. Being drawn out a little way, a cut is made with the scissors in the direction of the radiating fibres of the iris, at a point corresponding with one of the extremities of the incision of the cornea; the iris is then torn away from its ciliary attachments by slight traction with the forceps, and the flap snipped off with scissors at the other extremity of the incision, thus leaving, of course, a loss of substance in the iris corresponding in size with the length of the corneal wound, or less than this if the surgeon prefers to remove a smaller portion.

Should much blood be effused from the torn vessels

into the anterior chamber, it may be evacuated by gentle pressure with the forceps against the posterior edge of the wound; or, if slight in quantity, or not readily discharged, it may safely be left in the eye, to be dissolved and absorbed as the anterior chamber becomes refilled.

Professor Von Graefe insists on the importance of removing a segment of the iris to its very border, — separating it from its ciliary attachments; as he regards the mere removal of a portion of the iris tissue, unless carried to its extreme margin, insufficient to insure a good result in cases of glaucoma and iridochoroiditis. This is certainly not always requisite to complete success; yet it may be well to carry the loss of substance as far as the ciliary attachments, since there is reason to believe that neurosis of the ciliary branches may be the initial point of glaucomatous disease.

Iridectomy may be regarded as involving almost no risk of injury to the eye, if done with proper care and delicacy, — the iris tolerating in a remarkable degree any violence of this kind, — and it is unnecessary to subject a patient to long confinement and severe after-treatment.

The prognosis is almost always favorable, in acute cases, if seen within a few weeks from the onset of the disease, provided too extensive structural alterations have not taken place; — even where the pain has been intense and little more than a perception of light remains.

Should the organic changes be inconsiderable, success should not be despaired of, even after some months' duration of the disease and loss of perception of light, — instances of recovery having occurred where the conditions were thus unpromising. But the progress of pathological change is oftentimes so rapid, that no delay is admissible after the diagnosis is once fully made out, — a few days or even a few hours frequently changing the entire aspect of the case, and rendering an eye, which might with almost certainty have been saved, utterly incurable. The disease, in these instances, seems to destroy the vitality of the organ almost as rapidly and fatally as the stroke of lightning extinguishes animal life. As soon, therefore, as well-marked symptoms have declared themselves, the operation should be at once urged upon the patient. The extreme danger attending delay may be represented to him, — and he may be at the same time assured that the operation involves no risk, and, if done at the upper part of the iris, a scarcely perceptible deformity; — while he can be almost sure of inestimable benefit.

The tunics of the eyeball having been so greatly distended, there is, in a few instances, delay in obtaining union, owing to the bulging outward of the lips of the wound, and the scar, when formed, is at first thin, and has for a time a tendency to give way. But this merely protracts without seeming otherwise to interfere with the restorative process; though it should

induce caution as to premature exposure. As a rule, however, a few days' confinement to a moderately darkened room suffices for cicatrisation of the wound. The eyes should be bandaged, with moderate compression, for two or three days at least, but beyond this no local or general treatment is usually required.

The intense pain is at once relieved by the operation; but in a few cases a slight amount of pain and considerable sensitiveness to light, with a certain degree of tenderness on pressure, continues for some days subsequently. A wonderful improvement in vision is frequently observed within a few hours after the operation, even where sight had been apparently extinct; in other cases, the tension of the globe seems to be more gradually lessened, and perception is restored with corresponding slowness. The full benefit of the operation is often reached within two or three weeks; though sometimes a longer interval must elapse before its attainment.

The ophthalmoscopic appearances improve rapidly after the first days. The vessels of the retina regain their normal position and calibre, and the cupped aspect of the papilla becomes gradually effaced. Similar changes for the better occur in the other parts which had begun to assume unhealthy aspects, — the morbid phenomena gradually receding till the normal condition is re-established.

Usually, convex glasses are required after the operation, and sometimes a patient has little near or distant

vision except by their aid, — even requiring those of very high power.

HYDROPHTHALMIA.

Dropsy of the eye may be distinguished from conical cornea by the more uniform enlargement of all the anterior parts or of the whole globe. Happily it is of rare occurrence; but several cases are now and then met with, in one family. Of this tendency to affect brothers and sisters I have seen examples in families otherwise healthy, and having some members exempt from the disease.

The prognosis is more unfavorable than in conical cornea; the disease being seldom more than retarded in its course, and terminating at length in abolition of all useful vision, if it does not even go on to bursting of the cornea and collapse of the globe.

A limited degree of this affection is sometimes seen after corneitis or other inflammation; but the disposition to increase is present only to a slight extent in these circumstances.

Great care should be used to keep up the general health of the patient; and, when the disease is recognized, all use of the eyes upon objects which require much effort to distinguish them should be avoided. As the cornea grows thin from distension, all blows and shocks must be guarded against, — as instant rupture may ensue.

I have never seen the disease arrested by para-

centesis oculi; but, from having watched the progress of cases where the eye had been repeatedly punctured, have considered it quite as likely to advance the disease, by exciting increased secretion of aqueous fluid, as to retard it in any manner. The same is true in regard to iridectomy.

CANCER OF THE EYE.

Malignant disease of the eye develops itself in the form of encephaloid, melanosis, and scirrhus; the frequency of examples of each being in the order named.

ENCEPHALOID.

This variety of cancerous affection is almost always met with in very young subjects. It commences far back in the eye, and is first noticed as a yellowish discoloration of the field of the pupil. This appearance is frequently mistaken for cataract by those of limited experience in diseases of the eye; but the practised observer perceives that it is more deeply situated than the lens and must arise from a deposit of scrofulous or purulent matter, or from commencing malignant growth. It may continue sluggish for months; but when once it begins to make perceptible advance towards the cornea, its course is generally rapid. The child loses vision of the eye at an early period; but little pain is complained of till the

globe begins to feel distended, when the disease has reached, but has not penetrated, the cornea. As the opacity extends, and advances towards the iris and lens, the pupil is expanded and the lens loses its transparency. Further progress of the disease causes distension of the eyeball and disorganization of the iris and lens. The cornea may give way, or may resist for some time and be carried forward by the tumor, which soon fills the orbit and begins to protrude beyond its cavity. The enlargement goes on till the patient dies exhausted. An extremely offensive odor is often given off from the mass, requiring the use of disinfectants. The amount of pain is variable; sometimes it is severe, but in a case recently under my notice, the tumor in a child of five years reached a size beyond that of a man's fist, and led to a fatal termination, without having given rise to any pain or fretfulness; the only symptoms complained of being some wakefulness and loss of appetite.

Diagnosis and Treatment. — It is difficult, and in fact even impossible in some instances, to form a positive diagnosis at the outset, except with the aid of the ophthalmoscope, as to whether the appearances indicate the formation of purulent or scrofulous deposit or a commencement of fatal disease. The history of the case may aid us in this respect.

As regards treatment, the question of accurate diagnosis is unimportant. Whether the disease be a

mere deposit or a morbid growth, we can be but inactive spectators. Vision will, in any event, be lost, and our interference can do nothing to preserve it. If the disease be malignant, our endeavors to avert its fatal tendencies will be powerless,—if non-malignant, it may be left to itself, at least until some slight intervention is required to hasten the exit of any purulent matter which is finding its way through the cornea.

It is hard to declare a child doomed to slow exhaustion by a lingering and painful disease; but the reappearance of the fungous growth is so prompt, and its progress usually so much more rapid, after an operation for removal of the affected globe, that it is inexpedient to attempt it. All which remains for us is, to relieve pain as it arises, and render the patient comfortable as far as may be in our power. The fœtor accompanying the enlargement of the tumor is to be lessened by suitable disinfectants.

MELANOSIS.

Melanotic deposit is developed in various parts of the interior or exterior of the globe, in the form of black or brownish masses of soft consistence. The affection is less rapid in its march than encephaloid, but it leads to the same result; and though the chances of operation are not so absolutely unfavorable, there is little encouragement to hope for security against relapse.

SCIRRHUS.

This rare disease of the globe seems to most frequently attack eyes which have suffered from previous inflammation or chronic disease. The organ becomes hard and nodulated, and the morbid growth gradually involves the contiguous parts. In the earlier stages, an operation for removal of the globe might be admissible; especially as the operation is in itself slight, and involves no risk. But too often a prompt reappearance of morbid growth is the only result.

There are cases, however, of the development of tumors, having their origin in the cornea or iris, which bear a certain resemblance to scirrhous disease, but seem to belong to the class of epithelial growths. These may be removed with the assurance that the disease will not return. It is rarely necessary to take away more than the anterior part of the eyeball, — as the other structures are not involved.

OPHTHALMITIS.

This term is used to designate an inflammation in which all the tissues of the globe become almost simultaneously affected, and in which the lids and the cellular tissue of the orbit participate.

Causes. — This phlegmonous affection of the globe sometimes comes on as one of the sequelæ of typhoid or puerperal fevers, or is connected with phlebitis. I have also seen it induced by a slight injury, or by

taking cold, in eyes which were previously extensively diseased and staphylomatous.

Symptoms. — There is at first so little injection of the vessels of the eye, that, were it not for serous chemosis which exists without apparent cause, there would be little in the aspect of the globe to attract our attention. This chemosis, however, together with the intense pain, the intolerance of light, and loss of vision, which begin to be complained of, prove that serious changes are going on in the posterior parts of the organ.

As the disease reaches a second stage, the conjunctiva and the cellular tissue beneath it become thickened and livid, the iris loses its healthy appearance, and sometimes the transparency of the cornea and the crystalline lens is rapidly lost. No perception of light remains. The inflammation extends to the cellular tissue of the orbit, which becomes swollen and indurated to such an extent as to cause much protrusion of the eyeball, at the same time that the lids become greatly swollen and livid. The constitutional febrile symptoms are of extreme intensity, and the agony sometimes endured is sufficient to render a patient delirious, — the pain having a pulsative character, resembling that accompanying the formation of pus in other situations where it is confined by firm fibrous tissue.

When the crystalline and cornea continue moderately clear, matter can be seen collecting in the

bottom of the eye. It generally comes to the surface, and is discharged through the cornea.

Diagnosis and Treatment. — Phlegmon of the eye is sometimes supposed to exist when the pus, instead of being within the eye, is behind it, in the space between the globe and the ocular capsule, or fibrous socket in which the globe is enclosed and revolves. The symptoms are nearly the same in apparent severity, and, in all cases not recognized at the outset, vision is lost, from pressure on the eyeball, in cases of inflammation of the ocular capsule, as certainly as if matter had formed in the globe itself.

But as to the question of treatment, the difference is exceedingly important; in case of suppuration within the globe, not only the function, but the form of the eye must be eventually lost, and it is therefore proper to lay open the resisting tunics of the ball, to relieve the intense suffering and promote a more speedy recovery. But where the deposit of pus is within the capsule only, it tends to discharge, not through the cornea, but between the insertions of the recti muscles, where at first sight it seems to have made its way through the sclerotica, but in reality has only done so through the conjunctiva and the expansions of the tendons. Any evacuation of the contents of the globe is here wholly unnecessary and would occasion needless deformity. The matter may be reached by puncturing the ocular capsule at any spot between the muscles where it appears

disposed to point, and if the diagnosis is made sufficiently early, it is not impossible that vision may be preserved by its prompt evacuation.

Treatment. — In the very early stages, local depletion and active derivative treatment afford a chance, though a small one, of averting the fatal termination as regards the eye itself, and even, in some cases, as to the life of the individual. The suppurative process once commenced within the globe, no resource is left us except palliatives and a prompt interference at the earliest moment when the indications for evacuation of the pus become clear.

Yet we are now and then compelled, by a regard to the future peace of mind of the patient and his friends, to delay a resort to the bistoury longer than would be warranted by our own judgment. While the eyeball still looks, to them, as if merely suffering from an external inflammation, and scarcely any change has manifested itself in the internal parts of the eye or in the cornea, — to lay open the globe for the relief of suffering would in their opinion be a needless sacrifice, and one which they would ever regret. But when the disease has gone so far that pus is actually present in quantity, and ready to follow the knife, they can no longer flatter themselves with a belief that the eye might have been saved had not the surgeon opened it, and are quite ready to acknowledge the wisdom of his measures for abridging the patient's suffering.

Poultices may be applied with advantage after the operation, to accelerate the discharge. They should be very soft, moist, and light. Those composed of boiled apple, or arrow-root, preserve their moisture longer than those of bread, linseed-meal, or slippery-elm-bark. After a short period they should be laid aside for mild astringent solutions, that the atrophy of the globe may be as slight as possible.

An artificial eye may be worn to conceal the deformity after the parts have become healed.

SYMPATHETIC OPHTHALMIA.

When one eye has been lost by accident, especially if the accident has been caused by a blow from some jagged foreign body, or if the loss of the eye has been attended with long-continued severe symptoms, there is a predisposition in the other eye to take on a peculiar and most unfavorable form of inflammation.

The symptoms do not immediately supervene upon the injuries which give rise to them. On the contrary, the wounded eye, especially if it retain within it a bit of steel, percussion-cap, or other foreign substance, often apparently recovers from the inflammation which follows the accident, and may remain for some time in a perfectly quiescent state, though with diminished sight. But after thus continuing quiet for many months, fresh symptoms arise, the eye becomes again injected and painful, and suppuration perhaps

commences around the foreign body, to effect its elimination by bringing it gradually towards the surface. It is during these processes that danger of sympathetic inflammation is to be apprehended. Should the symptoms be violent or protracted, an effort ought to be made, without too long delay, to discover and extract the offending substance; or the globe should be at once removed; according to the circumstances.

In other instances, where the eye had been wounded, instead of becoming quiescent for a time, it continues in a state of low inflammation, — never wholly free from pain and injection.

This condition of irritability is especially dangerous to the safety of the other eye.

The beginning of sympathetic inflammation is indicated by a gradual diminution of vision in the best eye, and this is followed, if the disease is not arrested, by a peculiar dull, infiltrated aspect of the iris, and finally, by an effusion of lymph, closure of the pupil, and partial atrophy of the globe; these changes being often accompanied with considerable pain in and around the eye. The ophthalmoscope discloses congestion of the optic disc, and, later, if the view of the fundus is not cut off by the effused lymph, more serious changes there and in the retinal tissue, extending subsequently to the choroid and iris.

The only reliable means of arresting this formidable disease is the removal of the injured and useless globe; (unless there is reason to believe that the source of

irritation is situated in the ciliary region, in which case excision of the anterior half of the eye may possibly suffice;) as its presence constitutes an insidious source of mischief to the other eye, which no remedies can counteract. This proposition is startling to the patient, — who is reluctant to believe that an eye which has been injured months, or even years previously, and which, perhaps, at the time, is free from morbid phenomena, can be the cause of symptoms which appear to him of trivial importance. But it cannot be too gravely and imperatively insisted on, for delay annuls the chances of success, and the patient, forced at last by his increasing blindness to consent to any measure proposed for his relief, finds the means which, earlier employed, might have saved his eye, wholly unavailing.

Care should, however, be used, not to hastily sacrifice every eye which has suffered a considerable injury, even when the ciliary region is involved, as such an irreparable loss must not be needlessly inflicted.

Should the second eye exhibit much congestion or other change in the internal parts on ophthalmoscopic examination, it may be necessary, after the removal of the injured eye, to resort to local depletion from the temple, near the remaining eye, by means of leeches or Heurteloupe's instrument, and to employ such general treatment by derivation or otherwise as may seem adapted to the relief of the local condition.

OPERATION FOR REMOVING THE EYEBALL.

The removal of the eye has been regarded, and formerly justly so, as one of the most formidable of operations. By the methods once pursued, and before the use of anæsthetics in surgery, it was something to be shrunk from and avoided, unless as a last necessity. Now, however, the mode of effecting it is so simple, the unconsciousness of the patient so complete, and the recovery so prompt, that we can resort to it on various occasions with great advantage, and even substitute it, in many instances, for puncture or partial removal of the globe.

We should perform this operation, rather than merely lay the eye open, in cases where we have reason to fear that a constant irritation kept up by the presence of some foreign body within a disorganized eye may excite sympathetic ophthalmia in the other globe. We are thus sure of extirpating the source of irritation, which is perhaps fixed in the tunics of the eyeball, and might not be discharged if the contents of the globe were removed by suppuration after an incision only had been made.

As performed before the days of anæsthetics, the removal of the eyeball was a truly formidable procedure. Now, and especially in the improved mode of doing it, the operation may be regarded as one of the most trivial.

The conjunctiva is divided, close to the edge of the

cornea, on the side towards the inner canthus, and one or two of the recti-muscles are cut. Curved scissors are then carried behind the globe, and the optic nerve severed; after which the eye may be turned out of its socket and the remaining muscles and portion of conjunctiva cut away, close to the globe. The eyeball only is thus removed, leaving the fibrous capsule in which it revolves, with its muscular attachments, to form a sort of stump or cushion for the support of an artificial eye. The hemorrhage which ensues may be readily controlled by placing a piece of sponge in the orbital cavity and applying compresses and a bandage.

After twenty-four hours these dressings may be removed, and cold wet compresses applied for a day or two longer, at the end of which time recovery is complete or nearly so.

ENTOZOA WITHIN THE EYE.

The Cysticercus cellulosus is the form of entozoon most frequently met with in the interior of the eye; though some other varieties have been seen. It has been found under the conjunctiva, in the anterior chamber, in the vitreous humor, and between the choroid and retina. The ophthalmoscope has added quite a number to the few previously recorded instances in which it has been observed.

If accessible, cysticerci should be extracted from the eye; otherwise no treatment can be of any avail.

CHAPTER XIV.

ARTIFICIAL EYES.

THESE substitutes for one of the most expressive of the human features have been brought to a beautiful perfection. They have the form of a shell merely, so as to be light and movable, and to adapt them to be worn over a partially atrophied globe. A solid ball, like the eyes intended for stuffed animals and birds, would be so heavy as to be immovable. They are made of various forms and sizes, to adapt them to the cavity in which they are to be placed, and have the color of the iris and size of the pupil varied, so as to match the various conditions and appearances of the healthy eye opposite to which they are to be worn. Most of those in use are of Paris manufacture, though a few are made in this country.

If well-adapted, an artificial eye causes no discomfort, and is a most striking improvement to the countenance of the wearer. If possible, it should resemble the other eye in color, size of the pupil, and prominence, and should move in all directions with the movements of the other eye. But it should be slightly too little prominent and too small, rather

than the reverse, as too much projection gives a staring expression which at once attracts attention, while if slightly less than the other eye the difference will not be observed. If too large, or of unsuitable form, an eye acceptable in other respects may be ground to the proper size; but unless the ground edge be afterward smoothed and rounded off by being melted, it is more liable to fret the conjunctiva than when it can be left in its original shape.

If possible, the individual should himself go to make a selection from an assortment kept by those who sell them, as the fit is more certain to be accurate than when the most perfect representation of the other eye, and the best measurements of the cavity, are sent to the manufacturer.

An artificial eye should be worn as little as possible, that it may be preserved from the loss of polish which always results, after a time, from its being bathed in the conjunctival secretions. It should always be removed at night, and when convenient should be taken out once a day, and the eye bathed with cold water. If worn constantly, its surface soon becomes altered and rough, and if still continued in wear after this change has taken place, it speedily gives rise to irritation of the conjunctiva, which increases to such a height of inflammation that copious secretion is poured out, and the conjunctiva becomes thickened and covered with exuberant gran-

ulations. Should the person still persist in wearing the roughened eye, the cavity becomes filled by these fungous growths; by which the artificial eye is at length crowded from its place, and its re-introduction rendered impossible. As soon, therefore, as the polish of the eye begins to be destroyed, it should be repolished, or exchanged for another. With care, an eye may be worn from one to three years without requiring to be retouched; and, if not broken by carelessness or in the process of renewing the polish of its surface, it may last for eight or ten years, or more. There is no danger, or next to none, of their being broken, while being worn, by any violence.

Till the individual becomes accustomed to inserting and removing it, he should lean over a bed whilst doing so, that it may not be broken if he should let it fall. The eye is first to be dipped in water, — its longest end, or that which extends the greatest distance beyond the iris, is to be introduced as far as possible under the upper lid, then turned towards the outer canthus, and, the lower lid being now drawn down, the eye slips into its place. To remove it, the head of a pin, the end of a tooth of shell-comb in which a slight notch has been cut, or some similar contrivance, is insinuated behind the lower edge of the eye, and, the lower lid being depressed, the eye is slightly drawn forward, and drops into the hand held to receive it. After removal the

eye should be carefully washed and wiped, and laid on soft paper. If left in water during the night, it is softened, its surface rendered more susceptible to be acted on by the orbital secretions, and its polish sooner destroyed.

We sometimes observe the orbital cavity irregular in outline, and perhaps limited by more or less extensive adhesions between the lids and the globe. The patient is eager to have these divided, that no obstacle may prevent the insertion of an artificial eye. But unless these adhesions are small, or we can arrange our incision to allow of bringing the cut surfaces together in a different position so as not to have apposition of raw surfaces, we should interfere only with great caution with such bands of adhesion. It is easy to divide them, and to insert an artificial eye; but even its presence will not prevent retraction of the parts to perhaps even worse than their former condition, as cicatrization takes place. It is far better to endeavor to stretch these adhesions, or make them conform to the desired shape of artificial eye, by first inserting a small eye, which after a few days may be exchanged for others progressively increased in size.

It is not necessary that an eye which exhibits disagreeable deformity should be much lessened in size, to admit of its being covered by an artificial eye. Where it is still rather large, an elliptical-shaped portion of the cornea may be removed by

careful incisions with a cataract-knife, without loss of any of the contents of the posterior part of the globe. The edges of the incisions may be drawn together by a single point of fine suture, superficially inserted; or they may be left to themselves, the patient being directed to keep quiet and to avoid as far as possible all movements of the eye.

Where fungous granulations have formed in the orbit in consequence of improper wearing of an artificial eye, they should not be excised, however exuberant; as by so doing the dimensions of the cavity are almost certain to be lessened. It is only necessary to discontinue wearing the eye for a few days, and to use lotions of cold or tepid water, to ensure the subsidence of the morbid growths.

CHAPTER XV.

AFFECTIONS OF THE CHOROID.

THE intimate relations existing between the choroid and retina give a peculiar importance to any pathological conditions which may be developed in the former, as it is impossible that these should surpass a very narrow limit without involving the delicate structure and function of the contiguous nervous tissue.

CHOROIDITIS.

Apart from the implication of the choroid with the retina, in some cases of secondary and of inherited syphilis, and from the changes which take place in posterior staphyloma, this membrane is liable to become the seat of exudation or of disseminated inflammation.

As seen by the ophthalmoscope, spots which have been the seat of exudation present whitish patches generally surrounded by a border of aggregated pigment cells. In some of these patches little of the choroidal tissue remains, the whitish reflexion coming from the denuded sclerotica.

During the presence of disseminated inflammation of

the choroid, the vitreous, which seems intimately connected with it, loses in a degree its transparency, and often becomes pervaded with flocculi. The fundus of the eye is then indistinctly seen.

A strong tendency exists, in one form of this disease, to effusion of thin serous fluid, and this fluid, frequently holding pigment globules in solution or capable of producing them, finds its way through the retina along the course of its vessels, giving rise to secondary disease of that membrane and to the formation of pigment deposits there, and causing atrophy of its tissue and of its nutrient vessels from pressure. This affection, sometimes termed *retinitis pigmentosa*, has been attributed by Liebreich and other observers to consanguinity of the parents of the subject; though this has not been recognized as a predisposing cause by other authorities. Its symptoms begin in early life, — vision being defective, especially in a feeble light. The deficiency of power and limitation of the field of vision increase with age, and at or before middle life total blindness supervenes. Thus far all treatment has proved unavailing.

Simple choroiditis may become resolved, and the alterations to which it has given rise may in a great measure disappear; but more frequently — and this is especially true of its syphilitic form — choroiditis is the occasion of such changes of contiguous parts, of the retina or vitreous, that complete recovery is not obtained, and some limitation, at least, of the field of

vision remains. Even in favorable cases progress must be slow.

The most approved treatment consists in a resort to local depletion and the internal administration of bichloride of mercury in small doses. Other derivative means should at the same time be employed. The performance of iridectomy, especially in acute attacks or where the pressure of transfused fluid has increased the tension of the globe, is also sometimes of the greatest advantage. It should always be done, in these cases, unless for urgent and special reasons, in the upper portion of the iris, that the patient, after recovery, may be spared the dazzling caused by enlargement of the pupil downwards.

HEMORRHAGE FROM THE CHOROID.

Sudden partial or total loss of vision is sometimes occasioned by rupture of a vessel in the choroid and effusion of blood between this tissue and the retina. When caused by some violent effort, without previous disease of the choroid, the effusion may be absorbed and vision restored. No treatment is called for, unless to guard against further hemorrhage. When it occurs between the choroid and retina, it may, if of large amount, cause separation of the retina and permanent injury to vision.

SEROUS EFFUSION FROM THE CHOROID.

This consequence of chronic congestion of the vessels of the membrane is important, from the separation of the retina which it occasions. It will be again referred to in treating of the affections of that tissue.

ABSENCE OF CHOROID PIGMENT-CELLS.

This phenomenon is occasionally observed in albinos, and is generally attended with considerable sensitiveness to light, but not necessarily with any defect of vision. In fact, I have seen it accompany a remarkable degree of visual power. It may therefore be regarded as a curious anomaly, rather than a morbid condition.

CHAPTER XVI.

AFFECTIONS OF THE RETINA.

Prior to the invention of the ophthalmoscope, a large number of cases in which vision was enfeebled or lost, but in which no visible transformations had taken place in the tunics or media of the eye, were ascribed to changes in the retina or optic nerve, and were classed together under the head of amaurosis. But the revelations of this instrument, and the advance in other respects in the knowledge of eye diseases, have enabled us to explain many instances of impairment of sight as due to obvious lesions, and to classify them accordingly; and, on the other hand, allow us to give encouraging assurances to many a patient who would once have been deemed a victim of at least incipient amaurosis.

Before describing what we may still term, as a matter of convenience, amaurotic affections, some of which are more or less obscure in their origin and seat, I shall speak of certain admitted and clearly definable morbid changes occurring in the retina; premising, however, that most of the lesions observed in this structure are not primary, but depend on disease of the choroid, which has been at least a predisposing cause of the retinal affection.

INFLAMMATION OF THE RETINA.

Acute retinitis, uncomplicated with inflammation of other membranes of the eye, is exceedingly rare, and it is principally its more passive forms of which we may detect the presence by the aid of the ophthalmoscope.

Considerable congestion of the retinal circulation may exist without more than temporary derangement of the visual power, and we may offer every encouragement to patients who perceive their vision enfeebled, if we find evidence of hyperæmia without structural alteration. Our prognosis must be more guarded if we discover that exudation has occurred, though even this may exist, to a limited extent, along the larger branches of the vessels, without serious diminution of vision.

The treatment should consist in local depletion by leeches applied to the temple, and the use of derivatives to divert the circulation to other parts of the body; together with such alteratives as may seem adapted to prevent exudation, or to promote its absorption, should such means be required by an advance of the disease.

APOPLEXY OF THE RETINA.

From the fact that the vitreous mass forms the only support of one of the surfaces of the retina, we might anticipate that hemorrhagic effusion from the retinal

vessels would not unfrequently happen. Its occurrence is, however, rare.

It is now and then met with in patients who have disease of the heart, or in whom the menstrual or other periodic discharge has been suppressed, and may be seen in some instances where persons have had apoplectic attacks from which they have recovered, or may occur in persons seemingly in good health, as a consequence of sudden exertion.

In some cases, especially those connected with other apoplectic manifestations, small ecchymoses, having a flame-like appearance, are seen with the ophthalmoscope, in different parts of the retina; — in other instances, especially where unusual exertion has been the proximate cause, the effusion forms a uniform clot spread over a considerable surface. The symptoms vary, corresponding with the appearances. Where the extravasations are numerous but of small extent, vision is diminished, though not lost, throughout the entire field; where, on the contrary, a single clot has been formed, the other portions of the retina may perform their function, but the patient will be conscious of a dark spot, of greater or less dimensions, in his visual field, so that, in certain directions, objects or parts of objects are invisible.

These effusions may gradually disappear, leaving the retinal tissue apparently uninjured and vision perfect; or some portions of the clot may remain and become organized, interfering more or less with sight.

The treatment should be in accordance with the presumed cause, — every effort being made to avert any fresh outpouring, and to obtain the absorption of the blood already extravasated. Local remedies are in most cases of less value than derivative and constitutional measures.

Where the effusions are small but disseminated over a large part of the retina, the disease is termed *Retinitis Apopleptica*, and is often associated with cerebral symptoms, which render the prognosis very unfavorable. Such internal remedies should be given as may be indicated by the general condition of the patient.

BRIGHT'S DISEASE.

It is no less true than remarkable that we are able, by means of the ophthalmoscope alone, to diagnosticate this disease of the kidney. A patient presents himself complaining of gradual loss of sight, but whose eyes present externally every appearance of health. On examination with the ophthalmoscope, the optic papilla and retina are seen to exhibit marked structural changes, peculiar to and characteristic of this disease.

A slightly grayish opacity is visible in the optic nerve and over the retinal surface, with a marked alteration around the papilla and in the region of the macula lutea. This consists in a radiated whitish appearance of the retina, which would seem to have undergone transformation. Small spots of extrava-

sated blood are sometimes observed here and there in the retina.

Post-mortem appearances indicate that the retina has become thickened and indurated by fatty and other deposits. Changes may also have taken place in the choroid and in the vitreous humor.

In a more advanced stage, the white degeneration of the retina is sometimes replaced by atrophy.

As we can never determine what may prove to be the value of a new pathological fact, the phenomena above described may, in the future, throw much light on the causes and progress of the yet more grave lesion with which they seem to be associated.

SYPHILITIC DISEASE OF THE RETINA IN ADULTS.

Changes characteristic of this diathesis are sometimes observed in the retina in conjunction with syphilitic iritis, and they may occur independently of this. Under the ophthalmoscope the retina shows a very slight diffused, clouded appearance, as if infiltrated, — or sometimes so considerable a change that the outline of the optic disc cannot be distinguished from the surrounding parts, together with, in most cases, waxy-looking opacities extending irregularly outwards from the regions of the optic disc and the macula lutea. These differ materially from the strongly-defined alterations of color and structure observed in Bright's disease. Spots of hemorrhagic effusion are also now and then to be noticed. Little or no pain is complained of.

The morbid appearances are usually amenable to treatment, and vision may be in a good measure or even fully restored in patients whose symptoms had reached an extreme degree. Other cases, however, are less tractable, and where the constitution is utterly broken by the syphilitic cachexia, curative means are sometimes unavailing to arrest the disease before the sight has undergone irreparable injury.

As in congenital syphilis of the eye, the best treatment of these cases is a combination of tonic and specific measures. Among the latter, mercurial inunction seems to deserve prominence.

From the tendency to plastic effusions, it is generally desirable to make use of atropia to dilate the pupil, if any implication of the iris should be observed during the course of the retinal affection.

SEPARATION OF THE RETINA.

This pathological change, unfortunately extremely frequent, results from an effusion of serous fluid between the retina and the choroid. The exudation most often occurs at the upper portion of the retina, but soon finds its way by gravitation to the lowest segment. It may remain of limited amount, or may increase so as to detach the entire retina from its connection with the choroid. When the separation has reached this extreme degree the retina forms an infundibulum, retaining its attachment around the optic entrance, but everywhere else thrown into folds which float and roll upon each other with each movement of the eye.

The appearances exhibited at this advanced stage are often visible to the naked eye, especially if the pupil has been dilated, — and can be readily seen by the aid of lateral illumination.

Viewed with the ophthalmoscope, in the earlier degrees of the affection, the separated portion presents a slightly grayish translucent surface, evidently raised above the surrounding portions of the retina.

When more detached, it assumes the form of irregular folds bulging forwards towards the iris, and may often be best seen with the mirror of the ophthalmoscope without the lenses. These appearances should not be mistaken for the rolling masses of disorganized hyaloid membrane, sometimes containing crystals of cholesterine, which are now and then observed, and which offer at first sight a not dissimilar aspect. In some cases the two affections are concomitant, — separation of the retina occurring as a sequel to disease of the vitreous, — being drawn away from its normal position by contraction of that mass. It is also liable to take place as a consequence of posterior staphyloma, in cases of progressive myopia, — the thinned sclerotica and choroid receding from the retina and allowing of sub-retinal effusion, at first only to the extent of the staphyloma, but afterward spreading by infiltration over a larger space.

The treatment by enforcing perfect quiet, the patient lying on his back, as practised by Professor Donders, seems to have been successful, in young subjects,

in effecting absorption of the fluid, and reapplication of the retina to the choroidal surface. Professor Von Graefe has proposed incision of the separated portion, by means of a very minute knife passed into the eye-ball behind the crystalline lens and carried towards the centre of the separated surface, and Mr. Bowman has practised a laceration of the retina with two needles. The results of these operations have afforded some encouragement to at least a further trial; especially in the early stages of the affection, before the retina has become extensively displaced by a large accumulation behind it.

ENCEPHALOID OF THE RETINA.

This variety of cancer of the eye has been elsewhere described, and is here referred to merely to remark, that it may be detected, by means of the ophthalmoscope, in its early stages, while it is still but a small, irregular tumor at the bottom of the eye. But the young subjects in whom the disease usually occurs rarely complain of any symptoms or call our attention to the eye until the morbid growth may be seen by unassisted vision. The instrument is then useful by enabling us to determine if the disease has malignant features, or is merely a scrofulous deposit.

CHAPTER XVII.

AMAUROTIC AFFECTIONS.

THE term amaurosis has been vaguely applied to all conditions where, vision being affected without apparent alterations in other parts of the eye, the symptoms have been considered to originate in changes more or less obscure in the retina, optic nerve, or brain. The use of the ophthalmoscope has enabled us to substitute a disease for a symptom in a large proportion of cases; but there still remain a considerable number of pathological conditions, resulting from widely different causes, to which we must ascribe the production of one common symptom, diminution of sight, without being always able to determine the manner in which these various agencies exert their influence on the delicate nervous structures concerned in special sensation.

I shall classify separately certain temporary and partial disturbances of visual power; confining our attention, for the present, to those forms of the affection which have a more permanent character and do not depend on well-known and easily removed conditions.

Symptoms. — A patient with confirmed amaurosis

has almost invariably a vacant, wandering expression, and makes no attempt to concentrate his eyes upon objects. His pupils are generally widely dilated and insensible to light. These are the only objective symptoms proper to this affection; for where we observe softening or opacity of the media of the eye, or changes of retinal structure, we may give the disease its appropriate place, and remove it from the list of amaurotic affections. Even these symptoms may also be present where some of the morbid changes already described have taken place. But if one eye only is amaurotic, we shall not perceive either of the two symptoms above named unless each eye is examined while the other is closed, as dilatation and contraction of the pupil will take place in the diseased synchronously with the healthy eye. Nor must we assume enlargement of the pupil with dimness of vision as necessarily indicating amaurosis, —for these symptoms coexist, often in a high degree, in mydriasis, which may have been produced by paralysis of the third pair, or by the use of belladonna, and in which neither the retina nor optic nerve are in the least at fault, vision being perfect if refraction be corrected, and the adaptive power replaced, by allowing the patient to look through a pin-hole or other small aperture in a card, held before his eye to cut off the lateral rays coming from the object looked at, or by giving him a convex-glass of suitable power.

Blindness of one eye only may occur from injury to the optic nerve itself near its entrance into the globe, or from embolism of the central artery of the retina. When the amaurosis depends on disease of the central nervous system, as for instance on pressure or reflex irritation caused by tumors of the brain, both eyes are usually involved, one half or the whole of the visual field in each eye becoming obscured.

The optic disc often exhibits at first a swollen aspect and indistinct outline, with appearances resembling in a measure those seen in Bright's disease. These are afterwards replaced by a glistening white atrophy of the disc, usually with diminution in size of the retinal vessels.

As a rule, amaurotic patients see best in a clear day. Pain is often complained of, and if felt within the head is, in many cases, a symptom of cerebral disease, especially if the amaurosis is also accompanied by squinting, or partial paralysis.

Causes. — Exposure to intense light in looking at the midday sun, or a stroke of lightning, may cause instantaneous loss of sight, — the special sensibility of the retina being at once extinguished. Long-continued work upon bright objects, such as shining plates of metal, may induce more or less loss of vision.

Any pressure upon the retina, the optic nerve, or the portion of the brain from which it derives, by tumors developed in proximity to them, or in such a situation as to interfere with the free return of

blood from their vessels, constitutes an efficient cause of this affection. The same is true as regards any circumstances increasing the flow of blood towards the head. Hydrocephalus is not unfrequently accompanied by complete amaurosis.

Blows on the head, or on that point of the supra-orbital ridge where a branch of the fifth pair of nerves passes out upon the forehead, are sometimes followed by loss of vision; the fifth pair having intimate relations with the nutrition and functions of the eye. Frequently, however, in these cases, examination with the ophthalmoscope will disclose more or less lesion resulting from the blow, within the globe itself.

Amaurosis is also one of the symptoms of lead poisoning, sometimes preceding every other serious manifestation of its effects.

The free use of alcoholic stimulants or of tobacco seems to be an occasional cause of the loss of visual power, and should be interdicted if there is reason to suspect that an injurious influence is kept up by indulgence in them.

The same may be said of excessive sexual indulgence or masturbation.

Prognosis. — Our hope of relieving amaurotic affections must depend on their supposed cause, and the extent of lesion which we presume to have occurred. If hereditary or constitutional, or if resulting from hydrocephalus or advanced cerebral disease, we can have little expectation of deriving any

advantage from treatment. When the symptoms result from vascular pressure, from blows, or the action of poisonous substances, we may hope for amelioration or recovery. The less the duration of the disease, the more favorable — other things being equal — will be our prognosis.

Treatment. — Many of the curable cases depend on such causes that we may hope to obtain good effects from local depletion with active derivation by purgatives and counter-irritants. Leeches or cupping on the temple may be had recourse to, and repeated at short intervals. More advantage is gained, except in very acute cases, from the repeated application of two or three leeches, at intervals of a few days, than from a large number at one time. Dry cupping on the back of the neck is sometimes useful. Counter-irritants may be applied to the temples or behind the ears; but their value in ophthalmic practice, in the opinion of the best authorities, is much less than was formerly supposed. Where suppressed menstruation, or arrival at the critical period, may be supposed to have been a predisposing cause, an issue on the arm may be established, if thought to be indicated by the condition of the patient.

Mercurials have enjoyed high repute; but their warmest advocates admit, of late years, the importance of refraining from their indiscriminate use. The iodide of potassium may be of service where mercury would be of questionable utility, and especially where lead is believed to have induced the

symptoms. All the remedies employed should be directed to the removal of the supposed cause, by means appropriate to the condition of the patient in any given case.

Electricity is regarded by the best authorities as of very uncertain effect. For myself, I have seen no instance in which I believed it to have been of advantage, and many in which the patients thought they had been injured by its use. I have, therefore, never employed it; but I have watched its effects on many individuals, and regard it as likely to be very seldom useful, so far as its effect is to be immediately exerted on the eye.

Strychnia was at one time much employed; but on merely empirical and not rational grounds. It seems to have deservedly lost favor, having no effect whatever on those parts of the nervous system concerned in special sensation.

The use of saturated tincture of aconite and preparations containing veratria, applied in the region of branches of the supra-orbital nerve or other divisions of the fifth pair, seems to be desirable in some cases, for the sake of the relief often afforded to the pain complained of by the patient. Whether or not they could have a direct influence on the important symptoms would depend on the causes which gave rise to them.

Collyria, or other applications to the eye itself, would be useless.

Of course it is important to remove all exciting causes of the affection. Any occupation for which a person is evidently unfit should be given up, upon any suspicion that its pursuit will involve the loss of vision. Indulgences at table, or in smoking, should be curtailed, if there be reason to attribute to them any agency in bringing on the disease. Venereal excesses should be carefully refrained from, under penalty of a continuance or increase of the symptoms.

A peculiar feature of this disease is the disposition of patients who have confirmed, and nearly or quite complete amaurosis, to self-deception. They are ever trying to persuade themselves that they see a little more, and, though often disappointed, appear to be always willing to believe any flattering impostor who tells them they are gaining. This credulous tendency leads them to entertain enthusiastic expectations in regard to every new mode of treatment, especially if proposed by a man of acknowledged skill, and they constantly endeavor to persuade their physician, their friends, and themselves, that they are improving under the course pursued. The physician should, therefore, test their vision, quietly, from time to time, and observe for himself whether the avowed gain is real or imaginary; otherwise he may be too sanguine and express too much confidence as to the results of his treatment, only to be a sharer in his patient's disappointment.

CHAPTER XVIII.

TEMPORARY AFFECTIONS OF VISION.

A FEW peculiar conditions, in which vision is temporarily diminished or lost, are often classed with amaurotic affections; but seem to deserve a special description. Among these may be placed the inability to see at night, which, though sometimes a symptom in amaurosis, is in other cases but the temporary consequence of special causes; and the loss of vision sometimes occurring during pregnancy or lactation.

NIGHT BLINDNESS.

This symptom may attack persons in any circumstances of climate or occupation, but is by far most frequent in those who are exposed to strong contrasts of light and considerable fatigues, with perhaps an improper or innutritious diet, as is often the case with soldiers and sailors. It is most common among natives of temperate climates who are exposed to the bright sun and intense heat of southern latitudes, to which they are unaccustomed.

During daylight the individual sees as well as ever, or complains only of a certain sensitiveness to light;

but at nightfall he becomes unable to guide himself or distinguish objects. Sometimes he sees tolerably well in a bright artificial light; in other instances this scarcely increases his visual power. The symptoms disappear the next day, to be renewed at evening.

When the patient is plethoric, or has been subjected to the influence of a bright glare of light, it may be advisable to administer a purgative, and to resort to moderate local depletion, at the outset of treatment. But in much the larger number of cases patients exhibit an opposite state of the system, and if evacuants are used at all, they must be followed by tonic and sometimes by anti-scorbutic treatment. If the symptoms do not yield to these means, with a few days repose of the eyes in a moderate light, the patient should be removed from the climate or the situation which may have originated the disease.

LOSS OF VISUAL POWER DURING PREGNANCY OR LACTATION.

In some women, most frequently those of nervous or hysterical constitution, partial or even total loss of vision may occur during a part of the period of one or successive pregnancies. In others it occurs during lactation. It may continue, in some instances, from one of these conditions to the other, but I have never seen it persist for more than a brief time. When accompanying pregnancy, the patient may be comforted with the assurance that it will probably be recovered from after parturition.

The treatment, during pregnancy, must consist in endeavors to remove any special exhausting or depressing causes; and, if necessary, in fortifying the patient by generous diet, tonics, or a change of air. If the same means do not remove the symptoms when manifested during lactation, weaning must be insisted on as the only prudent course.

SEQUELÆ OF DIPHTHERIA.

Among the various forms of paralysis which sometimes follow diphtheria, we observe a loss of the power of accommodation of the eyes; so that patients are unable to use them for reading or other purposes requiring close application.

The loss of accommodation is usually accompanied by dilatation of the pupil.

This affection is not to be confounded with diphtheritic inflammation of the eye, which will be elsewhere spoken of.

As sequelæ of diseases of this type often gradually disappear with the complete restoration of strength and health, it is difficult to determine the value of specific remedies. But much apparent benefit has been obtained from the application to the conjunctiva of the extract of Calabar bean, by which the pupil is contracted and the ciliary muscle excited to action. Tonic general treatment should be at the same time employed.

EXOPHTHALMOS WITH ANÆMIA.

Apart from those cases where protrusion of the eyeball may be produced by direct causes, such as aneurismal or other tumors of the orbit, paralysis of the motor muscles, &c., it occurs as a temporary symptom in some patients, simultaneously with enlargement of the thyroid gland and with disease of the heart.

The coexistence of these conditions has been so often observed that there can be no doubt of their mutual relationship.

This affection presents so formidable an aspect as to be startling and repulsive at first sight. But it is important to recognize its true character, that we may be able to reassure the patient as to the prognosis, and to institute a treatment which will insure its removal within a comparatively brief period. The symptoms subside under the use of tonics, without the necessity, as a rule, of a resort to local means.

CHAPTER XIX.

PECULIARITIES OF VISION.

INABILITY TO DISTINGUISH CERTAIN COLORS.

THE individuals thus affected are usually so from birth, and have most difficulty in discriminating between red and green, though other colors are sometimes confounded. When congenital, treatment is useless. If the symptom manifests itself in the course of other diseases, no special remedies are to be directed solely to it, and we may look for its removal as relief of the primary disease is obtained.

INCREASED SENSIBILITY TO LIGHT AND ACUTENESS OF VISION.

These two conditions are usually associated in the rare disease to which I refer; though, in the acute form, the sensibility is exalted to such a degree, that even in absolute darkness the lids are spasmodically closed at the outset of the affection, and the intolerance of light prevents all exercise of visual effort.

The disease often assumes a chronic form, and is most frequent in young persons. It is not more common in one sex than the other, though when observed in male subjects, they have, usually, what

may be regarded as analogous to the hysterical temperament in females. I have seen, however, marked exceptions to the rule, having met with the disease in individuals of robust health and excellent nervous and mental condition. I have known it follow a fall upon the lower extremity of the spine; but except in this instance have not observed what could be regarded as exciting causes. It is said to be sometimes a consequence of long confinement in dark cells.

The affection varies in degree, some persons being able to bear exposure at twilight, and to go out freely in the night-time, while others cannot bear even this amount of light, but keep the eyes constantly covered with close, thick bandages. Generally, the patient can allow the eyes to be uncovered in nearly total darkness, though he may have severe pain in exposing himself to daylight, even with his eyes protected by bandages through which it would seem impossible for a ray to penetrate. In almost absolute darkness, the patient can sometimes see to read a fine print, and is frequently able to distinguish objects and persons. He often complains of the appearance of colored or bright spots before his eyes.

In extreme cases it is almost impossible to obtain a glance at the eyes in a full or even a moderate light; and the disinclination of the patient to permit an examination does not arise from perversity or hys-

terical apprehension, but often from a well-grounded belief that the symptoms will be materially augmented by any such inspection, experience having demonstrated to him that they are thus augmented. In these circumstances, it is not necessary to insist on looking at the eyes; for, when seen, they exhibit no phenomena to aid us in our treatment. They may be slightly injected, from having been so much covered, and they generally have a peculiar glazed expression, similar to that sometimes observed in the eyes of persons who have for years worn spectacles, when the glasses are taken off for a few moments.

The want of the appearances of inflammation or ulceration, the age of the patient, and history of the case, distinguish this disease from ordinary photophobia.

The duration of the disease is very variable. It may continue for months or years, and at length disappear almost at once. After an interval of exemption it may return, and persist for a considerable time, notwithstanding the use of remedies which appeared to have been previously effectual. In other cases it subsides spontaneously or yields to treatment within a brief period.

The treatment should be both constitutional and local. Tonics and antispasmodics are indicated in a large proportion of cases. Every effort should be made to discover and remove any causes which may

have a possible influence in keeping up the symptoms. Derivatives are often of service, and remedies having a special influence upon the nervous system are indicated. As local applications, those which may be used in the form of vapor are preferable to other means. The patient's head may be covered, so as to concentrate the vapor upon the eyes and forehead, or a cup containing the hot liquid may be held near the eyes. We can thus hope to act on the circum-orbital branches of the fifth pair, which seems to be implicated in the production of the symptoms, at the same time with the eyeball. Aqueous infusions of opium or other sedatives, used hot, may be thus employed, or the vapor may have a more stimulating character, if desired, by adding a little of one of the anodyne tinctures to boiling water. The tinct. saponis et opii of the old pharmacopœia seems often serviceable. A solution of iodine in chloroform, ten to twenty grains to the ounce, allowed to act as vapor upon the parts contiguous to the eye, the lids being kept closed, also answers an excellent purpose. These means should be used once or twice a day. The patient should be advised to take exercise, and allowed such a diet as seems best adapted to his general condition. He should be encouraged to accustom the eyes gradually to more and more light, and after a time to attempt to use them for purposes which do not demand any considerable exertion. He must not be allowed to entertain a morbid dread of light as likely

to cause blindness, for such is by no means the tendency of the disease, and even if he feels some pain after unusual exposure, he must not give it too much attention, unless it persists and seems evidently to lead to a decided relapse.

The extract of Calabar bean, recently added to our materia medica, is sometimes almost magical in its beneficial effects. A small drop of a solution of one part of the extract in two parts of glycerine, or a gelatine Calabar wafer, is to be put inside the lower lid, daily, if required, general tonic measures being also employed. I have seen patients relieved of all their distressing symptoms within a few days after first applying this remedy.

This veritable affection is to be distinguished from the simulated inability to bear light sometimes met with in hysterical persons. Close observation of these latter when their attention is otherwise occupied will enable the physician to convince himself that the symptoms are in a measure voluntary, and by inquiry he may often discover an evident motive for the assumption of an affection so well adapted to attract sympathy and relieve the individual from the necessity for disagreeable exertions or duties.

MUSCÆ VOLITANTES.

The appearance observed by patients as if flies or small particles of soot were floating, or as if the vapor from a hot stove were rising and falling before the

eye, is a frequent cause of anxious inquiry from them, as to whether these phenomena are a precursor of blindness. The impression has been very common that they were symptoms of incipient amaurosis, and patients have sometimes been subjected to long-continued active treatment for their removal, as well as to most intense and unfounded mental anxiety.

These floating spots have been demonstrated to depend on different classes of corpuscles, situated mostly in the vitreous, and actually moving before the retina with the movements of the globe. But they cannot be detected with the ophthalmoscope or seen upon dissection in many of the instances where patients have been annoyed by them.

As they are met with in all persons under certain circumstances, and do not interfere with vision, they are not to be regarded as a disease, unless accompanied by other symptoms. Most individuals can perceive them after more than ordinary use of the eyes upon small objects, after loss of sleep, or when much fatigued or in a state of debility; especially if they make an effort to discover them.

They have sometimes a resemblance to flies, in other cases to filaments, or strings of pearly or watery globules. If the eye be turned quickly towards the ceiling or the sky, they ascend, to fall again, gradually, when the eye is left at rest. In reading they move from side to side of the page, never covering the exact spot looked at, but always

a little on one side of it. It is when the person is thus employed that the minute black speck is the source of most annoyance.

If an individual direct his attention to these appearances they seem to become multiplied; if, on the contrary, he is convinced of their slight importance, and as far as possible ignores their presence, he soon ceases to be conscious of them, except now and then.

As their presence seems to be more constant after the eyes have been overworked, it is well to advise that these should not be too long employed on objects which task their power of endurance. The general health of the patient should also be looked after, if need be.

But the most important recommendation we can give the person who applies for advice is, to dismiss all apprehension as to the tendency of these phenomena to any serious result, and to think of or notice them as seldom as he can. By so doing he will usually be relieved from their constant presence, and if they should be sometimes observed during his whole life he will find them very endurable, when satisfied as to their harmlessness.

As a rule, floating muscæ are not entirely got rid of, and they may increase; but they never degenerate into the fixed spectra which are evidence of actual changes in the retina or media of the eye and are sometimes the initial symptom of grave organic dis-

ease; though of course cases will sometimes be met with where the two orders of phenomena may co-exist.

DOUBLE VISION.

Vision of two objects is not uncommon as a symptom of paralysis of one or more of the muscles of the globe, where it is attributable to the loss of correspondence of the axes of the two eyes; but it may also occur where there is no apparent deviation of visual direction. It is sometimes impossible for the patient to tell which of two objects he sees is the real one, and he cannot even guide himself safely without closing one eye.

This condition of things is most common in persons recovering from fever, or in professional men who have been too closely confined to fatiguing duties. Rest, abstinence from much use of the eyes, and above all, travelling, are to be recommended. The prognosis is favorable where the symptom does not depend on organic change.

Double vision with one eye alone is an effect of some disturbance of the refractive power and may sometimes be remedied by glasses.

SPECTRAL ILLUSIONS.

Patients are occasionally seen, who seem, to themselves, to perceive objects which are not really present. Mental or bodily depression favors the occur-

rence of this phenomenon. The symptom sometimes persists for weeks or months, but disappears with an improvement of the general condition.

Vision of colored or bright spots is complained of by some patients. When not connected with other disease, these visual impressions are due in most instances to some peculiarity of conformation in the eye, and are not likely to be influenced by treatment beyond the avoidance of any causes which have seemed to have had any agency in producing them.

CHAPTER XX.

AFFECTIONS OF THE ADAPTIVE POWER OF THE EYE.

In a normal condition, the eye is capable of adapting itself, at once and without effort, to near or remote, small or large, objects. The precise mechanism by which the necessary changes of refraction are effected has long been a subject of inquiry and discussion; but it is now admitted that the power of accommodation of the eye to different distances is due principally to slight changes of form in the crystalline lens, — its antero-posterior diameter, and consequently its convexity and refractive power, being increased or diminished by action of the ciliary muscle. The varying diameter of the pupil, governed by movements of the iris, also plays an important part by admitting or excluding lateral pencils of rays. When the ciliary muscle is paralyzed and the pupil widely dilated by the action of belladonna or other mydriatics, the accommodative power is abolished, and a person is rendered unable to see small objects with distinctness, except by the aid of additional refraction obtained by placing a convex glass before the eye.

In the majority of persons, up to the middle period of life, this power of adaptation is exerted instantly

and unconsciously, as the observer directs his attention to various objects. But a want of perfection in this ability to change the vision at will or even without conscious volition, exists, as a natural or acquired condition, in a large number of individuals; and is scarcely regarded by them as an infirmity, so long as they are able, by artificial aid from glasses, to place themselves on a par with others.

These variations from the average standard of adaptive power are, however, defects, and require most careful management; otherwise the attempts made to perform the duties or enjoy the privileges allowed to those who possess a full measure of this power, whether such attempts are made without assistance from lenses or with such as are ill-chosen, give rise to grave pathological conditions.

The results of modern investigations in regard to the function of accommodation, and to the various anomalies of accommodation and refraction are given, with ample illustrations, in the Appendix.

CHAPTER XXI.

ASTHENOPIA.

THE want of power to apply the eyes continuously to small objects constitutes one of the most troublesome affections of these organs. The patients are mostly young, and find themselves hindered, in the pursuits to which they wish to be devoted, by this inability. Vision is as good as ever; distant objects can be looked at without fatigue, and minute things can be distinctly seen; but after a short period of application, a sensation of fatigue commences, and goes on increasing till the individual is forced, *nolens volens*, to suspend his work. The sense of weariness extends itself to the forehead, and more or less pain ensues, not only in the eyes, but in the entire frontal region. Sometimes these symptoms compel the patient to desist from his efforts, without any dimness of sight having been produced; in other cases, this is added to the other phenomena, and contributes to force a suspension of his occupation. After even a few moments of rest, the person is usually able to resume his employment, but he cannot continue it long without a reappearance of the symptoms. Some individuals can use the eyes for a considerable time,

even an hour or two, before the supervention of the troublesome sensations; others find their eyes tolerant of only a few moments' close application.

On examining the eyes of such persons we seldom see any marked changes. Sometimes an inactive, dull expression, difficult to describe, may be observed by a practitioner of experience.

No pain is complained of in some of the cases, except after exertion of the eyes; in other instances a dull pain, and perhaps slight sensitiveness to light, is much of the time present.

Causes. — The exanthematous and febrile diseases seem to be not unfrequent causes of this condition of the eyes, even when they have not been used imprudently during convalescence. Great care should be taken, after attacks of measles and scarlatina, to avoid too constant use of the eyes, even for some time after recovery. Imprudent use in reading, during convalescence from any disease, is a fertile source of asthenopia. The habit of reading in bed, often in an unfavorable position as regards the light, the use of the eyes during twilight or in a feebly illuminated room, long-continued study by artificial light and during the hours required for sleep, undue exercise of the eyes for objects requiring close attention, as embroidery, &c., — all these causes are frequently the origin of this affection in its most troublesome forms. The application of naturally long-sighted eyes to trades requiring close attention, as

engraving, watch-making, &c., often develops the symptoms of asthenopia.

The tone of the system is generally low, and many of the patients are of excitable nervous temperament. Any agencies tending to reduce the strength, and especially to exhaust the nervous system, are therefore likely to induce the disease. Anxiety, watching, and habits of masturbation in either sex, especially when the eyes are at the same time severely taxed, are efficient causes of this peculiar weakness of vision.

Diagnosis. — The essential character of the affection seems to consist in some disturbance of the faculty of accommodation; the retina not being involved except as in all circumstances where an irregularly refracted image is formed upon it. It is to be distinguished from presbyopia, and from commencing amaurotic symptoms. The patient who is simply long-sighted does not see small objects distinctly, even on first looking at them, but with the aid of a suitable convex lens everything becomes clear; whereas an asthenopic patient sees as well as ever when he first looks at anything minute or after a little rest.

The amaurotic patient has indistinct perception of large as well as small objects, and, if able to discern them at all, it is often after a continued effort, by which his eye seems to have its power developed and brought into action, instead of being lessened, as is the case in asthenopia.

Prognosis. — A feature of this affection which renders it peculiarly annoying to the conscientious practitioner, is the impossibility of predicting its course. Nothing in the history or symptoms of any given case enables him to judge with certainty whether a prompt recovery will be effected, or whether the morbid condition may be of indefinite duration. If t evidently depends on some curable derangement of the system, the prognosis is more favorable than when it has apparently been induced by excessive exertion of the eyes. Yet, in cases seemingly the most favorable, we are often disappointed in the results of our efforts, while in other subjects this fickle disease vanishes almost as soon as it appears, or yields suddenly to a change of remedies, after having held out against means which seemed of better promise than those which appear to be crowned with success.

Of one thing the patient may be assured; that there is no tendency, in this disease, towards blindness. He may be unable to pursue his studies, or avocations requiring continued application; but he need fear no worse fate.

Treatment. — The origin of many cases of the affection in overwork, and the frequent failure of what appears to be well-adapted treatment, has led some to believe that rest was the only, and was an effectual means of restoration. Such is not the case. It is very common to see cases which have been left to themselves for years, the individuals abstaining

from even an insignificant amount of use of the eyes, and placing them in the most favorable circumstances, without realizing the least improvement. Yet these same cases sometimes prove readily amenable to treatment.

Though indisposed to admit the efficacy of entire abstinence from use of the eyes, I by no means undervalue the benefit to be derived from partial repose of the affected organs. The patient should use them for purposes which cause least fatigue, and for short periods only at a time. While doing so, it is well to relieve them occasionally by looking off from the book or work, and fixing them for a moment on larger objects. If slight uneasiness or pain is felt, the occupation need not be laid aside, as it is better not to regard too seriously symptoms which have become as it were a habit; but if the pain increases, and is accompanied with dimness of vision, or if experience has proved that the pain persists in any case for a long time after the use of the eyes is suspended, it is proper to abandon further efforts for the time being, and allow an interval to elapse before renewing them.

Many persons whose eyes cannot bear two or three hours continuous employment, are able to use them to this amount, or even more in the day, provided the work is done piecemeal, not more than a quarter or half an hour at one time, with suitable intervals of rest. If this plan is followed, proper attention

being given to the removal of all exciting causes of the symptoms, and to the improvement of the general health, patients are often able to acquire, in a short time, such a measure of ability to use the eyes as serves to encourage them, and to afford a foundation for further progress.

It is often imperatively necessary, where the affection has been induced by close application to some sedentary occupation requiring constant use of the eyes, to advise that the avocation should be changed for one better adapted to their sensitive condition; otherwise the morbid condition is kept up and treatment is of little advantage.

Such remedies are to be employed as seem adapted to the condition of the patient. As a rule, tonics and good diet are indicated, rather than depletive measures of any description. The primæ viæ should be kept in good order and any habitual constipation or diarrhœa corrected. Lupulin, and remedies of this class, have an excellent effect in some instances where the nervous system has lost its tone. Moderate exercise in the open air is to be recommended; but it is important to avoid excessive fatigue, which does harm by bringing on prostration of the nervous functions. It is well to have the patient surrounded by agreeable circumstances, and to devise means for keeping his thoughts occupied by something else than the state of his eyes.

As local applications, the vapor of spirit of rose-

mary, tinct. sapo. et opii, or tinct. opii added to boiling water, or of sulphuric ether, — held near the eyes once or twice a day, — are sometimes of service. Where much pain is complained of, lotions about the eyes, upon the brow and lids, with diluted tinct. of cannabis indica, or applications of saturated tinct. of aconite above the eyebrows at bedtime, by means of a small camel's-hair brush, are often effectual means of relief. These not only subdue the pain, but have a favorable influence in other respects in some cases. The aconite should be carefully sponged off in the morning before washing the face, as it causes much pain if it enter the eyes. A mild collyrium of a soothing rather than stimulating nature, as a solution of borax of ten grains to the ounce, is often grateful to the eyes, and favors their recovery. It is especially serviceable when we find any coexistent roughness or injection of the conjunctiva. Where there is much dilation of the pupil, the solution of Calabar extract is frequently beneficial, a small quantity being put into the eye once a day; as contraction of the pupil can readily be produced by this means. Lotions about the eyelids with cold or tepid water may be allowed, if grateful to the patient.

In other cases where pain is felt after attempts at use, relief from this symptom and permanent advantage is often derived from the use of a solution of iodine in chloroform, ten grains to the ounce, which

should be kept in a glass-stoppered "eye-bottle." Once a day, or more frequently if required for the relief of pain, the stopper is removed, and the cup at the mouth of the bottle is applied to the closed lids till the vapor finds its way through them and quite a sensation of heat is felt in the eyeball. The same remedy is also of service in certain cases of photophobia. The bi-sulphuret of carbon, used in a similar manner, is occasionally of service.

Other forms of asthenopia, where the symptoms are similar, but which depend solely on hypermetropia or on insufficiency of the internal recti, and require glasses for their relief, are described in the Appendix.

CHAPTER XXII.

AFFECTIONS OF THE MUSCLES OF THE EYEBALL.

STRABISMUS.

Strabismus, or squinting, consists in a loss of that harmonious muscular action in the two eyes which is necessary to give them a parallel or corresponding direction.

It is difficult to explain the precise nature of the change in the action of the nerves which supply the muscles of the globe, rendering it impossible to direct both eyes at the same time towards a certain object. It is not paralysis, for as soon as the other eye is covered the affected eye assumes a normal position, and can be turned in all directions.

The whole pathology of this affection has within a brief period been carefully reinvestigated, with results which have well repaid the attention which has been bestowed. Strabismus is no longer regarded as a mere deformity, but is found to have intimate relations with the function of the eye as an organ of vision. It has been demonstrated, that, as a rule, it is not a primary disease, but, at the outset, merely a symptom, occasioned by certain conditions of refraction; but it is also proved, that, once confirmed, it may act in its turn,

most injuriously, as an efficient cause of deterioration and even extinction of visual power.

In a large majority of cases where strabismus has continued for any great length of time, especially where the deviation shows itself usually in one eye, we find that vision is less perfect in the eye most affected. This is in consequence of a gradual decline of power, from the fact that the visual axes, (the lines drawn from the macula lutea, in each eye, through the optic centre, towards the object looked at,) cannot be brought simultaneously to bear upon the desired point. Vision is therefore confused, — images of objects being formed upon parts of the retina which do not correspond. To escape, then, the perplexity which results from double sight, all attempt at binocular vision is abandoned, and the image formed upon the retina of the deviated eye, being received at a point less favorable than the macula lutea for distinctness of perception, is disregarded by the brain, till, at length, perceptive power, from lack of exercise, is almost wholly lost in the disused eye.

We may ascribe to Professor Donders our present knowledge of the intimate relation existing between the form of the eyeball and a large proportion of the cases of strabismus; so that, to translate his own words, "It is only exceptionally that we find convergent strabismus without hypermetropia; and divergent strabismus is almost always a consequence of myopia."

CONVERGENT STRABISMUS.

The almost invariable coexistence of hypermetropia with convergent strabismus is explained by the mutual dependence of the movement of convergence of the internal recti muscles and the act of accommodation. As in hypermetropia the accommodative power must necessarily be exerted in a high degree, it follows that its associated function, convergence, by which this power is reinforced and enhanced, will be perpetually called into exercise. This takes place instinctively, in obedience to the dictates of the "muscular sense," as we may term it, — in order that the asthenopia which ensues upon strain of the accommodation may be avoided. Being thus brought frequently into play, and often maintained for some time in a state of tension, the recti interni acquire more power, whilst, on the other hand, the external recti, from relaxation and disuse, become relatively feeble.

It is probable that the frequency with which the earliest manifestations of strabismus are observed after some of the diseases of childhood, especially after those which have more or less of a nervous element, (as, for instance, whooping-cough, which is perhaps in popular opinion the most common of all the causes of strabismus,) may be due to the partial paralysis of the power of accommodation which is often one of the sequelæ of these affections. If the disease, followed by this partial paralysis, has supervened about the period when

the child first begins to pay close attention to objects, we may readily understand how an effort may be made to compensate for the deficient adaptive power in the ciliary muscle, by increased action of the internal recti in convergence.

The same reasons will explain what is termed intermitting strabismus, — the deviation only showing itself when the eyes are looking at near objects, — the very time when accommodation is being called into play. They will also account for another variety of intermitting strabismus, where the obliquity is manifested only when the child is fatigued, unwell, or in a state of nervous excitement from fright, diffidence, &c.

In these various instances the ciliary muscle, receiving an insufficient nervous stimulus, contracts too feebly to produce the requisite changes in convexity of the lens, and the accommodative power is therefore instinctively supplemented by the auxiliary action of the internal recti.

If we examine each eye singly, screening the other, and direct the patient to look at an object at a distance of a few feet, we find, in cases of ordinary convergent strabismus, that either eye is capable of being directed towards the object, while the other eye squints for the time being. This deviation of the more healthy eye is termed the secondary squint, and is in most instances equal in degree to that of the chiefly affected eye; though, where the strabismus is of long

duration, the usually deviated eye is less able than the other to bring its visual line to a given point of the object looked at. The fact that the squinting eye changes its position, and looks forward, as soon as the other eye is screened, proves that it takes little part in ordinary vision.

If we test the power of rotation, we observe that both eyes may be turned outwards; though, from the hypertrophy of the internal and relative atrophy of the external recti, already referred to, they turn less completely in this direction than normal eyes; for the same reason, they turn inwards to a greater extent than is normal. The movements of the two eyes, used together, are concomitant; there is no actual paralysis of muscular power; but the defect lies in a want of harmonious associated action.

It is very important to measure the degree of strabismus, as this determines whether an operation on one or both eyes will be required, and the extent to which the tendon of the internal rectus should be divided. For this purpose an ivory scale, fitted to the form of the eyelid, and graduated in lines and half lines, is convenient. It is placed against the lower lid of the converging eye, and the point where it is crossed by the vertical meridian of the centre or margin of the cornea or of the edge of the pupil, is noted. The other eye is then covered, and the squinting eye now becoming rectified, the number of lines on the scale between the formerly noted point and that now

crossed by the same meridian gives the amount of deviation.

Another mode of measurement is also proposed by Mr. Bowman; the points compared being, the position of the outer edge of the cornea in its relation to the external canthus in outward rotation, and the position of the pupil as regards the lachrymal punctum in inward rotation.

Whenever the deviation measures three lines or more, it is usually necessary to divide both the internal recti before harmonious action can be re-established between the eyes. It is well, therefore, to inform the patient of the probability that an operation on one eye may not be sufficient.

The various steps of the operation have been somewhat modified by modern surgeons. The incision through the conjunctiva should be small, so as to afford as nearly as possible the advantages of a subconjunctival operation. The tendon of the muscle should be divided close to its sclerotical insertion; unless it be desired to increase the effect of the operation, in which case the muscle may be cut farther back. If it be the intention, on the contrary, to limit the effect to be produced, the tendon may be only partially severed, or a suture may be taken in the conjunctiva to bring together the edges of the external wound.

From what has been said of the etiology of convergent strabismus, it follows that it must often be necessary to prescribe the use of convex glasses, to neutral

ize the hypermetropia, after the strabismus has been rectified by division of the muscle; that the patient may be secured from a recurrence of the deformity, and, especially, that the eye which from long disuse has very imperfect sight, may have its visual power developed and increased. Otherwise, even should no strabismus recur, we have gained only one, and this the least important of the advantages to be derived from the operation; the deformity is no longer obvious, but the function of one eye still remains more or less dormant, and the patient loses the immense advantages of binocular vision. Even without glasses, it is true, great improvement is often obtained, especially if the patient is intelligent in his endeavors to bring the eyes into associated use; but yet more benefit ensues when the original defect of refraction is also corrected by suitable lenses.

It is impossible to insist too strongly on the importance of an *early* operation for the relief of strabismus, and on the fallacy of the popular belief which thinks it probable that "the child may outgrow it," or considers it best to "wait till the child is older" before having anything done.

The sight, in thousands of eyes, has been sacrificed to these erroneous opinions.

DIVERGENT STRABISMUS.

As we have seen, convergent obliquity, resulting from unusual efforts of the internal recti in aid of

accommodation in hypermetropic eyes, is most often developed at the age when the influence of hypermetropia begins to be felt. Divergent strabismus, on the contrary, associated as it is with the opposite state of refraction, myopia, is a more passive condition, usually manifesting itself later in life, and perhaps only after occurrence of some of the changes which belong to progressive myopia.

The lengthening of the antero-posterior diameter in near-sighted eyes is effected in a great measure by the yielding of the posterior half of the globe, which gives to the eyeball a more or less ovoid form. This brings the centre of rotation farther from the posterior pole of the eye and from the insertions of the muscles, which thus act at disadvantage. The movements of the globe are therefore less easy and less extensive than in normal eyes, on account of the difficulty of rotating this ellipsoidal body within the orbital cavity, which has nearly the same form.

A greater convergence of the eyes being required as objects are brought nearer, and this convergence having become difficult or impracticable in myopia, from the change of form of the globe and the relative insufficiency of its internal recti muscles, it results, that one eye alone is employed for vision of near objects, while the other is allowed to diverge; the muscular consciousness, as it may be termed, teaching that a persistent attempt to keep up the convergence merely induces weariness of the internal recti and of the ciliary

muscle, without the actual attainment of the advantages of binocular vision.

At first, the tendency to diverge shows itself only after the eyes have been fatigued by continued use; but as the internal recti become more enfeebled, the inclination to yield to the divergent impulse becomes augmented. This is because the strong efforts required in convergence call into play an act of accommodation on the part of the ciliary muscles, which brings the far point yet nearer, and renders the perception of objects less clear. This is by no means agreeable to the patient, and he endeavors to avoid it by giving up binocular vision, and contenting himself with the clearer image formed by a single eye. He in fact unconsciously encourages an outward deviation of one eye, that he may have less annoyance from double images, which associate themselves with his ineffectual efforts to attain the proper degree of convergence for the formation of an image upon corresponding points of the retina in the two eyes.

The fact of the considerable change of form of the globe, and actual relative insufficiency of the internal recti, makes it more difficult to obtain as good a result, as regards the deviation, from simple section of the rectus externus, as may be gained from division of the internal rectus in convergent strabismus. It is frequently desirable to keep the eye in a position of forced inversion during the days following the operation, until the externus has formed a reunion with the

globe farther back than would take place without this precaution. This may be effected by passing a suture through a fold of the conjunctiva near the inner edge of the cornea, and then through the skin at the inner canthus.

Two needles, with one bit of thread, may be employed, — the first being passed through the conjunctiva a little above the horizontal meridian, and brought out at the meridian, — the other being entered at an equal distance below and brought out at the same point. The thread or silk thus obtains a larger hold, and maintains inversion of the globe for a longer time.

The suture cuts itself out after two or three days; but in the mean time allows opportunity for reattachment of the external muscle in the wished-for position. The patient should be directed to keep the eyes as quiet as possible during this period, that the suture may not be prematurely torn away.

The use of glasses after operation is even more important in divergent than in convergent strabismus, if we wish to obtain every possible guaranty against relapse; and these should be selected according to the rules given in speaking of myopia.

OPERATIONS FOR STRABISMUS.

The operation for division of the muscle on which the deviation of the eye depends has proved so satisfactory that it has nearly superseded other remedial

measures. It is not to be performed, however, where the strabismus results from causes which it may be hoped are of only temporary effect, — where it is due to paralysis of either the third or sixth pair of nerves, — or in children, where the affection has not become confirmed.

When the deviation is slight, an operation on one eye is generally sufficient; but where convergence is very marked in both eyes, it is frequently necessary to perform a double operation before perfectly harmonious action is recovered. A second operation should not, however, be too hastily resorted to, as we often obtain an excellent result from a single operation, where, at first sight, it seemed probable that section of both muscles would be required.

When the eyes differ in visual power, the weaker of the two should usually be selected for operation in all cases of alternating strabismus. In other instances, the same rule generally holds good; as the eye in which the deviation is most evident is likely to be feeblest in vision.

Time for Operating. — Any and all seasons may be selected for the operation, which is of so slight importance, as regards any after effects to be dreaded, that very few precautions are necessary.

Position of the Patient. — The patient may sit in front of the operator or recline on a couch. Children should lie on a couch or be held on the knees of another person.

If ether be given, the reclining posture is most convenient, though not essential.

If the patient is of reasonable age and firmness, the pain of the operation can be very well borne without resorting to anæsthetics; but if the person is nervously apprehensive, or is a young child, it is better to administer ether. The operation can thus be more quickly done, and with less disturbance of the parts contiguous to the muscle; but it is difficult to judge of the precise effect of the operation till the patient recovers from the anæsthetic condition, and consciousness and muscular power are restored.

It is necessary that the patient should inhale more ether or chloroform, when the eye is to be the seat of operation, than when operations are done at a greater distance from the brain and upon parts less exquisitely sensitive.

Modes of Operating. — I shall describe the operation as performed upon the rectus internus, for convergent strabismus, all the other operations, when required, being executed in a similar manner.

If the surgeon be provided with one of the spring elevators, which keep the eyelids separated without requiring to be held, he can dispense with the services of an assistant; but if the operation is performed without ether, it is more comfortable for the patient to have his lids held open by the finger; though it is not necessary to have an experienced aid, — any friend of the patient being able to perform the duty.

It is unnecessary to describe all the modifications which have been proposed in the methods of operating. They are virtually comprised in two principal modes: in the sub-conjunctival, the muscle is divided with but a mere puncture of this membrane; in the other, the conjunctiva is first divided to a certain extent, to expose the muscle, which is then cut.

For the sub-conjunctival operation, the instruments necessary are a small hook or forceps to raise a fold of the conjunctiva, a lance-shaped knife curved on its flat surface, and a probe-pointed knife like those used for tenotomy, but having a peculiar bend of its shaft near the handle.

It is well to cover the other eye, that the affected eye may move more freely, and may be directed forwards at the moment of commencing the operation. A fold of the conjunctiva over the lower edge of the internal rectus is raised with the forceps, and the lance-shaped knife is passed through this membrane and the fascia beneath it, and carried into the sheath of the muscle so as to pass behind it. Its convex surface is to be directed towards the globe, that the risk of puncturing the sclerotica may be avoided. The probe-pointed knife is then to be passed through the wound and behind the muscle, which is to be divided by turning the edge of the knife forward, and giving it a slight sawing motion, the patient being directed to turn the eye outwards as much as possible, or, if necessary, the globe being turned in

this direction by seizing it with forceps, so as to render the fibres tense and facilitate their section. The advantages of this method are, that the danger of falling back of the caruncle to hide itself at the inner canthus, or of the formation of granulations in the wound of the conjunctiva are avoided. Its disadvantages are, the considerable ecchymosis which results from the effusion of blood between the conjunctiva and sclerotica, the greater difficulty of determining whether all fibres of the muscle have been completely severed, and the danger of penetrating the globe with the instrument used for making the puncture; a danger which has not always been avoided, even by skilful operators.

For the other method of operation, the instruments required are a forceps for seizing a fold of conjunctiva, a pair of straight or curved scissors, and a blunt hook to raise and bring forward the muscle. The usual direction of the incision has been vertical, but some have proposed to make it horizontal to prevent falling in of the caruncle. The last plan renders it more difficult to reach and divide the muscle. I prefer an oblique incision, and one of very small size, as offering every facility, and, at the same time, perfect security against the possible objections to the vertical incision. A small fold of the conjunctiva and the sub-conjunctival fascia is to be raised with the forceps, half-way between the cornea and the inner canthus, and divided with the scissors in an

oblique direction, and a little below the equator of the eyeball, that the incision may be over the edge of the muscle. The blunt hook is then passed through the wound, carried behind the muscle, and brought out at its upper edge. This is then to be drawn towards the external wound and divided with the scissors. Should the breadth of the muscle or the smallness of the opening prevent the point of the blunt hook from being brought out at the wound, the conjunctiva may be seized with the forceps, and slid back over the point so as to allow of the division of the muscle without enlarging the conjunctival wound; or this may be divided to a further extent at the same time with the muscle. Should the eyes not appear parallel on testing them, the blunt hook should be again passed in, to explore if any fibres remain uncut. For some years I have in most cases inserted one or two points of suture, with very delicate threads, to bring together the edges of the wound of the conjunctiva; and, although this is less necessary when only the small oblique incision I have advocated has been made, yet it gives an additional security against the falling back of the caruncula, or the formation of fungous granulations in the wound, and hastens the recovery. The stitch may be placed so near the edges of the wound that the thread will be readily thrown off after union has taken place. But the case may be left to itself, if it is not possible to place the sutures on ac

count of returning consciousness as the effect of ether passes off.

A very ingenious hook has been devised by M Boyer, the two blades of which may be separated after seizing the muscle, allowing room for the scissors to cut between them. But, though very convenient in a case of strabismus instruments, it can perfectly well be dispensed with. In fact, with a pair of scissors, forceps, and a probe, which can readily be bent to the form of a blunt hook, the operation may be well and neatly done.

The advantages of this method are, its freedom from the danger of penetration through the sclerotica, which is regarded by many authorities as sufficient reason for discarding the sub-conjunctival method, its avoidance of the sub-conjunctival effusion, which requires considerable time for its absorption, and the facility it gives for satisfying ourselves that every portion of the muscle has been divided. Its disadvantages are, the possibility of slight sinking of the caruncle, or of the appearance of a small fungus at the centre of the wound, — neither of which consequences are to be looked for when the fine suture is employed.

Both these accidents, and an abnormal protrusion or eversion of the globe, were liable to happen after the operation, when unskilfully done and with a large incision. But these effects are obviated by the sutures and by limiting the incision to a quarter of an inch in length.

No after treatment is generally required in either form of operation, except lotions with tepid water or milk and water, and keeping the patient from exposure to bad weather during the first two or three days. Should ecchymosis follow the sub-conjunctival method, the blood will be re-absorbed. Should a fungus make its appearance in the wound, when the conjunctiva has been divided, it may be snipped off with scissors at a single stroke, or will fall off after some time if left to itself.

When, on examining the direction of the eyes after the operation, we find that they are not parallel, we are to ascertain with the hook if section of the muscle has been fully accomplished. If the eye can turn completely towards the inner angle there must be some fibres undivided, or some attachments of the fascia or the sheath of the muscle which require separation. If the eye cannot be thus turned, the other eye must be at fault, and the same operation should be performed on the second eye, if deemed necessary. Should there be any question as to the propriety of a second operation, it should be deferred; as parallelism is sometimes established after a short time, when at first it seemed unlikely to be so. It is often sufficient to divide the muscle in the second eye close to the cornea, taking care not to separate its attachments too largely.

We are to avoid large incisions of the conjunctiva or fascia, or extensive separation of the sheath

of the muscle from its attachments, lest the globe should be everted or should become very prominent. Eversion is a worse deformity than the convergence which originally existed. Should it occur, it may be remedied by division of the external rectus, — an operation on one eye being generally sufficient; or, in extreme cases, by removal of the old cicatrix at the inner angle, and, after liberating the muscle from its new-formed adhesions, bringing it forward and fastening it close behind the cornea by means of fine sutures. The dissection must be very delicately executed; etherization being generally employed to secure immobility of the eye and spare the patient the pain of a somewhat prolonged operation.

Double vision is sometimes complained of immediately after the operation; but, if this has been entirely successful, the diplopia passes off as the muscle becomes re-attached to the globe and recovers the power of moving it into proper positions to act with the other in receiving impressions of objects on corresponding points of the retina. Patients sometimes speak of immediate improvement in vision; more frequently, the good effects, so far as sight is concerned, are slowly developed.

Very slight symptoms generally follow the operation. Should the patient take cold, he may have conjunctivitis in a mild form, requiring, however, merely tepid lotions for its relief. But though it is

to be considered as involving no consequences endangering vision, the operation should be done with the greatest care, as instances are on record, though as very rare exceptions, where the eyeball has been seriously injured by inflammation arising subsequent to its performance.

PARALYSIS OF THE MUSCLES OF THE EYE.

The muscles supplied by the third and the sixth pair of nerves are those most frequently affected. Less often the fourth pair is the seat of disease; and in rare instances two or more of the motor nerves may be simultaneously affected. The diagnosis as to which branches are involved is a question requiring nice observation for its solution.

PARALYSIS OF THE THIRD PAIR OF NERVES.

Branches of this pair supply the superior, inferior, and internal recti, the inferior oblique, the levator of the upper lid, and those fibres of the iris whose action causes contraction of the pupil.

One or more of these branches may be paralyzed while the others retain their function. The symptoms will therefore be more or less extensive, according to the muscles whose function is suspended from lack of power in the nervous fibres distributed to them.

When all the branches of the third pair are implicated, the eye is drawn outward by the unopposed

action of the external rectus, the upper lid droops and the pupil is widely dilated. If the lid be raised with the finger, the eye is seen to be nearly immovable, and vision is confused, though it becomes clear, if the patient looks through a small hole in a card or uses a convex glass of sufficient power to regulate the refraction, disturbed by the enlargement of the pupil. Vision is double, except when the well eye is turned in the same direction with that of the affected organ.

Causes. — This affection may depend on cerebral disease; in which case the prognosis would be unfavorable; but it is often induced by other causes, of which I have found exposure to cold and wet the most common. Walking in a rain or snow storm, with one side of the face exposed to a cold wind, is not rarely followed by this pathological condition. It appears also, in some instances, in those whose nervous system has been debilitated by illness. In both these last-named circumstances, the prognosis is most favorable, though recovery may be slow.

Treatment. — When we have reason to suspect a sudden cerebral congestion, appropriate derivative or depletive measures may be employed. When pressure on the nerve by an abnormal growth, or extensive disease of the brain, is the cause of the symptoms, we can expect no favorable result from remedies. Where we can discover the exciting cause to be of a nature involving less grave lesions, we may hope for complete success from judicious treatment.

In nearly all the cases where no organic change has given rise to the symptoms, we find the system in a condition below the standard of health. Good diet and tonics should therefore be recommended. Stimulating lotions may be applied about the eyebrows and lids. The use of strychnia seems scarcely called for, unless the paralysis persists. Aconite and veratria are sometimes useful.

The symptoms gradually subside; the muscles regaining their power, at first partially and afterward entirely. Several weeks often elapse before complete recovery.

MYDRIASIS.

This disease results from loss of power in the branch of the third pair which presides over the contraction of the pupil, and may occur without other lesion or any impaired action of the recti muscles.

The pupil is widely dilated, and vision is confused; but, to an accurate observer, no amaurotic symptoms are present. We are able to give great delight to a patient who had feared blindness, by proving to him that vision is as perfect as ever, if he look through a small hole in a card. Mydriasis may exist in one or both eyes, causing in either case an indistinctness of vision and a sensation of dazzling if exposed to strong light, as well as a feeling, in many instances, as if a foreign body were in the eye.

Causes. — This condition may be induced by all

the causes we have cited as occasioning paralysis of the third pair. It may also result from blows upon the eye, or from the influence of belladonna, stramonium, or other narcotics of similar action upon the nervous system. The internal administration of preparations or portions of these plants, or the application to the eye of even a very minute quantity of either, speedily induces an artificial mydriasis, which continues several hours or days, according to the amount employed.

The affection is sometimes seen in persons, especially females, who have been much debilitated; without the other branches of the third pair having become affected. In this case both eyes generally exhibit the symptom.

Enlargement of the pupil is often observed in amaurotic and glaucomatous disease; but these conditions are not included in the present description, and the dilatation is then accompanied by symptoms not exhibited in mydriasis, which denote its origin.

Treatment. — Local stimulants, such as aconite or veratria, are to be applied near the eye, and the same general treatment pursued as has been advised in general paralysis of the third pair. When the mydriasis continues for some time, the patient becomes accustomed to the influx of light, and is less annoyed by it; but vision does not improve to a corresponding extent. It may be assisted by convex glasses, or, in extreme cases, a weak convex glass may be

covered with dark paper except in a small circular space at the centre, so as to cut off all the lateral rays, which require most refraction and give rise to an indistinct image.

The extract of Calabar bean is often of great service in relieving the mydriasis, and though its effects are at first only temporary, permanent benefit is often obtained, after a short time, from its continued use.

PARALYSIS OF THE SIXTH PAIR OF NERVES.

The external rectus, or abductor, being the sole muscle supplied by this nerve, the eye cannot be turned outwards, and vision is double when the patient looks in the direction of the paralyzed muscle. It can be brought to a central position by the combined action of the inferior and superior recti, and its movements are natural in all directions but outward. The causes and treatment of this paralysis are similar to those described for paralysis of the third pair.

PARALYSIS OF THE FOURTH PAIR OF NERVES.

The more rare paralysis of the superior oblique muscle, which is alone supplied by this nerve, is likely to pass unrecognized at first sight. But the patient complains of double vision, and the two objects, instead of being side by side, as in disease of the third or the sixth pair of nerves, are seen one above the other. This double vision disappears if the patient incline his head to one shoulder.

On attentive examination, we can perceive that the cornea of one eye is lower than the other, the globe drooping a little in the orbit. If we incline the head first to one side and then to the opposite, we observe that the eye does not rotate freely on its axis.

The same remark may be applied as to the cause and the management of this, as to the paralysis of other branches previously treated of.

CHAPTER XXIII.

AFFECTIONS OF THE EYELIDS.

Several of the abnormal conditions which may be produced in the eyelids by disease or accident would be unimportant, if they existed in another part of the body, but require special attention on account of their peculiar relations to the organ of vision.

PTOSIS; OR FALLING OF THE UPPER LID.

Falling of the upper lid has been already alluded to as occurring in consequence of paralysis of the third pair. It may also result from hypertrophy of the lid, or from congenital or other weakness of the levator muscle. These latter cases may be distinguished from paralysis, by the fact that, if a portion of the integument is held up by forceps, the muscle has then sufficient power to raise the lid. Temporary loss of power often follows œdema or inflammation of the lid, but is recovered from as the parts regain their normal state, and does not call for surgical interference.

In cases where the levator is still able to act to a certain extent, it is sufficient to remove an elliptical fold of the integument from the central part of the

lid. A forceps designed for this purpose, having a transverse convex branch at its extremity, is convenient, but an ordinary forceps may serve the purpose. As much skin is seized, in an oval form and horizontal direction, as appears to be sufficient, and a trial is then made of the patient's ability to open and close the lid. If not enough has been grasped, the eye will be but partially opened; if too much, the lids cannot be closed. It is particularly important to avoid the latter contingency, as it is easy to snip away an additional bit of skin, but by no means so to replace any portion which may have been removed in excess. Satisfied that the portion seized by the forceps has been well calculated, the surgeon may excise it with curved or straight scissors. After the slight bleeding has ceased, the cut edges may be united by two or three sutures. The wound heals at once, and leaves no perceptible cicatrix.

When the levator muscle is palsied or has but slight action, it is sometimes necessary to take away a much broader fold of the skin, and to make the flap extend nearly to the eyebrow, that the occipito frontalis muscle may lend its aid to raise the lid.

ŒDEMA OF THE EYELIDS.

Serous infiltration of the lids is very common when leeches have been applied above the eyebrows or too near the inner or outer canthus. Care should therefore be taken to avoid placing them close to the eye,

and especially above its level. Infiltration also accompanies the formation of furuncle of the lid, inflammation of the lachrymal sac, or any considerable degree of conjunctivitis. It is also seen in erysipelas affecting the lids or the contiguous parts of the face, and occurs as a symptom when arsenical preparations have been administered internally beyond the point of tolerance. We also meet with it where anasarca is present in other parts of the body.

When occurring from accidental causes, of temporary action, no other treatment than a mild stimulating lotion is required, and even this is rather useful in relieving the patient's uneasiness than in hastening the resolution of the effusion. When it depends on general causes, as for instance on albuminuria, its continuance will be affected by the course of the primary disease.

PHLEGMONOUS INFLAMMATION OF THE EYELID.

Inflammation of the lids, followed by suppuration, is not unfrequent in erysipelas, and it may occur idiopathically, especially in children. The lids become much swollen, tense, and livid, and severe constitutional symptoms are occasionally present. The cellular tissue of the orbit is sometimes involved by extension of the inflammation. As pus is formed, the pain becomes throbbing in its character, and oftentimes severe.

Should we fail to arrest the disease in its early stages by derivative treatment and the use of cold local applications, our only resource is to open the abscess as soon as we can detect the formation of matter. If this be not done at an early moment, the pus readily diffuses itself in the loose cellular tissue of the lids, and destroys it to so great an extent, that the movements of the lid become greatly impeded by the adhesions which form between the skin and tarsal cartilage, preventing the skin from being thrown into its natural folds. But great care must be used, in opening an abscess of the swollen lids, not to carry the point of the instrument too deeply, as an instance is related where the eyes of an unfortunate confrêre were laid open by an incautious surgeon in evacuating a small purulent deposit following erysipelas.

WOUNDS AND INJURIES OF THE EYELIDS.

In lacerated wounds of the eyelid, even if they involve the integument only, and especially if they have extended to the whole thickness of the lid, it is important to adjust the parts at once as nearly as possible in their natural positions, securing them if necessary by several fine sutures, in order to avoid the after effects produced by irregular cicatrices. These are not only unsightly, but often induce alterations in the eye itself, by depriving it of its natural protection, or by creating ridgy scars or inversion of the

edge of the lid, which injure the globe by perpetual friction.

Similar efforts to procure regular cicatrization must be made when the lids have been injured by fire, scalding or caustic liquids, or hot metal. If the eyeball has been injured at the same time, and a portion of the conjunctiva of both the eye and the lid has been destroyed, it is almost impossible to prevent cohesion between the raw surfaces of the globe and the lid. Should this be allowed to form, it is afterward very difficult to effect a separation of the adhering surfaces. Every endeavor must therefore be made to prevent it.

As is well known, contusions of the lid usually produce ecchymosis. After a violent blow in a pugilistic encounter, or from a fall against some angular object, the ecchymosis sometimes takes the form of a sudden effusion, forming a livid fluctuating tumor. More frequently the discolored appearance of the skin comes on some hours after the accident.

Even when the effused blood forms a distinct collection, it is not necessary to evacuate the tumor by puncture. Cold evaporating or astringent lotions are all which is needed. Leeches or active treatment are seldom if ever required; but, on the contrary, leeches or puncture are likely to increase rather than lessen the ecchymosis.

Various remedies have enjoyed celebrity, as being of service in hastening the recovery of a black eye, — a most unenviable attraction.

Of these, perhaps arnica is most useful. The bruised root of bryony, and of Solomon's seal, are in favor with pugilists. But the time required for absorption of the effused blood varies so greatly with the amount of injury inflicted, — one spot of ecchymosis disappearing in a day or two, another of similar appearance lasting as many weeks, — that it is difficult to judge of the effect of any remedy in a given case. Nature may be aided in her efforts by any mild means which the judgment of the physician may approve. The discoloration may be masked by painting the skin every day, should a patient be disposed to take the trouble thus to hide it.

FURUNCLE OF THE EYELIDS.

Boils sometimes form upon the lid, or over the lachrymal sac, causing much œdema of the surrounding parts and a severe burning pain. They frequently excite the pulse, and give rise to febrile disturbance entirely out of proportion to the apparent insignificance of the disease. Sometimes these may be arrested in their incipient stage, by constant cold applications or by touching the skin with a crayon of nit. argent. More often they go on till a portion of the cellular tissue loses its vitality, and a small slough is formed, which is thrown off in a few days. Warm fomentations and light poultices favor this process, and give some relief to the pain. An opiate may be given at night, if the pain is so severe as to

prevent sleep. The symptoms are relieved at once, when the little sloughy core has been expelled. A similar affection, though of less severity, commonly termed stye, will be described in another section, as affecting the edge of the lids.

Carbuncle and malignant pustule are very rarely met with in the eyelids. They require to be treated on general principles, as if occurring elsewhere in the body; every endeavor being made to sustain the patient's strength, and to neutralize the effect of the morbid poison upon the general system. Any local lesions from loss of substance in the lid should have such attention that unsightly and troublesome cicatrices may be avoided.

CANCER OF THE EYELIDS.

The more malignant forms of cancer seldom take their origin from the eyelids. What is termed epithelial cancer is more common, though by no means frequent.

Its most common seat is near the internal angle; where it commences, sometimes as a small, wart-like tumor, afterward degenerating into ulceration, sometimes as a broad layer of disease extending in the direction of the lachrymal sac.

In some instances frequent but gentle applications of a fine-pointed crayon of the nitrate of silver will gradually produce resolution of the morbid growth. Should these fail, excision should be resorted to at

an early period, that it may not be necessary to remove too large an extent of the skin and subjacent tissue; and when thus performed, the operation generally effects a radical cure. Syphilitic ulceration of the lids is not to be too readily mistaken for cancer. When occurring, it yields to appropriate medical treatment.

EXCRESCENCES OF THE EYELIDS.

It is important not to regard as malignant any mere warty tumors, or those temporary enlargements frequently seen at the edge of the lid where some previous inflammation of a Meibomian gland has occurred. These latter disappear if touched lightly a few times with a crayon of nitrate of silver.

Warts, or the horny excrescences occasionally seen, may be clipped off with scissors.

ABNORMAL ADHESION OF THE EYELIDS.

Congenital union of the lids to a greater or less extent is now and then seen. It may be a simple phymosis, — the lids opening only a little less extensively than in the natural condition, — or it may amount to complete adhesion of the entire edges of the lids. In the first-named case, the child has an unpleasant aspect, the eyes seeming very small, and the bridge of the nose having twice its usual breadth. It is sometimes unable to see directly before it with-

out holding the head back, and making strong efforts to raise the lid.

The lids may be separated towards the inner angle, but, to avoid reunion, it is necessary to bring the skin and conjunctiva of the upper, and the same surfaces of the lower lid, together, by sutures, to prevent apposition and reunion of the original cut surfaces.

Complete or nearly complete connection of the two lids is nearly always accompanied by imperfect development of the globe itself and a want of visual capacity. An operation would in such cases be inexpedient, as it would lead to no result improving the condition of the patient.

When adhesion of the edges merely, has occurred, after a burn or other accident, they may be separated, and the skin and lining of each lid united by sutures, if there should be reason to fear reunion.

ENCYSTED TUMORS OF THE EYELIDS.

Small encysted tumors are very common in the lids. They may occur in persons of every variety of constitution, but are most frequently met with in females whose general system is in a feeble or anæmic state. Several are often seen in the different lids. I have removed as many as thirteen at one time from an individual. They are oftenest developed between the tarsal cartilage and the skin, projecting outwards to the size of a pea or larger, but also causing thinning and perforation of the cartilage, so that on evert-

ing the lid the situation of the tumor can be readily seen. They sometimes discharge their contents, after suppuration, through the conjunctiva. Their contents vary, being sometimes granular or steatomatous; at other times having more of a fibrous character. It is unnecessary to describe all the differences of growth and situation of these tumors, described by authors under the head of tarsal tumors, encysted tumors, chalazion, &c., as these variations do not affect the prognosis or treatment.

They sometimes, though very rarely, disappear spontaneously. More frequently they increase to a size which causes a slight deformity and some sensation of discomfort from pressure upon the eye. In a few instances their removal seems to be effected by the application of stimulating lotions to the skin of the lid, and of these a strong solution of salt, or brine, seems to be most serviceable. Perhaps also they may now and then be dispersed by frequent applications of iodine ointment to the lid; but this is a more troublesome remedy than excision itself, requiring to be continued a long time, giving a disagreeable yellowness to the skin, and very uncertain in its result. Excision is the best treatment, if stimulants have been used without success, or if the patient desires to be speedily rid of his encumbrance. This may be performed through the skin or the conjunctiva, according as the tumor is most accessible. If removed through the skin, no scar will be observed from the small incision

which is necessary. A forceps, invented by M. Desmarres, having at one extrèmity an oval thin steel plate, and at the other a ring of corresponding size, is useful in preventing hemorrhage during the dissection, and thus allowing the operator to remove the tumor more readily and thoroughly. The thin plate is slipped under the lid, and the ring, including within it the tumor, is then screwed down upon the plate, cutting off the circulation and giving the operator a clear view of the parts as he proceeds with his dissection. The application of the instrument is slightly painful, but it assists very much in facilitating and shortening the operation. Opening these little cysts, and breaking up their contents with a probe, or touching their interior with caustic, is less certain to destroy the sac, unless the proceeding is several times repeated, and frequently delays cicatrization by causing fungous granulations to shoot from it. Still, this method may be adopted if the patient has a dread of the radical operation.

No after treatment is required after excision. Where the operation has been performed through the skin, a single suture, or merely a bit of court-plaster, may be employed, according to the size or situation of the wound. The patient may require tonic treatment to prevent a formation of other cysts of the lids at some future period. Should removal through the conjunctiva be followed by the protrusion of a fungous growth from the cavity, as may chance to

be the case where the tumor had attained a considerable size, the fungous granulation may be readily snipped off with scissors.

ALBUMINOUS TUMOR.

Small, roundish, white masses are frequently developed in the follicles of the lids or neighboring parts of the face. When they attain some size, a minute orifice forms at their centre and allows the discharge of a milky exudation which is capable of reproducing the affection. This disease, sometimes termed molluscum, is most common in children. Small and indolent globular formations are also common in adults.

The best treatment is to open the thin covering of these masses with a lancet or cataract-knife, and press out the contents between the thumb-nails, or between the blades of small forceps passed well behind the tumor.

STEATOMATOUS FIBROUS CYST.

The vicinity of the eyebrow, near the outer angle, is the almost exclusive seat of development of a firm, fibrous cyst, usually containing sebaceous matter mixed with hairs, and sometimes adhering to the bone. The tumor is often congenital.

When they lie somewhat deeply, an incision of considerable extent is required for their removal, as they must be dissected carefully from the surrounding parts.

VITILIGO.

This name is given to irregular, yellowish patches which seem to be seated between the epidermis and cutis in the loose skin between the edges of the lids and the border of the orbit. They appear to have a tendency to increase and extend around the lids if left to themselves, but their excision seems to effect a radical cure. The operation is easily done, and is not followed by a scar.

DISEASES OF THE MEIBOMIAN GLANDS AND CILIARY BULBS.

The Meibomian orifices sometimes become obstructed, and a small vesicular projection forms at the sharp edge of the lid, which annoys the patient by its friction upon the globe. It is not larger than the head of a small pin, and may be scraped away with a penknife or the point of a pin or needle. The patient may easily learn to do this for himself.

HORDEOLUM; OR STYE.

This disease, named from its fancied resemblance to a grain of barley, consists in a red, hard swelling at the edge of the lid, accompanied by considerable burning pain, and some febrile symptoms. After a few days, suppuration takes place, and the discharge of pus, and perhaps a small slough, is promptly followed by a disappearance of all the symptoms. Its

seat is in one of the follicles at the roots of the cilia. Children, and persons of strumous diathesis, are most liable to be affected with a recurrence of these small tumors.

It is seldom possible to arrest the course of the swelling when it has begun to be red and painful, but cold applications may be made, sometimes with success, at the outset. Afterward, warm fomentations are more grateful and serviceable. At night a little simple or rose-water ointment may be applied. When considerable pus has formed, its discharge may be hastened by puncturing the swelling with a lancet, and the symptoms speedily subside upon its evacuation.

To prevent a recurrence, it is important to fortify the system, and to use local means adapted to change the condition of the follicles and the Meibomian glands. The citrine ointment (ung. hydrar. nitratis), diluted with five or six times its weight of simple or rose-water ointment, is an excellent application. About the size of the head of a pin should be melted on the end of the finger, and applied along the edge of the closed lids at bedtime, once in two or three nights, and it is well to continue its use for some weeks, even after the necessity for it has apparently passed away. Two or three grains of the red oxide of mercury, or red precipitate, to a drachm of ointment may be substituted for the citrine ointment if a change is desirable. The quantity used should be

so small that it may not find its way into the eye, as in doing so it causes unnecessary pain, and acts as an irritant.

INFLAMMATION OF THE MEIBOMIAN AND CILIARY GLANDS.

This compound affection is the most common of all the diseases of the eyelids, and has been described under a great variety of names, — as ophthalmia tarsi, tinea ciliaris, scrofulous blepharitis, &c. It consists in an inflammation affecting both series of the glands situated along the edge of the eyelids, and if allowed to go on unchecked, causes extensive alterations in the tarsal border.

The earliest symptoms consist in a slight redness and swelling at one or more points along the edge of the lids, and the formation of small pustules about the roots of the lashes at the centre of the swollen part. These small purulent collections dry, and adhere to the border of the lid in the form of small scales, the eyelash passing through their centre. If these are allowed to remain, the subjacent surface becomes ulcerated, the conjunctiva swollen, the secretion of the Meibomian glands acquires an irritating character, and the disease rapidly extends itself to the glands contiguous to those first affected. The irritation of the parts increases the flow of tears and the conjunctival secretion; and these, mingling with the morbid discharges from the affected glands, cause excoriation of the edges of the lids and the skin of

the cheek, which, in its turn, gives rise to additional swelling, and aggravates the original disease. The lids are often agglutinated in the morning, and cannot be separated without considerable force and the loss of a number of the cilia; but the appearance of the parts at once distinguishes this adhesion from that caused by the accumulation of a copious mucous secretion in conjunctivitis.

The disease may thus exist, uncomplicated, but it is very common to find it coexistent with ulceration of the cornea, with the eruptive and the catarrhal form of conjunctivitis, and with various evidences of a strumous constitution.

Causes. — The strumous diathesis is the strongest predisposing cause, and where this is present the symptoms may be readily excited by exposure to cold, to irritating fumes, even those of tobacco, to sudden changes of temperature, as also by a constant indulgence in high-seasoned food or alcoholic stimulants. It is by far most frequent, however, among poorly-fed, ill-clothed, neglected children.

Prognosis. — The disease is readily arrested by mild treatment, but when neglected, leads to very grave changes. The glands which secrete the cilia are destroyed, after the symptoms have continued for some time, and the eyelashes are no longer reproduced; or if they grow, they take an abnormal direction, turning towards the globe instead of out-

wards, and constituting the affection styled trichiasis. The inner line of the edge of the lids loses its well-defined character, and the lids become rounded like the lips, which change, with the absence of eyelashes, constitutes a repulsive deformity.

Treatment. — Scarcely any disease is more entirely under the control of treatment, but in severe cases mild remedies must be used for some time after the extinction of the severer symptoms, to bring the glandular structures completely back to their normal condition. No other than mild remedies are admissible.

General treatment is desirable in a large proportion of the cases which have reached an advanced degree. The diet should be generous, the patient should be warmly clothed, and protected from atmospheric vicissitudes. If the diathesis be strumous, the iodide or some other preparation of iron is of great service. The children of the poor, who are especially liable to this affection, should have a nutritious diet and warm clothing if possible, — and cleanliness, almost universally disregarded, should be insisted on. When complications are present, in the form of ulceration of the cornea, or conjunctivitis, they should receive prompt attention, as it is almost impossible to remove the glandular inflammation while these exist.

But local remedies form the most important part of the treatment. The crusts should be carefully removed, every morning, by the patient or those

having the care of him, after softening them with warm water. During the day, lukewarm fomentations, with milk and water or some mild infusion, assist in soothing the irritability of the parts. If the skin of the lids or the cheek has become excoriated, it is to be protected from contact of the discharges, by smearing it with a small quantity of rose-water or other simple ointment. At bedtime, every night or every other night, about as much of a medicated ointment as would equal the size of the head of a pin is to be melted on the end of the finger and applied along the edges of the lids; the lids being kept closed, that the ointment may remain about the roots of the lashes and orifices of the Meibomian glands without getting into the eye. It is important that the crusts should be previously removed, so that the ointment may come fairly in contact with the affected parts. The citrine ointment, diluted with from four to six times its weight of simple ointment, lard, or rose-water ointment, deserves almost to be considered a specific in this disease; for there are very few cases which it will not remove, if properly employed. Pure citrine ointment is too strong for general use, and even diluted, as above directed, it should be carefully applied, in small quantity only. Ointment of the red oxide of mercury, with an equal amount of lard, is also very efficient, though the citrine is to be preferred at the commencement. After a time a fresh influence can sometimes be obtained by substituting another ointment for that prescribed at the outset.

When ulcerations exist beneath the crusts, the cure may be hastened by touching them with a fine-pointed crayon of nitrate of silver; but should the ulcers be numerous, it is best to touch but few of them at one time; otherwise, much inflammation of the lid may arise from the use of the caustic over too extensive a surface.

Should there be much thickening of the conjunctiva, a mild collyrium, of borax or a weak solution of sulphate of zinc, is of service.

The use of mild remedies is the sole plan to be recommended in this disease; as its chronic nature and the extensive alterations of tissue which often exist render it impossible to remove it at once by any active heroic treatment. When the morbid condition has existed for some time, recovery is proportionally slow. In most instances, the patient should be told to continue an occasional use of the ointment, once or twice a week, for a month or two after the disappearance of all crusting or tumefaction of the edge of the lid, — after in fact he is completely cured; as he is thus protected from any danger of relapse.

If the disease has caused incurable alterations, giving a shining red margin to the lids, and producing blear-eyedness, before we are consulted, we can only palliate the condition and remove all existing inflammation, by the use of fomentations during the day, and simple ointments at night; but are unable to create a new set of ciliary bulbs to take the

place of those which the disease has destroyed. The individual will therefore have no new growth of eyelashes, where the pathological changes have reached this extreme degree.

TRICHIASIS.

The inversion of one or more eyelashes is a frequent result of disease of their secretory glands, and may lead to serious changes in the eyeball long after the original disease has subsided. They are frequently so pale, from constant maceration in the fluids of the conjunctiva, that it is nearly impossible to detect them, except by observing that the watery secretions rise about them, as it were, by force of attraction. The constant friction of these deviated lashes upon the cornea causes much irritation and frequently leads to vascularity, opacity, and ulceration of its tissue.

The offending cilia should be plucked out at once, and as often as they return if their direction continue abnormal. Frequently, after a few repetitions of this process, the lashes regain their healthy condition and are no longer inverted.

Should this treatment prove only palliative, or be tedious to the patient, a radical cure may be effected by removing a narrow bit of integument with the bulbs of the affected cilia, or by uncovering the bulbs by incision through the integument, and removing them, without taking away any portion of the skin.

PHTHEIRIASIS.

Crab-lice, of the same species with those sometimes infesting the pubes and arm pits, are now and then, though rarely, met with upon the eyelashes. I have seen the parasite in this situation only in children who were otherwise cleanly and healthy, and who might have derived them from their attendants. They cling very closely, and are dislodged with some difficulty by means of a needle or fine forceps. They may be mistaken for the crusts resulting from disease of the ciliary glands, unless very closely observed.

The use of a small quantity of mercurial ointment or the careful application of a little of a solution of corrosive sublimate, two or three grains to the ounce, kills these insects, or weakens their hold so that they may readily be detached. The physician can usually thus effect a cure on the spot; but if for any reason he prefer to spare the feelings of the patient or friends by leaving them uninformed as to the nature of the disease, he may order the use of a very small quantity of citrine ointment, which will generally dispose of the affection, *tuto*, *cito*, *et jucunde*, if applied once or twice while the child is asleep.

ENTROPIUM.

Inversion of the edge of the eyelids, especially the lower, is very common in old persons in whom the

skin has become flaccid, and some slight conjunctival irritation gives rise to frequent contraction of the orbicularis. Entropium is also sometimes occasioned by long-continued inflammation of the glands of the edge of the lids, or by traumatic injury or caustics.

When existing for any period, the disease becomes a cause of other morbid alterations, from the friction of the inverted cilia upon the eyeball.

If caused by flaccidity of the integuments, entropium may often be remedied by keeping the skin of the lid covered with collodion till the tendency to inversion is removed. The same result may sometimes be gained by the use of narrow strips of adhesive plaster, which are first to be firmly stuck upon the lid, and then drawn down and fastened upon the cheek. When these means are insufficient, removal of a fold of skin of sufficient width, with a portion of the orbicularis beneath, is quite sure to be effectual. The edges of the wound are to be united by sutures, and the patient is well in two or three days.

If the change depend on previous inflammation or injury, the same operation will often suffice for restoring the natural order of things; but it is necessary to remove a larger portion of the muscle, near the ciliary border. Other methods of operating have been devised, but many of them have been based on irrational grounds, and have produced only temporary, if any benefit.

ECTROPIUM.

Eversion of the eyelids may occur in three ways, — from external traction, — the edge of the lid being drawn outwards by a cicatrix of the skin resulting from a burn or injury; from paralysis of the orbicularis; or from causes acting from within and pushing out the lid. However caused, the everted condition induces excoriation of the skin of the lids and cheek, by the constant flow of tears; and where it is excessive, the cornea is liable to become ulcerated, from the want of protection against atmospheric changes and irritating foreign substances. When displacement has existed for a long time, the puncta lachrymalia are frequently closed; but their situation can almost always be made out, and they are readily reopened by means of an Anel's probe.

When resulting from contraction of a cicatrix, it is useless merely to divide the latter, unless some provision is made for supplying the place of the lost substance by other material, slid from the neighboring parts into the vacuum. In aggravated cases a blepharoplastic operation, after excision of the cicatrix, becomes necessary.

If the consequence of paralysis, this must be treated according to its cause, as we have directed in speaking of paralysis of the muscles of the eyeball.

The larger number of cases of ectropium are produced by causes acting from within the lid. The

swelling of the conjunctiva is sometimes so great, in catarrhal or purulent ophthalmia, that the tarsal cartilage is completely everted, and if this eversion is not at once replaced, it may continue for an indefinite time, and assume a chronic condition, the conjunctiva being greatly thickened and acquiring almost a cuticular character.

At first sight, these chronic cases seem to require excision of a portion of the conjunctiva, to allow of a replacement of the lid in its proper relations to the globe ; but this is not essential, and is better refrained from, if the patient can be kept under treatment long enough to permit of the restoration of the normal condition by the use of astringents. If excision be resorted to, great care must be exercised to remove but a small portion, as, if the operation is too extensive, entropium may result, after cicatrization has taken place and the conjunctiva has become healthy, from contraction of the scar. In any event, the use of astringents must be combined as a subsequent treatment, should the operation be resorted to.

But the best method for these cases of eversion is the frequent application of astringents, — not to the most everted portion of the conjunctiva, at the edge of the lids, but to the part of that membrane nearest to that which is still *in situ*. This portion of the tissue is thus brought more and more nearly to a healthy state ; and as this takes place, the parts lying beyond are gradually drawn back towards their

proper position, to become, in their turn, improved. A light touch with a smooth crayon of sulphate of copper is the best way of effecting this improvement. Its action can be limited to the desired spot, and it does not act as an excessive stimulant, as is the case in these instances with solutions of the nitrate of silver. A mild collyrium of the sulphate or acetate of zinc may be dropped into the eye twice or three times a day to keep up an astringent influence. Some patience is required to accomplish a cure ; but I have never failed to relieve cases of even enormous protrusion of the conjunctiva, in this manner. A short time is usually sufficient to show a decided gain, and to prove that recovery is possible by this method,—and the change for the better goes on more and more rapidly, as the morbid tumefaction of the parts becomes resolved, and they begin to assume once more their normal features and positions.

APPENDIX.

RECENT ADVANCES IN OPHTHALMIC SCIENCE.

THE OPHTHALMOSCOPE.

NOTWITHSTANDING some isolated observations of reflection from the back part of the eye, it was till lately generally believed that rays of light reaching the posterior portion of a healthy eye were absorbed by the pigment layer of the choroid, and that none were returned to convey an image of its interior to another eye. This error was due to the fact, that in the ordinary inspection of the eye its fundus is but feebly illuminated, owing to the necessary interposition of the observer's head between it and any available source of light.

Fig. 1. Illumination of the retina by a candle-flame.

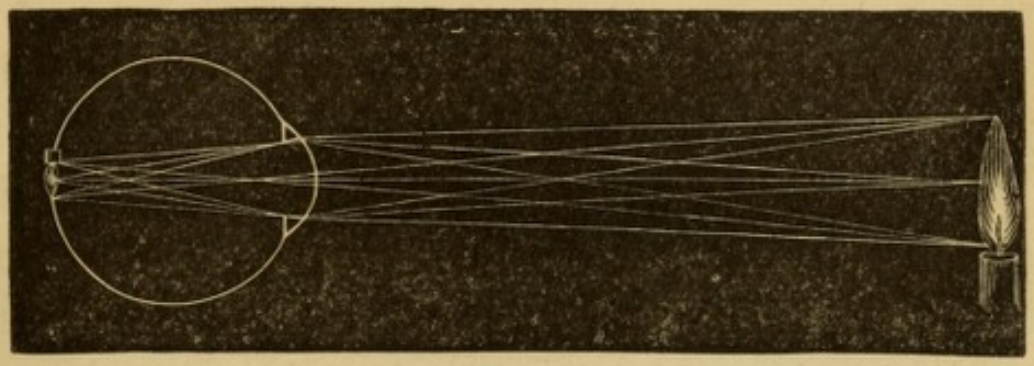


Figure 1 represents an eye having a portion of its fundus illuminated by rays from the flame of a candle. If now, as is shown in the figure, the eye is accommodated for distinct vision at the distance of the candle, a minute but clearly defined inverted image of the flame will be formed at the posterior pole, in the region of the macula lutea, while the general surface of the ret-

ina is left in comparative darkness. In order to obtain a view of this illuminated region it is necessary that some rays of light from it shall enter the eye of the observer; but these emergent rays can leave the observed eye only in the inverse direction to that in which the illuminating rays enter it, that is, in the exact direction of the candle. It is evident, however, that if the observer's head be interposed between the candle and the observed eye it will cut off the illuminating rays from all that part of the retina which is in the line of vision, while, on the other hand, if he attempt to obtain a view from a point beyond the candle the emergent rays will be intercepted and his eye dazzled by the flame.

N. B. In the plates illustrating the principles of the ophthalmoscope, what is termed a diagrammatic eye has been drawn, representing the total refraction of the cornea, aqueous, crystalline, and vitreous, as if effected by a single refracting medium of uniform density. The demonstration is thus simplified, and the confusion avoided which would result from an attempt to show the separate action of the crystalline lens in figures so limited in size.

The ophthalmoscope enables us to obviate this difficulty.

This beautiful invention of Helmholtz consists in placing before the eye of the observer a mirror, by which rays from a luminous object can be thrown into the observed eye, in the direction they would have if they came from the eye of the observer. Being refracted by the transparent media, they fall upon and illuminate a certain portion of the retina. This illuminated part of the retina becomes now a source of luminous rays, which emerge from the eye in the

same direction in which the illuminating rays entered it, that is, in the direction of the mirror. In order that these rays may reach the eye of an observer, either the mirror is made wholly or in part of a transparent material, or it is pierced with a small aperture at or near its centre.

The mirror of Helmholtz consisted in superposed plates of thin glass, usually three in number, placed obliquely before the eye. On the reception of the emergent rays from the observed eye, a part of these were again reflected towards the luminous object, their original source; but another portion passed through the mirror and entered the eye of the observer placed behind it.

Fig. 2. Original Ophthalmoscope of Helmholtz, consisting of a plane mirror made up of several plates of transparent glass.

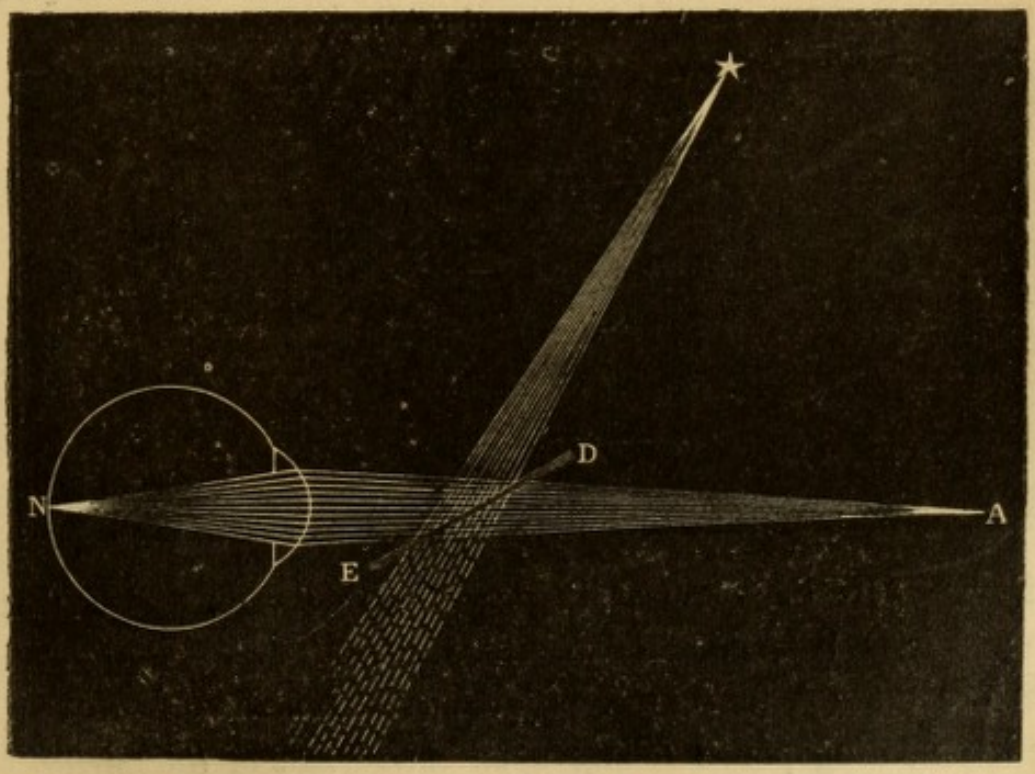


Figure 2 represents an eye placed so as to receive the rays

of light reflected by the plane mirror D E from a single point * of any luminous body, such as the flame of a candle. The mirror being made of a transparent material, such as plate-glass, a portion of the illuminating rays from * will pass through it, in the direction of the dotted lines, and be lost, while another portion will be reflected into the observed eye, and will light up the point N at its fundus. The emergent rays from N will, in like manner, be in part reflected back to *, but a part will pass directly through the mirror in the direction of A, and thus may be received by the eye of an observer.

Silvered or metallic mirrors, having greater illuminating power, have been generally substituted for the plates of glass as employed by Helmholtz; in this case the observer looks through a small perforation made for the purpose in the centre of the mirror.

Fig. 3. Ophthalmoscope, consisting of plane mirror of metal or silvered glass with central perforation.

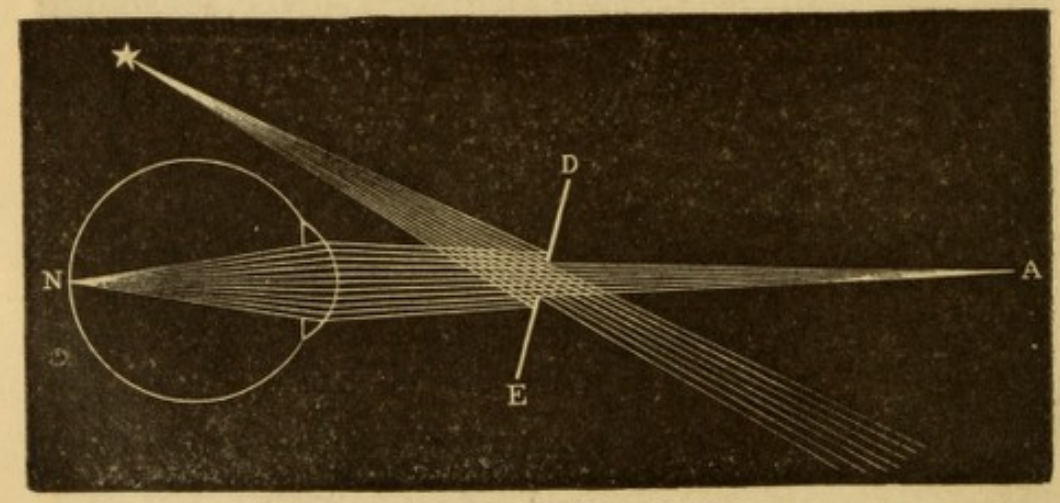


Figure 3 is the same as Figure 2, with the exception that the mirror D E is made of metal or silvered glass, with a small aperture through its centre. By this arrangement a portion of the illuminating pencil falling upon the surface of the mirror is reflected into the observed eye, and is brought to a focus at N,

while the portion of the emergent pencil which falls upon the hole in the mirror passes through in the direction of A.

As the rays thus received from the fundus of an eye under examination are ordinarily slightly convergent, they may be rendered parallel, and thus better disposed for the formation of a distinct image on the retina of the observer, (whose eye, if normal, is adapted either for parallel or for divergent rays,) by placing a concave lens behind the mirror.

Examination in this manner constitutes what is termed the direct method, and gives an erect and greatly enlarged image of the fundus of the eye explored; different portions of the retina being successively brought into view by slightly changing the position of the mirror and of the eye of the observer.

The emergent rays may also be rendered parallel, in many cases, without a concave lens, by simply requiring the patient to look at an object at a distance, by which action his eye accommodates itself for parallel incident rays, and the emergent rays undergoing the same refractive conditions become parallel. At the same time, the rays which enter the eye from the mirror, coming from an object nearer than the distance for which the eye is accommodated, and being therefore divergent, are not brought to a focus upon the retina, but behind it, and therefore form upon the retina a circle of dispersion, by which a somewhat larger portion of its surface becomes illuminated.

The use of a concave instead of a plane mirror affords a better illumination, as the rays being convergent when they enter the eye, are brought to a focus at a short distance behind the lens, and crossing each other there, diverge to form a circle of dispersion of such size as to light up a considerable surface of the retina.

Fig. 4. Ophthalmoscope, with concave metallic or silvered glass mirror, showing greater extent of illumination; also showing the use of a concave eye-glass.

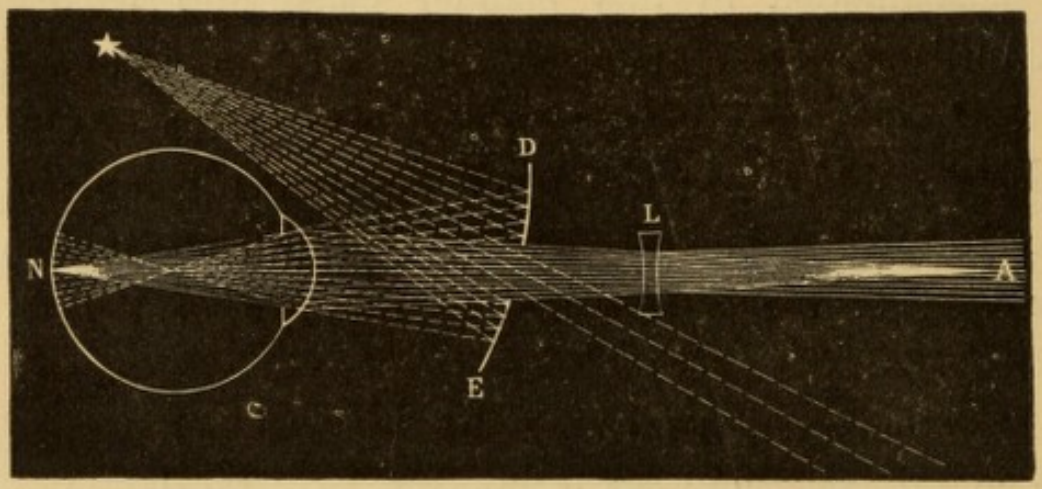


Figure 4 illustrates the use of a concave mirror, D E, instead of the plane ones shown in Figures 2 and 3. By comparing this figure with the two former, it will be seen that a very much larger pencil of light from the luminous point * is made to enter the pupil of the observed eye, thus insuring a very brilliant illumination of its fundus. It will be observed, also, that the illuminating rays converge to a focus in front of the retina, from which point they again diverge so as to light up a considerable surface instead of the single point N.

The small concave eye-glass L is placed behind the hole in the mirror in order to render the rays from the observed eye parallel or slightly divergent, thus fitting them to form a distinct image on the retina of the observer. The same form of

eye-glass is required with the mirrors shown in the two former figures. If the patient or the observer happens to be strongly hypermetropic the eye-glass may often be dispensed with.

The substitution of reflected light for the luminous object itself, and its return, after illumination of the observed eye, through the mirror to the eye of the observer, forms the first principle of construction of all the common forms of the ophthalmoscope.

The numerous modifications of the instrument have resulted from efforts to increase the extent and degree of illumination, to enlarge the field of surface visible at one and the same time, and, lastly, to avoid the necessity of frequent changes of lenses to correct refractive anomalies in the eyes both of the patient and of the observer.

From the desire to fulfil these indications has arisen the "indirect" method of examination, where an inverted image of the fundus of the eye is perceived by the observer.

In this mode of exploration, a bi-convex or plano-convex glass, of from two to four inches focal distance, is held near the observed eye. By this means two results are obtained; — the rays from the mirror are rendered yet more convergent, and after refraction by the crystalline they form a large circle of dispersion, illuminating a considerable portion of the fundus; and, secondly, the rays emerging from the illuminated retina are brought to a focus in repassing through the

convex lens, forming a brilliant and clearly defined inverted image.

Fig. 5 Ophthalmoscope, combining the concave mirror and a convex objective lens, showing the greatly increased field of illumination. The illuminating rays only are represented.

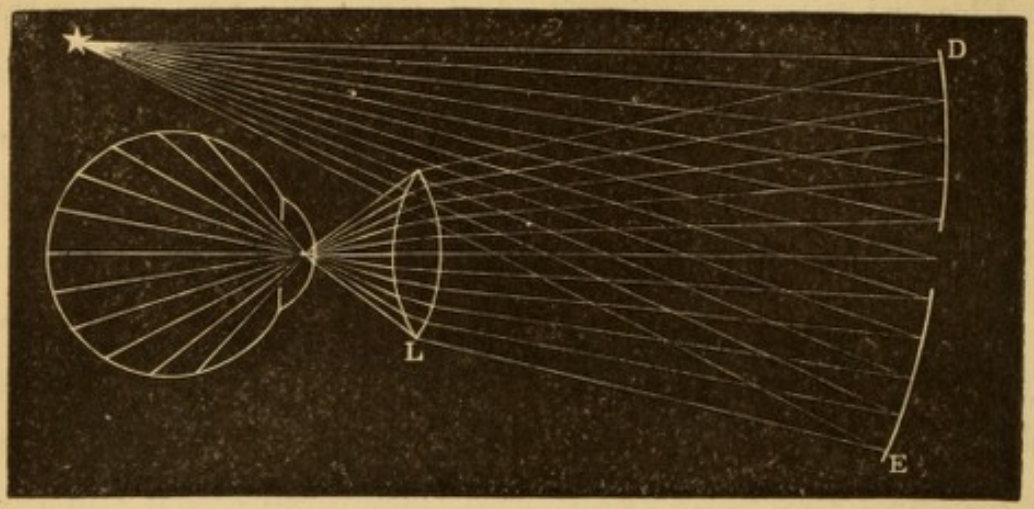
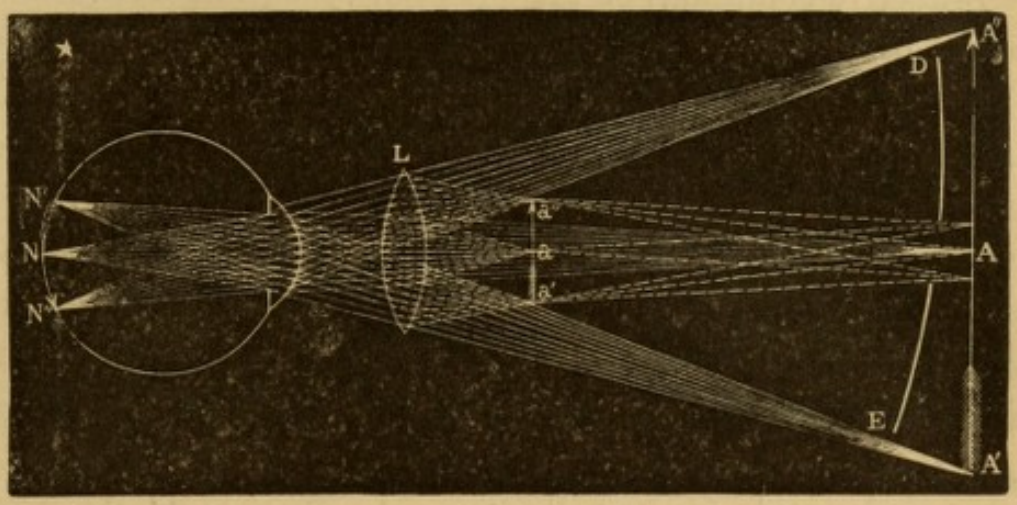


Figure 5 shows the combined effect of the concave mirror D E and the objective lens L in rendering the illuminating rays strongly convergent, and consequently lighting up a very large portion of the fundus of the observed eye.

By the employment of this lens all nice distinctions as to the myopia, hypermetropia, or accommodation of the observed eye, which must without its use be taken into account in searching for the retinal image, may be comparatively disregarded; and we know that this image must now be found within a short distance of the principal focus of the objective lens.

Figure 6 shows the action of the objective lens L in forming at a′, a, a″ an inverted image of the portion of illuminated retina N′, N, N″. The dotted lines to the right of a′, a, a″ which pass through the hole in the mirror are continuations of the rays which by their convergence have formed the image

Fig. 6. Ophthalmoscope with concave mirror and convex objective lens, showing the formation of an inverted image. The illuminating rays are omitted.



a′, a, a″. The whole image a′, a, a″, corresponding to the whole surface N′, N, N″, is therefore visible at a single glance to the eye of an observer placed directly behind the mirror, whereas without the objective lens only a very small portion of the retinal surface can be seen at a time, and the examination of any extensive region can only be made, as it were, piecemeal, by moving the mirror and thus bringing different parts successively into view.

It is only requisite to bring the eye of the observer a little nearer to the observed eye if the latter is myopic, and the contrary in a case of hypermetropia.

Fig. 7. Diagram illustrating the position of the inverted image at or near the principal focus of the objective lens.

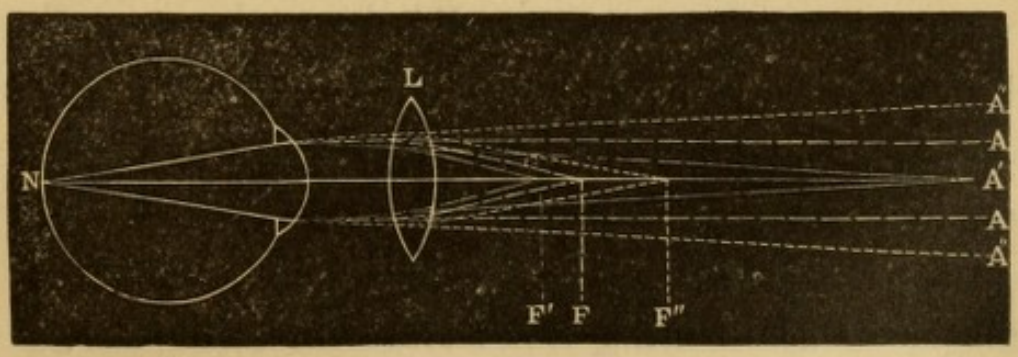


Figure 7 is intended to illustrate the various positions of

the inverted image formed by the objective lens L, under different refractive conditions of the observed eye. The three conditions of myopia or forced accommodation, emmetropia, and hypermetropia are represented in the three directions of the emergent rays; viz. myopia by the rays which converge to A′, emmetropia by the parallel rays A, A, and hypermetropia by the divergent rays A″, A″. In the case of the emmetropic eye accommodated for an infinite distance, the rays A, A, which emerge parallel from the observed eye, are brought to a focus and form an inverted image of the retina at the principal focus, F, of the objective lens L. If the observed eye is myopic or accommodated for near objects, say at the distance A′, the emergent rays, which are already somewhat convergent, will be brought to a focus at a point a little nearer to the lens L than its principal focus, say at F′. If, on the other hand, the observed eye is hypermetropic, the emergent rays, although somewhat divergent, are by no means sufficiently so to neutralize the convergent action of the powerful lens L; they are therefore brought to a focus, not at or within the principal focus of the lens L, but beyond it, say at F″. In the case of an excessively hypermetropic eye, or after the removal of the crystalline, it may be sometimes advantageous to employ an objective lens of greater power than usual, say one of less than two inches focal length; but for the vast majority of eyes, a lens of from two to four inches focal length is sufficient.

This image may be magnified, or the eye of the observer, if presbyopic or hypermetropic, aided, by placing a second convex glass of less power, say of ten inches focal distance, behind the mirror; which must, perhaps, in this case be placed nearer the aerial image, so as to bring this latter within the range of the second glass.

Fig. 8. Use of convex eye-glass in the examination of the inverted retinal image.

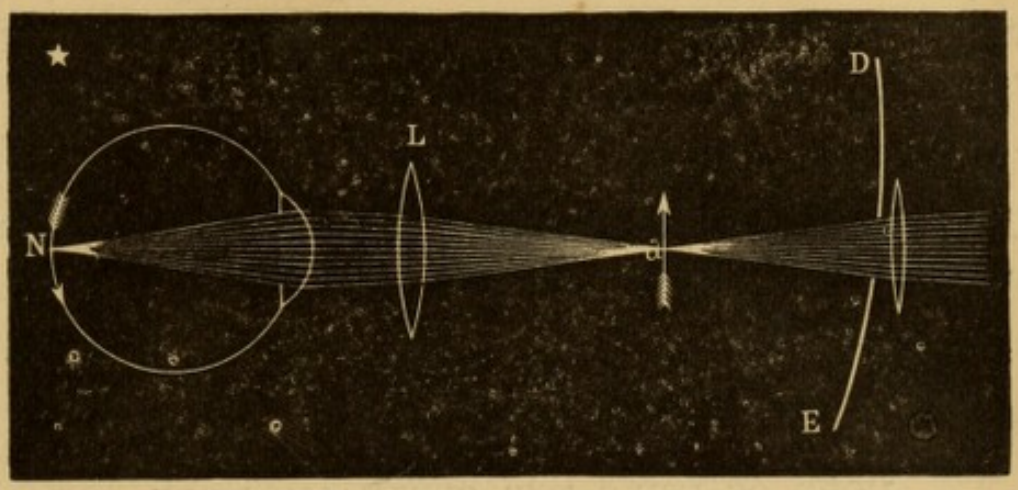


Figure 8 shows the use of a convex eye-glass in viewing the retina by means of its inverted image. If the objective lens L is chosen of moderate power, and especially if the observed eye is strongly hypermetropic, the image a will be formed so far from the lens L as to necessitate the removal of the observer, and consequently of the mirror, to an inconvenient distance. This difficulty is entirely obviated by the employment of a convex eye-glass placed behind the hole in the mirror D E, which gives the additional advantage of a more highly magnified image. The image may be magnified to almost any desired degree by the employment of a weak object-glass and strong eye-glass.

For this method of examining the eye by the inverted image, concave silvered or metallic mirrors are employed, in order to secure a sufficiently extensive and brilliant illumination; but for certain examinations in the erect image, or where the pupil has not been dilated by atropia, or, especially, where great sensitiveness of the retina is present, the plane mirror of Helmholtz, composed of thin plates of glass, is often to be preferred, owing to the less intensity of the light reflected by it.

The direct method, with the upright image, is particularly well adapted for the exploration of the parts of the eye lying anterior to the retina.

Opacities or other changes in the vitreous or the crystalline lens can thus be detected, and their relative positions determined, with great readiness and certainty.

MODE OF USING THE OPHTHALMOSCOPE.

In a very large proportion of ophthalmoscopic examinations, especially where it is only desired to observe the optic disc and its surrounding parts, — as, for instance, in cases of myopia, where we wish to determine the presence or absence of posterior staphyloma, — it is unnecessary to dilate the pupil; but as the eye can be more readily as well as more thoroughly explored after the pupil has been enlarged by the use of atropia, it is sometimes desirable or important to employ it. A weak solution, say of one grain to the ounce of water, will generally be sufficiently effective for this object, and its influence soon passes off, without subjecting the patient to the annoyance caused by the long-continued mydriasis and the loss of accommodation which is occasioned by the use of a strong solution.

The patient should be seated in a darkened room, near a table. On this an argand or petroleum lamp or gas-light is placed, a little behind the plane of his

forehead, and nearly on a level with it. The eye will thus receive only the rays reflected from the mirror. The surgeon seats himself opposite, with his eye at about the level of that of the patient, or a little above it.

If examining by the "direct" method, the light from the mirror is now to be directed to the field of the pupil, and the surgeon, looking through the aperture in the mirror, perceives the bright reflection from the fundus of the eye. If the vessels of the retina are not distinctly seen, the instrument and the eye of the observer are brought a little nearer to or removed a little farther from the eye looked at, until the point of clear perception is ascertained. If this does not succeed, the observed eye may be at fault; if myopic, or persistently accommodated for near objects, a concave lens must be placed behind the mirror, and immediately in front of the eye of the observer; if hypermetropic in any marked degree, it may be necessary to use a convex glass in the same position. In examining a normal eye, a concave glass of moderate power (say twelve inches) is often very useful in correcting unconscious efforts at accommodation on the part of the patient, and perhaps also of the surgeon. In examining simply presbyopic eyes this may usually be dispensed with.

To bring into view the optic disc, or entrance of the optic nerve, the patient is directed, if the right eye is to be examined, to look at some object over the

right shoulder of the observer; if the left eye, he may be told to look toward the observer's left ear; each eye, in short, being turned slightly inwards and upwards whilst being looked at. The optic disc affords a good starting-point, from which the exploration may be extended in all directions, the patient being required to turn his eyes slowly to the right, left, upwards, or downwards, so as to bring successively into view various portions of the retina. The macula lutea is brought into view when the patient looks directly at the mirror. If the pupil has previously been enlarged by atropia, nearly the whole of the retinal surface can thus be inspected.

If the "indirect" method be employed, the convex lens is held near the observed eye with the thumb and finger of one hand, whilst the other holds the ophthalmoscope. The lens should be held somewhat obliquely, so that the reflection of the mirror from its two surfaces may not interfere with the observer; and a plano-convex lens has an advantage over the biconvex, as giving less of this disturbing element. As observed eyes differ in their refractive power, the lens must be held slightly nearer to or farther from the eye, in order to gain at the focus of the lens a distinct image of the retina. A moment's trial suffices to establish the proper position.

The observer at the same time keeps the ophthalmoscope and his eye at such distance from the focal point of the lens (at or near which the image is to be

formed) as is adapted for his clear perception of small objects.

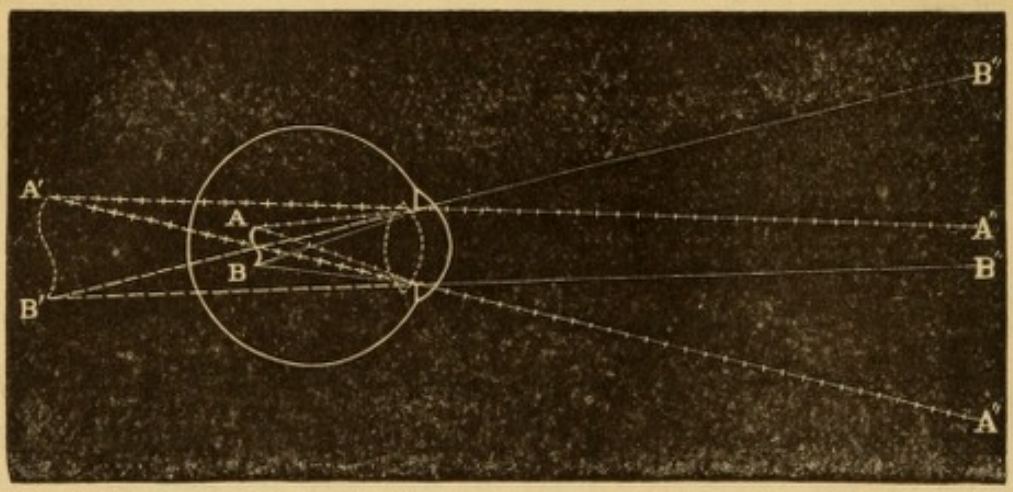
The aerial image being thus brought to a determinate point, a short distance from the observed eye, and rendered clear, it may be enlarged, if desired, by placing behind the ophthalmoscope a convex lens of say ten inches focus. The instrument is to be held at about the focal distance of this secondary lens from the inverted image formed at or near the principal focus of the objective lens, as already described.

In examining the refractive media of the eye, accurate ideas respecting the situation and form of opacities or effusions in those media may be best obtained by the aid of the mirror alone.

If these are in the anterior chamber or the crystalline lens, their nearness to the surface allows of their being detected; and if in the vitreous, the cornea and crystalline together act as an auxiliary magnifying lens to render them more obvious. In viewing objects situated in front of the retina, we may see them, if very brilliant, by reflected light; but in the majority of cases, being themselves of a dull color, they appear, by reason of their opacity, as dark spots or lines, obscuring in part the more brilliant fundus of the eye.

Figure 9 illustrates the use of the ophthalmoscope in the investigation of opacities or floating bodies in front of the retina. Let A B represent a floating body in the vitreous; being in front of the posterior focus of the eye, the rays from it emerge divergent from the eye, although less so than before traversing

Fig. 9. Use of the ophthalmoscope in the investigation of opacities or floating specks in the lens or vitreous.



the crystalline and cornea. The rays from the point A, therefore, after emerging from the eye, assume the direction A″ A″, as if they had really come from the more distant point A′, and the rays from B assume the direction B″ B″, as if coming from the point B′. The effect is, that the eye of an observer placed in front of the observed eye will see at A′ B′ an enlarged erect image of A B.

It would be useless to attempt, here, an account of the numberless patterns of ophthalmoscopes which have been invented and found more or less of favor. The most convenient for ordinary purposes are small concave mirrors having a focus at about the ordinary distance at which small print can be read. That of Liebreich may be mentioned as a good example. This is fastened to a short handle, and has at one of its edges a hinged support in which a small convex or concave glass may be fixed, which can at will be turned away from or placed behind the mirror. In the case containing it is also a convex lens or two, to

be used in examinations with the inverted image, and several small glasses of different foci.

FIXED OPHTHALMOSCOPES.

Besides the more portable ophthalmoscopes, large instruments have been constructed on the same principles, which afford a ready means for exhibiting the phenomena to be observed within the eye to those who have not acquired facility in these explorations.

They are provided with supports for the patient's head, and a point upon which, after it has been suitably adjusted, he can fix his attention, thus keeping the eye in any wished-for position, and allowing the portion of its fundus which it is desired to exhibit to be seen by a large number of observers in succession.

BINOCULAR OPHTHALMOSCOPES.

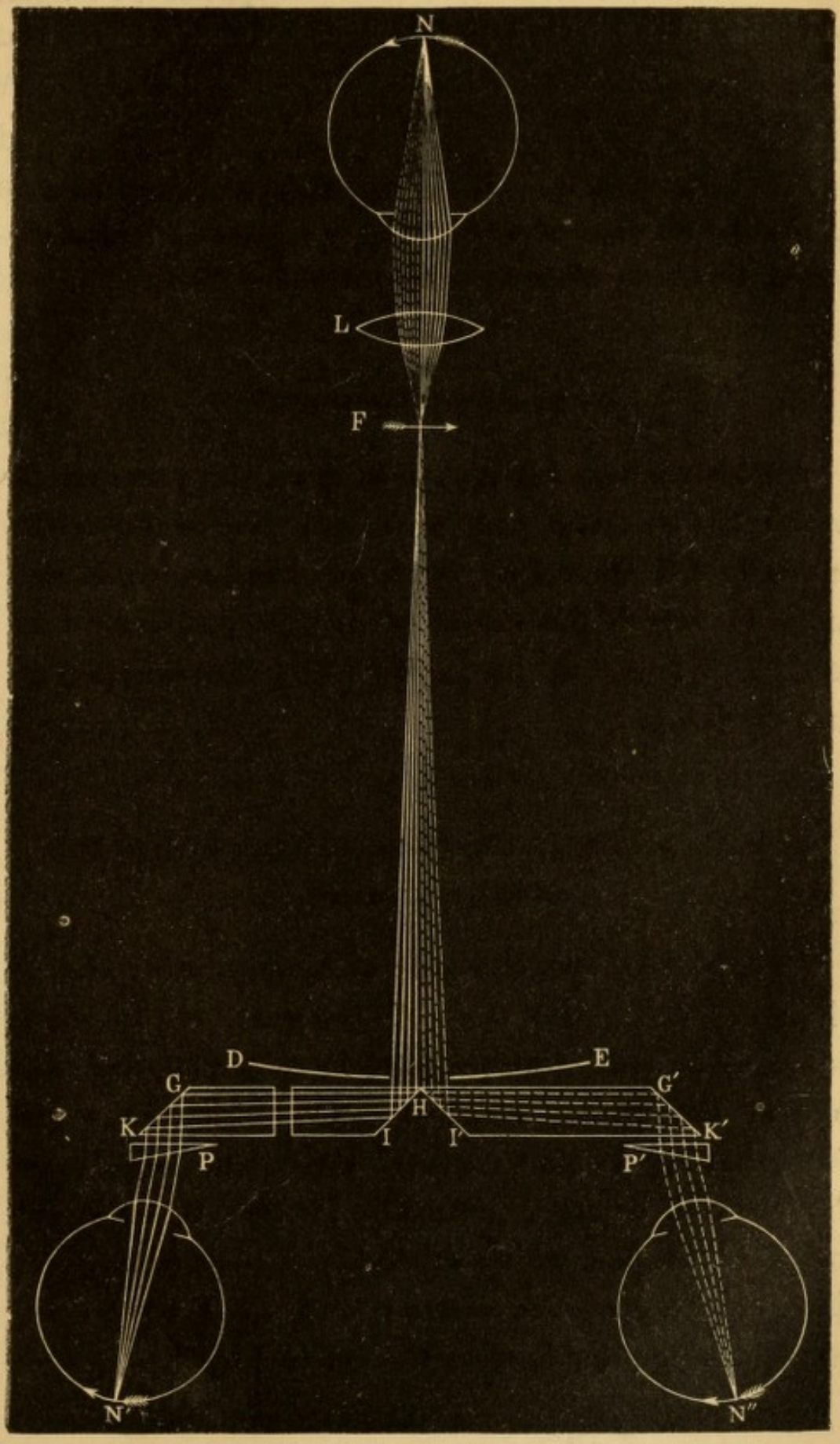
In order to obtain the advantage of vision with both eyes, a most ingenious instrument has been devised, which, by a combination of rhombohedral and prismatic glasses behind the mirror, allows an image to be formed on corresponding parts of the retina in each of the observer's eyes. The advantages of this instrument are, that, as in the stereoscope, objects may be seen in apparent relief, and any inequalities in the retinal surface, whether excavation of the optic disc, posterior staphyloma, or encroaching growth of en-

cephaloid or other tumors towards the centre of the globe, may be more readily discerned, and their degree estimated.

The instrument forms one of the most beautiful and ingenious applications of the principles of optics to the furtherance of scientific research; but it has the disadvantage of being somewhat less quickly adapted to the eye under observation than the small ophthalmoscope of Liebreich.

Figure 10 represents the optical principle of the Binocular or Stereoscopic ophthalmoscope. N is the fundus of the observed eye, and N′ and N″ of the left and right eye of the observer. The objective lens L forms at F an inverted image of the illuminated retina N. Instead, however, of viewing the image F directly through the hole in the mirror D E, the two rhombohedra H G K I and H G′ K′ I′ are interposed in such a position as to receive the rays as soon as they have passed through the hole, and to transmit them, by total reflection, half to the right hand toward G′ K′, and the other half to the left in the direction of G K. Here they undergo a second total reflection, and are then refracted slightly outward by the small prisms P and P′, to be received by the two eyes of the observer and brought to a focus upon his two retinæ, N′ and N″. It will be seen now, by inspecting the figure, that the rays from the left side of the point N, shown dotted in the diagram, after helping to form the image F, cross to the right side so as to fall upon the right-hand rhombohedron H G′ K′ I′, and finally come to a focus and form an image upon the retina N″ of the right eye of the observer. The rays from the right side of N, on the other hand, are in like manner received by the left-hand rhombohedron H G K I, to be conveyed to the observer's left eye at N′. The result is, that if there is any irregularity of

Fig. 10. The Binocular Ophthalmoscope.



surface at N, as, for instance, an excavated optic disc, the right and left hand bundles of rays form somewhat different images in the two eyes of the observer, and from the combination of the two impressions stereoscopic vision results. The Binocular Ophthalmoscope is also of use, by enabling the observer to use both eyes at once, even where there is no irregularity sufficiently marked to produce the impression of solidity or excavation, — binocular having always an advantage over monocular vision.

AUTO-OPHTHALMOSCOPES.

An instrument has also been devised by means of which an observer can with one eye examine the retina of his other eye; and, yet further, an instrument by which the retina of an eye can inspect itself, — an image of its papilla being thrown upon its macula lutea.

NORMAL APPEARANCES TO BE OBSERVED WITH THE OPHTHALMOSCOPE.

In a healthy eye, the optic disc, or papilla, as it is often termed, — the spot of entrance of the optic nerve, — is considerably lighter in color than the surface of the retina, and forms a whitish disc, sometimes having an almost silvery reflection. From this the arteries emerge, generally in two superior and inferior branches, which subdivide as they run toward the periphery of the retina; and to it return the veins, distinguishable from the arteries by their darker

color and less direct course. In a certain number of eyes in which the fundus is really normal the optic disc appears to have an oval contour instead of its usual circular form. This illusion is often due to a disturbed refraction in the cornea, in consequence of variations of curvature in its different meridians. This oval appearance of the papilla depending on astigmatism of the cornea, and not on any actual deformity of the papilla itself, is not to be confounded with a pathological change in its outline often seen in extreme myopia, which will be hereafter described under the head of posterior staphyloma. But an apparently oval image will also be seen if the objective lens is held very obliquely.

Differences of color are often observed in the optic disc; slightly bluish spots and appearances of excavation being seen, especially at its central portion, in eyes which are functionally perfect. These are due to differences in the aspect of the lamina cribrosa and the nerve fibres passing through it. Another variation from the normal type is found in the existence of a more or less complete dark crescentic line of pigment at the margin of the disc. But this is not to be deemed abnormal, it being compatible with excellent vision.

The general surface of the retina appears pinkish or reddish, according to the amount of pigment in the choroid beneath. The retina itself can, in most cases, scarcely be distinguished, but may be some-

times made out as a thin grayish layer overspreading the choroid. In albinos, or persons of very light complexion, the quantity of pigment matter in the choroid is so small that the choroidal circulation may be distinctly seen, the vessels being paler and more tortuous than those of the retina, and evidently underlying the latter. In those of dark complexion these vessels of the choroid are masked by the abundant pigment. Where the amount of pigment is very small, the portion of the eyeball bounded posteriorly by the choroid and anteriorly by the iris fulfils only imperfectly its office of a dark chamber; and too great amount of light passing through the sclerotica and iris into this chamber causes confusion of the retinal images and photophobia.

The macula lutea, the central spot of visual perception, is situated about the distance of three lines from the papilla, towards its outer side, and is brought into view when the eye looks directly forward. It often cannot be readily distinguished on ophthalmoscopic examination, since no vessels converge towards it, as they do towards the papilla; but not unfrequently there is an evidently increased amount of pigment granules around it, marking its situation and leading to its discovery on close inspection. This part of the eye should always be carefully examined where there is reason to suspect retinal disease, as it is a frequent seat of pathological alterations, which are easily perceived if looked for.

In some instances, not abnormal, the entire surface of the fundus, except the papilla, seems of an almost brownish color, divided into patches by choroidal vessels anastomosing in all directions. Overlying this network are seen the retinal vessels in their usual course.

This brief sketch of the appearances revealed by the ophthalmoscope in healthy eyes, seemed to have its place as an accompaniment to an explanation of the instrument itself. But, to avoid repetition, descriptions of pathological conditions will be reserved, to be connected with some account of the diseases which give rise to them.

ADVANTAGES OF THE OPHTHALMOSCOPE.

It is not claiming too much, to assert that the ophthalmoscope has done more to increase our knowledge of diseases of the eye than had been accomplished during a century by all other means. The practitioner is not now obliged to include a large number of deep-seated diseases of the eye under the designation "Amaurosis," to which the well-known remark of Walther was unfortunately but too apropos, — "A condition where the patient sees nothing, and the doctor also — nothing." "*Jener Zustand, bei welchem der Kranke nichts sieht, aber der Arzt auch nichts.*" He is relieved from many embarrassing uncertainties in diagnosis, painful to himself, and more

or less detrimental to his patient, — and is no longer in the dark; but, in regard to the interior of the eye, can speak of what he knows and testify of what he sees. As accurate diagnosis is and must be the basis of all successful treatment, the oculist can already point to brilliant therapeutic triumphs over diseases hitherto deemed incurable, which have directly resulted from the knowledge acquired by means of this instrument.

TEST LETTERS.

It has been very desirable to have some generally accepted standard by which the amount of visual power or acuteness of sight, and the range of vision, might be ascertained, and which, being referred to in published accounts of cases, should be universally understood. Professor Edward Jaeger has published a scale, beginning with the smallest type used in printing, and extending to letters of such size as may be easily read by a normal eye at a distance of twenty feet.

More recently Dr. Snellen of Utrecht has published a series of test-types in which the letters are made up of squares. They are arranged without order, F H K O S, &c., so that actual vision is required to read them, and they cannot be guessed at when only part of a line is seen, as may often be done with ordinary words.

A similar series of test-letters has been prepared by Dr. Dyer of Philadelphia.

I have appended to this work a series of letters similar in plan to that of Dr. Snellen. The selection has been carefully made, so as to include only those letters which have throughout nearly a uniform size, without masses of black in some parts, and they are all of the

same style. Those of rounded and square outlines have been placed alternately, to give equality to the interspaces, as far as might be. The larger sizes having been most carefully engraved and printed, copies of the letters, as adapted for each of the distances given, were obtained by accurate photographic reduction with mathematical exactness, and were then cut on wood, impressions from which give a very distinct outline.

Two other series have been added as reading tests, — one of Gothic letters, the other of handsomely cut Roman type. Both of these are almost perfectly accurate in their gradations of size, — and correspond, the first with the same numbers of Snellen's scale, the second with those of Jaeger's test.

Parallel horizontal and vertical lines, for the determination of the presence and direction of astigmatism, are included with the other tests.

The figures placed above each series of letters indicate the distance, in feet, at which this No. should be read by a normal eye. No. XX, for example, should be read at twenty feet; but if this No. can be read only at ten feet distance we say V, which expresses the acuteness of vision, is equal to $\frac{10}{20} = \frac{1}{2}$. If No. VI, which should be read at six, can be read only at two feet, V $= \frac{2}{6} = \frac{1}{3}$.

Should the patient be unable to distinguish the letters at normal distances, we may then proceed to ascertain whether the inability depends on abnormal

focal power, on opacity of the transparent media, or on loss of susceptibility in the nervous structures in which lies the faculty of perception. If the deficiency arise from the first cause alone, it is corrected by the aid of glasses; if from either of the other two conditions, we must look to proper remedial measures for its cure.

LIMITATION OF THE VISUAL FIELD.

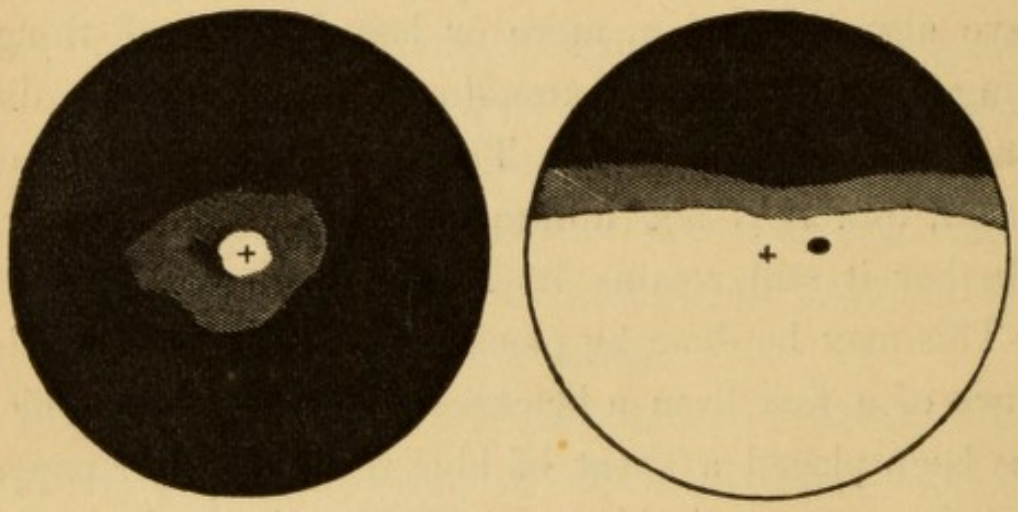
We are all aware that we are not only able to distinguish objects clearly at a given point, but that we have also perception, more or less distinct, of things lying within a circle extending to a considerable distance around that point. This is termed the field of vision, and it is not unfrequently important to learn whether it still retains its normal limits.

This may be done by placing the patient at the distance of a foot from a blackboard or a frame in which has been placed a sheet of blue tissue or other paper. On the centre of this a small cross is marked with chalk or pencil, and the patient is directed to fix his eye upon this point, the other eye being closed. The crayon is now moved over the paper, being carried successively upwards, downwards, and to the right and left horizontally, marking in each direction the extreme limits at which the patient perceives it. The same plan is followed for all the intermediate points, and the outline thus drawn upon the board or paper

shows the limit of the field of visual perception. The other eye may then be tested in the same way.

Visual power may be nearly perfect at a central point, as sometimes in glaucoma, while it has become extinct to within a small space around this point; or it may be preserved over a considerable portion of the field upwards or downwards, while wanting in other parts, as in cases of separation or apoplexy of the retina. These drawings will illustrate the manner in which the extent and seat of morbid changes may be defined.

Fig. 11.



The figure to the right exhibits the effect of separation of the retina. The space occupied by the fluid having utterly lost its perceptive power is represented in the circular field of vision by a black space, next to this is a limited shaded margin where slight perception, perhaps sufficient to distinguish a candle flame, remains, and in the rest of the field vision may be tolerably good, so long as the separation is confined within moderate limits. Similar appearances sometimes follow the effusion of blood, in cases of apoplexy of the retina.

The figure to the left shows a small space in the centre of the field where vision remains distinct, a shaded halo marks the

limit of imperfect perception, and beyond this all is dark. Such are the conditions found in some cases of glaucoma and in the form of choroiditis sometimes termed retinitis pigmentosa.

The sensibility of the retina may be determined in cases of cataract, and sometimes in other diseases, by employing candles instead of the point of a crayon. One candle, at which he is to look, is to be placed before the patient's eye at the distance of a foot, while another is moved before his eye, at the same distance from it, and the limits noted beyond which he no longer perceives the flame. This is of importance where there is reason to suspect that other and more serious disease may exist behind the lenticular opacity.

The question whether or not there be limitation may be rapidly tested, by directing the patient to look steadily at the surgeon's nose while it is ascertained whether he sees the hand moved in different positions before his eye within the usual lateral range of vision.

Should any limitation be thus detected, its precise amount and seat may be determined as above described if it be thought important.

NEW THERAPEUTIC AGENT.

One substance of exceptional properties and uses, Calabar Bean, *Physostigma Venenosum*, deserves special mention. In his work on Diseases of the Eye, published no longer ago than 1861, M. Stellwag von

Carion, of Vienna, one of the most distinguished of the German oculists, says, "We possess no means of effecting contraction of the pupil." Even then, experiments were in progress which were to endow us with this invaluable acquisition.

It is to Drs. Frazer and Robertson of Edinburgh that we are indebted for the introduction of the Calabar Bean into our materia medica; Dr. Frazer having first announced, in his inaugural thesis, its power of contracting the pupil, and Dr. Robertson having experimented upon its practical uses and brought it prominently to the notice of the profession.

Hitherto it had been regarded as an object of curiosity merely, having been sent to Europe by missionaries residing on the Calabar coast, as an article employed by the natives for purposes of ordeal, as a test of the guilt or innocence of accused persons. Eaten in any considerable quantity it has active poisonous properties, and if not ejected by vomiting, causes speedy death. More than sixty children, one at least of whom died, were recently poisoned at Liverpool, from having picked up and eaten some of the beans which had been thrown out with rubbish from the hold of a vessel. The bean is about an inch in length, and covered with a hard, brownish husk or envelope. Its alkaloid or active principle not having been yet extracted in any quantity, if at all, the alcoholic extract, rubbed up and diluted with glycerine or syrup,

--or paper which has been dipped into a solution of the extract, — are the forms in which the remedy is obtainable for medical use.

A very minute quantity of the diluted extract applied to the conjunctiva, causes extreme contraction of the pupil in about fifteen minutes; and this apparently continues as long as the dilatation produced by an equal amount of extract of belladonna, though, as of course we might expect, its influence is counteracted by a small quantity of atropia, which is a so much more concentrated preparation.

Besides its action upon the pupil, it affects the accommodative power and renders a person temporarily myopic, — in all these respects apparently acting as the antagonist of belladonna. On account of the small number of rays which can pass through the diminished pupil, the perception of objects is rendered somewhat indistinct, as if seen at twilight.

Its application to the eye is sometimes followed by slight dull pain in the globe or the supra-orbital region, but this is usually of brief duration.

This welcome remedy is to be of great service in the treatment of mydriasis, — in hernia of the iris occurring near the margin of the cornea, — and in the management of some of the disturbances of the faculty of accommodation. The limited experience allowed by its recent introduction has already proved its great value in cases which seemed amenable to no other treatment.

REFRACTION AND ACCOMMODATION.

Of all the advances which the last few years have witnessed in ophthalmic science, unquestionably the largest in its application is the development of the theories of accommodation and refraction, — which we owe, mainly, to the accurate observation and genius of Professor Donders of Utrecht.

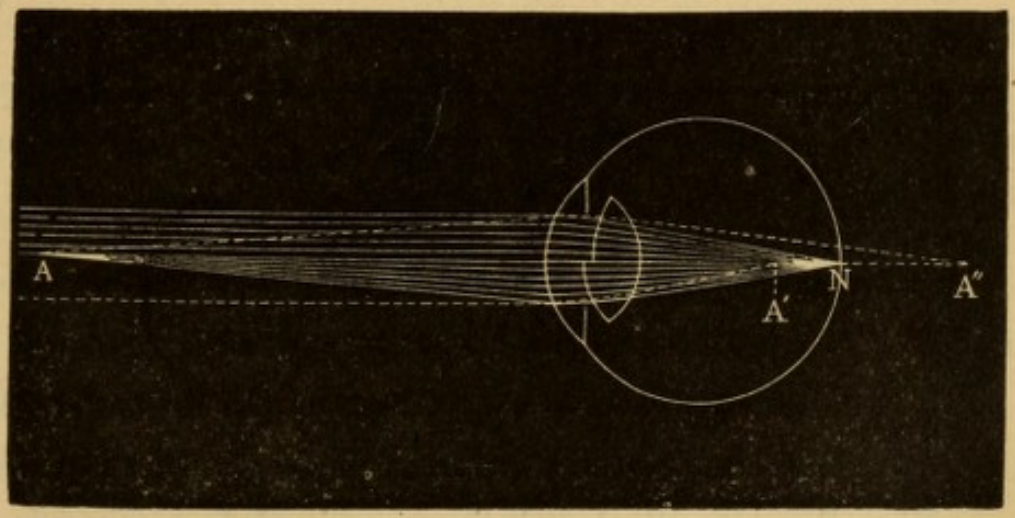
THE FUNCTION OF ACCOMMODATION.

A normal eye, when in a state of rest, is adapted to receive upon its retina well-defined images of distant objects, — the rays emanating from which may be considered as parallel. It is then said to be accommodated for its far point, *punctum remotissimum*, designated by the letter r. In practice, all objects placed at or beyond eighteen or twenty feet are regarded as virtually at an infinite distance, — the rays derived from them diverging so little as to be in effect parallel.

But a normal eye is also capable of an unconscious adaptation, by which it can bring to a focus *diverging* rays, from an object situated very near it. It is then said to be accommodated for its near point, *punctum proximum*, designated by the letter p.

The distance between these two points is termed the range or latitude of accommodation, designated by A. This extends, generally, from three and a half inches, the near point of distinct vision, to an *infinite* distance. Anywhere within these limits, objects can be clearly seen; *beyond* them, images of objects are no longer distinct, but circles of dispersion are formed upon the retina.

Fig. 15. Diagram illustrating the physiology of accommodation in the emmetropic or normal eye.



The upper half of this diagram represents an emmetropic eye in a state of rest, the lower half in a state of full accommodation for the near point A. The only difference in the refractive media is in the crystalline, which in the lower half of the figure is shown thicker and more sharply curved than in the upper half. In the upper half is shown a bundle of parallel rays which undergo successive refractions at the cornea and the two surfaces of the crystalline, so as finally to converge to a focus and thus form an image upon the retina N. In this condition of the eye divergent rays, as from the point A, and indicated by the upper dotted line, are not brought to a focus upon the retina, but tend to converge to a point farther back, as to A″, thus forming

upon the retina N a vague circle of dispersion, instead of the clearly defined image which is essential to perfect vision.

In the lower half of the diagram is shown a pencil of divergent rays, emanating from a near point, A. These divergent rays, having undergone partial refraction in passing through the cornea, are again very strongly refracted by the sharply curved crystalline, so as finally to converge to a focus on the retina at N. Less divergent rays, or parallel rays, as indicated by the lower dotted line, are, under the same conditions, refracted so strongly as to converge to a point in front of the retina, as at A′, a result wholly incompatible with distinct vision. The point A, representing the nearest point of distinct vision, is called the near point, *punctum proximum* (p).

It follows, therefore, that in a state of rest the emmetropic eye can see distant objects only, and the same eye in active accommodation is fitted only for near vision.

After many years of almost fruitless speculation upon the theory and mechanism of accommodation, it is now proved by positive mathematical demonstration that this most important function has its seat in the crystalline lens, and that it is exercised by means of changes in the curvature of its anterior and in a slight degree also of its posterior surface; which changes are effected, in a manner not yet fully explained, by the action of the ciliary muscle.

For a long period the accommodative power was supposed by many to be exercised by elongation of the globe, and consequent increase of its refraction, by means of pressure exercised upon it by the recti muscles. This theory failed, however, to account for the total loss of accommodative power which is always

observed after removal of the crystalline lens in the various operations for cataract; and it has been absolutely disproved by the occurrence of a case of total paralysis of all the motor muscles of the eye, but in which accommodation remained perfect.

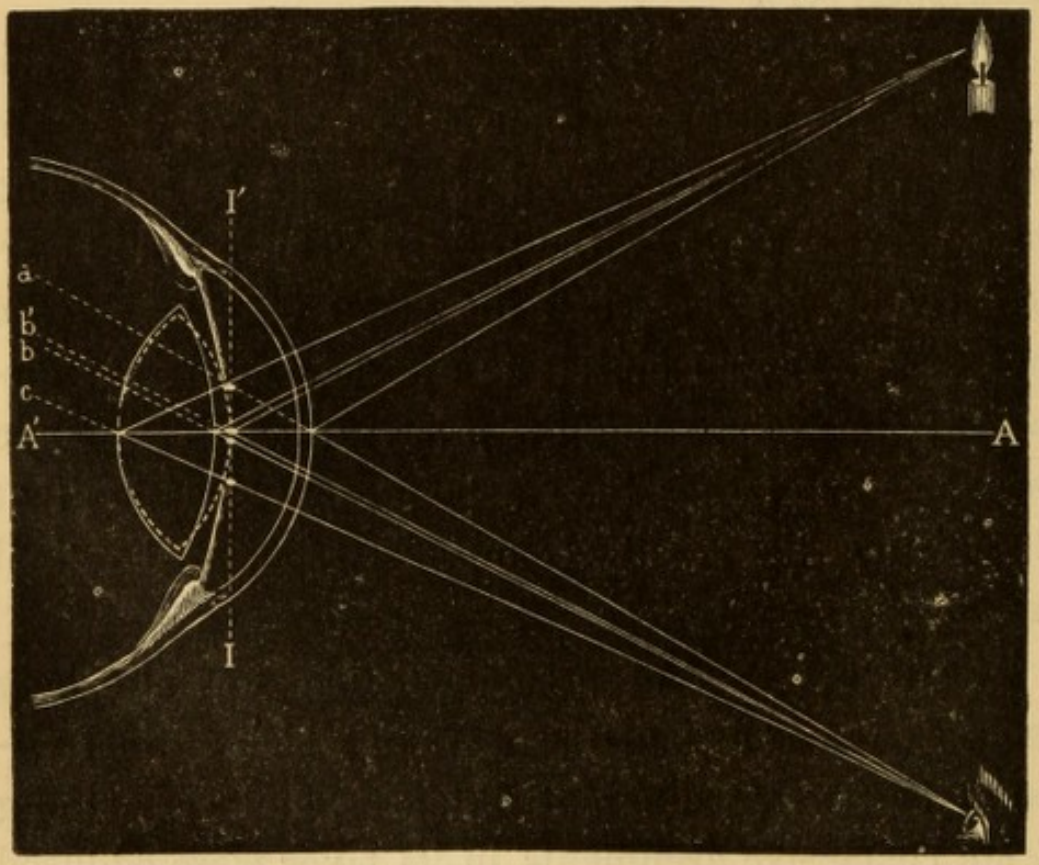
A second, and for a long time widely accepted theory, referred this power of adaptation to a change in the position of the crystalline lens; but upon submitting it to rigorous mathematical analysis it was found that the requisite range of motion of the lens to account for the varying conditions of accommodation would necessarily involve such a change in its position as could hardly escape the critical inspection of practised observers.

A third explanation assumed that there was no such thing as any active accommodative power, but sought to account for the observed phenomena by supposing that different parts of the refractive media, and particularly of the lens, had the effect of bringing the rays from external objects to a focus at different distances; thus considering the principal focus of the eye as a short line rather than a point, and assuming that all vision is the result of imperfectly defined retinal images.

The true theory of accommodation was also long ago accepted as one of the ways in which distinct vision is possible at different distances, and very strong if not conclusive arguments in its favor were adduced at the very beginning of this century by Thomas

Young in a paper in the Philosophical Transactions; but it was reserved for two observers of our own day, Kramer and Helmholtz, working independently of each other and nearly simultaneously, to reduce the problem to an ocular and mathematical demonstration. By the ingenious instruments devised by these eminent observers, the alterations of curvature in the crystalline of an observed eye, as it is accommodated for near or distant objects, are made perfectly obvious to an observer, while it is at the same time evident that no change of curvature of the cornea takes place during the experiments.

Fig. 16. Diagram explaining the change in position of the image formed by the anterior surface of the crystalline (after Donders).



The observed eye is directed to the point A, and a candle and the eye of the observer placed symmetrically on either side of A,

as shown in the figure. Now the only rays from the candle which can reach the eye of the observer are those which are reflected from the central portions of the cornea, and anterior and posterior surfaces of the lens. The rays reflected from the cornea will then reach the observer as if they came from the point a, and those from the posterior capsule as if they came from the direction c. The rays from the anterior surface of the lens, when the eye is at rest, as is shown by the flatter outline of the lens, will reach the observer's eye from the direction b. Images of the flame, either real or virtual, will appear to the observer in the direction from which these rays respectively come, and will naturally be referred in position to the dark plane of the pupil, indicated by the line I I′, upon which they may be represented by the large white dots. If now the observed eye, still looking in the direction A, is strongly accommodated for some near object, the last-mentioned image will be seen to change its position so as to appear to be in the direction b′. This change in position can depend only upon a change in the place of the reflecting surface as indicated by the more convex dotted outline. The refraction of the rays from the two surfaces of the lens is not shown in the figure, as it occurs equally in the case of the incident as of the reflected rays, and therefore does not affect the demonstration.

Figs. 17 and 18. Reflected images of a candle-flame, as seen in the pupil of an eye at rest and in accommodation for near vision.

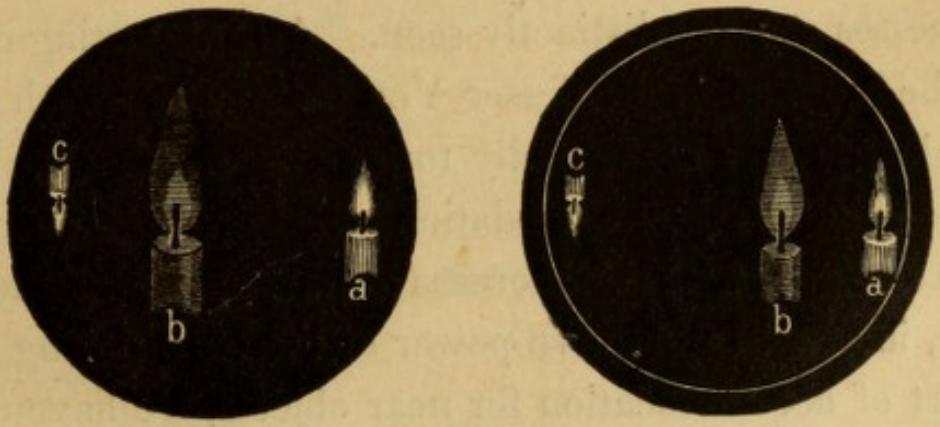


Figure 17 represents the pupil of an eye in a state of rest, showing the three images, a b c, of the flame of a candle, formed

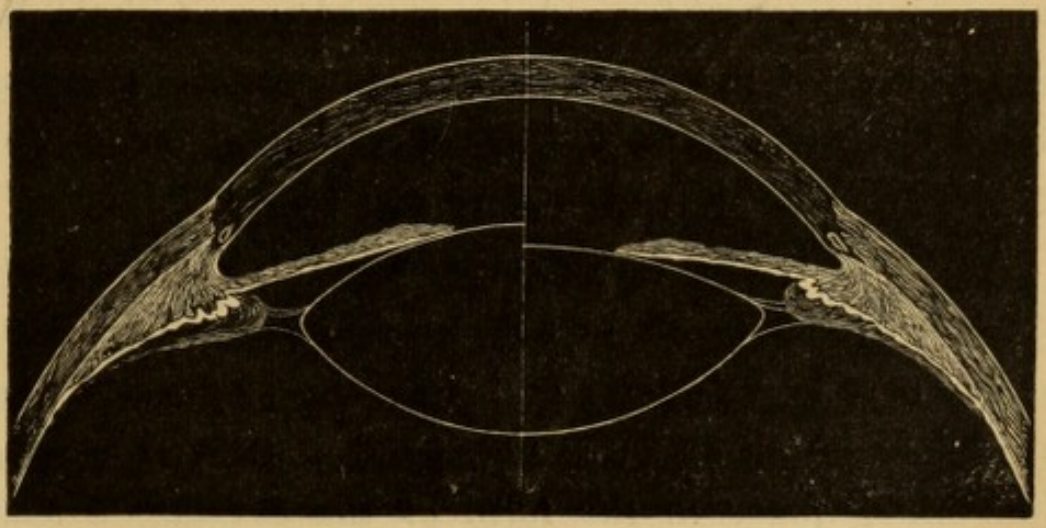
respectively by reflection from the cornea, anterior capsule, and posterior capsule. Figure 18 shows the same eye in a state of accommodation for near vision, — the pupil somewhat contracted, as indicated by the circular white line, and the image b, formed by the anterior capsule, changed both in size and in position. The smaller size of this image is the direct result of the increased curvature of the anterior surface of the crystalline, making it act as a convex mirror of less radius; the change of position depends upon the protrusion forward of the same surface in consequence of the increased thickness of the lens in accommodation. The images a and c, formed respectively by the cornea and the posterior capsule, are not sensibly changed either in size or position; proving that in accommodation there is no appreciable change in the curvature of the cornea or in the curvature or position of the posterior surface of the crystalline.

The mode in which the action of the ciliary muscle is brought to bear upon the lens, whether by drawing forward and relaxing the suspensory ligament, or in some other manner, is yet an undetermined question: that it is not the result of marginal constriction of the lens by the iris, or ciliary processes, is proved by cases of congenital absence of the iris, in which the ciliary processes can be distinctly seen. An interesting case in the practice of Professor Von Graefe, in which the whole iris was accidentally torn away, shows also the same thing, the accommodation remaining unimpaired.

Associated with this increase of thickness, and, therefore, increased refractive power of the lens, during the effort of accommodation for near objects, we have certain auxiliary changes in the iris. The most impor-

tant of these is the contraction of the pupil, by which the lateral rays, which require most refraction, are cut off, thus efficiently contributing to the formation of a clear image. The central part of the iris is also pushed forward and its peripheral portion backward; but these changes seem to be a mechanical result of pressure, and probably only slightly modify perception.

Fig. 19. Diagram showing the relative condition of the eye when at rest and in strong accommodation (after Kramer and Helmholz, the anatomy after Arlt).



The right-hand half of the diagram represents the eye in a state of rest, the left in full accommodation for near vision, the relative curvature of the crystalline on the two sides corresponding quite accurately in scale to the calculations of Kramer and Helmholtz. The pupil is also shown as projected forward and somewhat contracted in accommodation. It will be noticed that the ciliary processes do not, in either case, touch the margin of the lens, an observation due to Von Graefe, and confirmed by other investigators.

Another coincident action occurs during the accom-

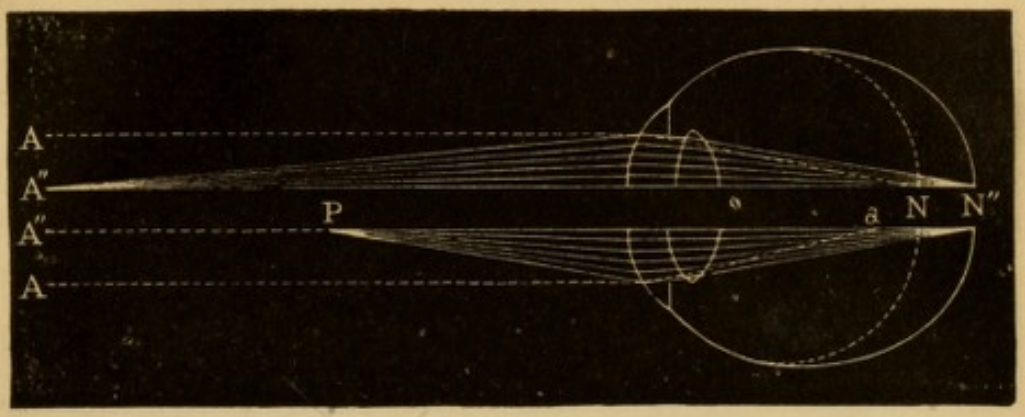
modative effort, — a convergence of the axes of the two eyes by consentaneous contraction of the internal recti muscles. In what manner the ciliary muscle becomes reinforced by this external influence is not fully determined, but the fact is undoubted.

It will thus be seen that the accommodative is quite another thing from the refractive power of the eye. Refraction is a passive condition, depending solely on the focal power of the transparent media; so that the eye may be compared to an optical instrument, in which images are formed in accordance with well-known laws of physics. No change can take place in these images, except by an alteration in either the focal power or the position of the lenses.

Accommodation, on the other hand, is a physiological action, the result of active muscular movements, which may be voluntary or involuntary, by which the conditions of refraction are changed, — such an alteration taking place in the form of the crystalline lens that its focal power is increased. That such is the case is proved by the suspension of the adaptive function when paralysis of the ciliary muscle has occurred from disease, or has been artificially induced by the use of atropia, and by its total annihilation when the crystalline is displaced by accident or removed by operation.

Figure 20 represents the two halves of a myopic eye, the upper half in a state of rest, the lower half in full accommodation for near vision. The refractive media are substantially the

Fig. 20. Diagram illustrating the action of the accommodative faculty in the myopic eye.



same as in the emmetropic eye, but the retina occupies a position farther back than normal, owing to the elongation of the eyeball. The relative position of the retina in the myopic as compared with the emmetropic eye is indicated by the elliptical outline N″, the dotted curve N representing the normal condition. In the upper half of the figure, which shows the eye at rest, parallel rays, indicated by the dotted line A, are brought to a focus at the normal distance of the retina N, but the actual retina N″, lying as it does behind this point, is not in a position to receive the image. The result is, that the myopic eye, even when at perfect rest, cannot see distant objects clearly; the only rays, in fact, which can form a distinct image upon the retina N″ are those which emanate from a comparatively near object, say at A″, and which are sensibly divergent. This point A″ represents, therefore, the extreme distance at which distinct vision is possible, and is called the far point, *punctum remotissimum* (r).

In accommodation, as shown in the lower half of the figure, the increased curvature of the crystalline greatly augments the refractive power of the eye, so as to bring to a focus upon the retina N″ rays emanating from the very near point P, *punctum proximum* (p), which is considerably nearer the eye than in the normal condition.

Fig. 21. Diagram illustrating the action of the accommodative faculty in the hypermetropic eye.

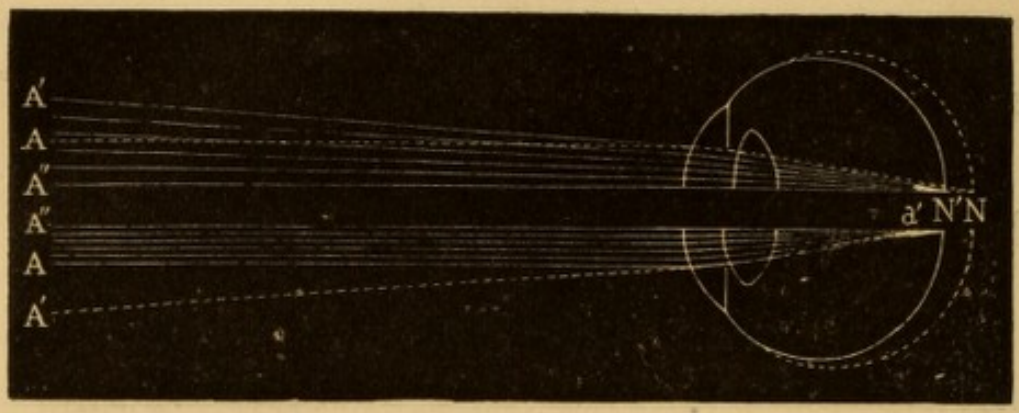


Figure 21 represents the two halves of a hypermetropic eye, the upper half in a state of rest, the lower in full accommodation. The hypermetropic is shorter than the emmetropic eye, as is indicated by the flattened outline N′, the dotted curve N representing the normal position of the retina. In the upper half of the figure, showing the eye at rest, the refractive power of the cornea and crystalline is just sufficient to bring parallel rays A to a focus at the normal distance of the retina N, but is not sufficient to form an image at the actual distance N′. The only rays, therefore, which can converge upon the retina of the hypermetropic eye in a state of rest are convergent rays A″ A′, such as no natural object gives off.

The exercise of the full accommodative power may be just sufficient to admit of the convergence upon the retina N′ of parallel rays A″ A (in the lower half of the diagram), in which case distant vision is possible, but no power remains to be exerted in viewing near objects. Such a person has no effective power of accommodation. If, on the other hand, the hypermetropia is less in degree, there may still remain a surplus of accommodative power sufficient to bring to a focus rays somewhat divergent; in which case there will be a near point of distinct vision, but farther from the eye than the near point of a normal eye. In very high degrees of hypermetropia the accommodative

power may be insufficient to form a clear image even with parallel rays, in which case distinct vision is impossible at any distance except by the aid of glasses.

Fig. 22. Diagram illustrating aphakia (absence of the crystalline) and its effect upon vision in the emmetropic and in the myopic eye.

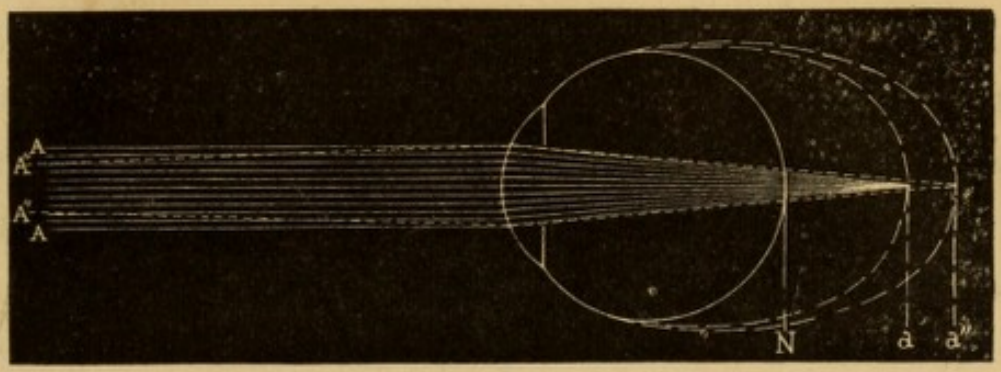


Figure 22 represents an eye in which the crystalline is wanting, either as the result of absorption or of removal by an operation for cataract. The refractive power which remains is too feeble to bring parallel rays A A to a focus at the retina N, but suffices only to give them a convergent direction towards the point a, which is about three eighths of an inch behind the normal position of the retina N. The feeble refractive power of the aphakial, but otherwise normal eye, needs therefore to be strengthened by the use of powerful convex glasses even for distant and still more for near vision; if, however, the aphakial eye happens to be very strongly myopic, as indicated by the elongated outline a, the patient may enjoy perfectly clear vision for distant objects without the aid of glasses. The still more elongated outline a″ shows the extraordinary degree of elongation of the globe which must be assumed to account for a very remarkable case, occurring under the care of the author, in which a patient after extraction of cataract was able to read small type with ease at the distance of twelve inches, and actually needed concave glasses for distinct vision at a distance. The course of the rays in this case is approximally indicated by the divergent dotted lines A″ A″.

RANGE OF ACCOMMODATION.

The range or latitude of accommodative power may be determined by employing small frames across which fine wires are stretched, or plates in which minute holes have been pierced, and measuring within what distances these are clearly defined. Or test types may be more conveniently used, and the nearest and farthest points noted at which they can be read with ease.

Professor Donders has proposed that the range of adaptive power shall be expressed by $\frac{1}{A}$, and its value in any particular case determined by the formula

$$\frac{1}{A} = \frac{1}{P} - \frac{1}{R}.$$

If, therefore, we have a normal eye, able to see distinctly from four inches (4″), its near point (p), to infinite distance (∞) its far point (r), we have

$$\frac{1}{A} = \frac{1}{4} - \frac{1}{\infty} = \frac{1}{4} \cdot \left(\frac{1}{\infty} = 0\right).$$

Should the eye be myopic, having its far point (r) at eight inches (8″), and near point (p) at four inches (4″), we should find

$$\frac{1}{A} = \frac{1}{4} - \frac{1}{8} = \frac{1}{8}.$$

The presbyopic eye, its far point (r) at infinite distance (∞), and its near point (p) at twelve inches (12″), has

$$\frac{1}{A} = \frac{1}{12} - \frac{1}{\infty} = \frac{1}{12}.$$

The figures thus found represent the focus of an ideal lens which placed upon the crystalline would give to rays coming from the near point a direction as if coming from the far point.

Another mode of determining the range of accommodation, proposed by Professor Von Graefe, consists in placing a strong convex glass, say of six inches focus, before the eye, and noting the near and far point at which No. 1 of Jaeger's test types can be read. Held at six inches distance, (the principal focus of the glass,) the rays passing through it would be parallel on emerging, and therefore would strike the eye as if they came from infinite distance.

The rays from the far point (r′) and near point (p) thus found are refracted by the lens as if they came from the real far (r) and near (p) points.

The mode in which the accommodation is found by the aid of the convex lens will be explained by the following diagram.

Fig. 23. Diagram illustrating the use of a convex lens in determining the range of accommodation.

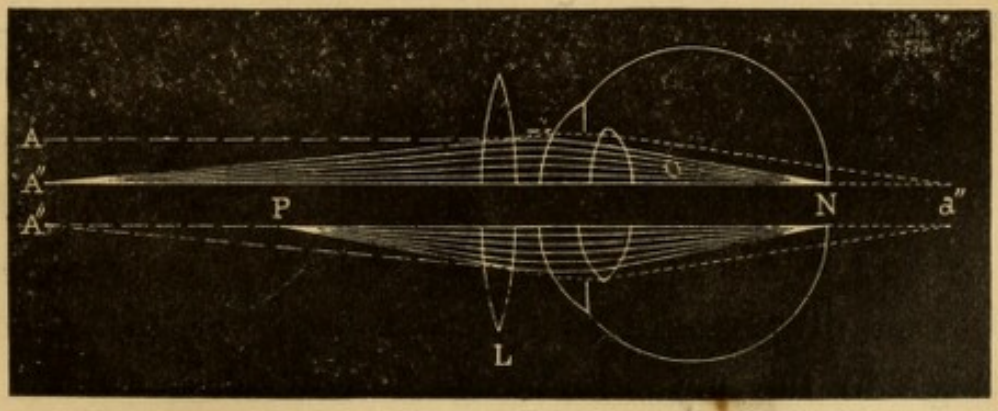


Figure 23 represents the two halves of an emmetropic eye, the

upper half at rest as required for distant vision, the lower half accommodated for the near point A″. By the interposition of a convex lens of about six inches focus, the divergent rays from a certain point A″, being the principal focus of the lens, (in the upper half of the diagram,) are converted into parallel rays so as to enter the eye as if they came from an infinite distance, as indicated by the dotted line A; the divergent rays from the point P (in the lower half of the diagram), being within the principal focus of the lens, are in like manner rendered less divergent, so as to enter the eye as if coming from the near point A″, of the eye, as indicated by the dotted lines. The result is, that the eye thus armed with the lens has its far point (r) changed from an infinite distance to that of the principal focus of the lens (i. e. six inches), while its near point is brought considerably within the principal focus. The whole region of accommodation is thus brought within the narrow limits of a few inches, and may, with a carefully constructed instrument, be very accurately measured. The range of accommodation is readily obtained by the following formula:—

$$\frac{1}{A} = \frac{1}{P'} - \frac{1}{R'},$$

$$\frac{1}{A} = \frac{R' - P'}{R' P'}.$$

P′ being the distance from the near point P to the lens, and R′ the distance of the far point A″.

The limit of the range of accommodation is reached when the object is brought so near that the rays become too divergent to be united on the retina by any change in the crystalline.

Fig. 24. Instrument for measuring the range of accommodation.

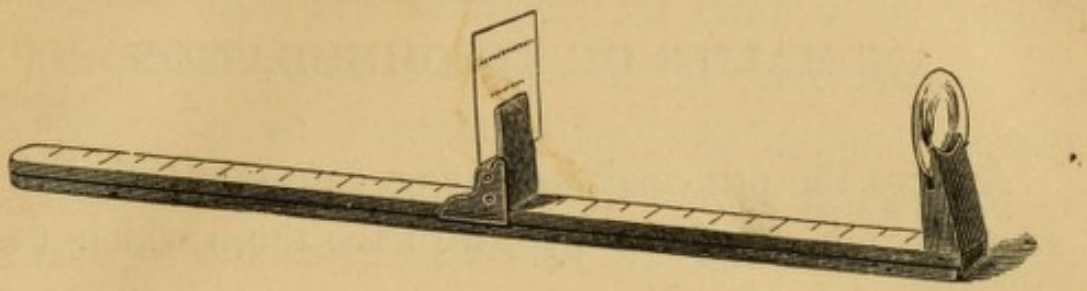


Figure 24 shows an instrument, altered from the ordinary shoemakers' measure, which is very useful for determinations of the range of accommodation by this method. The scale is marked in inches and fractions of an inch, and the stationary and sliding upright pieces are cut off to about an inch in length. The stationary piece is notched for the insertion of a lens of six inches radius, and the sliding one for a card on which are letters No. 1. The instrument being supported against the malar bone, with the lens thus brought in front of the eye, it is easy to measure at once and with accuracy the distances at and within which the patient can read the letters with facility.

If we find that the far point is within the focal distance of the lens we know that the eye has not a normal refraction, but is adapted, not for parallel, but for divergent rays; — therefore myopic.

On the contrary, if the far point is beyond six inches the eye can bring convergent rays to a focus upon the retina, — and is hypermetropic.

These last conditions will be elsewhere considered.

ANOMALIES OF ACCOMMODATION.

Among the principal disturbing causes affecting the adaptive power of the eye, we have three which deserve special attention.

One of these, presbyopia, is the effect of age, and sooner or later makes itself felt in most eyes as a limitation of the accommodation; the others are, insufficiency of the internal recti muscles, and paralysis of the ciliary muscle.

PRESBYOPIA.

Presbyopia, or old sight, was formerly supposed to be the opposite condition from myopia; the former being regarded as a deficient, as the latter is an augmented refractive power. It is now known that this opinion was erroneous, the refractive power for distant objects remaining undiminished in presbyopia; parallel rays being still brought to a focus upon the retina. The actual change consists in the recession of the near point from the eye, and a consequent limitation of the range of accommodation. Hence, although still able to read No. 20 of Jaeger or Snellen at twenty feet, there is difficulty in seeing small objects; as, if close to the eye, the rays are too divergent to be united upon the retina, and if placed at the distance from the

eye to which the near point has receded, the images formed upon the retina are too small to be distinctly perceived. This recession of the near point is occasioned by an increase of hardness in the crystalline lens, so that its form can no longer be readily changed and its convexity increased by action of the ciliary muscle.

The researches of Professor Donders and others have proved that this change in the crystalline begins very early (in emmetropic or normal as well as in ametropic eyes), — even at ten years of age, — and goes on, gradually lessening, with advancing life, the ability to accommodate. At about the age of forty, the near point is at eight inches from the eye, and it is now agreed to consider this distance as the point of commencement of presbyopia. In advanced life the far point may also recede, probably because the denser crystalline loses not only its susceptibility to a change of curvature but also a portion of its refractive power. The eye thus becomes not only presbyopic by limited accommodation, but hypermetropic by lessened refraction. Glasses, of lower power than those used for reading, are then required for distant view.

Presbyopia may be distinguished from amblyopia, or weak sight, by testing the visual power with convex glasses. A merely presbyopic eye ought, if provided with suitable glasses, to see No. 1 of the test types as well as ever, at from eight to twelve inches distance; while an eye in which the acuteness of vision is di-

minished, cannot readily see very small type at any distance, with or without glasses.

As presbyopia is due to alterations of consistence in the crystalline lens, rendering its form less susceptible of modifications by accommodative effort, it follows, that myopic and hypermetropic, as well as normal eyes, are subject to this change. In myopic persons the range of accommodation is thus greatly limited. It is a mistake to suppose, as is often done, that short-sightedness grows less with age, except that the change in the refractive power of the lens incident to old age may in some cases suffice to correct moderate degrees of myopia; as, though a myope is able, and in fact compelled to place small objects further from his eyes than formerly in order to see them well, yet as his far point remains the same, or nearly so, he is by no means the gainer by this shortening of the range of adaptation, — which has removed his near point from three to twelve inches, while his far point continues at, for instance, eighteen inches.

Presbyopia, as we have defined it, cannot, however, occur in extreme myopia, where the far point is already within eight inches. In cases where presbyopia supervenes upon hypermetropia we have even more serious disturbance of vision, for loss of accommodation is added to already deficient refraction.

Practically, we may regard presbyopia as beginning when a person finds himself compelled to place small objects at an increased distance from his eyes, and to

seek a brighter light, which not only illuminates the objects on which it is thrown, but, by inducing contraction of the pupil, admits fewer lateral pencils of light, and thus lessens the circles of dispersion. This change generally takes place at about forty-five years of age, in eyes originally normal.

When these symptoms of loss of adaptive power begin to be felt, the eyes should be aided by convex glasses of sufficient power to compensate for the deficiency; otherwise they are fatigued by futile efforts, and yet more serious disability may result. It is useless to postpone wearing glasses, in the hope that the necessity for resorting to them may be overcome.

In the upper half of Figure 15 we have an illustration of the condition which exists in presbyopia. Parallel rays are brought to a focus upon the retina; but the crystalline, having lost its susceptibility to change of form, can no longer accommodate itself for divergent rays coming from the near point A. The increased refraction necessary to bring these rays to a focus at N (instead of at A″, where they would naturally unite) must therefore be obtained by placing a suitable convex glass before the eye, the effect of which on rays from the near point will be equivalent to that exercised by the crystalline in a state of full accommodation, as shown in the lower half of the figure.

Such a glass should be selected as will bring the near point to a distance dependent upon the particular requirements of the patient, say eight inches or rather more, for reading, sewing, &c.

If, following Professor Donders, we accept 8″ as the

starting-point of presbyopia, its degree may be simply expressed in symbols by the difference between the assumed normal power of the eye when accommodated for near objects (i. e. $\frac{1}{8}$) and the observed power of the presbyopic eye, which we may express by $\frac{1}{n}$. We have, then, the formula

$$Pr = \frac{1}{8} - \frac{1}{n}.$$

Now, if by testing an eye with small type we find its near point at twelve inches, we have $n = 12$ or $\frac{1}{n} = \frac{1}{12}$. The value of Pr then will be

$$Pr = \frac{1}{8} - \frac{1}{12} = \frac{1}{24},$$

which simply means that a convex glass of 24″ focal length will be required to neutralize the presbyopia and enable the patient to see with distinctness a small object placed at the distance of 8″ from his eye.

We must generally, however, give rather weaker glasses than those thus calculated, as the convergence of the optic axes at a shorter distance will otherwise bring the near point within less than eight inches. The weakest glass which gives distinct vision at the desired distance should be selected, especially if the range of accommodation is not extensive.

A myopic person may, as he grows older, become also presbyopic, — and while still needing concave glasses for a distance, to lessen his excessive refraction, may nevertheless require convex glasses for small objects, to obviate his loss of accommodation.

When presbyopia supervenes on hypermetropia, it gives rise to more disturbance than when it occurs in a normal or a myopic eye. In hypermetropia all vision, even for remote objects, requires an effort of adaptation, which must be yet more increased if the eye be directed to near and minute objects. When, therefore, the crystalline begins to yield less and less readily to the accommodative effort, vision becomes more and more difficult at first for near, and afterwards for distant objects. We have here, therefore, to supply two convex glasses, one for distant vision, to compensate for the want of refraction depending on hypermetropia, the other for reading, &c., to supply both the deficient refractive power and the loss of accommodation.

The usual formula for ascertaining the range of accommodation may also be applied in presbyopia.

$$\left(\frac{1}{A} = \frac{1}{P} - \frac{1}{R}\right).$$

If the near point be at twelve inches, the far point at infinite distance, we have

$$\frac{1}{A} = \frac{1}{12} - \frac{1}{\infty} = \frac{1}{12}.$$

Rapidly increasing presbyopia, especially if the patient is in poor health or has been under depressing influences, is to be regarded with suspicion, — as it is not an unfrequent precursor of glaucoma. If therefore a patient has been obliged within a short period

repeatedly to augment the strength of glasses, inquiry should be made if any other symptoms have been observed, such as iridescent colors around the lamp, occasional loss of sight for a short time, or pain in or about the eye, — and we should examine if there be any increase of tension of the globe or evidence of commencing change in the optic disc.

INSUFFICIENCY OF THE INTERNAL RECTI.

It is not uncommon to hear complaints, especially from myopic patients, of inability to use the eyes continuously, though they exhibit no serious changes when viewed with the ophthalmoscope, have good latitude of accommodation, and perfect acuteness of vision. If one eye is screened whilst the other looks directly forward we observe that the covered eye deviates outward, though it instantly assumes a position in harmony with its fellow when the screen is removed. If a small object, a pencil for instance, is brought gradually very near the eyes, they at first converge normally towards it, but suddenly one or both eyes turn outward, as if wearied, — denoting insufficient power in one or both recti interni. We can readily suppose that fatigue must here follow prolonged efforts to keep up the degree of convergence necessary for reading or other work requiring minute attention. The power

of converging the axes of the two eyes upon any near object is intimately connected, although in a manner not yet fully understood, with the function of accommodation, so that any considerable disability of the internal recti is in general associated with more or less disturbance of the accommodative faculty, giving rise frequently to asthenopia or fatigue of sight.

If the patient employ his eyes very much upon small objects, a confirmed divergent squint is produced. To avoid double vision, which necessarily occurs when exhaustion of the internal recti puts an end to the proper convergence of the eyes, the eye most deficient in power turns yet more outward, and gives up all attempt to share in the visual act, — neglecting altogether the image formed on a part of its retina which does not correspond with the place of formation of the image in the stronger eye.

Insufficiency of these muscles may be sometimes relieved by persevering and careful exercise with prisms, to overcome which, and avoid the formation of double images, the muscles are forced to increased exertion. But in most cases division of the external rectus affords the most speedy and effectual means of cure, — though it is generally necessary, and almost always where the myopia is considerable, to advise also the use of concave glasses in order to obtain the full benefit which should result.

PARALYSIS OF THE CILIARY MUSCLE.

Loss of power in the ciliary muscle is not an infrequent consequence of diphtheria, and may also follow other exhausting diseases, — or it may occur in syphilitic or chlorotic conditions of the system, — or as a result of cerebral disorder.

The ciliary branch of the third pair may be alone paralyzed, or the branches supplying the iris and those distributed to the external muscles of the globe may be simultaneously affected. In the former case the contractility of the pupil and the various movements of the eyeball remain unimpaired; the higher degrees of the affection are marked by mydriasis and divergent strabismus.

The effect of ciliary paralysis upon vision varies greatly, according to the refractive condition of the eye. Consisting, as it does, in a loss of accommodative power, it will be most felt by those patients who depend most upon that power in the ordinary use of the eyes. It follows, therefore, that a strongly hypermetropic person who exercises his accommodative faculty in every act of vision, even of the most distant objects, will altogether lose the power of seeing any object with distinctness; an emmetropic eye, on the other hand, loses only the power of seeing near objects clearly, but remains unimpaired for distant vision;

while a myopic eye, which without the exercise of accommodation sees distinctly at the distance of a few feet, becomes aware of the loss only when looking at very near objects.

An artificial paralysis may be temporarily produced by the use of solutions of atropia of four grains to an ounce of water. A weaker solution suffices to dilate the pupil, but does not wholly suspend the action of the ciliary muscle.

General tonic treatment is in these cases of the first importance.

At the same time, repose from accommodative efforts is to be obtained by giving the patient such convex glasses as will allow him to see distinctly without exertion.

As the system regains its normal condition and the power of the ciliary muscles is gradually restored, the strength of the glasses may be diminished, and they may be used less and less, and finally altogether dispensed with.

The extract of Calabar bean, applied to the eye, has been of great use in some cases of this affection, and gives promise of rendering excellent service as a means of treatment.

SPASM OF THE CILIARY MUSCLE.

In this rare affection the crystalline appears to be continually acted upon, and a state of excessive but varying convexity of its surface is kept up, so as greatly to interfere with, or even wholly to prevent, the voluntary exercise of the accommodative function. Distant objects are therefore seen very indistinctly; and although those near the eye are seen clearly for a short time, the effort of close attention soon fatigues.

This morbid condition is oftenest met with in persons who use the eyes continuously for fine work. It sometimes comes on suddenly. Temporary spasmodic action is occasionally induced where the extract of Calabar bean has been employed as a local remedy.

In combination with such treatment as may be indicated for lessening nervous sensibility and improving the general health, we should enjoin rest from fatiguing employment of the eyes; — and even, if necessary, place the accommodative power in repose by paralyzing the ciliary muscle by means of a solution of atropia. The use of convex glasses may often be advised for a time, in order to insure complete rest from accommodative efforts.

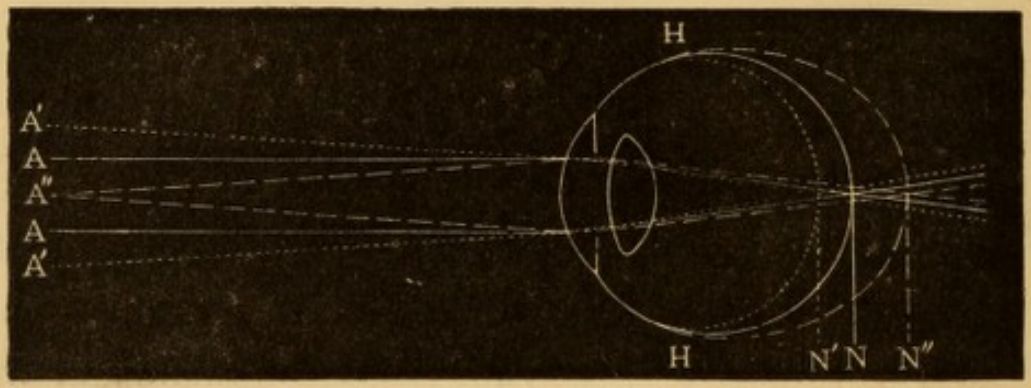
ANOMALIES OF REFRACTION.

An emmetropic or optically normal eye has, in a state of rest, a refractive power capable of concentrating parallel rays to form a distinct image upon the retina, — and furthermore, possesses the faculty of increasing this refraction, by the exercise of accommodation, to a degree which admits of the formation of a well-defined image from even strongly divergent rays.

But there are eyes which have not normal powers in a state of rest, and in which no change in the curvature of the crystalline lens which is within the capacity of the ciliary muscle to effect is sufficient for perfect accommodation. Such abnormal eyes owe their defect to one of three conditions, generally inherent in the construction of the globe; — the optic axis is either too long, giving excessive refractive power, and constituting myopia; or it is too short, causing insufficient refraction, or hypermetropia; or the surfaces of the cornea or lens may present an unequal curvature in different meridians, creating irregular refraction, or astigmatism.

Figure 25 represents sections of three different eyes, the outer or elongated elliptical outline being that of a myopic eye, the middle or circular outline being that of the emmetropic or normal eye, and the inner or flattened elliptical outline being that of a hypermetropic eye. They are all represented as in a state of

Fig. 25. Diagram showing the relative form of the myopic, emmetropic, and hypermetropic eye.



rest, that is, without the exercise of any accommodative power. The myopic eye, from its long antero-posterior diameter, is capable of converging upon its retina at N″, divergent rays emanating from a point A″, which is its far point for distinct vision; the emmetropic eye, under the same conditions, can only bring to a focus upon its retina at N parallel rays A A, or those which emanate from very distant objects; while the hypermetropic eye, with its antero-posterior axis abnormally short, has such a deficiency of refractive power that it can only bring to a focus upon its retina at N′ rays already convergent as A′ A′. Each of these three kinds of rays is shown by a particular style of engraved line; and it will be observed that while each set comes to a focus, and so forms an image at the retina of the eye for which it is adapted, the others are received either before or after reaching their respective points of convergence, and so form either mere circles of diffused light, or at best but very vague and confused pictures of external objects.

This figure also explains the reason for the diminished acuteness of vision often existing in myopic eyes. Inasmuch as the retina, which in a normal eye would occupy the space shown by the line H N H, has become distended over the larger surface H N″ H, its nervous elements, being thus diffused, are capable of receiving a less vivid impression of an image formed upon any given superficies.

MYOPIA.

Various causes were formerly assigned for short sight, — too great convexity of the cornea or of the crystalline, a misplacement of the latter, etc. Recent observations have proved that it depends, not upon these supposed causes, but upon an elongation of the antero-posterior diameter of the eyeball, involving a faulty position of the retina with reference to the cornea and crystalline. The result of this abnormal conformation is, that the retina lies behind the principal focus of the eye, so that parallel rays coming from distant objects are received upon that membrane in the form, not of a distinct image, but of more or less vague circles of dispersion. Divergent rays, on the other hand, coming from near objects, may converge to a focus upon the misplaced retina, and thus afford distinct vision without any exercise of the accommodative faculty. Vision is therefore perfect for near objects, but more or less defective for distant ones. See Fig. 25.

Measurements by Professor Donders and others have shown a length of from one and one fifth to one and two fifths inches in some myopic eyes; whilst others, in which hypermetropia, the opposite refractive condition, existed, had an antero-posterior diameter of less than four fifths of an inch. See Fig. 25. But

we do not require an autopsy to satisfy ourselves of the fact of this elongation. The unusual length of the globe may be seen, at the outer canthus, by separating the lids and directing the patient to look as far as possible towards the opposite side. The eyeball is then observed to fill, more than commonly, the space at the outer angle, and to have evidently an oval, acorn shape, instead of a nearly spherical form.

Myopia results then, in most cases, from anatomical conformation; it is often hereditary; and, except in the slighter cases, is capable of being scarcely if at all modified for the better by age or by treatment. On the contrary, there is a strongly progressive tendency in cases where this affection exists in a high degree, — and even where it is slight in amount there is generally a period of temporary increase. This tendency may be greatly enhanced by improper management, or on the other hand may be in a measure counteracted by using suitable precautions.

There can be no doubt that myopia exists from birth in numerous instances, though its presence is unsuspected until the child is old enough to observe and to study. On reaching the age of about fifteen, — that is to say, soon after the time when, having learned how to study, he applies himself more closely to his books, or when perhaps he begins an apprenticeship to some trade requiring close attention to minute objects, — the myopia, hitherto only moderate in degree, becomes much increased. This change results

from pressure of the recti muscles upon the globe during the act of convergence; which tends to cause yet more extension of its long diameter. Where the elongation of the globe is inconsiderable, the myopia, after reaching a certain point, continues stationary. Where, on the contrary, the tunics of the globe are already abnormally thinned, and have assumed an egg-shape, the action of the muscles, together with the congestion of the ocular vessels occasioned by leaning the head forward in reading or working, tends to increase the malformation of the globe, and favors the production of posterior staphyloma, or enlarges it if pre-existent. Such a yielding of the posterior part of the globe increases yet more the myopia, requiring additional efforts to overcome the altered conditions of refraction; — the staphyloma and myopia thus act and react upon each other to mutual disadvantage. It is rare that staphyloma is absent in high degrees of myopia, and it is not unfrequent where this is but moderate in amount.

It is the demonstration of these facts, proving that myopia is often to be looked upon as a disease and not merely an infirmity, which has given so much interest and importance to modern researches upon the subject.

In myopic eyes we have, then, two special abnormal conditions, — elongation of the globe, which places the optical centre farther from the retina; and distension of the tunics, which dilutes, as we may say,

the perceptive power, by extending the nervous elements of the retina over a larger space than that naturally occupied. See Figs. 25 and 26.

This expansion of the nervous elements over a larger space than normal (see Figs. 25 and 26) will explain the fact, that even with the best adapted concave glasses the vision of many myopes is still very imperfect for distant objects; for it must be remembered that concave glasses, while they increase the distinctness of the retinal image by bringing parallel rays to a focus at the proper place, may nevertheless so far diminish its size, by displacing the optical centre of the eye, as in part or wholly to neutralize the advantage gained by clearer definition. Myopic persons have, in fact, very often a certain degree of amblyopia.

Near sight is most common among the better educated classes of society; and, in the laboring class, is more frequent among the artisans of cities than the agricultural population. The reason is obvious; an hereditary predisposition may exist in an equal number of both classes; but it is far more likely to be developed in those whose attention is mostly directed to minute objects observed at short distances from the eyes, and with the head bent forward so as to favor congestion of those organs, than in those who scarcely use the eyes for other than large and distant objects. In the latter class the influence of hereditary predisposition may remain inoperative.

A moderate amount of stationary myopia is scarcely a defect, and involves no future dangers; but where the affection is considerable and progressive it constitutes a positive disease, the course of which should be watched and its advance prevented, lest, if unchecked, it terminate in separation of the retina, disorganization of the choroid and vitreous, and deteriorated or ruined vision. The frequency of posterior staphyloma should lead us to assure ourselves, by means of the ophthalmoscope, as to its presence or absence, and whether, if present, it be complicated with inflammatory symptoms. Should such be discovered, it will be important to avoid all employment which might induce congestion of the eyes and thus increase the staphyloma, and, if necessary, we should advise antiphlogistic or other treatment. Blue glasses are often highly serviceable under these circumstances, as by neutralizing those rays of the spectrum which are the most irritating, they favor the subsidence of ocular congestion.

It is evidently useless for persons affected with myopia to deprive themselves of the very great aid to be derived from the proper use of glasses, in the hope that with advancing years their vision may become normal.

Something, it is true, may be gained by long-continued training, and a slight change results as age advances, from a diminution in the refractive power of the crystalline (hypermetropia acquisita). But, ex-

cept in very slight cases, the gain thus eventually obtained is insignificant, and in the mean time the sacrifice in enjoying no really distinct perception of distant objects is very great.

Fig. 26. Myopia corrected by the use of a concave lens.

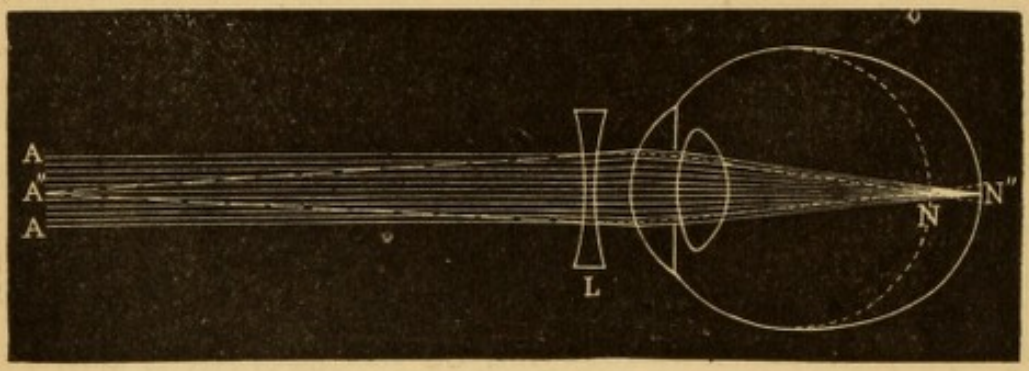


Figure 26 represents a myopic eye at rest, in which condition the divergent rays from its far point A″ are refracted to a focus upon its retina N″. Parallel rays A A being, under the same conditions, refracted to a focus at the normal position of the retina N. By the interposition of the concave lens L the parallel rays A A are rendered divergent so as to enter the eye in the same direction as if emanating directly from A″, and are thus made to converge to a focus upon the actual retina N″.

The degree of myopia in any particular case is measured by the far point (r) for distinct vision, and is expressed by the letter M. It may be very easily and exactly determined by means of Jaeger's, or still better Snellen's test letters, or those appended to this volume. A person with good vision will distinguish the different sizes of letters at the appropriate distances with about equal facility. A myope, on the other hand, will distinguish the smaller letters held near the

eye while he will fail to read the larger letters at a greater distance. If now a myope reads Nos. 1, 2, 3, and 5, at the distances respectively of 1, 2, 3, and 5 feet, but fails to distinguish Nos. 8, 10, 12, and 20, at 8, 10, 12, and 20 feet, we decide that his myopia is of very low degree, and represent it by a fraction having for its numerator unity, and for its denominator the number of inches at which the corresponding size of type is clearly read, that is, No. 5 being read at the distance of 5 feet, or 60″, we have

$$M = \frac{1}{60},$$

which means that the excessive refractive power of the eye is equal to a convex lens of sixty inches focal length, and that to neutralize it will require a concave lens of the same negative focus.

If now, to take another example, we find that the patient sees No. 2 clearly at two feet or 24 inches, but cannot distinguish No. 3 at three feet, or the larger sizes at corresponding distances, we say that in his case

$$M = \frac{1}{24},$$

and will require a negative or concave glass of 24 inches focus.

This test, although a convenient one, is subject to many sources of error, and the results obtained by it should therefore be taken as approximations only to the real degree of M. It serves, however, to suggest

to us a suitable glass with which to try the patient, and we can then easily correct it in the following manner: —

Suppose that in the second case which we have just instanced, we try the patient with a pair of 24-inch concave glasses, and direct him to look at a distant object, say No. 20 of the test types, at 20 feet distance, — he will probably at once perceive a very great improvement; if now we place in front of his glasses a second very weak pair, say No. 60 concave, and if with this addition vision is further improved, the glass we are testing is too weak; if with it vision is not more distinct, but on the contrary is made better with *convex* 60, the glass is too strong. If not improved by adding either a weak concave or convex glass, the one first selected is the best the patient can have.

Should the addition of the second pair of weak glasses result in greater distinctness of vision for distant objects, the correction may be applied by the following formula: —

$$\frac{1}{x} = \frac{1}{a} \pm \frac{1}{b},$$

$$\frac{1}{x} = \frac{b \pm a}{a\,b},$$

that is, the focal distance of the corrected glass (x) is equal to the sum or the difference of the focal lengths of the two glasses divided by their product.

Should a myope desire glasses for reading as well as for viewing distant objects, he may often, with advan-

tage, use a pair of less power than those he requires for far sight. Should his far point be at 6 inches, and he wishes to read at 12″, the requisite glass would be indicated by the formula, $-\frac{1}{6} + \frac{1}{12} = -\frac{1}{12}$. If he has good power of accommodation, and his eyes do not exhibit posterior staphyloma, he may be even allowed to wear glasses for reading which are sufficiently strong to completely neutralize his myopia. But should he have limited power of adaptation, and at the same time amblyopia arising from distention of the fundus of the globe, it will scarcely be prudent to permit the use of any glasses for near vision.

It is important to ascertain the amount of accommodation in myopic eyes, to aid us in deciding whether or not glasses should be allowed for near objects. Professor Donders determines this by first giving such glasses as render distant objects most distinct. The patient is then directed to read No. 1 of the test types, and the distance of the near and the far point, which gives the latitude of accommodation, is noted. The accommodation may also be measured without concave glasses, by observing the distance at which No. 1 can be read. If, for instance, the far point (r) is at 6, and the near point (p) at 3 inches, we have $A = \frac{1}{p} - \frac{1}{r}$; that is,

$$A = \frac{1}{3} - \frac{1}{6} = \frac{1}{6}.$$

But the convergence of the optic axes at short distances renders this method less positive in its results than that previously given.

Glasses worn for distant vision should be of the least power which will afford sufficient distinctness; as the eyes are directed only a small part of the time to far distances, but more frequently to objects which are comparatively near. Should the glasses have too high power, they will be too strong for looking at these nearer objects, and will require efforts of accommodation, — from which the eye should be spared as much as possible.

Glasses of the same focal power should generally be used for both eyes, even where they have different degrees of myopia; as less confusion is practically found to result than where we attempt to adapt a glass to each eye. The glass chosen should in most cases be that which suits the least myopic eye.

When intended for distant vision the centre of the glass should be in front of the centre of the cornea. Otherwise the eye looks through the edge of the lens, and the effect is more or less that of a prism. But if designed for reading, the lenses may be a little less separated from each other, and thus adapted for the convergent position of the optic axes.

We owe to Professor Donders the demonstration of an interesting fact in relation to myopia, — that it is the most frequent cause of divergent strabismus. The phenomena arising from this affiliation will be explained when speaking of the last-named affection.

HYPERMETROPIA.

It is only within a few years that this affection, the opposite of myopia, can be said to have been fully recognized in its true character. Many cases occurred, it is true, troublesome to physician and patient, in which no obvious symptoms existed, and where vision was perfectly good; but where the eyes were incapable of continued use, especially upon small objects, without experiencing so much fatigue as to compel suspension of their employment.

The researches of Professor Donders have shown, that in a large proportion of these cases the cause of the inability is to be found in hypermetropia, or deficient refractive power.

This condition, like myopia, generally depends on defect of construction of the globe; the antero-posterior diameter being too short, so that parallel rays are brought to a focus at a point behind the retina. See Fig. 25.

As, therefore, only convergent rays can be concentrated to a distinct retinal image when the eye is at rest, and even parallel rays from remote objects require an effort of accommodation, we can understand the pain and fatigue resulting from long-continued use for near objects, from which divergent rays only are received. At first, however, these objects are seen

clearly, for the eye is capable, *pro tempore*, of the requisite accommodative effort; but this strain of the ciliary muscle cannot be long kept up without producing a sensation of lassitude and discomfort, which presently extends from the eye to the brow, is followed perhaps by a loss of clearness of perception, and at length compels a cessation of the occupation which requires such tension. The eyes being left for a while in repose recover their adaptive power, and can be again used for a time, to become again disabled by a recurrence of the symptoms after a longer or shorter period.

Fig. 27. Hypermetropia corrected by the use of a convex lens.

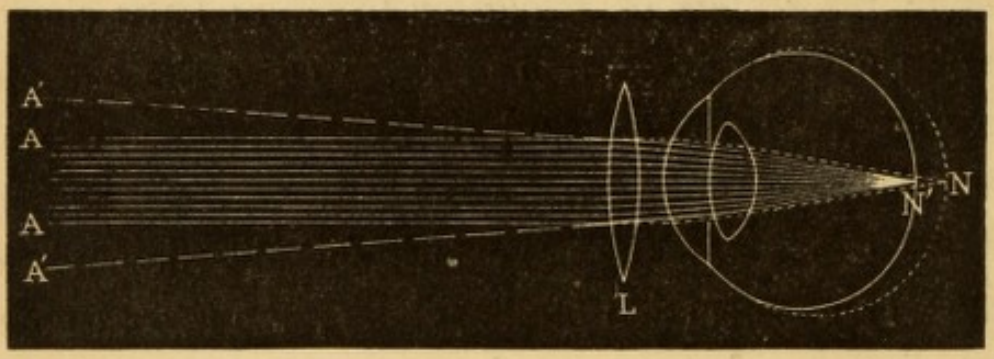


Figure 27 represents a hypermetropic eye at rest, in which condition the convergent rays A′ A′ are refracted to a focus upon its retina N′. Parallel rays A A being, under the same conditions, refracted to a focus at the normal position of the retina N. By the interposition of the convex lens L, the parallel rays A A are rendered convergent, and thus enter the eye in such a condition as permits the formation of a distinct image upon the actual retina N′.

As in myopia, a peculiar form of the eyeball may

be observed on inspection. The patient being told to look strongly inwards, we find at the outer canthus an evident shortness of the globe from before backward. It does not fill the space at the outer angle like a myopic, or even a normal eye, but its posterior surface shows a rapidly retreating curve. Its antero-posterior diameter has perhaps only four fifths of the length of the normal standard. In extreme cases the globe has the shape, as contrasted with a myopic eye, that a turnip has compared with an egg.

At a given distance the image of any object will be smaller in a hypermetropic than in a normal eye; as, from the shortness of the axis, the optic centre will be nearer the retina. The near point of distinct vision will of course be farther from the eye.

Hypermetropia involves no such progression and tendency to deterioration of structure and function as we too often find in myopia, where, as we have seen, there is frequently a disposition to staphyloma of the sclerotica, atrophy of the choroid, and distention or even separation of the retina. It is a permanent condition; modified, however, in advancing age, by supervening presbyopia, — the symptoms arising from the original conformation being thus increased.

It is found that the actual degree of hypermetropia cannot always be estimated by tests with glasses, as the amount of myopia may be; and that it is frequently necessary to add to the *manifest* a certain amount of *latent* hypermetropia, in order to have the

sum of the *absolute* affection. The reason of this can be explained in few words.

A person having a normal eye sees large objects at a distance perfectly well, without making use of any accommodative power, — which he reserves for smaller and nearer objects. But if hypermetropic, he does not see even distant objects clearly, when the eye is passive, but is compelled to bring into use a portion of his accommodation. This he may do unconsciously, and in so doing may mask and render latent a part of his hypermetropia. Thus, though having no apparent hypermetropia, he has less accommodative power in reserve for the perception of minute objects, and soon experiences symptoms of asthenopia or fatigue of the eyes, if he employ them a long time continuously upon such objects. Especially is this true where, as is often the case, a high degree of hypermetropia is associated with a limited range of accommodation, and where the effort necessary for the formation of distinct images would be, perhaps, twice what would be requisite in a normal eye.

To ascertain the amount of absolute hypermetropia, and determine how much has been rendered latent by exertion of the accommodative power, it is necessary to paralyze the ciliary muscle by atropia. A drop or two of a solution of four grains of the sulphate in an ounce of water is applied to the eye, and requires some two hours for its complete effect.

Only one eye at a time should be subjected to its

action, that too much inconvenience may not be felt; as until its effects have subsided it is difficult to see small objects.

If we then place the patient at a distance of twenty feet, we find that to read No. 20 of Snellen's or of our test-types, — which a normal eye can do even after mydriasis and paralysis of accommodation, — he requires the assistance of a convex lens; or if previously needing glasses for viewing distant objects, he now requires a much stronger one than before the suspension of his accommodative power.

The glass which is now required for distinct vision at a distance is the measure of the absolute hypermetropia, which we may express thus,

$$H = \frac{1}{12}, \frac{1}{24}, \text{ etc.}$$

If, without having paralyzed the ciliary muscle, we give a patient such a glass as seems to be sufficient for him, he may find his symptoms only partially relieved. We have, in fact, only taken account of the apparent, and have ignored, what is perhaps even larger in amount, the latent hypermetropia.

On the other hand, if we at once give glasses strong enough to neutralize the absolute hypermetropia, we perhaps only increase the patient's discomfort, for as he cannot immediately lay aside his habit of constantly employing a considerable amount of accommodation, we give him an excess of refractive power, and virtually render him myopic. He may, therefore, be al-

lowed weaker glasses at first, — sometimes of even less power than suited him previous to the use of atropia, — their strength being afterwards increased, as his habit of continuous accommodation is gradually laid aside, till he reaches the power which is equivalent to the amount of his hypermetropia.

Theoretically, it is for the advantage of the hypermetrope to wear his glasses constantly, even for distant sight, — as he thus avoids tasking his accommodative power for such purposes, but keeps it in reserve for near vision. But few persons are willing to do this, inasmuch as vision is very often perfect at a distance without glasses, and in nearly all cases the patient is able, at least during early life, to discern large objects sufficiently well for most purposes. Where, however, there is a high degree of the affection, its subjects usually resign themselves, even from youth, to the use of glasses, and nearly always in advanced age require two pairs, the weaker for distant vision and the stronger for reading.

The latitude of accommodation may be tested by first adapting to the eye such glasses as completely neutralize the hypermetropia, and then measuring the nearest point at which small objects can be distinctly seen.

A high degree of hypermetropia is by no means rare in childhood, and is often hereditary. Its existence or absence should always be determined by an examination if the eyes readily become fatigued by use.

Hypermetropia to a slight extent becomes a normal condition, even in emmetropic eyes, at an advanced age, the far as well as the near point receding from the eye.

As Professor Donders was the first to announce the extreme frequence of hypermetropia, so we owe to him the demonstration that this condition of refraction is the usual cause of convergent, as myopia is of divergent strabismus.

We have seen that the hypermetrope is compelled, even for distant vision, to employ a portion, and often a large portion, of his accommodative power, leaving little to be devoted to the perception of near objects. When, therefore, he has occasion to give his attention for some time to very small and near objects, he endeavors to reinforce his adaptive power by increased convergence of the optic axes. This forced exercise of the internal recti creates after a time a constant excessive action of these muscles; and the squint, at first only occasional, becomes at last a permanent obliquity. It is thus that strabismus oftenest becomes developed at an age when the child first begins to look at things with intentness.

Early performance of an operation for removing the infirmity is extremely important. Otherwise the squinting eye, if one be more affected than its fellow, is thrown out of use, and the impressions made upon its retina, not harmonizing with those in the other eye, soon come to be disregarded; the perceptive power

becomes then speedily impaired by disuse, and it can never be restored if the operation be too long delayed.

The use of glasses after the operation ought, in many cases, to be advised, that relapses may not occur from the persistent influence of the hypermetropia, the original cause of the deviation.

ASTHENOPIA.

It has been already remarked that asthenopia, or fatigue of the eye after having been intently used for a long time, often depends upon hypermetropia, which calls for excessive exercise of the accommodative power. It may be relieved, in these cases, by rest and the use of such convex glasses as obviate the necessity for much accommodative effort. It is this accommodative asthenopia which, by inciting for its partial relief an inordinate action of the internal recti, gives rise to convergent strabismus in hypermetropia.

A similar fatigue (*asthenopia muscularis*) may also arise from insufficient power of the internal recti muscles, in *myopic* patients, causing them to become readily exhausted by efforts at convergence, and favoring the development of divergent strabismus, so commonly associated with myopia. This form of asthenopia may sometimes be relieved by the use of concave glasses for near as well as for distant vision.

Even in a normal eye, too prolonged attention to minute objects may induce similar evidences of fatigue, constituting yet another variety of asthenopia, and rest and tonics are often of great service in relieving the symptoms and restoring the ability to bear continuous effort.

ASTIGMATISM.

We owe to English scientific men, Dr. Young, Airy the astronomer, and others, the first descriptions of astigmatism, as observed in their own persons; but these were till lately regarded only as curious and exceptional instances. Professor Donders has recently greatly extended our knowledge of this anomaly of refraction, and pointed out the comparative frequency of its occurrence.

Astigmatism results from a want of symmetry in the curvature of the cornea, in consequence of which its refractive power is unequal in different meridians. The images formed by such rays as converge to a focus upon the retina are therefore confused and rendered more or less indistinct, in one or the other direction, by the simultaneous formation of a vague circle, or rather oval, of dispersion. A similar irregularity of curvature may exist in the crystalline, giving rise to similar visual disturbance; but this is of comparatively rare occurrence.

In nearly all eyes there is a slight variation in the refraction of rays in different planes, — the general rule being, that rays entering the eye in a vertical are sooner brought to a focus than those in a horizontal plane. The near point is therefore somewhat nearer for horizontal than for vertical lines. This slight degree of astigmatism, which may be termed normal, is not sufficient perceptibly to disturb vision.

An irregular refraction sometimes results from lesions of the surface of the cornea produced by ulceration, which may cause confused or double vision in the affected eye. But these deviations are not to be remedied by the means which relieve astigmatism, and do not require consideration here.

In astigmatic eyes vision is disturbed in such a manner that the patient finds it difficult to describe his symptoms ; but on testing his sight, it is evident that it has not the normal acuteness, and that it is improved in a slight degree only by ordinary convex or concave lenses. On desiring him to look at test lines, of equal length and breadth, placed parallel to each other, — some of them in a vertical, some in a horizontal position, — we find that he sees one set of the lines more clearly than the other. A square appears elongated to a parallelogram, and at the same time less sharply defined in the direction of its length. A small round hole in a screen, behind which is a bright light, seems oval or even linear. If large Roman letters are looked at, at twenty feet distance, some of the lines will be

clearly seen, while those at right angles with the first will appear blurred or of double contours. On looking through a stenopæic disc, (a metal plate perforated with a narrow slit,) held in a proper direction, the confusion disappears.

This forms, perhaps, the readiest method of determining the direction of astigmatism. Its degree is ascertained by placing convex or concave glasses before the slit, until we find with what number vision is clearest.

The glasses adapted to neutralize this abnormal refraction are cylindrical in curvature, instead of being ground to a uniform convexity or concavity. Such a glass causes no deviation of rays in the plane of its axis, and this should therefore be placed to correspond with the meridian in which refraction is normal. Rays passing through other planes of the lens will be refracted, — those most of all which pass through the meridian at a right angle to the axis, — which is precisely the line of greatest astigmatism.

The glasses must be convex cylindrical or concave cylindrical, according as the astigmatism is hypermetropic or myopic. If we have no normal meridian, bi-cylindrical or sphero-cylindrical glasses must be employed, the curvature of the two meridians being adapted for those needing rectification in the eye in question. Bi-cylindrical glasses are appropriate to cases of mixed astigmatism, where one meridian is myopic, the other hypermetropic; sphero-cylindrical

are suited to compound astigmatism, where both meridians have myopic or hypermetropic deviation, but in different degrees. One surface of the glasses is therefore ground with a spherical curve to correct the simple hypermetropia or myopia, and the opposite surface with a cylindrical curve to correct the astigmatism.

Great care is required in setting cylindrical glasses; as even a slight want of correspondence between the meridian of deviation and the proper relative position of the glass almost annuls its effect. The glass is to be turned before the eye till the vision becomes clearest, and at this point should be marked by the optician so that it may be set in the frames in precisely the same position. The frames should be well fitted to the wearer, as even a very slight obliquity or tilting of the glasses lessens their beneficial effect. For this reason spectacles are usually to be preferred to eye-glasses, as they keep more steadily their proper position.

The cylindrical glasses are required for all purposes; both near and distant objects seeming blurred and distorted without their aid.

The pleasure experienced by those who thus, for the first time in their lives, see with perfect distinctness, is very great.

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THE END

No. 1.

The voyager who sails from the dark waters of the restless Atlantic into the deep blue Mediterranean, notices at sunset a rich purple haze, which rises apparently from the surface of that fair inland sea, and drapes the hills and vales along the beautiful shore with a glory that fills the heart of the beholder with unutterable gladness. The distant snow-covered peaks of old Granada, clad in the same bright robe, seem by their regal presence to impose silence on those whom their majestic beauty has blessed with a momentary poetic inspiration which defies all power of tongue or pen. It touches nothing which it does not adorn, and the commonest objects are transmuted by its magic into fairy shapes which abide ever after in the memory. Under its softening influence, the dingy sail of a fisherman's boat becomes almost as beauti-

No. 2.

ful an object to the sight as the ruins of the temple which crowns the height of Cape Colonna. But when he approaches nearer to that which had seemed so charming in its twilight robes, his poetic sense is somewhat interfered with, and the shore, though it may still be very beautiful, lacks the supernal glory imparted to it by distance. It is very much after this fashion with manhood, when we compare its reality with our childish expectations. We find that we have been deceived by a mere atmospheric phenomenon. But the destruction of the charm which age had for our eyes as children, is compensated for by the creation of a new glory which lights up our young days, as we look back upon them with the regret of manhood, and realize that their joys

No. 3.

can never be lived over again. Few men would be willing to live again their years of manhood, however prosperous and comparatively free from trouble they may have been; but fewer still are those in whose memory the records of boyhood are not written as with a sunbeam. There is no pleasure so satisfactory as that which an old man feels in recalling the happiness of his youthful days. All the woes and anxieties and heart-burnings that disturbed him then have passed away, and left only sunshine in his memory. He who retains the happy spirit of boyhood cannot have outlived all of its

No. 4.

generosity and simplicity. "Once a man, and twice a child," says the old proverb; and if at the last we could only recall something of the sincerity and innocence and unselfishness of our early life, second childhood would indeed be a blessed thing.

Many will grow enthusiastic with the recollection of their schoolboy days,—their snowballings, their manly sports, their mighty contests with the boys of the town,—and, though they may not claim the genius of the former head-

No. 5.

master of Rugby for the guardian of their youthful sports and studies, will cherish an affectionate remembrance of a wise, judicious, and lovable teacher.

The generosity, and all the priceless charms of boyhood, rarely outlive its careless years of happiness. They are generally severely shaken, if not wholly destroyed, when the youth begins to take his

No. 6.

share in the conceit and ambition and selfishness of full-grown humanity. It is sad to think that a human boy, like the morning star, full of life and joy, may be stricken down by death, and all his hilarity stifled in the grave; but it is even more melancholy to think that he may live to grow up, and be hard and worldly and ungenerous. For this latter fate is accompanied by no consola-

No. 1.

SELFSHOTEU

No. 2.

ULHOEDTSFG

No. 3.

FOECHSUTDL

No. 4.

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TCHDFSEULO

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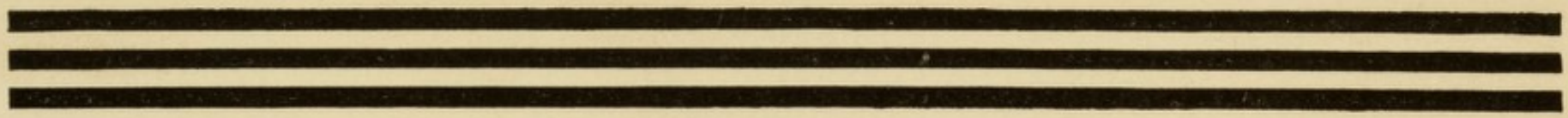

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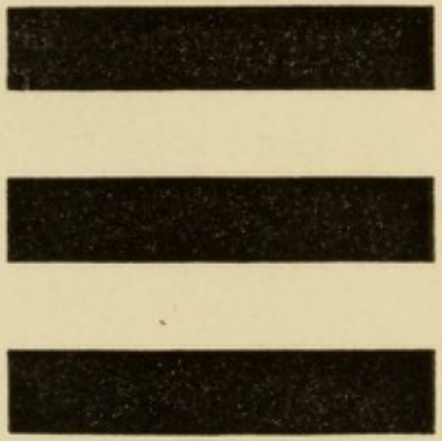

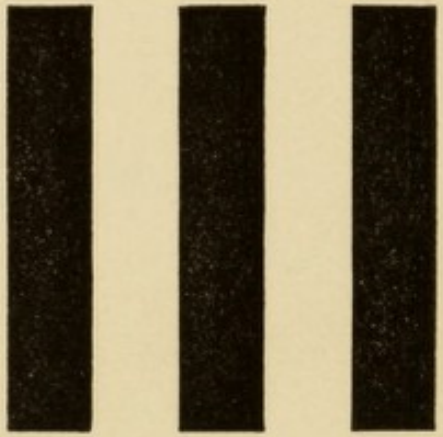

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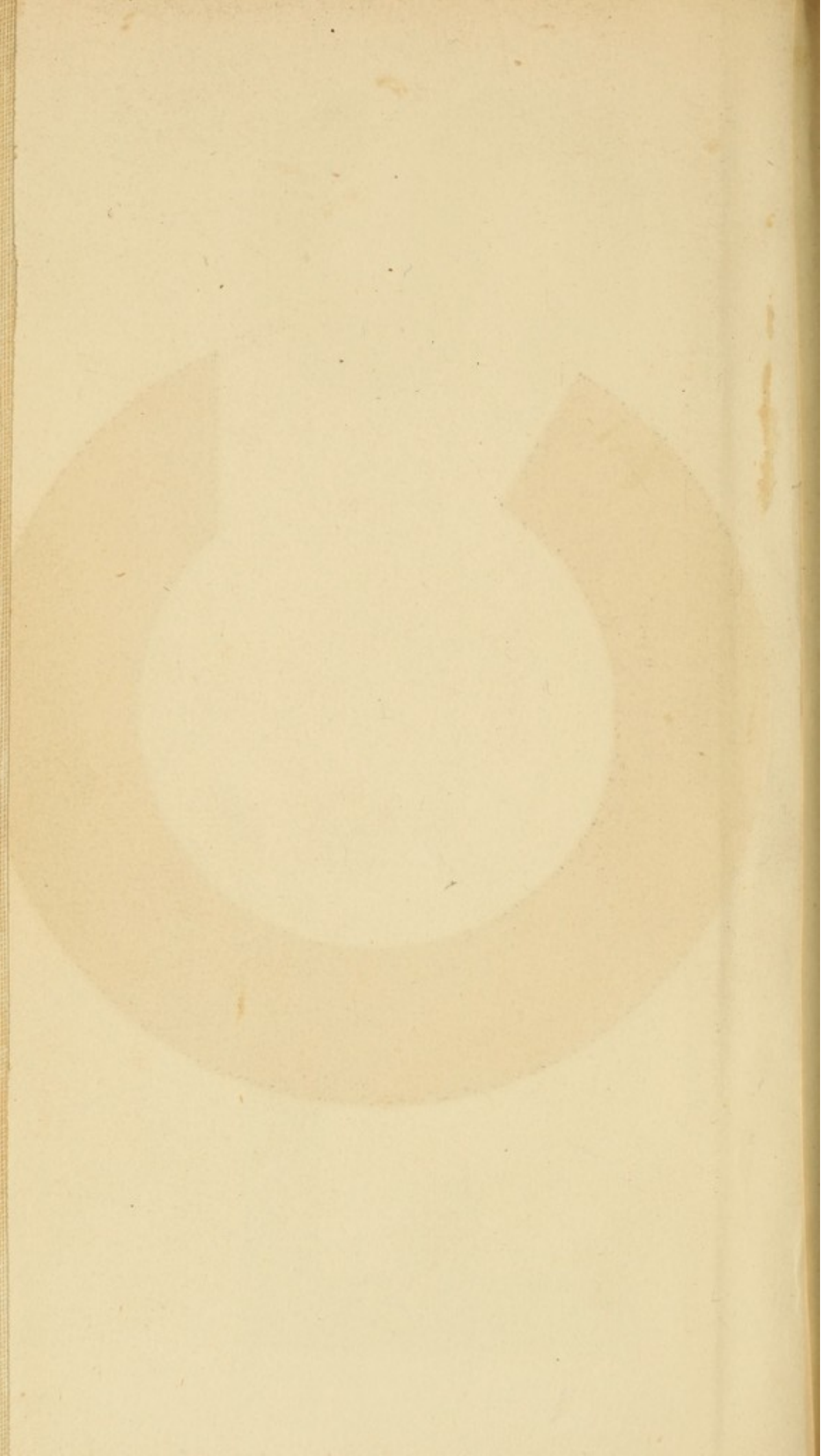

B.P.L. Bindery,
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