EYE INJURIES AND THEIR TREATMENT

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EYE INJURIES

AND THEIR TREATMENT

BY

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TO

JOHN CLELAND,

M.D., D.SC., LL.D., F.R.S.,

REGIUS PROFESSOR OF ANATOMY IN THE UNIVERSITY OF GLASGOW, THIS BOOK IS DEDICATED, IN TESTIMONY OF THE AUTHOR'S GRATITUDE TO AN INSPIRING TEACHER AND A SINCERE FRIEND.

PREFACE

PROMPTNESS and decision of action in emergencies are the best tests of the power and resource of any man, and especially of a medical man. At any hour of the night or day he may be summoned unexpectedly to attend an urgent case. Everyone in practice must remember with what trepidation he used at first to respond to such calls, and how anxiously he wondered what the illness might be and what he would be able to do for the patient. After a time, however, the exigencies of general practice habituate one to such sudden demands, and one learns more and more to possess the soul in patience and to trust to experience for guidance; but even then an experienced practitioner may still feel anxious when he is called in haste to attend to some critical condition in connection with the eye. When he arrives at the house the patient may be in great agony, and both he and his relatives all much excited lest blindness or impaired vision is to be the result of the accident. Unless the medical man keep cool and collected, know well what he is about, and is possessed of a fair measure of common sense, he is prone to become infected by the atmosphere of nervousness around and to err in being too optimistic or too pessimistic. In the former case, knowing nothing of the conditions, he may assure the patient that all will be right in a day or two, and may thereby arouse hopes that can never be fulfilled. On the other hand, by being too pessimistic, he may, with equal ignorance of the case but perhaps more regard for his own reputation, occasion much needless suffering by giving a grave prognosis, when, with fuller knowledge, he might have been able to do much to relieve the patient's sufferings and to quiet the alarm of all concerned.

Unguarded expressions of medical opinion are always to be deprecated, and can be avoided only when a case is approached with full professional knowledge and with the care that comes of deliberate consideration; for it must be admitted that want of care is just as common a cause of mistakes in practice as is want of knowledge. If a general practitioner does not feel confident in his own ability to make a thorough diagnosis, he ought to have no hesitation in expressing a wish for aid by consultation; and, when he is in doubt, he ought never to accept the responsibility of advising the patient to wait for a few days on the chance that the difficulty will pass away. An opinion begotten of hope rather than based on experience is always baneful, for it lulls a patient into a false sense of security and does irremediable harm by allowing time to be wasted which fuller knowledge and larger experience might have put to good purpose.

In the country emergencies are much more difficult to cope with than in towns, because it is often impossible immediately to obtain many things that are absolutely necessary. Every country practitioner should, therefore, for the instant demands of ophthalmic cases, always carry with him an emergency supply, and for this purpose a pocket set of ophthalmic discs will be found convenient.

The lectures on which the present volume is based were, in their original form, delivered in connection with post-graduate courses, and, at the time, appeared in whole, or in part, in various medical journals. They have been rewritten and are now published all together in the hope that they may prove helpful to general practitioners. Their scope is purely clinical, consequently all discussion of theories has, as far as possible, been avoided. Personal experience, even though it be limited, is always of value, and I have simply tried to give a plain statement of facts as they are observed at the bed-side.

As the book deals largely with treatment, I have added a chapter on Ocular Therapeutics, and another giving General Directions for Operations on the eye. The formulae in use at the Glasgow Ophthalmic Institution may serve to guide practitioners in writing prescriptions suited to the needs of individual patients and so save them from being compelled to fall back on proprietary medicines.

I desire to thank Dr. J. Hamilton M'Ilroy for the photogravure plates to which her name is attached,

Mr. A. Kirkpatrick Maxwell for his care in connection with the coloured illustrations, and my friend Mr. William Melven, M.A., for much help in the revision of the proofs.

15 Woodside Place,
Glasgow, *December*, 1906.

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INTRODUCTORY.

In every large industrial centre accidents resulting in impairment of sight and loss of eyes are of daily occurrence; and few cases give the practitioner greater cause for concern than these, inasmuch as, no matter how trivial an eye injury may seem, there is always the risk of disastrous after-results. The fate of the damaged eye depends, indeed, on the treatment first adopted, and the sense of responsibility is at all times intensified by the knowledge that a wound of one eye may be followed by sympathetic inflammation of its fellow, and that this may be so severe as to cause complete loss of vision. Moreover if, in any other part of the body, a wound heals perfectly, the presence of a scar is not, as a rule, of much consequence; but in the eye, if the functional integrity of the organ is to be perfectly preserved, there must be no scar at all. A cicatrix situated in the central area of the cornea may be so thin as to be detected only after very careful examination, but such an apparently trivial nebula is quite sufficient to cause serious impairment of sight, and it is because injuries to the eye are so often followed by deterioration or loss of vision that the accidents which cause them give rise more frequently perhaps than any others to legal proceedings.

As, therefore, the surgeon who has examined the case may be cited to a court of law to give expert evidence, and asked, perhaps, to determine the loss to the earning ability of the patient which has resulted from the accident, it is of the utmost importance that the examination be conducted in a methodical and systematic manner, and notes for future reference taken at the time. It is always well in the first place to obtain a clear history of all the circumstances of the case, and to find out the nature of the missile, the direction and distance from which it could have come, and the probable velocity with which it was travelling. The tension of the eyeball ought next to be estimated and the vision tested. Afterwards there should be a careful examination, in regular order, of the orbital margins, the eyelids, the conjunctiva, and the cornea; and diligent search should also be made for any sign of perforation of the globe. The colour and general appearance of the iris, and the position, size, shape, and mobility of the pupil should next be noted, and contrasted with those of the sound eye. Unless the presence of blood in the anterior or posterior chamber prevent it, an ophthalmoscopic examination should never be omitted, for by this means any alterations in the lens and vitreous, and in the deeper structures of the eyeball, can at once be detected. When, too, the results of an examination such as this are to be embodied in a medical report, it is always necessary to distinguish clearly between lesions that have previously existed in the injured eye and those which are directly the result of the accident; and when an expression of opinion has to be given regarding the probable progress and ultimate issue of the case it must be remembered that an injury, otherwise trivial, may become very serious when complicated by a blennorrhoea of the tear passages, and that the healing process will always be retarded by such general diseases as diabetes or albuminuria, either of which may, indeed, *per se* give rise to grave disturbance of vision.

In every case in which a patient complains of failure or loss of sight, but in which there is no sign of injury to either the superficial or deep structures of the eyeball, a very guarded prognosis ought to be given. In the absence of any visible lesion the surgeon is wholly dependent upon the patient's testimony, which may be true or false. Under such circumstances he ought to examine the eyes repeatedly, in order that he may be either assured of the truth of the statements made to him, or able to put an end, as promptly as possible, to any attempt at malingering.

After railway accidents, in particular, difficulties often arise, and great care requires to be taken not to cast doubt on the veracity of a patient who is really suffering from defective sight. The mental strain incidental to any medico-legal inquiry connected with the settlement of a claim for damages tends to make even those who have no wish to deceive give an exaggerated description of their symptoms, and although in many instances recovery begins as soon as the amount of compensation has been fixed, yet in a certain percentage of cases the defective vision persists. Above all, it must never be forgotten that cases of so-called traumatic amblyopia do occur, in which, notwithstanding the absence of any discoverable ophthalmoscopic changes, there is not only failure in central vision, but also a contraction of the visual field, and that degenerative changes in the optic nerve may be detected only perhaps years after the accident. It cannot be denied, however, that there are people who are unable to resist the temptation to make the most of an accident, and who, in striving to obtain greater pecuniary gain, make statements regarding their eyesight which they know to be false. To detect such deception is one of the most obvious and important duties of the surgeon. When the pretended blindness is said to exist only in one eye, as is usually the case, there are several well-known tests which can be applied, and by means of these it is not difficult, as a rule, to expose the fraud. The certainty of the diagnosis depends, however, upon the degree of blindness which is simulated, and when a malingerer pretends to be blind in both eyes, or has only one eye, tests are not of much assistance, and the deceit can be found out only by keeping a careful watch over the pretender so as to catch him when off his guard.

A doctor is often also asked to state what he thinks would be reasonable compensation for a workman whose sight has been damaged, and he should therefore acquire some knowledge of the kind of work the patient has been doing. The Compensation Act provides not for the indemnification of a workman for injury to, or even for the loss of, one eye, but for the diminution in wage-earning capacity consequent on the deterioration of sight resulting from the accident. Remuneration for labour depends on the amount and character of the work, and while "upon the use of the organ of vision depends the earning power for the large majority of trades or professions, yet it must be remembered that what is regarded scientifically as normal vision is determined according to a higher standard than is required for efficient working or wage-earning acuity." The farm labourer can perform his duties quite satisfactorily although he has much less sight than would be necessary for a skilled mechanic.

As occupation, too, plays a very important part in connection with the occurrence of injuries to the eye (men employed in iron and steel works, for example, suffer far more frequently than other workers), it is expedient that every medical practitioner should be competent to advise regarding the best means for the prevention of accidents. Prophylaxis is of the first importance, for prevention (and this could often be carried much farther than it is at present) is always better than cure, and there is, besides, much careless inattention to well-recognised precautions.

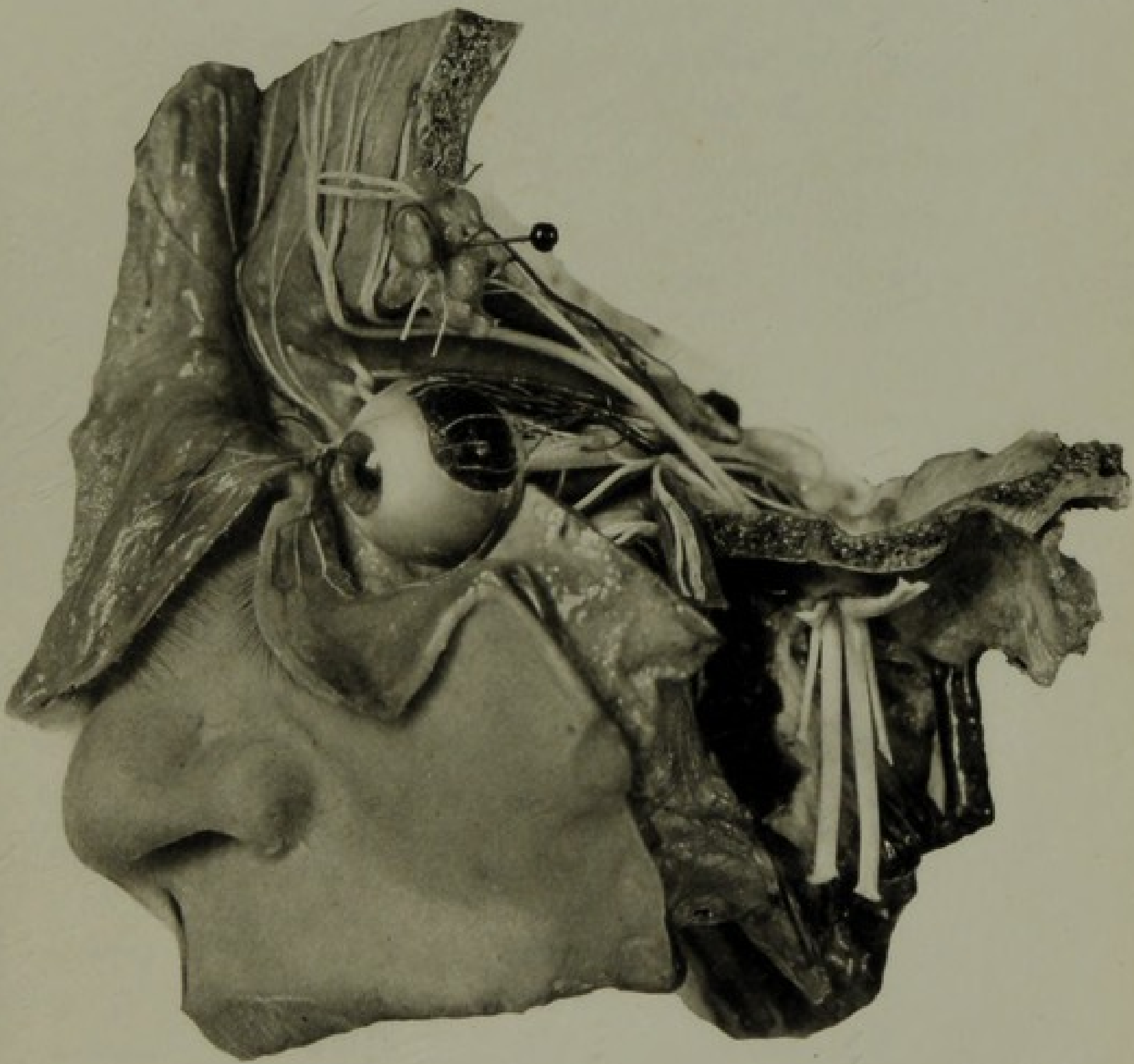
When, indeed, we consider the exposed and prominent position of the eyes, the wonder is that they are not accidentally injured much oftener than is the case. Their escape is entirely due to the admirable provision nature has made for their protection. (Plate I.) Every ophthalmic surgeon could cite from his own experience numerous cases of eye-injuries where the full force of the violence fell upon the appendages while the ball itself escaped unhurt. The anatomical formation of the eyes and of their surrounding structures seems indeed specially designed to secure the greatest possible safety for the delicate tissues constituting the organ of vision. Lodged in the cavity of the orbit, the eyeballs have their movements facilitated by their rounded shape, while the fat in which they are partially embedded prevents the globes from coming roughly in contact with the bony walls of their sockets. In addition, the capsule of Tenon, by means of prolongations attached to the orbital margin (the outer and inner check ligaments), maintains the eyeball in its normal position, and by its special arrangement gives all the security of a ball-and-socket joint. Should these ligaments be ruptured the globe may be dislocated completely forwards (exophthalmos) or driven backwards into the socket (enophthalmos). The shape of the orbital cavities, and their sunken position within the skull, would of themselves render the eyeballs fairly secure against external injury, but great additional protection is afforded by the formation of their margins, more especially the overhanging frontal border, the projection of the nose, and the malar eminence. The eyebrows and eyelashes also contribute to safety by turning drops of perspiration, etc., away

PLATE I.

ANATOMY OF THE ORBIT.

In this plate there is presented a picture of the orbit dissected to show its contents from the temporal side. On the eyeball the opening in the sclerotic reveals the long ciliary nerves and arteries; while behind is the optic nerve pierced by the retinal artery, to the outer side of which is the ciliary ganglion. From the ganglion ciliary branches enter the sclerotic round the optic nerve entrance, above the optic nerve is a motor root from the inferior division of the third nerve, and below it is a sensory root from the nasal division of the fifth nerve. Farther back are seen two divisions of the third nerve emerging separately from the sphenoidal fissure, with the nasal branch of the fifth between them. The fifth nerve is seen entering the orbit in three divisions, the nasal through the apex of the muscle cone, and the lachrymal and frontal above it; and the supra-trochlear and conjunctival branches of the frontal, and the infra-trochlear and conjunctival branches of the nasal may be specially noted. On the deep surface of the superior oblique is the fourth nerve, and on that of the external rectus is the sixth. The cavernous sinus has been opened to show the third, fourth, fifth, and sixth nerves, and the internal carotid artery on which lies the sympathetic plexus (not, however, seen). The lachrymal gland has been displaced, and is pinned away from its proper position at the upper and outer angle of the orbit. The nerve and artery entering it are well seen, as are also the recti and oblique muscles in their proper places. The superior maxillary division of the fifth nerve, entering through the foramen rotundum, passes first into the spheno-maxillary fossa, and thence by the infra-orbital canal, and through the infra-orbital foramen on to the face. The inferior maxillary division of the fifth nerve is seen passing through the foramen ovale on the surface of the internal pterygoid muscle (the external pterygoid having been removed), and breaking up into two large branches—the lingual and inferior dental—and several smaller muscular branches.

PLATE I



from the globe, and by arresting small particles of dust, which would otherwise impinge on the conjunctival surface, while the busy winking of the eyelids keeps the surface of the cornea constantly clear and bright. On the slightest warning of the approach of danger the eyelids close instinctively, and in association with this movement the ball rolls upwards in order that the cornea may be brought wholly under cover of the upper lid. If, however, a foreign body manages to evade all these natural guards, and to gain entrance to the conjunctival sac, the amount of irritation which it excites is, in itself, a source of safety. Although the facial nerve is now regarded as controlling the secretion of the lachrymal gland, the fifth cranial nerve endows the cornea and conjunctiva with sensibility, with the result that when a particle of dust falls upon the eye a reflex flow of tears at once occurs, sufficient in most instances, provided a little patience be exercised, to wash the irritant towards the inner canthus, where it floats on the surface of the lacus lachrymalis until it is washed out.

Again, the ease and rapidity with which the balls can be turned in every direction, and the perfect co-ordination of the nervous and muscular arrangements for the maintenance of binocular vision, widen the visual field, and so, by enabling one eye to act as the guardian of the other, diminish the risk of danger approaching unawares. It is well known that a workman who has lost the sight of one eye is, from that very circumstance, much more liable to suffer injury to the other. A missile approaching from the blind side will be all the more likely to strike the sound eye because it comes unseen, and consequently no time is given for defence against its assault. From time to time, therefore, one has a patient who states that no sooner had he returned to work after an accident that cost him the sight of one eye, than a fresh misfortune of a similar kind deprived him of the sight of the other. Take, for example, the case of a blacksmith who was struck on the left eye by a piece of steel which perforated the cornea and wounded the lens. Traumatic cataract followed, and he was discharged from hospital blind on this side. Three days after he resumed work the right eye was struck by a piece of iron and so severely injured that it had to be enucleated. Fortunately it was possible to remove the cataract in the left eye, and thus to restore vision.

It is true that a person who has been so unfortunate as to be born blind of an eye, or to have lost one in infancy or early childhood, grows up practically unconscious of his defect, but it is very different when the loss of sight on one side happens in adult life. There is then always present (though the discomfort certainly becomes much less in course of time) the consciousness of a contracted visual field, of need to turn the head in order to see all round about, and of difficulty in estimating the distance and the size of objects.

The proper treatment of ocular injuries is then, in every respect, a matter of great moment for the whole

PLATE II.

BACTERIOLOGY OF HEALTHY CONJUNCTIVAL SAC.

A. Surfaced gelatine plate, which was inoculated from the conjunctival sac of a house physician in a general hospital who had recently returned from a holiday and was in the best of health, with a conjunctiva apparently quite normal at the time of inoculation, and which remained normal without washing out after the culture had been made.

Numerous colonies are seen:

(1) A colony of *staphylococcus aureus.*

(2) A colony of *a large white coccus* frequently found in air, and non-pathogenic.

(3) Numerous colonies of the so-called "*Xerosis Bacillus.*"

(4) One colony of a *red yeast.*

(5) One colony of a *brown mould.*

B. Film of the "*Xerosis Bacillus*" stained with methylene blue.

C. Film of the large *air-coccus*, which tends to appear as a *diplococcus*, stained with methylene blue.

D. Film of the *red yeast*, stained with Fuchsin.

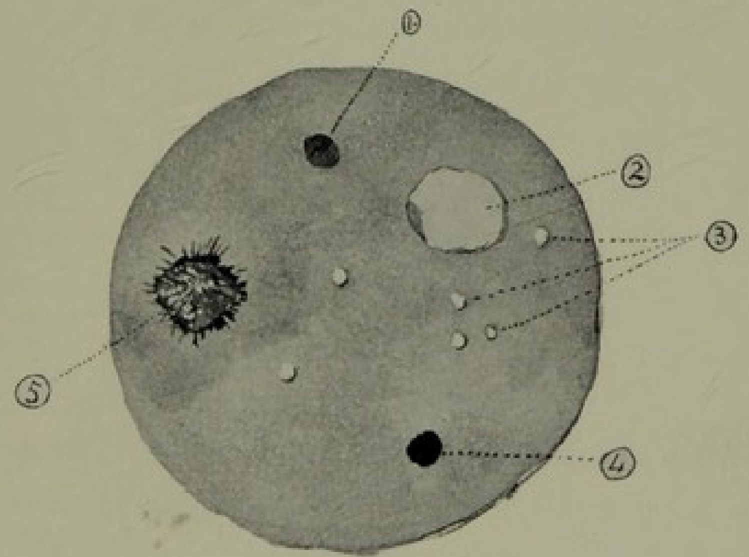
E. Film of the *staphylococcus aureus* stained with Fuchsin.

I have to thank Dr. J. Campbell M'Clure for making the culture and drawing the plate.

PLATE II.

B.

C.



A.

D.

E.

J.C.M
May 1906.

community. All experience teaches that the greatest anxiety arises, in most instances, not from the actual physical damage, but from infection of the wound; and so in each case the diminution, or prevention, of sepsis ought to be the guiding therapeutic principle. Such treatment is now, thanks to the researches of Pasteur and their practical application by Lister and his followers, a very simple matter, but it must never be forgotten that it has, in dealing with the eye, to be carried on under conditions peculiar to that special organ. The conjunctival sac probably always contains germs which are, or may rapidly become, pathogenic (Plate II.), and if by chance it is at any time swept clear of microbes it is speedily re-invaded through the tear passages by bacteria which come from the nasal cavities and their adjoining sinuses. To destroy these germs is practically impossible. It was natural to think of dealing with infection by washing out the conjunctival sac with antiseptic lotions, but both carbolic acid and corrosive sublimate, even in weak solution, injure the epithelium and induce opacity of the cornea. It would be useless to kill the micro-organisms if the bactericide employed caused so much structural damage that the transparency of the cornea was impaired. As, therefore, strong antiseptics cannot be used, and weak are quite ineffective, it is wisest to avoid the risks of ordinary chemical disinfectants and to douche with a bland fluid. In my own practice I employ sterile physiological salt solution, or a saturated solution of boracic acid.

Happily, however, as may be seen every day in connection with cataract and other operations, absolute freedom from germs is not a necessary condition for primary union of a wound of the cornea. For years past a systematic bacteriological investigation has been made of the fluids in the conjunctival sacs of all the patients suffering from cataract on whom I have operated, and it has been demonstrated over and over again that the wound heals perfectly in the presence of the staphylococcus albus, provided the patient be in sound health and the microbes are not present in overwhelming numbers. The risk of suppuration is always greatly increased if there has been previous inflammation of the edges of the eyelids, or of the conjunctiva, or of the lachrymal sac and tear passages, or if the patient's vitality be low. Collateral conditions are indeed always of considerable importance, for while the intense germicidal action of any chemical can readily be demonstrated by experiment in the laboratory, the results thus obtained are but seldom borne out in actual ophthalmic practice. The great amount of attention which has been given to the study of micro-organisms has tended to divert attention unduly from the soil in which the bacteria grow. All clinical experience proves, indeed, that suppuration occurs much more rapidly in some patients than in others, and that general mal-nutrition, by lowering the resisting power of the tissues, favours the onset of sepsis. That being so, one must not only pay every attention to strict antiseptic precautions, but must also devote the utmost care to what is of equal importance, the giving the patient himself increased power of resistance. Good food, fresh air, rest, and every means of strengthening digestion are all essential. While on the one hand the most trivial ocular injury may, through neglect or unskilful treatment, have the most disastrous results, the natural power of recuperation of the eye is, on the other hand, so great that damage which in former days would have been treated by enucleation can now be repaired, and sight preserved, by following as far as possible the practice of antisepsis.

CHAPTER II.

SUPERFICIAL INJURIES.

WHEN any foreign body, such as a particle of dust, a small fly, etc., manages to get inside the lids, a copious flow of tears at once results by reflex action, and the irritant is washed towards the inner canthus, and there ejected. Rubbing the eye, an action to which everyone in such circumstances is strongly inclined, seriously interferes with this process, because the foreign body is either driven to take refuge beneath the upper eyelid or, if it possess sharp edges, to embed itself in the cornea; and so it is better to exercise patience and keep the eyelids gently closed for a brief space till nature brings matters right in her own way.

In many cases, however, the foreign body becomes lodged beneath the upper eyelid, and in order to effect its removal it is necessary to evert the lid. This is a simple matter if it be gone about in the right way. Seat the patient in a good light, and ask him to look down; then grasp the eyelashes with the thumb and index finger of the left hand, and pull the eyelid forwards and downwards; lay a probe or the edge of a coin along the upper margin of the tarsal cartilage, turn the eyelid upwards, and the operation is complete. When a patient complains that he has received an injury to his eye, the doctor should invariably make a careful examination of the conjunctival surface of the upper lid; to overlook a foreign body in this position is certain not only to cause much unnecessary pain to the injured person, but also to bring a great deal of discredit on the medical man concerned. Among farm labourers, particles of straw or chaff frequently become so deeply lodged in the upper conjunctival cul-de-sac that they may be hidden from view, even when the upper eyelid is everted. It is necessary, therefore, if it be suspected that a foreign body is present, not only to evert the eyelid, but also to make a careful exploration of the cul-de-sac with a small probe. It is all the more needful to bear this in mind, because, though the smallest particle of dust within the eye usually gives rise to intolerable uneasiness, yet larger bodies may remain for weeks in the loose folds of this cul-de-sac, without their presence being indicated by any signs more serious than inflammation accompanied by swelling of the conjunctiva, and puro-mucous discharge. Such an inflammation, however, does not yield to the usual remedies, and subsides only after the removal of the exciting cause.

Particles of dust, etc., are usually found lying loosely upon the conjunctiva, and are, as a rule, readily removable with the point of an unused toothpick, a camel-hair brush, or the edge of a small spud; but should the foreign body be firmly fixed in the substance of the cornea or of the conjunctiva, the difficulty of its removal is directly proportionate to the depth to which it has penetrated.

Among artisans no accident to the eye is more common than the embedding in the corneal epithelium of a minute particle of metal. This is spoken of by the workmen themselves as a "fire," and the term is not inappropriate, because as a rule the particle is at a white heat when it flies from the tool, and therefore when it reaches the eye it burns its way in. As the heat has rendered it aseptic, it would in all probability rarely cause any serious subsequent damage to the cornea, but it gives rise to so much immediate pain that the sufferer is naturally desirous of having it removed at the earliest possible moment. He accordingly very often appeals for aid to a fellow-workman, whose attempts to give relief, if unskilful or careless, are unfortunately always more harmful than the "fire" itself. By inducing sepsis, they transform a very trivial injury into a suppurative keratitis which, if it does not destroy the eye, will in all likelihood lead to permanent impairment of sight. The "fire" itself will damage the eye less than such rough, unskilful, and persistent efforts to remove it.

If the patient do not present himself to the surgeon until two or three days after the injury has been received, and if he has not allowed any one to meddle with his eye in the interval, it will be found that the embedded substance is surrounded by a whitish ring of softened corneal epithelium, which a very slight touch with a spud will cause to separate from the parts beneath. In fact, if the sufferer had waited a day or two longer, the probability is that nature alone would have brought about the same result by casting off the softened corneal tissue, foreign body and all, leaving a breach of surface of greater or less depth. The sooner, however, such intruders are skilfully removed the better, and the most convenient instrument to use is either a cataract needle or a small gouge rendered aseptic by being passed through the flame of a spirit lamp. The instillation of a few drops of a two per cent. solution of cocaine renders the operation perfectly free from pain, and in cases where the foreign body is very minute material aid is afforded by the introduction of a drop of a solution of fluorescein. This, by colouring the abraded epithelium green, enables the lesion to be more readily seen and the foreign body to be more easily removed.

In dealing with cases of this description, seat the patient in a good light, with his head firmly supported by the back of a chair, or, preferably, by the hands of an assistant, Separate the eyelids with the thumb and index finger of the left hand, and press slightly backwards, so as to fix the eyeball; then pass the needle or gouge behind the foreign body, and lift it from the cornea. Should it have penetrated deeply, and there be danger of pushing it back into the eye, a second and broader needle should be passed into the anterior chamber behind, and with this extra support removal is usually a matter of no great difficulty.

The brownish stain which often remains after the operation ought to be carefully scraped away, so that the healing process may be hastened. When the substance is embedded in the conjunctiva it should be grasped with a pair of forceps, and the piece to which it is adherent cut out with a pair of curved scissors.

Removal is in all cases followed by an immediate sense of relief, and, as a rule, nothing more requires to be done, except to bathe the eye with some antiseptic lotion, and, if pain continue, to apply an ointment of cocaine and vaseline, and to adjust a compress and bandage. These should be worn until all signs of irritation have passed away. When, however, in consequence of the foreign body having been long present, or of rough and unskilful attempts having been made without success for its removal, the breach in the corneal surface is slow to heal, the wound should be lightly dusted with equal parts of precipitated iodoform and boracic acid in very fine powder. This treatment stimulates the healing process and counteracts, as far as possible, any tendency to suppuration. Acetate of lead should never be used. Lead lotions have enjoyed a well-deserved popularity in the treatment of conjunctival inflammations, but, whenever there is a breach of surface, the acetate is decomposed and a white precipitate is formed. If this be deposited on the cornea, a dense white glaring opacity is the result, and the vision of the eye is permanently impaired. (Plate III., Fig. 1.)

PLATE III.

ULCERATION OF THE CORNEA.

Fig. 1 is a marked example of the disastrous results that follow the application of a lead lotion to the eye when the cornea is ulcerated. A deposit of white-lead has formed on the raw surface and given rise to a staring white opacity which is permanent.

Figs. 2 and 3 show how a simple abrasion of the cornea may be changed by infection into a sloughy ulcer which may completely destroy the eye. The first of these figures illustrates the case of a man, sixty-eight years of age, who was accidentally struck on the left eye with a piece of coal four weeks before he came to the Ophthalmic Institution. As far as could be made out, the original injury was very trivial, but within forty-eight hours a sloughy ulcer had formed on the cornea. This was not properly attended to, and, when the man presented himself at the Hospital, the greater part of the cornea was destroyed, Descemet's membrane alone remaining towards the centre. Perforation of this took place, and a prolapse of iris followed. As it was not possible to save the eye the globe was enucleated.

Fig. 3 illustrates the case of a woman, sixty-six years of age, who had got her right eye scratched by a child's finger nail. Suppurative keratitis followed, and sight was lost, but for twenty years thereafter there was no further trouble. Then, without any known cause, purulent inflammation reappeared and extended to the deeper parts of the globe. The suffering was so acute that the patient readily agreed to enucleation.

PLATE III

YE INJURIES AND THEIR TREATMENT.
A. MAITLAND RAMSAY, M.D.

JAMES MACLEHOSE & SONS,
PUBLISHERS, GLASGOW

Some time ago I saw a patient whose right cornea had over its surface a white cloud that seriously affected its transparency and dimmed the sight so greatly that fingers could not be counted when held more than three or four feet away from the eye. The man told me that three months before, as he was entering a room in which he kept a pet canary, the bird flew to meet him and accidentally struck his right eye with its claw or beak. It is not certain whether the cornea was actually scratched at the time of the accident; but there was a minute cut at the margin of the upper lid, and an eyelash had been driven into the wound in such a way that with every act of winking it rubbed against the cornea. The irritation thus produced occasioned intense suffering, and as the cause of it had been overlooked, and only momentary relief was obtained from the use of the remedies prescribed, the patient, who was a pharmaceutical chemist, took the treatment of his case into his own hands and sent to his shop for an ointment containing carbolic acid, acetate of lead, and cocaine. A more mischievous combination could hardly be imagined, for no sooner was it applied than the sight, which had up to that moment been unaffected, suddenly became dim, and the cornea was observed to have lost its transparency owing to a deposit of white lead having taken place over its surface.

It often happens that, owing to the extreme sensitiveness of the structures implicated, an accident to the eye seems much more serious than it really is. Indeed, the pain and symptoms of distress are often in inverse proportion to the gravity of the injury. Here, again, it is very difficult to make a satisfactory examination, for the pain and intolerance of light set up blepharospasm so intense that it is almost impossible to separate the lids. The accident often occurs in the simplest manner possible—a woman while doing her hair strikes the cornea with the brush or with the curling tongs, a man is lighting a pipe when a spark flies from the head of the match and enters the conjunctival sac, or a mother is playing with a baby and receives a scratch on the eye from the infant's finger nail. These are only a few examples from many that might be cited. In nearly every case the patient believes that serious damage has been done. He speaks of the pain as agony, and is quite unable to open the eyelids. As a rule, however, a few applications of a two per cent. solution of cocaine overcome the surface irritability and permit the surgeon to separate the lids and to examine the cornea. A small abrasion is usually detected, and if this be treated by an antiseptic lotion, an ointment containing cocaine, and a compress and bandage, healing takes place rapidly. If, however, the breach of surface be infected by micro-organisms, suppuration ensues, and what was, to begin with, a very insignificant injury becomes a serious one, and a grave menace to sight. It must at all times be remembered that an injury to the eye is never so trivial that it can with safety be neglected, or so insignificant as not to require the most skilful treatment.

In cases of corneal abrasion the greatest danger is always in the risk of septic infection. Micro-organisms, some of which may be pyogenic, are constantly lurking in the conjunctival sac, but as long as the epithelium remains intact they do no harm. Should the corneal epithelium, however, be abraded never so little they at once find their way through the breach of surface and immediately begin to manufacture toxins, whose irritant action extends to the deeper, as well as along the superficial, ocular tissues. This infection may occur at the time of the accident, or it may take place later through inoculation of the wound by secretion from the conjunctiva, from diseased tear passages, or from the nasal mucous membrane. Some cases run a peculiarly virulent course, and not only is the destruction of the cornea rapid and complete, but the whole of the tissues of the globe may become implicated, and the result is acute panophthalmitis. (Plate III., Figs. 2 and 3.)

I remember once seeing a carter, who stated that he had, the day before, got some dust from the road into his eye. Intense inflammation followed, and within twenty-four hours the whole cornea had suppurated. Treatment was of no avail: panophthalmitis speedily followed, and in less than a week the patient was seized with erysipelas, beginning in the eyelids and extending all over the head and neck.

Another case I remember well was that of a woman who was under treatment for blennorrhoea of the tear sac. A doctor when washing out the lachrymal passages accidentally scratched the cornea, and next morning there was a rapidly-spreading ulcer and evidence of infection of the deeper tissues. In a couple of days the eye was hopelessly destroyed. Fortunately such virulent and intractable cases are of rare occurrence, and the resources of modern ophthalmology can in most instances either prevent the onset of sepsis or successfully combat its progress.

CHAPTER III.

WOUNDS AND BURNS OF THE CONJUNCTIVA.

WOUNDS.

Wounds of the conjunctiva usually heal rapidly, and rarely require to be sutured. It is sufficient to keep the part thoroughly clean with a weak antiseptic solution, and to protect it by means of a compress and bandage. Should a fungoid granulation develop at the site of the injury it must be snipped off with a pair of scissors.

When a wound implicates the margin of the eyelid a suture is, however, necessary, for if the edges be not accurately brought together it is likely that one or more cilia may become inverted and, scratching the cornea with every movement of the lids, prove a constant source of discomfort. If the injury be situated at the inner canthus, there is a grave risk that the tear passages will be wounded, and, unless the condition be at once recognised and a road for the escape of the tears opened up, complete obstruction will take place in the process of cicatrisation, and the patient will suffer from persistent watery eye. These precautions appear obvious but they are often neglected, and what might have been a very trivial injury becomes, through inefficient treatment at the outset, a cause of great trouble and annoyance. Some time ago, for instance, I was consulted by a gentleman whose carriage had come into collision with an electric car, and who had, in consequence, received from a piece of broken glass a slight wound at the inner canthus of the right eye. He was at once attended to by a medical man who applied a dressing to the injured part, and in a couple of days healing was complete. The patient then, however, began to complain of watery eye, and more careful examination showed that the cut, tiny though it was, had severed the lower canaliculus, and that the cicatrix had blocked the duct. There was a complete stricture, and only after much difficulty was this overcome and the patency of the tear passages restored. Had the true nature of the condition been recognised at the time of the accident, and the canaliculus slit up to the lachrymal sac, the damage might have been repaired with the greatest ease.

Wounds in the neighbourhood of the eye are, like injuries in any other part of the body, liable to be infected by the germ of tetanus. Here is an example. A woman, twenty-three years of age, was struck on the right eye with a walking stick. She was admitted to hospital four days after the assault, when she was found to have a suppurating wound extending for about three-eighths of an inch outward from the external canthus of the injured eye. There was no corneal injury, but there were extensive chemosis of the bulbar conjunctiva covering the cornea over its outer half, ecchymosis of the lids, and swelling extending over most of the right side of the face. The intra-ocular tension was sub-normal, the anterior chamber of natural depth, the pupil dilated and irresponsive to light, the fundus oculi could not be illuminated, and all perception of light was lost.

About three days after admission the patient began to complain of stiffness of the lower jaw, especially on the right side. As no maxillary injury could be detected, this did not at first attract much attention, and was attributed to the extensive swelling and bruising on the right side of the face. Though, however, the swelling gradually subsided, the stiffness steadily increased and it was manifest that the condition was serious and strongly suggestive of trismus. The patient could by this time open her mouth only on the left side, and the right corner drooped towards the chin. All the muscles on the right side of the face were paralysed, but, owing to the injury and swelling, it was difficult to determine the degree of the palsy of the orbicularis palpebrarum, and the labio-nasal fold was never completely obliterated. The occipito-frontalis was also involved, and the wrinkles on the left side of the face were much more marked than those on the right. On both sides the knee jerks were exaggerated, and ankle clonus was present.

A week after the injury there was complaint of stiffness of the right trapezius, and fears were now entertained that the case would turn out to be one of general tetanus. Examination revealed a sinus leading down to bare bone at the malar process of the superior maxilla, and bacteriological investigation demonstrated the presence of the tetanus bacillus in large numbers. The injection of antitetanic serum was at once commenced, and for two days the conditions remained practically unchanged. On the third evening while the eye was being douched and the sinus syringed, the patient had an attack of laryngeal spasm, so severe while it lasted that it was feared she would die of suffocation. In a few minutes, however, the muscles relaxed, but shortly afterward, while the girl was taking a drink, she was suddenly seized with slight spasm of the pharynx similar to that which occurs in hydrophobia.

The serum injections were continued and chloral prescribed in large doses, and on the following day the tonic contraction of the muscles of mastication was distinctly less, although there was again a tendency to the occurrence of spasmodic dyspnoea when the wound was being dressed. The attack was not, however, nearly so severe as that of the previous evening, and spasms of a similar nature did not again recur. In fact, from this time onward there was steady improvement, and the injections were intermitted for six days. During sleep the muscles relaxed so much that the mouth remained open, but on waking there were still occasional spasmodic contractions of the muscles of mastication, and several times the patient bit her

PLATE IV.

BURNS OF THE EYEBALL.

Fig. 1 shows the eye of an ironworker, twenty-nine years of age, who became a patient in the Glasgow Ophthalmic Institution in 1906. Ten days before admission he had been struck on the right eye by a piece of red-hot metal. Both upper and lower lids were severely burnt, the ocular conjunctiva over the nasal aspect of the ball was much destroyed, and the inner third of the cornea was covered by a greyish slough. The rest of the ocular conjunctiva was greatly chemosed, and overlapped the cornea both above and below. The eye was exceedingly painful, and there was a considerable amount of muco-purulent discharge.

The patient was kept in bed; atropine and cocaine in castor oil were instilled several times a day; the lids were painted first with argyrol and afterwards with nitrate of silver; and the eye was kept clean by frequent douchings with hot boracic solutions. As the pain became very severe about a week after admission, and the cornea seemed as if it would perforate, the patient was, for some days, kept slightly under the influence of morphia. Gradually the slough separated, leaving a clean surface which rapidly healed. There was a small symblepharon both above and below. The patient was under treatment for twenty-two days.

Fig. 2 shows the eye of an ironworker, fifty-five years of age, who became a patient in the Glasgow Ophthalmic Institution in 1906. Three weeks before admission he had been struck on the left eye by molten metal. There was a deep ulcer involving both cornea and sclerotic at the lower and inner aspect of the globe, the iris was inflamed, and there was pus in the anterior chamber. The patient was put to bed, and treated with atropine and argyrol in twenty-five per cent. solution, and with trikresol lotion. After a lapse of several weeks the hypopyon disappeared, and there was a good recovery.

Fig. 3 shows the eye of an ironmoulder, forty-two years of age, who, in 1904, was severely burnt by molten metal, both ocular and palpebral conjunctiva being extensively destroyed. The conjunctival sac was thoroughly cleansed, and some pieces of metal were removed from beneath the upper eyelid; while pain was subdued by instillations of chloretone oil and subcutaneous injections of morphia. When the slough separated there was a deep ulcer involving the lower half of the cornea, and as this healed the lower lid became extensively adherent to the globe. Above the symblepharon was a piece of transparent cornea. For many months there was purulent discharge, which was controlled by painting the lids with two per cent. nitrate of silver solution. When cicatrisation was at length complete, almost seventeen months after the accident, the symblepharon was carefully dissected from the cornea and sclera, the lid freed down to the retrotarsal fold, and the raw surface covered by a flap of mucous membrane from the lip.

PLATE IV

EYE INJURIES AND THEIR TREATMENT.
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tongue severely. After a month there was constant progress, and six weeks from the accident there was little difference between the two sides of the face, although the right occipito-frontalis did not act so well as the left. The electrical reaction of the facial muscles on the right side was normal, but the response to both galvanic and faradic stimulation was more sluggish than it was on the left.

Considering the large percentage of cases of cephalic tetanus that prove fatal, such a complete recovery was very gratifying. In this instance it was probably to be attributed to the use of the antitetanic serum, which was administered seven times to a total amount of about one hundred and fifty cubic centimetres. Distinct benefit followed every injection after the third. The patient was all through kept quiet, well nourished (careful attention being paid to the action of the bowels), and chloral in large doses was given to secure rest and sleep, the total amount of this drug used being three thousand grains. For the first sixteen days one hundred and fifty grains were taken every twenty-four hours. The patient's strength was well maintained throughout, the pulse averaged about ninety, and the temperature was always normal.

BURNS.

Of all injuries to the conjunctiva, none is more disastrous in its results than a burn, especially one due to the action of any chemical irritant, such as quicklime, sulphuric acid, etc. In all cases of this kind the prognosis must be very guarded, as the action of the chemical extends far beyond its point of application, and what seems at first sight only to have caused a greyish haze over a part of the surface of the cornea will probably by the end of a fortnight have brought about the total destruction of that membrane, and the consequent extinction of vision.

In all cases of burns or scalds of the eyeball the general symptoms are the same, and their severity depends upon the nature of the irritant, the length of time it has remained in contact with the eye, and the extent of the structural injury it has produced. After a burn, from whatever cause, the pain is very severe, and the inflammatory reaction is rapid and violent. The eyelids are usually injured, but whether they are or not they rapidly assume a dusky red colour, and become so swollen that the interior of the eye can be seen only with difficulty. There is chemosis of the ocular and palpebral portions of the conjunctiva, and the cornea becomes hazy over greater or less part of its surface. In from twenty-four to forty-eight hours the burnt surfaces are clearly mapped out, and are separated from the other tissues by a well-defined zone, in which the inflammatory reaction, the result of the injury, is most acute. Pus begins to be discharged, and the tissues destroyed by the burn are separated as sloughs, after which, if the injury to the eye has not been too great, recovery more or less complete commences. (Plate IV., Fig. 1.)

Should the case, however, be severe, the inflammatory process goes on, the conjunctiva becomes thickened and fleshy, pus forms in the anterior chamber (Plate IV., Fig. 2), the cornea suppurates and bursts, and the eye ultimately shrivels. In cases where the cornea does not give way, and the shape of the eyeball is preserved, a dense leucoma remains, or, from the thinning of the parts due to the separation of the sloughs, the cornea, unable to resist the intra-ocular tension, bulges forward, and a staphylomatous projection is produced. In this connection it may be noted that very severe causes do not always bring about proportionately severe results. When molten metal, for instance, gets into the eye, it might be expected to, and very often does, cause serious structural damage, and yet, on the other hand, there are cases where the injury is remarkably slight. The explanation is that, on the first entrance of the metal, the great heat causes the moisture in the eye to pass into what physicists call its "spheroidal state," and the spheroids of water, acting as a non-conducting layer, protect the eye from injury.

In all severe burns both ocular and palpebral mucous membranes are destroyed, and the raw surfaces that are left adhere in the process of healing, so that the eyelid becomes firmly fixed to the eyeball. (Plate IV., Fig. 3.) This condition, which is known as symblepharon, will, no matter how much care has been taken to prevent it, certainly occur in every case where the retrotarsal fold of conjunctiva has been destroyed; and, if it be extensive, it not only interferes with vision but causes intolerable discomfort from the sense of dragging which it produces. It is, unfortunately, but little amenable to treatment, and may be complicated by union of the eyelids—anchyloblepharon.

After a burn the healing process is slow. The vitality of the tissues has been lowered by the injury, and, as the cicatrix goes on contracting, the eyelids may either become inverted, so that the eyelashes rub upon the eyeball, or else they may be everted, with the result that the face is frightfully disfigured and the original damage to the cornea is augmented by the constant exposure of the ball.

Burns of the globe are treated in the same way as acute suppurative inflammation, and where the injuries have been caused by chemical irritants, special precautions have to be taken from the very first. In the case of quicklime the severity of the burn is due to the fact that the lime usually remains for a considerable period in contact with the tissues, and its powerful escharotic action has thus time to take full effect. The slightest particle of it entering the eye gives rise to the most intense irritation, leading to spasmodic closure of the eyelids and a copious secretion of tears—a combination of circumstances which is, as we have seen, most favourable in ordinary cases for the extrusion of a foreign body, but which in this case is most unfortunate, because by the firm closure of the eyelids the lime is pressed against the eyeball, while the tears slake any portion which is yet unslaked, and the heat consequently evolved increases the rapidity of the work of destruction. When, therefore, unslaked lime has caused the injury, any particles remaining should be at once removed, and after the eyelids have been everted the conjunctiva should be thoroughly douched by a stream of cold water, or by a weak acid solution if this be available. On the theory that sugar will dissolve the lime, and so cause its thorough removal, it has been recommended that the eye should be douched with a solution of sugar; but the rapidity with which the lime destroys the tissues is so great that the mischief is done before the surgeon sees the case, and as the solvent effect of saccharine solutions on slaked lime is very gradual, it is better to waste no time but at once to make sure that the conjunctival sac is thoroughly freed from any of the particles which may be adhering to it. After a burn from an acid, for example in cases of vitriol-throwing, an alkaline douche is of course preferable, but in all cases, when the eye has been washed, castor oil and cocaine, or preferably a five per cent. solution of chloretone in oil, should be applied to the conjunctiva, an iced compress laid over the closed eyelids, and the patient put to bed. In order to combat the inflammatory reaction which is sure to follow, the ice-cold compress should be continued, and saline purgatives administered, while the pain must be subdued by the application of leeches and either by the administration of full doses of opium or by hypodermic injection of morphia in the temple. The use of these anodynes has the additional advantage of inducing sleep and soothing the nervous system generally. After forty-eight hours, warm applications are usually found to be more grateful to the patient than the iced compress, and the sedative effect of these fomentations may be increased by poppy-heads and chamomile flowers, while much additional relief may be obtained by smearing the eyelids, forehead, and temples with a mixture of extract of belladonna and glycerine. When the acute symptoms have subsided, and the sloughs have begun to separate, antiseptic lotions should be used, and much benefit is often obtained from the daily instillation of a two per cent. solution of nitrate of silver. Any iritic complications must be treated by the judicious use of atropine, but in this connection it may be mentioned that as burns of the corneo-scleral margin are apt to give rise to glaucomatous symptoms, the use of the atropine must be at once stopped if the patient complain of increased pain with sudden dimness of vision, and an endeavour must be made to reduce the increased tension of the eyeball by the energetic use of eserine or pilocarpine, or by paracentesis of the aqueous chamber.

During the cicatricial stage the greatest attention must be devoted to overcoming the tendency to symblepharon. The adhesions must be diligently broken down with a probe, and the eyelids drawn away from the eyeball, so as to permit a layer of vaseline to be instilled between the two raw surfaces. In spite of all one's efforts, however, symblepharon will, in bad cases, occur, and although much ingenuity has been displayed in devising mechanical apparatus to keep the lid separated from the eyeball, these as a rule fail to accomplish their purpose, because, as cicatrisation progresses, they get displaced, and the adhesions form again and again with a pertinacity that is most vexatious.

Of the many operations that have been proposed for accomplishing the same object, the one first described by Mr. Teale is most likely to give satisfactory results. The lid must be dissected from the eyeball as far as the fornix, and then a flap of conjunctiva taken from either side of the globe. One of these is utilised to cover the raw surface of the lid and the other is taken to fill up the gap in the bulbar surface. The flaps must not be put too much on the stretch, and are kept in position by fine silk sutures. When the symblepharon is too extensive to be satisfactorily dealt with by Teale's method, flaps of mucous membrane may be transplanted from the lip, from a frog's mouth (Leslie Paton), or from a rabbit's conjunctiva, and if proper precautions be taken considerable success may follow these transplantation operations.

ELECTRIC OPHTHALMIA.

This is occasionally observed in those engaged in electric-welding operations, and usually appears about eight hours after the eyes have been exposed to the glare, the evil effects of which are due, in great part, to the predominance of ultra-violet rays. The eyes at first feel hot and pricking, and every now and then acute darting pains shoot through the globes. The pains become more and more intense and are accompanied by erythematous swelling of the skin of the lids and face, similar to what is seen in severe sun-burning, while tears gush continuously from the eyes in large quantity. The symptoms gradually subside after one or two days, and vision is unaffected; although for a considerable time the patient is unable to work freely by bright electric light. Much relief is obtained by frequent instillation of two per cent. solution of cocaine, and by the application of iced compresses to the lids. Preventive measures are here of great value—when work is being done under strong arc lights the eyes should always be protected by smoked or coloured glasses.

PLATE V.

SERPIGINOUS ULCER OF CORNEA.

Fig. 1 represents the right eye of a miner, forty-eight years of age, who, while at work, was injured by a blow from a chip of stone. The accident seemed such a slight one that for two days medical advice was not sought; but at the end of that time the eye had become painful, and a doctor was consulted. Under treatment everything seemed to go well, till on the ninth day a hypopyon appeared. When the man came to the Ophthalmic Institution, on the fourteenth day after the accident, there was a large serpiginous ulcer in the centre of the cornea, the anterior chamber was one-third full of pus, the iris was inflamed and the pupil irregular, there was great pericorneal injection, there were very pronounced symptoms of irritation, and the pain was so severe that for several nights the patient had been unable to sleep. The ulcer was thoroughly cauterised, and ten per cent. iodine-vasogen afterwards applied twice or thrice a day. After the operation, pain subsided and never recurred, and the ulcer began to heal. The leucoma which marks the site of the injury is very dense, but vision may yet be improved by an iridectomy, and the unsightly appearance of the eye by tattooing.

Fig. 2 represents the eye of another miner, forty-five years of age, the history of whose case may be taken up at the point where that of Fig. 1 is left off. This patient came to the Ophthalmic Institution four months after his left eye had been injured. At the centre and lower part of the cornea there was a dense white adherent cicatrix, which was dealt with by an optical iridectomy and by tattooing the scar.

Fig. 3 illustrates the case of a miner, forty-seven years of age, who was struck on the left eye by a chip of coal. There was acute infection by pneumococcus, and ulceration spread so quickly that when, seven days later, the man was admitted to the Ophthalmic Institution, the greater part of the central area of the cornea was destroyed. The sepsis was overcome by the cautery and the application of iodine-vasogen; but the destruction of tissue had been so great that after the patient was dismissed from hospital an anterior staphyloma formed. The occurrence of such an after result may be best prevented by the careful application of a bandage, and by enforced rest in bed.

PLATE V

ye Injuries and their Treatment
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James Maclehose & Sons,
Publishers, Glasgow

CHAPTER IV.

SERPIGINOUS ULCER OF THE CORNEA.

ASSOCIATED with the presence of the pneumococcus is a form of ulceration of the cornea to which the name serpiginous ulcer has been given. (Plate V., Fig. 1; and Plate VI., Fig. 1.) Although one of the most dangerous diseases of the eye, it usually follows a very trivial injury. A miner or a stone-breaker gets his eye struck by a piece of coal or stone, but so little does he think of it that he continues at his work; a mother while nursing and playing with her child receives a tiny scratch on the cornea from the infant's finger nail; an artisan, with a "fire" in his eye, gets the corneal epithelium abraded by the clumsy attempts of a companion to remove the foreign body with the point of his pocket-knife. Such accidents are most trivial in themselves, involving only a breach of the corneal epithelium, and yet, if the wound become infected by the pneumococcus, the consequences may be most disastrous. The sufferers are mostly adults, and, as the virulence of the micro-organisms seems to be increased by hot weather, some of the very worst cases occur among agricultural labourers whose eyes have been injured in the harvest field. The ulcer is usually situated towards the centre of the cornea. It is somewhat crescentic in shape, and while its floor shows only a shallow depression, rough and glistening, its margins are opaque, raised, undermined, and suppurating. One of its most striking characteristics, and that from which it derives its name, is the tendency it has to creep over the surface of the cornea. While progressive in one direction, however, it usually tends to cicatrise along the opposite border, although in some cases it spreads with such intense rapidity that the whole cornea may be eaten away in a few days. Its peculiarly infective nature may be early diagnosed by its extreme painfulness, by the occurrence of deposits on Descemet's membrane, and by the formation of pus in the most dependent parts of the aqueous chamber, while associated with these are intolerance of light, injection of the conjunctival and ciliary blood-vessels, and swelling of the lids. The deeper parts of the cornea are early involved, and this leads to inflammation of the iris, which is always accompanied by increase in the hypopyon.

The researches of Leber have thrown considerable light upon the pathology of serpiginous ulcer. He has shown by experiment that when the cornea is inoculated with micro-organisms the toxins they manufacture are speedily carried by diffusion to the surrounding parts, and set up an irritant action in blood-vessels at a considerable distance from the original seat of infection. The process is analogous

PLATE VI.

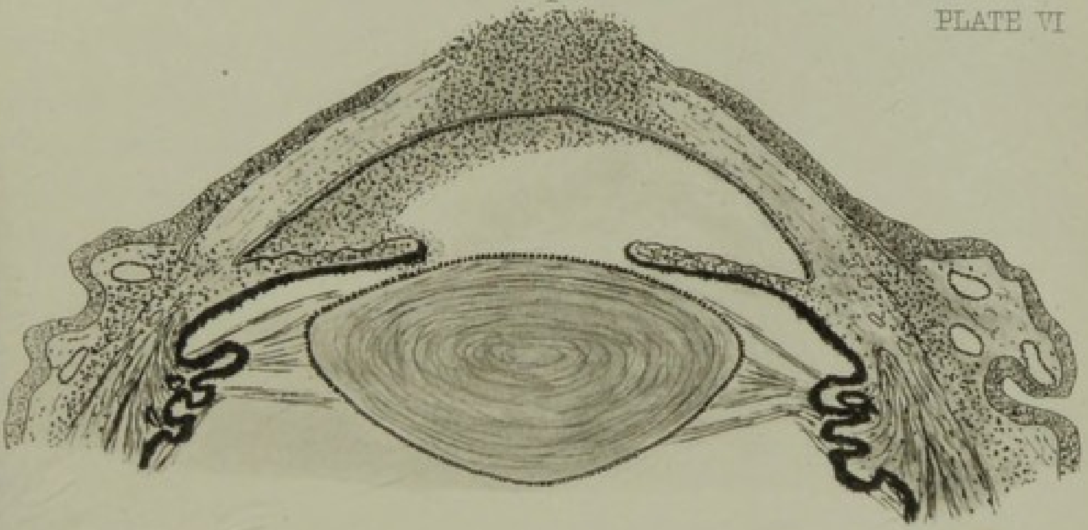
SERPIGINOUS ULCER—HYPOPYON AND ANTERIOR STAPHYLOMA.

Fig. 1 illustrates a case of acute ulcer of cornea with hypopyon following injury and sepsis. It is magnified six diameters. The surface of the ulcer projects beyond the corneal outline (the infiltration being more extensive towards the posterior surface of the cornea), and the floor reaches to Descemet's membrane, which, however, is intact, although its endothelial lining is markedly infiltrated with inflammatory cells. There is a dense aggregation of inflammatory corpuscles, and a condition of well-marked keratitis. The surface epithelium is infiltrated with leucocytes, and is perforated by the ulcer mass. Bowman's membrane is seen as a homogeneous band projecting beyond the ends of the epithelium, but it also is ruptured at the centre. There is a dense infiltration of the conjunctiva at the limbus of the ciliary region, and of the iris, with inflammatory cells; but at the meridian where the section has been made no posterior synechiae are visible. The anterior chamber contains a large quantity of pus in its lower part—hypopyon.

Fig. 2 illustrates a case of anterior staphyloma following ulceration. The figure represents the eye of a woman, forty-eight years of age, who had for two years suffered from progressive corneal ulceration. The globe was enucleated on account of increased tension and intense pain. The anterior chamber is deep and irregular in outline, with the thinnest part of the cornea at the apex of the staphyloma. The structure of the cornea proper is, in a low-power view, much obscured at this part, as it consists chiefly of densely packed fibres of cicatricial tissue; but the epithelium itself is not much altered. The thicker parts of the cornea show a more fibrous structure than is natural; the presence of numerous darkly-stained corpuscles indicates that the inflammation has not entirely passed away. The iris is bound down to the posterior surface of the cornea by inflammatory exudation, and pigment has been deposited over the whole surface of the cornea. The endothelium of Descemet's membrane is obscured by the pigmentary deposit, and the ciliary body is atrophic.

1

PLATE VI



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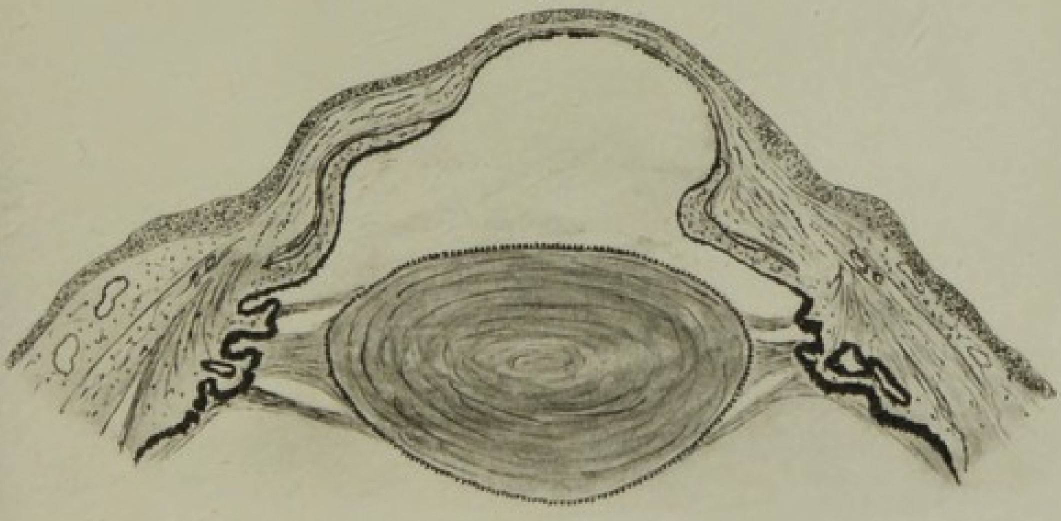


to that induced by the diffusion of a chemical poison, and, as a result, the circumcorneal vessels become dilated, and there is a rapid migration of white blood corpuscles through their walls. These leucocytes quickly force their way through the cornea to reach the spot where the microbes are most active. The nearer they approach this, however, the more intense becomes the action of the toxins, and at length, overpowered by the poison, many perish and form a purulent zone round the ulcer, while those which survive enter the microbe area to wage war against the germs. According to this view the cornea is perfectly passive, and the leucocytes wander through it at will, to overcome the action of the microbes, or to be themselves overcome and to meet their death by poisoning in the neighbourhood of the infected area.

The cornea is not, however, a passive agent; on the contrary, it is intensely active, and its protoplasmic elements respond at once to the very slightest irritation. Throughout every part of the substance of the cornea are corpuscles united the one to the other by thread-like prolongations, so that in its essence the corneal tissue may be regarded as a sheet of protoplasm, and consequently one of the most vital structures in the body. (Plate VII., Fig. 1.) Under ordinary circumstances these corpuscles proliferate and multiply to provide for the growth and maintenance of the cornea, so it is not surprising to find that under the increased stimulation brought about by disease this physiological activity becomes greatly exaggerated. No one has investigated this subject with greater care than Dr. Thomas Reid, and he has demonstrated that this process of proliferation of the fixed corneal corpuscles begins almost from the very moment of the injury, and in a specimen he obtained, enucleated twenty-four hours after the occurrence of an abrasion, this new development of protoplasm extended throughout the entire thickness of the cornea; and on Descemet's membrane, even at this early period, there were signs of exudation associated with proliferation of its endothelial cells. (Plate VII., Fig. 2.) Dr. Reid's microphotographs also demonstrate that at a later stage the protoplasm is broken up and has, throughout its substance, an immense number of round bodies, which bear no resemblance to leucocytes on the one hand, or to the original nuclei of the corneal corpuscles on the other. (Plate VII., Fig. 3.) Whatever these may be, they seem to be the result of an expiring effort on the part of the protoplasm to restore the injured tissue before the corpuscles become completely destroyed. It appears probable, therefore, that coincident with the migration of leucocytes there is also proliferation of the fixed corneal corpuscles—the former try to protect the cornea from the invasion of the microbes, the latter to repair the structural damage which the micro-organisms have caused.

The irritant action of the toxins extends to the deeper parts as well as along the surface, and so, in the course of serpiginous ulcer, not only do the vessels surrounding the cornea undergo the changes already

PLATE VII.

SERPIGINOUS ULCER—CORNEAL CORPUSCLES.

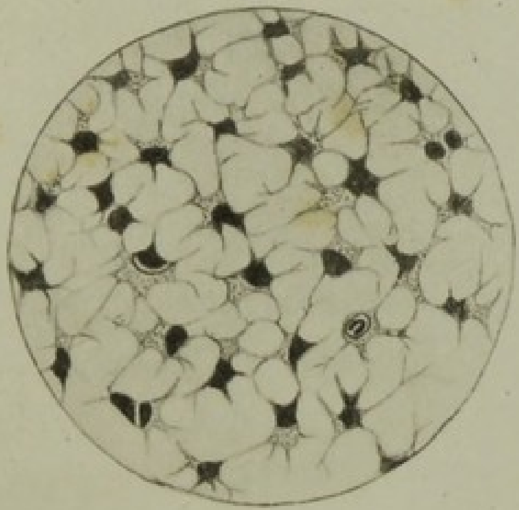
Plate VII. shows drawings made by Dr. J. Hamilton M'Ilroy from microphotographs of specimens prepared by Dr. Thomas Reid. In Fig. 1, where the corneal corpuscles are magnified 350 diameters, the specimen was prepared by macerating the cornea of a calf for six months in vinegar. Under this treatment the cornea swells up into a pulpy mass, a small portion of which is pressed between a slide and a cover glass and stained with haematoxylon. The corpuscles in their normal condition have their processes anastomosing with one another. The nuclei of the cells are more deeply stained than the surrounding protoplasm which is slightly granular. In some cases the nucleus is seen to be sub-divided, exemplifying the normal condition of vitality; but should any irritant be present the process rapidly becomes much exaggerated, as is shown in Fig. 2.

Fig. 2 shows a section of the cornea of a patient in whom septic ulceration had set in after an operation for extirpation of the Gasserian ganglion. It is magnified 70 diameters. The globe was enucleated within twenty-four hours of the time when the ulcer was first observed. The epithelium is absent at the site of the ulcer except for the presence of a few adherent cells. Bowman's membrane shows no loss of continuity, but it has been raised slightly by the aggregation of inflammatory cells immediately beneath. These are seen in side view and are very numerous, while their active condition is made manifest by the proliferated nuclei. The normal regularity in the lamellation of the cornea is obscured by the presence of these cells, which are most numerous at the surface and become less so towards the posterior aspect. The area occupied by them is somewhat wedge-shaped, with the base outward. At the posterior surface the cornea has more or less its normal appearance and regularity. The intensely irritating character of the toxins is shown by the appearance, even at this early period, of inflammatory cells on Descemet's membrane.

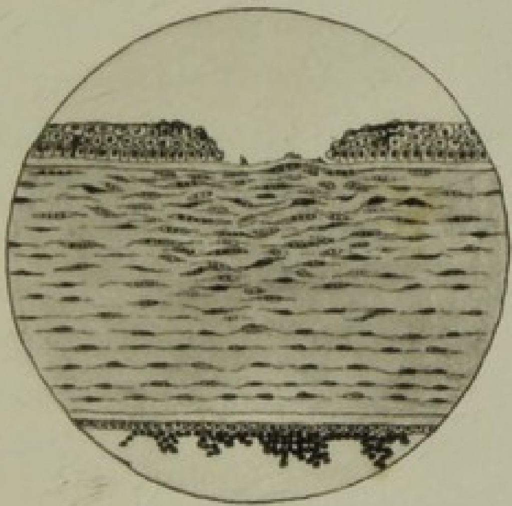
Fig. 3 illustrates corneal corpuscles showing degeneration after injury. The outlines of the corpuscles can be made out, but they are foggy as compared with the distinct and sharp contours of the normal condition. The protoplasm and nucleus are practically indistinguishable from one another. The beaded appearance is due to degeneration.

PLATE VII

1



2



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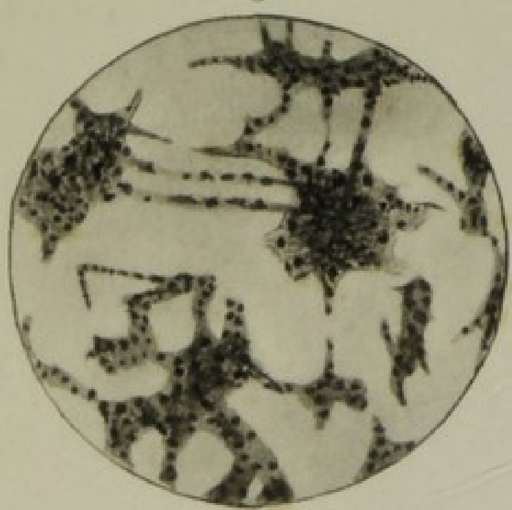


described, but at a very early period those of the iris and ciliary body are also implicated. It is this action of the toxins upon the highly vascular uveal tract that in great part determines the occurrence of hypopyon. Formerly it was believed that the pus in the anterior chamber came direct from the ulcer through a perforation in Descemet's membrane, but that is by no means a full explanation, because in some instances pus can be seen actually rising up from behind the iris and entering the aqueous through the pupil. Besides, if in all cases there was direct communication between the ulcer and the hypopyon, one would expect to find in the latter micro-organisms similar in kind to those present in the former. Such, however, is rarely the case, for if in the early stages the pus in the anterior chamber be examined for bacteria, no micro-organisms are found, and such a negative result points to the conclusion that hypopyon is due, in its beginning at least, to the irritant action of toxins rather than to the presence of the micro-organisms themselves. The pus of the hypopyon being sterile its evacuation cannot be regarded as analogous to the opening of an abscess. In many cases, too, and especially during the early periods of the disease, the pus in the anterior chamber is intimately mixed with fibrinous exudation which can be derived only from the blood-vessels of the iris and ciliary body. To this view of the case clinical experience also lends support. In hypopyon ulcer, where the exudation into the anterior chamber is so plastic that it does not flow out after paracentesis, but requires to be removed by forceps from the lips of the wound in the cornea, the prognosis is usually more favourable than it is when the pus is quite fluid, varying in amount from day to day, and emptying itself completely after an opening has been made into the aqueous chamber. I have never been able to demonstrate it, but I think it is very probable that in the latter cases a rupture has taken place in Descemet's membrane, whereby the micro-organisms have gained entrance to the interior of the eye, and have inoculated the hypopyon, which they have liquefied by their action upon the fibrin intermingled with the pus cells.

If left to itself, serpiginous ulcer progresses steadily until at length the cornea gives way, and in the most virulent cases the micro-organisms, finding a soil suitable for their propagation in the uveal tract and the vitreous, speedily set up such intense inflammation that every tissue in the eyeball is involved. Happily, however, owing largely to improved methods of treatment, panophthalmitis need not nowadays be a common sequel to hypopyon ulcer, for even although perforation of the cornea takes place this is often the turning point in the course of the disease, and recovery may be said to begin from the time when it occurs. The prognosis of serpiginous ulcer is, however, always serious; for even where early perforation brings with it arrest of suppuration before the cornea has been extensively destroyed, a dense white scar remains, and as this is usually situated in front of the pupil, sight is seriously impaired, and can be only imperfectly restored by operation. There is, moreover, another source of anxiety. If pyogenic micro-organisms gain admission to the eyeball their presence causes danger not only to the eye primarily attacked, but also to its fellow, which, from the intimate and peculiar nervous and vascular connection existing between the two eyes, is liable to suffer from sympathetic ophthalmitis. Whenever, therefore, the cornea has been destroyed so completely as to preclude all hope of restoring sight, the wisest treatment is to enucleate with as little delay as possible.

The most important indications for the treatment of serpiginous ulcer are to keep the eye at rest, to protect it from further injury, and to relieve pain. The patient ought to remain in bed with all bright light excluded from the room, and the eyelids should be closed by a bandage, so as to promote healing by keeping the parts at rest. In order that the bandage may lie smoothly, and not exert unequal pressure, the hollows at the inner canthus and beneath the orbital margin should be filled up carefully with cotton wool. This ought never to be neglected; a bandage carelessly applied is worse than useless. When there is discharge from the lachrymal sac, means must be taken not only to arrest it but also to keep the tear-passages clear. As iritis is a constant complication, atropine must be instilled from the very outset; locally it soothes the nerves and diminishes vascular congestion, while by dilating the pupil and paralysing the ciliary muscle it ensures physiological rest for the eye. The effect of atropine upon the pupil is one of the safest guides in prognosis, for the more quickly the iris responds to the influence of the mydriatic, the more favourable will be the course of the disease. When pain is acute, and there is much congestion of the iris, the good effect of the atropine is greatly increased by the application of leeches. In the early stages, free bleeding from the temple always does good for the time being, and in many cases brings about a favourable turn in the course of the disease. Three to six leeches may be applied round the outer canthus, or a Heurteloup's artifical leech may be employed. In either case, free bleeding from the wounds should be encouraged. It often happens that after leeching the pupil begins to dilate, although before the blood-letting it had remained persistently contracted. The atropine, in a one to two per cent. solution, should be instilled three or four times a day, but it must not be forgotten that this drug acts on some persons as an irritant, producing redness and swelling of the eyelids, accompanied by an eczematous eruption of the skin in the neighbourhood of the eye, and on others, especially if they be old and feeble, so as to cause acute delirium. These are idiosyncrasies and nothing more; but it is necessary to be on the watch, so that when such cases do occur the atropine may at once be stopped and another mydriatic substituted. When the ulcer is about to perforate, the use of eserine is preferable to that of atropine, but with this exception, the former drug has, in serpiginous ulcer, a very limited sphere of usefulness, and almost invariably it is the latter which should be employed. To avoid accidents, however, care ought to be taken to guard against any of the solution finding its way into the mouth, and while it is being instilled the lid should be drawn well away from the eyeball, and pressure applied over the inner canthus to prevent absorption by the tear passages. Moreover, when the patient is to use the drug himself, it is safer to prescribe it in the form of an ointment or of tabellae, rather than of a liquid. The liquid extract of belladonna applied to the brow will sometimes cause the pupil to dilate when instillations of atropine have failed.

When the irritation is very severe, and there is much pericorneal congestion, great benefit is obtained from the application of fomentations. Moist heat, by diminishing congestion and thereby reducing intra-ocular tension, speedily relieves pain; but a fomentation to be effective must be properly applied, and it must be repeated every two or three hours. It may be made more soothing by the addition of Battley's sedative solution of opium, or by an infusion of chamomile flowers.

If, however, in spite of this treatment, the ulcer continue to progress, a knowledge of its pathology affords the clue to further procedure. Disinfectants must be used. The eye should be freely irrigated by a hot saturated solution of boracic acid, until all discharge has been washed away, and the floor of the ulcer made as clean as possible; then a powder composed of equal parts of iodoform and boracic acid very finely triturated ought to be dusted freely over its surface. Many other disinfectants have been recommended, the most satisfactory being a collyrium of chinosol, 1 in 4,000, and solutions of the newer salts of silver—protargol five to ten per cent., collargol ten per cent., argyrol twenty-five per cent. The efficacy of the salts of silver is undeniable, but when they are instilled in solution their germicidal action is too transient, and in order to overcome this I use a disc made from a mass of gelatine and glycerine, which after being carefully sterilised is impregnated with ten per cent. collargol. The mass is then divided into thin wafers one centimetre square. When one of these is placed in the conjunctival sac, it takes from two to three hours to dissolve, and consequently the bactericidal action of the drug is steadily maintained all that time. I have found these discs of great value, but in a few instances they have caused so much pain that their use has had to be discontinued and argyrol in solution substituted. Iodine-vasogen is another antiseptic of undoubted value. It is employed in ten per cent. solution, and ought to be thoroughly applied by means of a camel hair pencil to the whole of the ulcerated surface two or three times a day. Some advocate the use of sub-conjunctival injections of solutions of mercurial salts, but my own experience of this form of treatment is not such as to warrant the expression of a strong opinion in its favour.

In addition to such local means general constitutional treatment is always required. A calomel purge—three to ten grains, followed in a few hours by a saline draught—is necessary in most instances, and after this has acted a distinct improvement in the condition of the eye is frequently seen. The patient must be well-fed, and if old and weakly should have a small quantity of alcohol with meals, malt liquors (if they do not disturb digestion) being preferable to any other form of stimulant. The drugs of most value are quinine in full doses, and opium administered by the mouth, or morphia by hypodermic injection.

After forty-eight hours of the treatment just described most cases begin to show signs of improvement, but if the pain and other symptoms of irritation are in no way relieved, if the pupil does not dilate, and if the ulceration progresses, the actual cautery should be applied without delay. Under such circumstances the only hope of arresting the disease lies in destruction of the infiltrated spreading edge of the ulcer. To be of any service, however, the cautery must be used thoroughly, and as the infection of the cornea extends beyond the apparent margin of the ulcerated surface no operation should be attempted until the boundaries are demarcated by instilling an alkaline solution of fluorescein. The resulting bright green line then serves as a guide, a fine platinum wire heated to a dull red being applied to the cornea just outside of it, and the burning continued till every part of the infiltrated margin is thoroughly destroyed. It sometimes happens that pus is enclosed between the layers of the cornea, forming an abscess, and when that is so its evacuation must be effected by repeated punctures of the floor of the ulcer with a fine cautery point, each application being followed by the appearance of a minute drop of pus. As healing will be greatly promoted by the reduction of the intra-ocular tension, the cornea should be incised at its lower aspect by a keratome or a Graefe knife, and the anterior chamber slowly emptied. The evacuation of the aqueous and of the hypopyon is always attended by excruciating pain, owing to the displacement forwards of the inflamed iris and ciliary body, and on the surface of the former haemorrhages are often visible. If, however, a fomentation be at once applied to the eye, and one-sixth of a grain of morphia injected under the skin of the temple, the patient's sufferings are mitigated so much that in a short time he falls into a sound sleep—the first, perhaps, since the onset of the disease. If the cauterisation has been properly performed, healing begins at once and proceeds rapidly, and, unless fresh inoculation take place, the progress of the case will be uninterrupted until cicatrisation is complete, the resultant scar being usually much less than would have been anticipated from the extent and virulence of the ulceration. In many cases vision can be greatly improved by an iridectomy, and the deformity produced by the scar may be lessened by tattooing. (Plate V., Fig. 2.) Dionine promotes the absorption of inflammatory deposits in the cornea in a most wonderful way, and its action is greatly increased if it be used along with collargol. The best results are obtained when a five per cent. solution of dionine is instilled in the morning, and a disc of ten per cent. collargol gelatine is placed in the conjunctival sac in the evening. I am satisfied that this procedure hastens the clearing of the cornea after an attack of ulceration, and I recommend it strongly after the use of the cautery.

Fresh infection is always accompanied by recurrence of pain, and is, in most instances, due to carelessness on the part of the patient. Rest in bed, and the careful application of a bandage until the ulcer has healed completely, are in my experience essential parts of the treatment, and if these precautions be rigidly followed they will almost certainly prevent the occurrence of anterior staphyloma of the cornea. (Plate V., Fig. 3; and Plate VI., Fig. 2.) It sometimes happens that, through neglect, the cornea is destroyed so extensively before the case comes under skilled treatment that it is not possible to apply the cautery. In these circumstances the cornea ought, as Saemisch recommends, to be freely incised with a linear section knife, to permit the escape not only of the hypopyon, but also of the pus contained between the corneal lamellae. The wound ought to be kept open for several days to facilitate drainage. This treatment has the obvious disadvantage of allowing the iris to become extensively adherent to the wound in the cornea, but its use in desperate conditions is always to be recommended, because sight may thus be saved in cases which would otherwise inevitably result in total blindness, if not in complete destruction of the eye.

The practical lesson to be learnt from all this is that, as it is infection rather than traumatism which brings about serious injury to the cornea, proper precautions and early attention to all trivial injuries will prevent the occurrence of suppurative keratitis, but if inoculation has occurred and ulceration is progressive, early and thorough application of the cautery is likely to cause its arrest. In the treatment of serpiginous ulcer, once so formidable and intractable, modern ophthalmology has obtained one of its most brilliant successes.

CHAPTER V.

CONTUSION INJURIES.

THE eyeball is a semi-fluid mass enclosed by membranes possessing little elasticity, consequently when it is struck by a blunt object there may simply be concussion of the whole globe, a portion of its surface may for the moment be flattened, or, if the blow be severe enough, the containing walls may give way and allow the contents more or less completely to escape. (Plate VIII., Fig. 3; and Plate IX., Fig. 3.) Such injuries may be caused in many different ways—by a blow from a fist, a stone, a cricket or a tennis ball; by the impact of a cork suddenly expelled from a bottle of aerated water; by the rebound of a chip while wood is being chopped; by the flick of a whip-lash, of a sail, of a rope, of a branch of a tree, etc. Of any sharp sudden shock, indeed, the structures of the eye are peculiarly intolerant, and many persons have lost their sight as a result of a contusion injury which seemed at first to be very trivial. On the other hand, a heavy blow, falling as it does more on the surrounding parts, may be unattended by damage to the eyeball itself. For instance, in a street fight, where the combatants face one another, eyes are not often seriously damaged, although the amount of swelling and discolouration of the lids may be extreme; but on the other hand the would-be peacemaker, going in from the side, is very apt to have his eyeball burst as the result of a blow at the outer canthus where there is practically no protection.

Naturally then concussion injuries divide themselves into those where the full force of the violence falls on the lids and surrounding parts, and those where the eye itself is damaged.

First.—Where the full force of the violence falls on the lids and surrounding parts.

The simplest and most familiar example of an accident of this kind is a black eye—ecchymosis of the eyelids. The circumorbital tissues are so lax that a blow at once induces rapid swelling of the lids and of the surrounding parts, all of which speedily become discoloured from the effusion of blood. This would of itself pass away in about a fortnight; but the disagreeable ideas so often associated with a black eye, and the unsightly appearance it presents, make patients extremely desirous to get rid of all traces of this form of injury. The swelling and discolouration may be kept in check by the application of cold and a pressure bandage. Nothing is more efficacious than a pocket-handkerchief dipped in cold water and tied tightly over the eye. Many so-called specifics have been recommended—arnica, hazeline, a raw beefsteak, a slice of raw ham, etc.—but it is doubtful if any of

PLATE VIII.

CONTUSION INJURIES OF EYEBALL.

Fig. 1 illustrates the case of a woman, sixty-nine years of age, who, a month before I saw her, fell and struck her eye against the corner of a table. When the great swelling and discolouration of the lids which followed had disappeared, it was seen that there was a large effusion of blood beneath the conjunctiva at the upper aspect of the cornea (which it partially overlapped), and in the centre of the blood-clot was a distinct swelling whose contour corresponded exactly with that of the crystalline lens. The discoloured and blood-stained iris was lacerated at its upper aspect, so that the pupil was dragged upwards. The intra-ocular tension was reduced, there was considerable tenderness on pressure over the ciliary region, and vision was completely gone. Here evidently the ball was ruptured, the sclerotic having given way at its upper and inner aspect just beyond the corneo-scleral border. See Plate IX., Fig. 2.

Fig. 2 illustrates the case of a lad, twenty-two years of age, who was accidentally struck on the left eye with a bar of iron which had been carelessly thrown aside by a fellow workman. So severe had been the blow that the ball was flattened in front and otherwise knocked out of shape. When I first saw the patient, the anterior chamber was full of blood, and as the hyphaema disappeared it was seen that the iris had been ruptured at its upper aspect, and that the lens was dislocated backwards into the vitreous chamber. The lens was extracted a week after the accident, and no inflammatory reaction followed the operation. After the wound was healed, however, the iris was seen to be drawn backwards by adhesions, and a large mass of exudation from the ciliary body was visible at the lower aspect of the pupil. The eye was quite blind, probably from rupture of the choroid and detachment of the retina, and on ophthalmoscopic examination only a faint red reflex was seen; but there was no pain or tenderness on pressure.

Fig. 3 illustrates the case of a young man who told me that, the night before I saw him, when he was on his way home, he had been assaulted and robbed by a gang of ruffians, and had received a kick upon the right eye. The excruciating pain and great loss of blood caused him to faint, and he was found in an unconscious state by a policeman some time afterwards. There was a wide rent in the sclerotic, through which it was evident that the clear structures of the eye had escaped, and through which a large prolapse of the choroid and retina had taken place. The ball was filled with blood, which had also infiltrated the substance of the cornea and formed a thin layer in front of the iris, giving rise to the appearance of a pupil though no pupil was there. The conjunctiva was chemosed, and the lid was swollen and discoloured. When the globe was enucleated, it was found to be occupied by a large blood clot, all the proper intra-ocular structures having escaped except some fragments of the uvea and the retina.

PLATE VIII

them is of the slightest use in hastening the natural process of absorption. If it be very important to get rid of the disfigurement, the expedient of painting the parts should be resorted to. The application of leeches is not to be recommended, neither is puncture of the skin; and the practice of sucking out the effused blood is objectionable, and not without danger: I have known it cause a chancre of the eyelid.

When the injury is more severe, the bones at the inner side of the orbit are fractured, and communication with the frontal and ethmoidal sinuses is opened up, thereby allowing air to enter the surrounding cellular tissues—emphysema of the eyelids. This is usually accompanied by epistaxis, and the nature of the soft swelling is readily distinguished by its crackling to the touch, and increasing rapidly in size when the patient blows his nose. Here again the best method of treatment is the application of a pressure bandage. The patient should also, of course, be warned not to blow his nose.

Since the time of Hippocrates it has been known that blows on the frontal, or on the malar, region are sometimes followed by blindness. The explanation is that such injuries frequently cause fracture through the optic foramen. The optic nerve is thus torn or compressed, and the vision immediately extinguished. Accidents leading to this result may occur in many different ways. In one typical case which came under my notice the patient fell when stepping off an electric car while it was in motion, in another he had lost control of his bicycle and been thrown against a wall, and in the third he fell from a scaffold. In every one of these the loss of sight in the affected eye was sudden and complete. Of course, after an injury of this kind the general symptoms of concussion first occupy the attention of the medical attendant, and it is usually several days at least before any definite opinion can be formed regarding the state of the eyes. Not till after the patient has recovered consciousness is any complaint made of loss of sight. In the three cases referred to no proper examination of the eyes was made for some days after the accident. Even then in none of them was there anything abnormal in the external appearance, and, although the blindness was absolute, the ophthalmoscope revealed no pathological changes in the fundus oculi. The reaction of the pupil, however, showed that the optic nerve had been injured; for although the consensual reflex was present, and the pupil of the blind eye responded to the stimulus of light, yet the contraction was only partial and momentary, and full dilatation occurred while the light was still being held in front of the eye. The serious nature of the condition could not be misunderstood, and in a few weeks it was easy, by means of the ophthalmoscope, to detect complete atrophy of the optic nerve.

In such a state of matters treatment is obviously impossible. Even though the skiagrams taken demonstrate an obscure line of fracture, the X-rays are not of so much assistance in diagnosis as one would imagine.

PLATE IX.

CONTUSION INJURIES OF EYEBALL.

Fig. 1 shows the eyeball of a man who was injured by a blow from a stick. Iridocyclitis, accompanied by extremely high tension and great pain, set in, and as, at the end of two months, there was no improvement, the eye was enucleated. The ball appears to be of normal dimensions. The anterior chamber is rather deep, and is entirely occupied by the large transparent lens, which has become dislocated forwards through the pupil. The posterior surface of the lens is covered with a thin but dense white exudate, and this is continuous with the large mass of rather clear exudate which lies behind the iris and ciliary region. The rest of the eyeball exhibits no marked pathological changes. The retina and choroid are *in situ* and appear healthy.

Fig. 2 shows a case of rupture of the ball, accompanied by severe intra-ocular haemorrhage and escape of the ocular contents. The patient, a stoker, was struck by a piece of glass from a burst steam-gauge. On his admission to the Ophthalmic Institution it was found that the large wound near the corneo-scleral margin of the left eye was infected and purulent; the iris was prolapsed, and the lens had escaped through the lips of the opening and the vitreous was escaping. The eye was enucleated the day following the accident. The ball is somewhat collapsed laterally; there is a large gaping wound near the periphery of the cornea; the iris and ciliary body at the side are drawn into the opening; and the free portion of the iris lies closely applied to the posterior surface of the cornea, the anterior chamber having completely disappeared. A small portion of the lens capsule remains behind the iris, but the transparent lens is seen lying under the conjunctiva just below the wound. The large mass which is seen prolapsing through the wound consists chiefly of the semi-purulent vitreous; and the retina is detached in its posterior portions and thrown into folds, there being a considerable amount of haemorrhage between it and the choroid, as well as in the space formed by the detachment of the choroid itself from the underlying sclerotic. Spots of haemorrhage occur over the external surface of the sclerotic.

Fig. 3 shows the eye of a man, fifty years of age, who was accidentally struck on the face by rubbish thrown up during blasting operations, carried on by means of dynamite. The patient was admitted to the Ophthalmic Institution three days after he had been injured. A ragged healing wound was seen just below the eyebrow; the lids were greatly swollen, and the conjunctiva was very much chemosed; the cornea was dull, and marked with striae on its posterior surface; there was haemorrhage in the anterior chamber; the pupil was obscured; and only a small rim of iris could be seen. The superficial layers of the cornea were intact. The eyeball was extremely soft and yielding, and there was pain on palpation. The diagnosis of rupture of the eyeball is fully borne out by examination of the enucleated specimen. The globe is entirely filled with blood-clot, and both cornea and sclerotic are deeply stained by the extravasated blood; the anterior chamber is very deep, and the ciliary region with the anterior portion of the choroid are detached; the lens is cataractous, and displaced backwards by the blood-clot in front of it, while the capsule is deeply stained; the retina is pink and oedematous, and is partially detached from the choroid; and the choroid is, at its posterior portion, almost indistinguishable from the general blood-clot, though in its anterior portion the pigmentary tissue stands out with fair distinctness. There is no definite breach in the contour of the globe, and the haemorrhage was probably caused by concussion.

PLATE IX

Eye Injuries and their Treatment
A. Maitland Ramsay, M.D.

James MacLehose & Sons,
Publishers, Glasgow

If it were possible at first to detect the real nature of the injury it might be practicable to open into the orbit by removing its outer wall as recommended by Krönlein, and, when the optic nerve has been thus exposed, to relieve the pressure, or to re-unite the torn ends. After a blow on the head it occasionally happens that there is complete paralysis of all the muscles of the eyeball—ophthalmoplegia externa and interna. In such a case the lesion is at the sphenoidal fissure through which the third, fourth, and sixth nerves, and the ophthalmic division of the fifth, enter the orbit; and, in addition to the motor paralysis, there is also anaesthesia of the parts supplied by the ophthalmic division of the trigeminus. When the nerves are simply compressed by blood-clot, or by inflammatory exudation, more or less complete recovery may be expected as absorption takes place; but when the bones are fractured and the nerves torn, the paralysis remains permanent.

Second.—When the eyeball is itself damaged.

When an eye is struck the patient generally experiences severe pain, and may for the moment feel stunned. Examination usually reveals slight abrasion of the cornea, injection of the conjunctiva, congestion of the iris, contraction of the pupil, and more or less dimness of sight. The pupil does not readily yield to atropine, which may have to be instilled several times before full dilatation is produced. Even then the expansion is often irregular, and it is characteristic that the shape frequently becomes oval before assuming the natural circular form. The eye waters, and is so intolerant of light that it may be difficult to make an ophthalmoscopic examination; but if this be possible, it is, as a rule, seen that the details of the fundus are indistinct, as if viewed through a cloud of smoke. If, however, the injury has been more severe, the optic disc shows clear signs of congestion, and between it and the macula the retina presents a greyish swollen appearance. Berlin has described this condition under the name of commotio retinae, and has demonstrated that, in addition to oedema of the retina, there are also minute haemorrhages between the choroid and sclerotic.

These instances of concussion of the eyeball differ only in degree, and, although spontaneous recovery in a few days is the rule, it is well not to trust to a purely expectant line of treatment, but at once to adopt antiphlogistic measures. As soon as possible after the accident put the patient to bed, instil atropine, leech the outer canthus freely, apply a cold compress, and administer a purgative.

In blows of much severity the symptoms just described as due to concussion are complicated by haemorrhage, which may be sub-conjunctival or intra-ocular. Sub-conjunctival haemorrhage may be limited to the spot where the eyeball was struck, or, as sometimes happens, may completely cover the sclerotic. The effused blood forms a clot visible through the transparent conjunctiva and bounded in front by the corneal limbus. Now and then, however, these limits are overstepped, and blood finds its way for a short distance into the substance of the cornea. It always more or less completely hides the sclerotic, and this changed appearance of the eyeball is at once noticed by the patient or his friends, and usually causes much anxiety. Gradually the clot becomes absorbed, passing through varying shades of brown and green and yellow, until the sclerotic again becomes visible. The time required for the disappearance of the blood varies from a few days to several weeks, but in all cases in which the haemorrhage has been extensive a yellowish staining of the white of the eye remains for a much longer time. When sub-conjunctival ecchymosis occurs immediately after an accident it is of very little significance, and Nature alone will do all that is required for its removal, so it is rather with a view to calming the fears of the patient than with the idea that the process of absorption will be in any way hastened, that a lotion containing arnica or hazeline is prescribed. It must, however, be remembered that if the haemorrhage makes its appearance after a lapse of several days the prognosis is very serious, because it is then one of the most trustworthy indications of fracture through the anterior fossa of the skull. This sign is, therefore, of great value as indicating a grave condition which may be followed by death, so that it is always very important in every case of injury to the head to note whether sub-conjunctival ecchymosis be present, and to enquire whether it appeared immediately after the accident or not for several days.

Intra-ocular haemorrhage is always serious, though the gravity of the condition is much less when the blood is in the aqueous, than when it is in the vitreous, chamber. It may indicate not only rupture of blood-vessels, but also rupture of some of the internal structures of the eyeball. As long as the haemorrhage persists, it is, of course, impossible to say how much damage has been done, and it is only after the clot disappears that the true nature of the injury becomes apparent. If the effusion be confined to the aqueous, the bleeding comes from the vessels of the iris or ciliary body, but if it be into the vitreous, it comes from the vessels of the choroid or retina.

The iris frequently suffers. As a result of a contusion both iris and ciliary body may be paralysed, and, though occasionally either or both of these conditions may persist, yet, in most instances, the dilatation of the pupil and the loss of the power of accommodation pass away in a few days. Structural lesion, whether it occur at the pupilary border or at the ciliary margin, is permanent, although in its slighter forms it does not necessarily interfere with sight. A small clot arising from simple rupture of blood-vessels may easily be mistaken for a structural tear—an error that time will soon show, as the blood will quickly disappear. Lacerations of the pupilary border so small that they can be detected only by careful examination give rise to permanent dilatation of the pupil, and if a distinct rent be visible the pupil will also be irregular in outline. When the iris is separated from its ciliary attachment (iridodialysis) the point of lesion is marked by a black crescent, and the pupil loses its rounded form, being flattened on the injured side. If the aperture be at first small, it will, in course of time, become less, but if it be large it will always remain visible, and when light is transmitted to the eye by the ophthalmoscope a red reflex is obtained through the rupture as well as through the pupil. In severe cases there may be more than one lesion, and occasionally the whole iris is separated, and may either lie loose in the anterior chamber, or be extruded from the eyeball, giving rise to the condition known as traumatic aniridia.

Haemorrhage from the vessels of the choroid is always a very serious matter, because the blood will be effused either between the sclerotic and the choroid or between the choroid and the retina. The former condition involves separation of the two structures concerned, and the latter more or less extensive detachment of the retina. The history of the accident, the suffering of the patient, the appearance presented by the eye, and the diminution of the intraocular tension, would lead one to suspect rupture of the choroid even although the presence of the blood render it impossible to see the lesion. When, after a time, longer or shorter according to the size of the blood-clot, the media become sufficiently transparent to permit the fundus to be seen, there will be found in the choroid, usually to the outer side of the papilla, one laceration, possibly more than one. The rupture shows itself as a narrow streak thick in the middle, pointed, and sometimes branched at the extremities, and bordered by pigment, the white colour being due to the fact that the sclerotic is visible through the tear. As time goes on the inflammatory symptoms subside, and the outline of the lesion is more sharply defined, while in many instances the posterior pole of the eye becomes distinctly pigmented.

Rupture of the retinal vessels through violence is not nearly so common, and when it does occur the haemorrhage takes place, as a rule, between the retina and the hyaloid, giving rise to a large disc-shaped clot situated, in most instances, in front of the macular region. That the retina itself is not seriously implicated in this bleeding is clear from the fact that, although the patient may not be able to distinguish any object, yet when he looks at a gas or candle flame it appears red, this being due to the blood colouration. Such clots become, in most cases, gradually absorbed, and, if the eye has not been otherwise injured, the sight will, in course of time, be completely restored.

Where detachment of the retina is the result of violence the prognosis is much more favourable than when it is due to disease; but under any circumstances the condition is always most serious. If the detachment is localised it will be distinctly visible on ophthalmoscopic examination, and its extent may be mapped out by the restriction of the visual field as measured by the perimeter. In such cases much may be accomplished by suitable treatment, but if the separation be complete there is no hope of recovery of sight.

A contusion so severe as to produce the injuries just described will also almost certainly cause rupture of the zonule and dislocation of the lens. (Plate VIII., Figs. 1 and 2; and Plate IX., Figs. 1 and 2.) The displacement may be partial or complete. In the former case the lens remains in the posterior chamber, its black outline being readily visible on ophthalmoscopic examination, and if the vitreous be fluid it is seen to swing up and down, and the iris, deprived of its support, trembles with the movements of the eye. In complete dislocation, the lens may be forced into the vitreous, and may lie at the bottom of the chamber quite removed from the line of vision. In other cases, more especially if it be small, it escapes through the pupil and falls into the aqueous. In this situation it acts like a foreign body, and may give rise to much trouble by setting up secondary glaucoma. After dislocation the lens may remain transparent, but more usually it becomes cataractous, and in old-standing cases undergoes calcareous degeneration, its bulk being so much reduced that it slips backwards and forwards through the pupil without any difficulty. When the injury is more severe, the tissues of the eyeball are ruptured, and the lens escapes beneath the conjunctiva. The sclerotic usually gives way at its upper or inner aspect, just beyond the corneo-scleral border, where it is naturally weak owing to the presence of the canal of Schlemm. It is easy to distinguish the lens as a little swelling covered by conjunctiva. At the site of the rupture the iris seems wanting owing to its having been driven back into the vitreous at the time the lens escaped. Here, as in the other instances that have been described, the true nature of the injury is at first often obscured by the occurrence of haemorrhage, followed later by considerable inflammatory exudation. Although the upper and inner aspect of the globe is the usual site for rupture of the sclerotic, the eye may, through direct violence, be burst at any point. Where the blow is a very severe one the rent in the tunics is so large that the clear structures escape, and the choroid and retina prolapse through the wound. The globe becomes filled with blood, which may infiltrate the substance of the cornea and form a thin layer in front of the iris, giving rise to the appearance of a pupil although no pupil is there. There is always great chemosis of the conjunctiva, and swelling and discolouration of the lids.

In the treatment of these severe conditions one must necessarily be guided by circumstances, and good results can follow only if the structural damage has not been extensive. A clot in the aqueous is readily absorbed, but one in the vitreous is much more persistent. It breaks up in course of time, but traces of it remain in the form of little black flakes which disturb sight. It may, however, as a general rule, be said that the antiphlogistic line of treatment, mentioned when concussion was being dealt with, is applicable to all cases in which there is any chance of recovery, and that, in addition, special complications require special remedies. Traumatic separation of the retina is most likely to be benefited by rest in bed, and by sub-conjunctival injections of saline solution as highly concentrated as can be borne.

My method of treatment is as follows: The patient is kept in bed, lying for most of the time on his back, and both eyes are closed with a pressure bandage. In every case where the site and character of the detachment are deemed favourable, scleral puncture is performed. Careful attention is paid to the patient's general well-being—he is suitably dieted and special care is taken to ensure regular and efficient action of the bowels, kidneys, and skin.

On the second or third day of the treatment, the first injection is made—five to twenty mimims of 1 in 2000 bicyanide of mercury, with eight per cent. chloride of sodium, being the usual solution used. An ordinary glass hypodermic syringe with an irido-platinum needle is the instrument employed, every care being taken to ensure asepsis. An assistant separates the eye-lids with his fingers, a fold of conjunctiva as near as possible to the site of the detachment is picked up with fixation forceps, the needle is inserted well backwards, avoiding Tenon's capsule, and the fluid is injected very slowly. The ocular conjunctiva rises in a bleb, but this soon disappears, being replaced by a diffuse oedema. Severe pain always follows, though this is mitigated by the use of chemically pure chloride of sodium and by the addition of a few drops of a one per cent. acoine solution to the injection fluid immediately before use. Some suffering, more or less severe, is inevitable, but this may be prevented from becoming unbearable by the application of a fomentation immediately after the injection is made. As a rule, the patient expresses himself as feeling much more comfortable whenever the heat is applied to the eye.

On the day following the injection there is marked increase in the intra-ocular tension, and the fluid media are seen to be distinctly hazy; but this loss of transparency is only of brief duration, and even forty-eight hours after the first injection the patient declares that his sight is clearer. In from four to six days the conjunctival oedema has, as a rule, disappeared, and the eye is ready for another injection. The average number of injections given is from four to six.

When the treatment just outlined has been tried for from ten days to a fortnight without any manifest improvement, a sub-cutaneous injection of an eighth to a fourth of a grain of pilocarpine is given. The free diaphoresis thus induced occasionally marks the starting point on the road to recovery.

A marked chemosis of the conjunctiva is essential to the success of the treatment, the improvement in vision seeming to go on *pari passu* with the degree of reaction following the injections. On this principle I am in the habit, when the reaction is absent or ill-marked, of increasing the strength of the fluid employed. Formerly I used in these cases the saturated saline solution recommended by Dor, but this, though efficacious in many ways, was always followed by such severe pain and sickness that a substitute was sought for.

This was found in dionine, and now far more powerful effects are got when one to two per cent. of dionine is added to the above mentioned bicyanide of mercury and chloride of sodium solution.

Opinions differ regarding the modus operandi of the saline injections. Some say the process is osmotic, but for obvious reasons this explanation cannot be accepted in every case. It is more likely that the injected fluid acts simply as a local counter-irritant, and this is borne out so far at least by the experimental researches of Dr. Karl Wessely. According to this authority the injection is followed by dilatation of the blood-vessels of the ciliary area, and the aqueous comes to contain a large amount of albumen, such results being due to the injection acting as a powerful conjunctival stimulus upon the vaso-dilator mechanism of the eye.

The average duration of the whole treatment is about a month, but the greater my experience becomes the more am I inclined to prolong the period of absolute rest, because relapse, prone to occur at all times, takes place all the more readily in patients who have remained in bed for only two or three weeks. If after three weeks in bed no sign of improvement can be detected, further treatment is useless, for the case under these circumstances is certainly incurable.

It is very desirable that the patient should, as soon as possible, be sent to the country for a few weeks, in order that the general health may be brought up to its normal vigour. Occasionally it happens that considerable improvement occurs during this period of convalescence. The patient must always be warned to carefully avoid all acts which tend to cause straining or congestion of the head and face, and to take special pains to secure regular action of the bowels—constipation seems to play a most important part in bringing about a relapse.

The lens should, in cases of dislocation, be extracted as soon as possible. It is easy to remove it from the aqueous chamber, provided it can be kept there till the operation be completed; but, should there be any chance of its slipping back into the vitreous chamber, it should first be fixed by passing a needle behind it, before the extraction is begun. When, however, it is floating free in the posterior chamber operative interference is undesirable unless there be some special reason for it. Sub-conjunctival dislocations are easily dealt with by slitting the conjunctiva over the lens and allowing the latter to escape; but the operation should never be attempted till several days after the accident, so that the wound in the sclerotic may close before the conjunctiva is disturbed. This delay prevents any risk of the lens slipping back through the wound, and diminishes the danger of septic infection. When an eyeball is burst, enucleation is the best possible treatment; and the sooner the operation is performed the better, in order to anticipate the onset of inflammation and suppuration, and so to save the patient much needless suffering.

CHAPTER VI.

PENETRATING WOUNDS.

Penetrating wounds of the eyeball may be divided into lacerated, incised, and punctured. The first are the result of a blow which causes rupture of the sclerotic, and have already been described in the lecture on contusion injuries. Incised and punctured wounds are inflicted by some sharp instrument, *e.g.* a knife, a pair of scissors, a fork-prong, a pen, a piece of glass, a chip of metal, a bullet, etc., etc. Where the injury is due to the bursting of a bottle, or to any accident of like nature, the lids are nearly always severely implicated, and, swelling up, conceal the globe. In such cases great care must be taken not to overlook a wound of the cornea and sclerotic—an error in diagnosis which might obviously be followed by most serious results. Should the globe be perforated, the great risk is that whatever caused the wound may at the same time have carried infection with it. Aseptic wounds are to be found only after carefully performed surgical operations: all other wounds may be regarded as septic, and though the injury may, in a case of puncture, be very slight, so slight indeed as to be hidden by sub-conjunctival ecchymosis, yet should micro-organisms have been conveyed into the interior of the ball, the eye will in a few days be entirely destroyed by suppuration. The difficulty of diagnosing these seemingly trivial cases will be considerably lessened if care be taken to examine the tension of the globe: whenever there is an opening in the cornea or sclera the intra-ocular tension is diminished.

Incised wounds, usually self-evident in themselves, are, besides, accompanied by prolapse of the iris, ciliary body, or choroid, by injury to the lens, and by escape of the vitreous. (Plate X.) If they be extensive, and more particularly if the ciliary region be involved and the escape of vitreous be large, the eye will almost certainly be lost, because, even although the wound heal, there is always subsequent inflammation of the uveal tract, and this leads to shrinking of the globe, and possibly to sympathetic inflammation. Indeed the chances of preserving a serviceable eye after a penetrating wound will depend very largely upon the site and extent of the injury, the amount of the loss of vitreous, and the risk of septic infection.

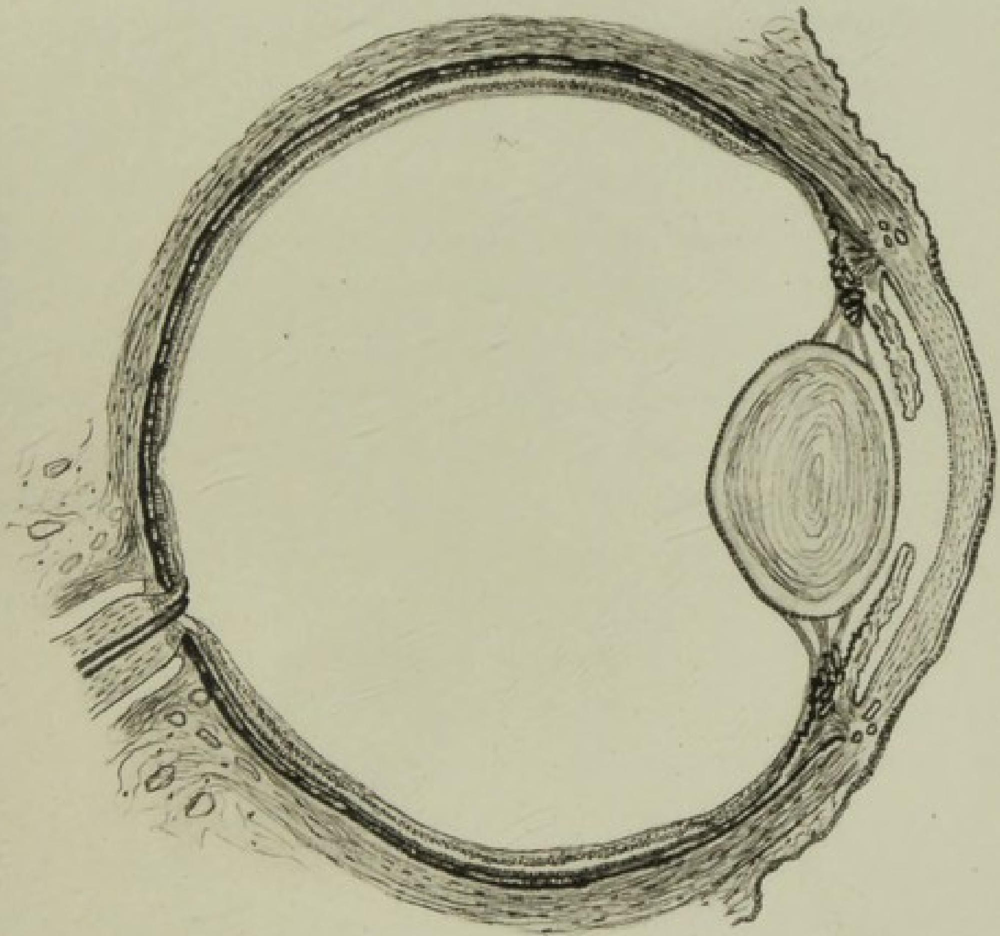
Wounds of the cornea admit, as a rule, of a more favourable prognosis than those involving the sclerotic, not because the cornea is less easily infected, but probably because the aqueous humour on escaping washes the micro-organisms away from the lips of the wound. The progress of the case is governed, however, more by the depth of a wound than by its surface extent; and hence it is that puncture wounds are always so

PLATE X.

SECTION OF NORMAL EYEBALL.

This plate is introduced for the purpose of recalling the main features of the anatomy of the eyeball. In everything pertaining to operations on, and injuries to, the eye, it is absolutely necessary that such a picture be kept constantly and clearly before the mind. The illustration was drawn by Dr. J. Hamilton M'Ilroy from a section of the normal human eyeball. Passing from the front backwards there is seen, first, the conjunctiva which, at the limbus, becomes closely adherent to the subjacent structures and passing over the cornea forms its anterior epithelial layer. Behind this come Bowman's membrane, the substantia propria of the cornea, and Descemet's membrane with its lining of endothelial cells. Directly continuous with the cornea, but possessing a different curvature, is the sclerotic, and the two structures together complete the outer or protective tunic of the eyeball. A second tunic is formed by the uveal tract composed for the most part of blood-vessels and pigment, and divided from before backwards into iris, ciliary body, and choroid. This is the nutritive coat of the eyeball, and is perforated in front to form the pupil, and behind to permit the optic nerve to gain entrance to the interior of the globe. The optic nerve is seen in section surrounded by its subdural and subarachnoidal sheaths, and containing the retinal artery and vein. At the level of the sclerotic it becomes constricted, and its individual fibres pass through the cribriform plate devoid of their medullary sheaths, so that only naked axis cylinders enter the eyeball as the optic papilla. From this, these expand in all directions to form the retina or sentient tunic. To the outside of the optic papilla and directly in the line of the visual axis is the shallow depression that marks the yellow spot. The illustration also indicates the layer of rods and cones, and more indistinctly the nerve fibre and granular layers of the retina. The cavity of the eyeball is divided by the crystalline lens and its ligament into a larger posterior chamber filled by the vitreous, and a small anterior chamber containing the aqueous humour. At the level of the corneo-iritic angle the canal of Schlemm and the spaces of Fontana are clearly visible. The drawing represents the eye about four times the natural size.

PLATE X



disastrous, for they not only involve the cornea or sclerotic, but they generally also implicate the iris, ciliary body, and lens. Simple wounds of the cornea heal very rapidly. (Plate XI., Fig. 1 and 2.) Almost immediately after an accident the cut edges become covered by a new development of epithelial cells, supported by glia tissue—Reid—(Plate XII.), and if this reparative process be not arrested, the wound within a very few days heals by first intention. This is seen to best advantage after incisions for surgical purposes, for then the union is oftentimes so perfect that the scar is visible only on careful examination. It is of the utmost importance, therefore, that the lips of a corneal wound should come into accurate apposition, but this is frequently prevented by prolapse of the iris. Should this have happened the fate of the eye depends, in most instances, on the skill with which the prolapse is treated.

If it be recent, the iris is not adherent to the lips of the wound, and an attempt ought at once to be made to replace it within the aqueous chamber. To accomplish this, eserine should be instilled into the conjunctival sac in order to cause the pupil to contract—the action of the myotic will be increased if the eye be exposed to a bright light—and the prolapsed iris gently massaged into position through the closed lids, or moved into place by means of a small spatula. If the tissue of the iris be much bruised, however, these attempts will fail, and there must then be immediate excision. For this, the iris should be firmly caught by forceps, and, while it is held slightly on the stretch, should be cut through by a single snip of curved scissors of which the blades are pressed backwards against the eyeball. If the iris be kept tense in this manner the cut edges almost always retract perfectly within the aqueous after the prolapse is excised, and it is most important that no part should remain adherent to the wound in the cornea. After the excision, the lips of the latter ought to be brought into accurate apposition by means of a small spatula, and, the eye having been thoroughly cleansed by copious douching with hot boracic solution, or with sterile saline solution, the wound should be covered by a flap of conjunctiva. For this purpose, if the injury be extensive, it is perhaps best to separate the conjunctiva all round the cornea, pass a purse-string suture through its free margin, and pull this tight so that the cornea is completely covered. The conjunctiva adheres only to the wounded surface, and in a few days it slips back, leaving the edges of the wound thoroughly closed against infection.

If, however, more than forty-eight hours have elapsed before surgical treatment begins, the prolapsed iris will be firmly sealed to the corneal wound by inflammatory exudation, and before any attempt at excision is made these adhesions must be carefully broken down. If they are so firm as to be separated only with difficulty, the surgeon must allow his experience to guide him as to whether he should persevere in his attempts or should leave the case to Nature. In the majority of instances

PLATE XI.

INCISED WOUND OF CORNEA.

Fig. 1 shows an incised wound of the cornea less than twenty-four hours after the accident. The case was that of a man who had been struck on the left eye by a piece of iron pyrites. There was a large gaping wound involving the whole width of the cornea across the centre, and the haemorrhage was so severe that it not only filled up the incision itself but extended into the anterior chamber both in front of and behind the iris. The double funnel shape is due to the surfaces being more widely separated than the centre. The epithelium dips down anteriorly almost to the apex of the anterior funnel. Bowman's membrane is divided sharply and slightly retracted, and Descemet's membrane is divided and curled back at the ends. There is an increased number of leucocytes at the site of the wound in the cornea proper.

Fig. 2 illustrates a healed incised wound of the cornea five weeks after the injury. The case was that of a schoolboy whose right eye was struck by a piece of glass thrown by a companion. On the outer aspect of the ball there was a well-marked scar involving the ciliary region, the cicatrix showing a decided depression and shrinking. The eye, which was painful and tender on pressure over the ciliary region, was enucleated five weeks after the injury. The wound is in the centre of the cornea, which dips in over the site of the scar. The epithelium is proliferated and irregular. Bowman's membrane has healed, but is irregular in outline ; Descemet's membrane has not re-united, its ends projecting inwards towards the substantia propria. Owing to inflammatory exudation the iris has become adherent to the lens, and the cornea to both lens and iris. The ciliary region is congested and contains many leucocytes, a condition indicating the existence of cyclitis. The lens is cataractous.

PLATE XI

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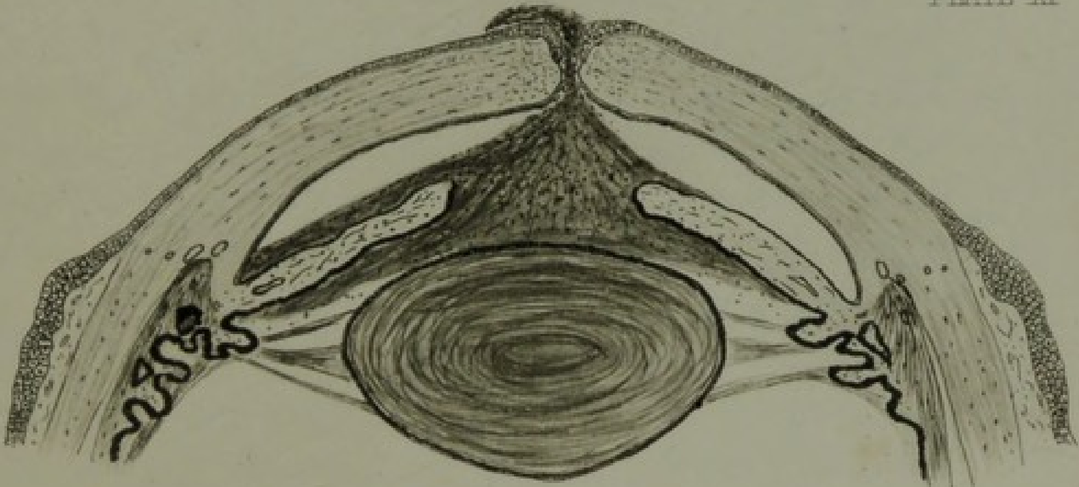

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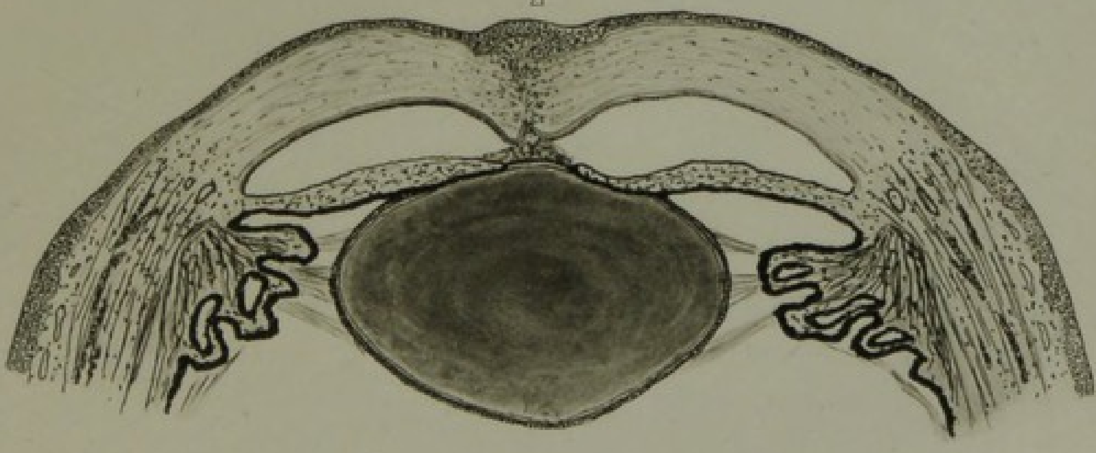

the latter is probably the more prudent course, for very soon the base of the prolapse becomes surrounded by a line of white inflammatory exudation, which by and by contracts, and forms a firm constriction. At a later period its surface is coated with new-formed tissue, and it is, by cicatricial changes, flattened against the cornea and held there securely under a white scar, towards which the pupil is displaced. That is Nature's method of cure; and on the whole the results are satisfactory. Indeed, should several days have passed before surgical treatment can be begun, and the iris be glued by exudation to the lips of the wound, interference is likely to do harm rather than good. The forcible breaking down of the adhesions which have been formed between the two injured structures would be the opening of a new path for the entrance of germs, and might lead not only to the loss of the injured eye, but also to the destruction of its fellow from sympathetic inflammation.

There are, however, cases where the prolapse is so large that it is dangerous to leave it alone. Under such circumstances it is probably best to wait until the base of the prolapse is firmly sealed to the lips of the corneal wound and all signs of acute irritation have passed away, and then by means of a cautery heated to a dull red heat carefully to burn down the prolapse to the level of the cornea, taking great care not to make an opening into the anterior chamber. After the operation the wound should be covered by a flap of conjunctiva.

It happens, though rarely, that, when the cornea is injured, eyelashes are driven into the eye and imprisoned in the anterior chamber. Their presence in this unnatural position tends to keep up inflammation, and may form the starting point for the development of an implantation cyst of the iris. (Plate XIII., Figs. 1 and 2.)

While simple wounds of the cornea, as has been already said, heal very rapidly, those of the sclerotic, on the other hand, do not heal of themselves. (Plate XIII., Fig. 3.) The sclera is passive, and union is effected by reparative changes in the episcleral tissue, in the conjunctiva, and in the choroid. The gaping which always occurs should be dealt with not by suture of the sclerotic itself—an operation both difficult and dangerous—but by suture of the conjunctiva. This is carried out by excising a portion on one or other side of the cut, drawing the opposite edge over the wound, and fixing it to the free margin above or below. When the injury is large and implicates the cornea my practice is to detach the conjunctiva, and, by means of a purse-string suture, draw it over the front of the eyeball. In about ten days the ligature gives way and the flap falls back, leaving the corneal incision and scleral wound in process of cicatrisation. An injury of the sclera close to the cornea may, instead of healing, simply become covered by conjunctiva; and, should this be so, aqueous will exude through the fistulous opening thus left, and, collecting beneath the conjunctiva, distend it like a bladder. (Plate XIV.,

PLATE XII.

GLIA TISSUE (DR. THOMAS REID).

These three diagrams were drawn by Dr. J. Hamilton M'Ilroy from micro-photographs of specimens prepared by Dr. Thomas Reid. That glia tissue occurs in the brain has long been recognised, but not till Dr. Reid demonstrated its presence in the epithelium of the eyeball was it believed to exist in other derivatives of the epiblast.[1]

In Fig. 1, which is taken from a section of healthy palpebral conjunctiva, the glia tissue is shown in the midst of the epithelial cells. It extends as a more or less continuous layer along the surface of the stratum corneum, sending down processes between the cells of the stratum granulosum to meet similar bands which pass upwards from the connective tissue and intercalate with the cells of the columnar layer. It takes up the ordinary nuclear stains readily, and at times, within the cells, the nuclei can be seen still more deeply coloured. That its function is protective is shown by the part it plays in reparative processes.

Fig. 2 shows a wound made experimentally in the conjunctiva of the limbus fifteen minutes before the eye was enucleated. At the lower part of the cut the edges are some distance apart, but at the upper part they are united by a mass of glia tissue continuous with that which covers the surface of the epithelium, and intercalating with the cells of the deeper layers. The borders of the gaping portion are covered with a thick layer of the same tissue, and here the more darkly stained nuclei are distinctly visible. Here, too, we see how rapidly it acts in support of the delicate epithelial cells which are already beginning to make their way towards filling up the breach of surface. On the extreme left of the figure the line of section along which enucleation was made is seen to have also a covering of glia tissue.

Fig. 3 shows a corneal wound at the end of six days. There has been such extensive proliferation of the epithelium that the large gaping cleft is partially filled up, the apex of the cut being completely occupied by delicate newly-formed cells. The fixed cells of the corneal tissue are in a state of active division, and there are many inflammatory cells close to the borders of the gap. Along the overhanging edges there is a considerable amount of intercalary connective tissue continuous with the normal interepithelial tissue. The wound has been both large and affected by sepsis, so that the surfaces do not approximate in the same way as they do in the simple linear and aseptic cut shown in Fig. 2.

[1] Ricerche microscopiche fatta del professore Thomas Reid di Glasgow sulla presenza fra gli epiteli di elementi cellulari connetivali. (Comunicagione reassuntiva 'fatta alla R. Accademia di Medicina di Torina, nella sedula del 22 Aprile, 1904, del professore C. Reymond.)

PLATE XII

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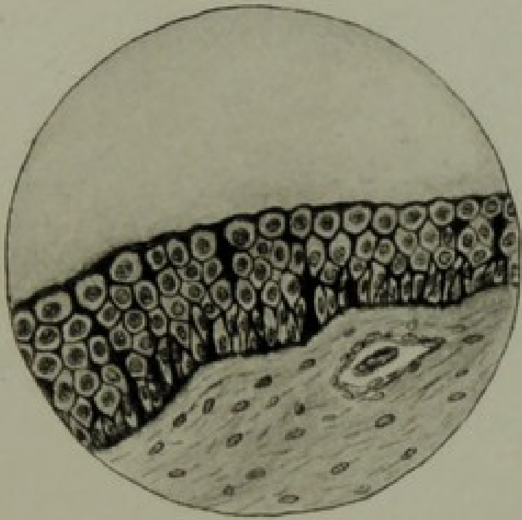

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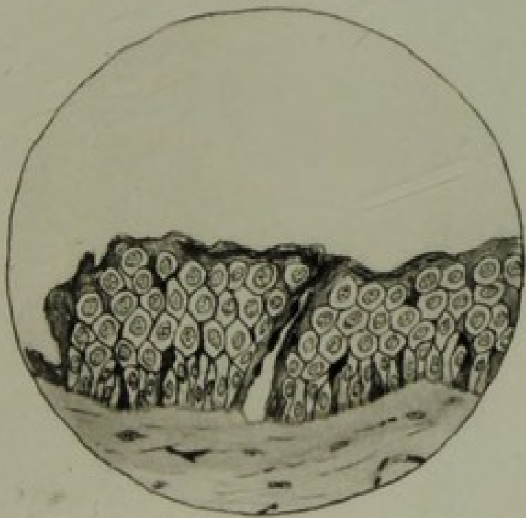

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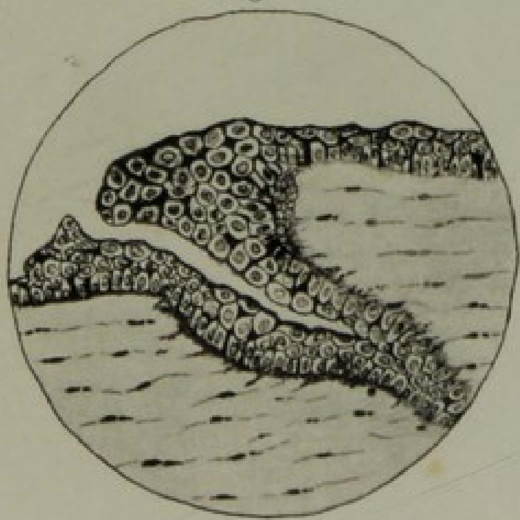

Figs. 1 and 2.) Wounds that implicate the choroid and retina—as so frequently happens—may, under favourable circumstances, heal without trouble; but they are often followed by detachment of the retina and by inflammatory changes which terminate in the shrinking of the globe. An injured lens is always a serious complication, for it rapidly becomes cataractous, and, by swelling and acting as a foreign body, renders the original mischief much more serious. (Plate XIV., Fig. 3.) In children the conditions are distinctly more favourable than they are in adults, because in early life the lens is so soft that the cataract is quickly dissolved and absorbed by the aqueous. In adult cases, in order to diminish the risk of cyclitis, the cataract should be washed out by copious irrigation with warm sterile saline solution. The irrigator must be rendered thoroughly aseptic by being boiled, and then, the point having been carefully introduced into the aqueous through the wound in the cornea, the stream of fluid is directed so as to pass inside the capsule. Should the injury be extensive and the eyeball collapsed through loss of vitreous, the globe may, on rare occasions, be saved by filling it up with sterile saline solution; but probably in the majority of cases the wisest plan is to enucleate at once so that the patient may be saved much useless suffering, and the risk of sympathetic inflammation be avoided.

In a recent wound, when the eye does not contain a foreign body, my routine practice is to cleanse the conjunctival sac thoroughly with a hot saturated solution of boracic acid, or with physiological saline solution, to carefully clear away any prolapse of iris or ciliary body, to irrigate the anterior chamber and wash out the lens if it be cataractous, and to apply a collargol disc over the wound, which is then covered by a flap of conjunctiva. All that remains to be done thereafter is to instil a drop of a two per cent. solution of atropine, to bandage the eye carefully, and to put the patient to bed. To relieve pain, which is often very severe, an ice-bag should be applied over the bandage, and one-sixth of a grain of morphia injected beneath the skin of the temple. The immediate danger is the occurrence of inflammation of the iris and ciliary body, and in all cases this should be anticipated by the use of atropine, by a sharp calomel purge, and by the regular use of a mixture containing aconite and quinine. The use of a five per cent. solution of dionine in addition to the atropine is to be recommended. It quickly relieves the deep-seated pain, and hastens the absorption of lenticular matter.

After the wound has healed, the opaque capsule of the lens, to which the iris is always more or less adherent, blocks the pupil and interferes seriously with vision. It is usually necessary, therefore, to perform a capsulotomy. An incision is made in the cornea with a keratome, and a pair of Carter's or De Wecker's scissors introduced through the opening into the anterior chamber. The blades of the scissors are opened, and one passed behind and the other in front of the constricting band of capsule, which is then divided. If the operation be successful, the iris at once springs open to form a pupil. Each case must be judged on its merits, and as a rule the principal incision must be made where previous examination has shown the iris to be most tightly stretched. The opening in the capsule can be made larger by one or more cross cuts. Great care must be taken to avoid the escape of vitreous, and, if the patient be nervous, it is, as a rule, safest to administer an anaesthetic. (Plate XXIII., Fig. 3.)

In cases of penetrating wounds due to the bursting of a bottle; to a blow from a stone, or a fragment of a broken tumbler, cup, plate, or bowl; to a touch with a dirty knife; to a prick from a fork, etc., there is infection at the time of the accident. Whenever sepsis becomes pronounced pain is always severe and is deep seated and throbbing in character, the lips of the wound become infiltrated, the conjunctiva oedematous, and the iris discoloured. In such circumstances the suppurative process may be held in check by free irrigation of the conjunctival sac with hot sterile saline solution. This mechanical cleansing washes away all discharge and diminishes the number and the activity of the micro-organisms. The ocular congestion is lessened, and pain relieved, by snipping the chemosed conjunctiva with scissors, and encouraging the bleeding by douching with warm salt solution. A collargol disc ought to be placed in the conjunctival sac every two or three hours, and the first assurance that the infective process is being overcome is given when the collargol gelatine is seen to cling to the lips of the wound. The eye must be kept covered by antiseptic fomentations, and the pain relieved by the judicious use of hypodermic injections of morphia. The patient ought to be kept in bed, well fed, and skilfully nursed.

A cataractous lens is one of the best culture media for micro-organisms, and so, when the interior of the eyeball becomes infected, the process of suppuration goes on unchecked by the treatment just described. The pain persists and is always characterised by periods of exacerbation during the night. The eyeball is exceedingly tender to the touch, the iris is intensely inflamed, and, if the lens retains its transparency, a yellowish reflex is occasionally seen through the pupil. If, on the other hand, the lens has been injured, the purulent exudation imparts a yellow colour to the opaque lenticular substance. Pus very soon appears in the anterior chamber, and the condition is critical in the extreme. Even in such desperate circumstances an attempt ought always to be made to save the eye. The wound in the cornea must be opened up, and the cautery applied thoroughly to its edges. The anterior chamber should be irrigated freely with saline solution, and any pus completely washed away. A few drops of a twenty-five per cent. solution of argyrol ought then to be injected carefully into the interior of the eyeball, or a little rod of gelatine impregnated with collargol may be introduced into the aqueous chamber, where it gradually dissolves. My experience is more favourable to the use of argyrol

PLATE XIII.

PENETRATING WOUNDS OF EYEBALL.

Figures 1 and 2 illustrate the case of a boy, twelve years of age, whose left eye was cut by a piece of broken earthenware. The upper lid was penetrated, the cornea beneath wounded, the iris prolapsed, and the lens injured. Immediately after the accident several eyelashes were removed from between the lips of the wound and from the conjunctival sac, and the opening in the lid was stitched; thereafter healing took place with but little pain and without any acute inflammation. When the boy was brought to the Ophthalmic Institution, four weeks afterwards, the iris was adherent to the whole extent of the corneal cicatrix and was congested, the pupil was dilated and irregular in outline, and the lens was cataractous. In the shallow anterior chamber three cilia were seen imprisoned, two large ones embedded at their upper extremities in inflammatory exudation mixed with cataractous lens, and one small one lying free on the surface of the iris at the outer and lower aspect of the corneo-iritic angle. The two large cilia were removed through an incision made in the upper part of the cornea, but the third, which could not be grasped without injuring the iris was removed by irrigation, and at the same time most of the cataractous lens was washed away. There was no escape of vitreous. On the day following the operation the iris became congested and the aqueous muddy; but there was no pain, and with the use of atropine and fomentations all signs of iritis passed away within forty-eight hours. At the end of sixteen days, recovery was so complete that the patient was allowed to go home. A band of capsule impregnated with inflammatory exudation passed straight downwards behind the iris, and when the patient was again seen, three weeks afterwards, this had contracted and produced partial closure of the pupil. The cornea was incised a second time, and the constricting band divided with De Wecker's scissors, when the pupil immediately sprang open.

About two years after the date of the accident a small growth appeared at the lower aspect of the iris, at the spot where one of the eyelashes had been imprisoned in the anterior chamber. The tumour was of a yellowish white colour and pearly lustre, stood out distinctly from the iris, and extended from its ciliary attachment to the margin of the pupil. It was completely excised, and was found, on microscopic examination, to have all the characters of an implantation cyst.

Fig. 3 illustrates the case of a little boy, two years of age, whose left eye was severely cut by a piece of a broken china cup. The wounds on the lids were at once carefully stitched by the local doctor, and, three days later, when it was discovered that there was a large, gaping, ragged wound penetrating the sclerotic at the outer aspect of the globe, the child was sent to the Ophthalmic Institution. The tear was covered by conjunctiva, and healing took place without any unfavourable symptoms. At the end of a fortnight the boy returned to his home in the country, but four months later he was brought back. The eye was then soft, and at the site of the wound the sclerotic was indrawn and puckered, while clearly visible through the pupil was a yellowish-white mass of inflammatory exudation. As the sight was entirely gone, and there were symptoms of sympathetic irritation in the sound eye, enucleation was at once carried out. The section shows the eyeball to be shrunken, and on its lower surface, near the corneal margin, the outline of the sclerotic is interrupted by a widely gaping wound, the severed edges of which are strongly incurved and sealed down to the underlying structures. There is a small cicatrix at the outer aspect, and between the edges behind is a large mass of exudate continuous with the remains of the cataractous lens capsule and with the prolapsing ciliary body. The lens has entirely escaped. The dragging of the ciliary region and lenticular structures through the wound has caused a constriction to take place at the corneo-scleral margin, and the cornea appears to bulge forwards in consequence. The anterior part of the aqueous chamber is shallow, the iris being drawn up close to the cornea, but the space between the iris and lens capsule is abnormally large. The retina is oedematous, and has become detached and thrown into numerous folds. The choroid is still in apposition with the sclerotic. The specimen illustrates the difference between the process of healing in a scleral wound and in a corneal wound. In the former the edges retract and do not become approximated to each other as they do in the latter, and therefore the raw surfaces cannot unite by first intention.

PLATE XIII

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and collargol in this way than to that of iodoform. In most instances, however, the infective action has penetrated to a point too deep to be reached by any antiseptics, and the probability is that the eye will be lost from panophthalmitis, or from chronic iridocyclitis. Whenever, therefore, it is evident that sight is to be lost it is far the wisest course to enucleate at once. If there be acute suppuration of all the tissues of the globe an element of danger attends enucleation, for there is then a risk that the operation may be followed by purulent meningitis. Under such circumstances it is probably wiser to eviscerate than to enucleate.

Ophthalmic surgeons have suggested many means whereby the deformity produced after the removal of an eyeball may be lessened, and a more natural appearance given to the prothesis. Mules suggested evisceration and the implantation of a glass or silver ball in the sclerotic. The cosmetic results following the successful performance of this operation leave little to be desired; but it has the disadvantages that the whole of the eyeball is not removed, that there is a tendency for the ball to escape from the sclerotic, and that the healing after the operation is often accompanied by much inflammatory oedema of the orbital tissues and by very severe suffering for several days. In order to get rid of these disadvantages I form a stump for an artificial eye by injecting paraffin into Tenon's capsule.

The patient having been placed fully under the influence of chloroform, the eyelids are separated and kept apart by a spring speculum. The conjunctiva is divided as close as possible to the corneal margin, each rectus muscle is caught up on a strabismus hook, and a strand of catgut, knotted at one end, is passed through the tendon and overlying conjunctiva, the knot preventing it from slipping. The tendons of the recti muscles are cut at their insertion into the sclerotic, and thereafter the operation for the removal of the eyeball is completed in the ordinary manner, great care being taken not to injure the capsule of Tenon. If adrenaline chloride solution be freely used the amount of bleeding is slight, and any haemorrhage is easily stopped by douching the socket with hot sterilised water. The capsule is opened to its utmost capacity by holding the recti muscles on the stretch by means of the four catgut sutures. It is then packed with gauze moistened with adrenaline and a strong black silk purse-suture is passed round its mouth. This done, the gauze packing is removed, and if the whole interior surface be dry the melted paraffin is injected. The paraffin used is a sterilised preparation, melting at 104° Fahr.

Formerly I employed an ordinary glass syringe, but Down Brothers have made for me a metal one, the great advantage of which is that it has two side rings which enable it to be held firmly by the first and second fingers, while the thumb passed through the loop at the end of the piston regulates its movement with the greatest ease. The piston itself is graduated so that the exact amount of paraffin injected is

PLATE XIV.

PENETRATING WOUNDS OF EYEBALL.

Figures 1 and 2 illustrate the case of a girl, seventeen years of age, who was struck on the right eye through the accidental bursting of a lemonade bottle. The accident had happened three years before she came to the Ophthalmic Institution. A large, translucent, bladder-like cicatrix occupied the lower and inner aspect of the corneo-scleral junction. Towards this the iris was drawn, and the pupil was represented by a narrow slit. There was no inflammation, but the conjunctival vessels, especially those surrounding the cornea, were distinctly injected. The eye was sightless. At the time of the accident the upper lid had been cut, and, as the edges of the wound had not been properly approximated, a distinct V-shaped notch remained permanently in its margin. The globe was enucleated and paraffin injected into Tenon's capsule to form a stump for an artificial eye. The globe was hardened in 5 per cent. formaline solution and bisected. The section revealed a large cavity corresponding to the cystoid cicatrix already described. The retina was completely detached and crumpled up into a cord which extended right across the vitreous from the optic nerve entrance to the back of the iris and the remains of the lens capsule which had become calcareous. The anterior chamber was very shallow, and the vitreous was completely filled by a mass of dark starch-coloured exudation.

Fig. 3 represents the eye of a man, forty-eight years of age, who came to the Ophthalmic Institution immediately after being struck on the left eye by a splinter of steel which flew from the hammer with which he was working. A ragged wound extended downwards and outwards from the corneo-scleral margin towards the centre of the cornea. The iris had prolapsed and had been caught by the lips of the wound. There was a large rent in the lens capsule, and already a traumatic cataract had begun to form. A skiagram was taken but no foreign body was discovered. The lens swelled rapidly and pressed the iris forwards; and, as the patient complained of pain, and the intra-ocular tension was increased, the cataract was removed by irrigation through an incision at the outer aspect of the cornea. The recovery was uninterrupted.

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known, and the fitting is so careful that the instrument works with the utmost smoothness. The barrel has a rubber jacket which acts as a non-conductor and keeps the paraffin from cooling too rapidly. The jar containing the paraffin is put into a water bath heated to about 107° Fahr., and the syringe, carefully sterilised and heated beforehand, is filled. The nozzle having been inserted into the capsule of Tenon, and the suture drawn tightly round it, the sac is distended with paraffin, the nozzle withdrawn, and the suture quickly pulled tighter still so that none of the injected matter may escape. The ends of the silk thread are then securely fixed by a double knot, and the catgut sutures are tied, the superior rectus muscle being approximated to the inferior and the internal to the external. The paraffin is thus induced to mould itself in the socket, and to form a stump to which the divided muscles readily attach themselves. Any excess is wiped away, and, after the conjunctival surface has been carefully bathed with boric solution, a compress and bandage are applied.

The operation as thus performed is, as a rule, followed by only slight inflammatory reaction, and with care to gauge accurately the amount the capsule will hold, the discomfort is never so great as to keep the patient from sleeping. It must always be remembered that the paraffin shrinks on cooling and, consequently, although the sac seems fully distended immediately after the operation, the stump will not be nearly so large a fortnight later when all inflammation has disappeared. For several days after the operation the eye should be douched with a hot solution of trikresol (1 in 1,000), as this does much to lessen any inflammatory swelling and to allay discomfort. The suture is kept in place for a fortnight, and when it is removed at the end of that time there will be found over the freely movable paraffin stump a clean non-discharging surface of conjunctiva. Three or four weeks later an artificial eye can be adjusted, the ordinary shell proving as a rule quite satisfactory, though sometimes better results may be obtained from the use of the form recommended by Snellen. Care needs to be taken that this is not too large, otherwise the paraffin stump will move behind the prothesis. The best results are obtained when a plaster cast of the socket is taken and the glass eye specially made to fit it.

To insure success two points require special attention: First, the operation must be carried out with every precaution against sepsis, and so must not be attempted in cases where the eyeball is in a state of active suppuration: and Second, the sutures must hold the conjunctiva in accurate position over the paraffin. It is on the purse suture that most reliance requires to be placed, and it is, therefore, very important to see when this is introduced that an equal grip is taken of the conjunctiva all round the free edge, and also that too wide an interval is not left between the stitches; but the catgut strands to which the muscles are attached afford great additional security.

The paraffin simply lies in the tissues and gives rise to no irritation. The advantage is not so much in the greater mobility of the prothesis as in the minimising of the flat, sunken appearance of the upper lid which nearly always follows simple enucleation.

CHAPTER VII.

PENETRATING WOUNDS OF THE EYE WITH RETENTION OF A FOREIGN BODY.

It has already been said that penetrating wounds of the eye are at all times serious, but they are more serious still when complicated by the presence of a foreign body in the interior of the eyeball. It is true that a small piece of metal may become encysted, and be carried about in the eye for a long period, but all experience goes to prove that under such circumstances destructive inflammation may arise at any moment. For years no harm may result, and then, suddenly and inexplicably, there may be such a severe onset of cyclitis as to destroy the eye, while only by prompt enucleation can its fellow be saved from destruction through sympathetic ophthalmitis.

Take the case of a man of thirty years of age who came to the Ophthalmic Institution, Glasgow, complaining of recurrent inflammation of his left eye, the sight of which was rapidly deteriorating. He said that when he was about ten years of age he was, while standing one day in a blacksmith's shop, struck on this eye by a piece of metal. He was skilfully treated at the time of the accident, and made an apparently perfect recovery. At all events, for more than twenty years the eye had never caused him a moment's discomfort, and so far as he knew sight was in no way impaired. A short time before I saw him, however, he had begun, more especially during the night, to suffer pain in the left eye, and to notice that sight was rapidly failing. He could assign no cause for the occurrence of these inflammatory attacks, which had gradually and steadily become worse. When he was admitted to the hospital the eye was very painful and tender to touch, there was much circumcorneal injection, the iris was discoloured and tremulous, the pupil small and irregular, the vision very defective, and, owing to opacities in the media, no details of the fundus oculi could, on ophthalmoscopic examination, be distinguished. For a few days after admission the symptoms abated considerably, but on the tenth night there was a sudden outburst of excruciating pain accompanied by severe retching and vomiting, and in the morning the aqueous chamber was nearly a quarter full of pus. The immediate result was a brief respite from suffering, but from this time onward the patient was tormented by constantly recurring attacks of pain and vomiting, followed by the appearance of pus in the anterior chamber. In the intervals he had very little discomfort, but the eye was quite blind, and on the occurrence of a very severe relapse he readily consented to enucleation. After the globe was hardened in formaline and bisected it was seen that the lens was dislocated and the ciliary body and iris were inflamed, while firmly embedded in the ciliary region was the cause of all the trouble—a small fragment of steel.

Though it was formerly thought that if the foreign body lodged in the lens it might remain there and do no harm, yet even in this case the safety of the eyeball cannot be regarded as permanently assured. That is well illustrated by the case of an ironturner who was struck on the left eye by a chip of steel, which perforated the cornea and embedded itself in the lens. The accident had apparently been followed by very little inflammatory reaction, and when the patient was first seen the eye presented a perfectly natural appearance, and the visual acuity was quite up to the normal. When the pupil was dilated by atropine, and the eye examined by the ophthalmoscope, a minute black glistening particle was seen lying in the lens, which, however, except in the area immediately enveloping the foreign body, had lost none of its transparency. As any attempt to extract this tiny fragment of metal would certainly have been followed by traumatic cataract, the patient was advised to let well alone, but to report himself regularly so that the eye might be kept under observation. For eleven months his progress was all that could be desired, but then the eye, without warning, and for no reason known to the patient, became excessively painful, and sight disappeared completely a few hours afterwards. On the following morning perception of light was lost,

PLATE XV.

SIDEROSIS BULBI.

Fig. 1 shows the section of an eyeball, in the vitreous chamber of which a splinter of iron has become embedded. The globe was enucleated and has been preserved for years in a specimen jar in the museum of the Ophthalmic Institution. The metal is still *in situ*, and is covered with a thick layer of rust, which has also impregnated the tissues of the ball, giving them a reddish brown colour—siderosis bulbi. The retina is detached and bound down to the inflammatory mass that surrounds the foreign body; the choroid is completely separated from the sclerotic, and passes obliquely across the space between the sclerotic and the detached retina; the lens is shrivelled and surrounded with inflammatory products, and has the iris adherent to it in several places; and the anterior chamber is shallow. The cornea as shown in the plate is normal, the wound being out of the line of section.

Fig. 2 illustrates the case of a man who, two years before admission to the Ophthalmic Institution, had been struck on the right eye by a piece of metal. The lens was injured, and on its surface were several rust-coloured spots, while the iris, which had formerly been blue, had become of a reddish-brown colour. An X-ray photograph revealed the presence of a splinter in the ciliary region—see Plate XIX. The cataract was extracted and the magnet applied to the eye, but the metal was not attracted. A skiagram taken a week after the operation showed the piece of metal exactly in the same position as before. It had evidently become encapsuled and completely insulated. The patient made a good recovery, but as the metal is still in the eye there is always the risk of acute cyclitis.

Fig. 3 shows the bisected eyeball of a man, fifty-two years of age, who, on the day of admission to the Ophthalmic Institution, had been struck by a splinter of steel, which penetrated the cornea and lodged in the vitreous chamber. The metal was at once extracted by an electro-magnet, but as its edges were sharp and rough its exit from the eye was attended by much laceration of the ciliary body and iris. Owing to the dirty appearance of the fragment it was feared that septic inflammation would supervene, but the eye healed up quietly, although there was no recovery of sight. The patient left hospital with the right eye in sound condition, but he returned some weeks later complaining of symptoms that pointed to sympathetic irritation. As the left eye was manifestly shrinking, it was at once enucleated, and the sympathetic symptoms thereafter speedily disappeared.

When the globe was hardened and bisected it showed a distinct flattening, due to adhesions, while towards the corneo-scleral margin there was a well-marked cicatrix extending through the whole depth of the cornea. The posterior surface of the cicatrix is seen to be continuous with a large mass of inflammatory exudate, in which are embedded the iris, ciliary body, and lens capsule; and this mass extends back between the folds of the completely detached and cystic retina, the process being suggestive of the presence of calcareous degeneration. The lens is small, and has been drawn away from the wound, from which it is separated by the prolapsing mass of lens-capsule, etc. The retina is completely detached, thrown into cystic folds, and surrounded by exudation; and the choroid is in some places detached from the sclerotic, the intervening space being occupied by exudate. The exudation is stained here and there with blood.

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and the ball was red, painful and tender to touch but of normal tension, the iris was discoloured, the pupil was contracted and did not dilate after the instillation of atropine, and the fundus oculi could not be illuminated. The patient was put to bed, and after treatment by atropine, opiates, leeches, and fomentations, the cyclitis subsided and light perception returned, but the media were so muddy that the interior of the eyeball could not be examined, and the iris, which was formerly of a light blue colour, had become a deep reddish brown—siderosis. (Plate XV., Figs. 1 and 2.) An X-ray photograph was taken, and demonstrated the presence of the foreign body exactly as it was before the occurrence of the inflammatory attack. As a result of the cyclitis the lens had become much more cataractous, and when it was extracted there was great improvement of vision. A skiagram taken ten days after the operation showed that the foreign body was gone.

In the case just recorded the foreign body was detected in the first instance by means of the ophthalmoscope. It is only very occasionally, however, that the presence of a foreign body can thus be determined. In most instances it rapidly becomes concealed by haemorrhage, or hidden by increasing opacity of the lens, or by an outpouring of inflammatory exudation. It is, therefore, of the first importance that the eye be thoroughly examined at the earliest possible moment after the accident, and the nature of the latter, along with its attendant circumstances, ought always to be carefully and fully elicited. Obviously an eye which has been penetrated by the prong of a fork, or cut by a knife, is not at all likely to contain a foreign body, but, on the other hand, when the accident has been due to a blow from a chip of steel, of glass, or of stone, or where it has been the result of an exploding cartridge, or of a shot-pellet, the risk that the missile has become lodged in the globe is exceedingly great. The appearances presented by the eye are also of great value in aiding a diagnosis of the presence or absence of a foreign body. If this be present there is usually a penetrating wound of the cornea or of the sclerotic, the iris is torn, the aqueous stained by blood, and the lens cataractous. It is often remarkable how slight is the suffering immediately after such a severe accident. The patient rarely makes any complaint of pain, but states that the sight is more or less defective. In a few days, however, there is marked congestion of the circumcorneal blood-vessels, and considerable tenderness on pressure over the ciliary region. The degree of inflammatory reaction subsequent to the injury depends not only upon the size and shape of the foreign body, and the position which it occupies within the globe, but also upon the changes which it is capable of originating, as a result either of direct sepsis or of simple chemical reaction between the foreign body and the tissues in which it is embedded. Chips of metal, for example, nearly always set up severe inflammation, whereas splinters of glass, if introduced into the eye aseptically, may

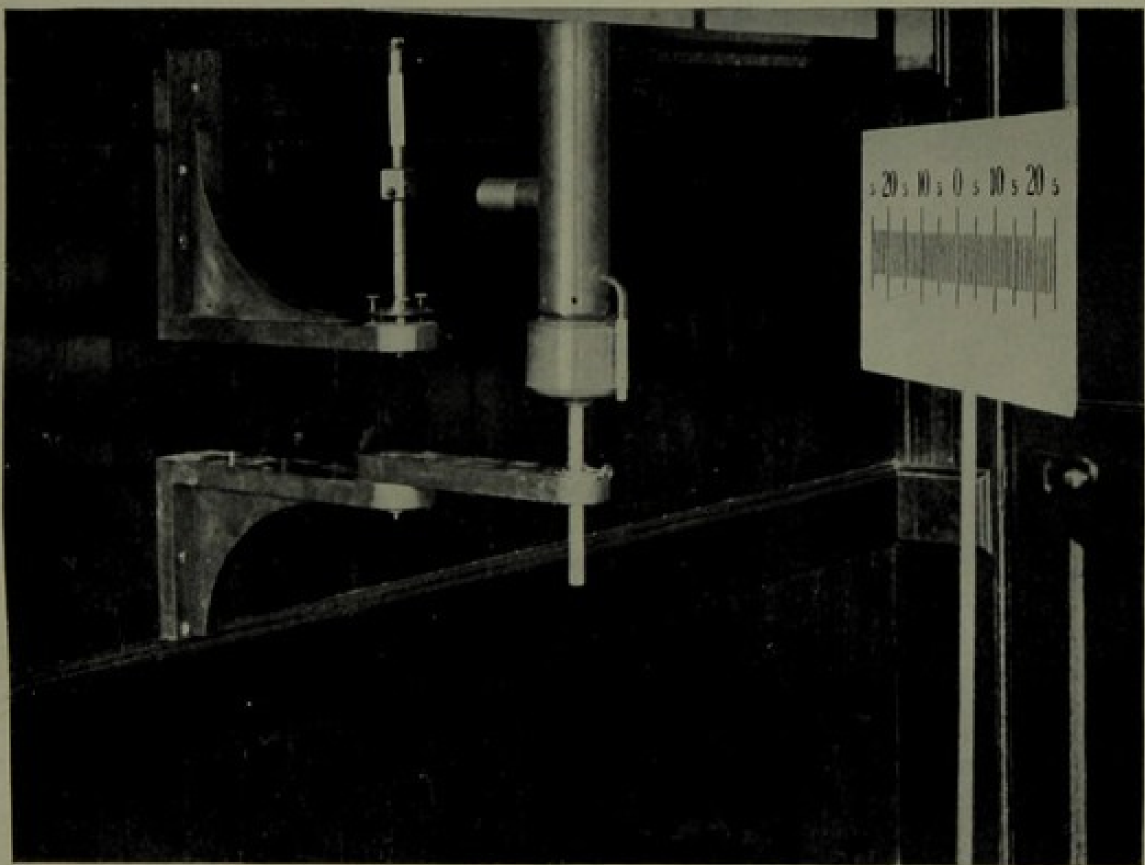
PLATE XVI.

HIRSCHBERG'S SIDEROSCOPE.

Hirschberg's sideroscope is an instrument for determining whether a foreign body present in the eye be a chip of iron or steel, and if so to indicate its approximate position. Securely fixed to a firm wall, which should if possible run north and south, are two projecting angle supports, on the upper of which is placed a glass tube fixed at the bottom to a metal stand with adjustable screws. Hanging in this tube is a magnetic needle (with the north pole marked by a groove) suspended by a fine silk thread from a bar at the top of the tube. Fixed to the needle is a small mirror. On the lower angle support is a lamp so arranged as to throw a beam of light on this mirror. There is also a graduated scale fixed to a stand which can be moved from place to place.

When the instrument is to be used the tube is adjusted by the movable screws so that the needle and mirror swing freely, with the north pole of the magnet pointing to the north, and the mirror reflects the light on to the graduated scale which is placed at a distance of 2 or 2½ metres. The patient is then seated on a chair with the affected eye as near as possible to the magnetic needle. Should a chip of iron or steel be present the needle will move and the spot of light will travel along the scale. The size of the splinter may be determined by the extent of the deviation—the greater the swing, the larger will the foreign body be; while its position is got in like manner by bringing different portions of the eye near to the needle—the foreign body is nearest when the beam of light records the maximum of movement.

PLATE XVI.



produce but little disturbance. Leber has shown that copper is particularly dangerous, even when it is quite free from micro-organisms, for it always sets up destructive inflammation as a result of chemical reaction. The account of the accident, the position and character of the wound, and the subsequent history of the case, may all afford strong presumptive evidence that the eye contains something extraneous, but this suspicion can be confirmed only by actual demonstration of the presence of a foreign body. If the media be transparent the substance may be seen either by the naked eye or by means of the ophthalmoscope, but care should always be taken not to mistake a small blood-clot, or a minute rent in the iris, for a particle of metal. In many instances, however, the media are not transparent at the time the patient seeks advice. If the intruder be a chip of iron or steel its presence may be determined by aid of Hirschberg's sideroscope (Plate XVI.), or by bringing a powerful magnet (Plate XVII.) closely up to the eye, when the patient will at once experience sharp pain owing to the metallic particle being attracted from the deeper parts of the eye towards the surface.

In many instances the Röntgen rays afford most valuable assistance, for not only do they render it easy to demonstrate the presence of a foreign body whose existence would otherwise be doubtful, but they give still greater assistance in determining its exact position. The principles underlying the method by which this is accomplished were first fully described by

MacKenzie-Davidson, but the apparatus designed for me is somewhat simpler than his. (Plate XVIII.)

The method of using this apparatus is as follows:

1. A small wire cross is fixed by means of adhesive plaster to the external orbital margin on the side of the injured eye, on a level with the outer canthus.

2. The patient is seated with the photographic plate in contact with that side of his head which corresponds to the injured eye, the Crooke's tube is on the opposite side of the head, 300 millimetres from the centre of the eye, the centre of the anode being exactly opposite the centre of the small wire cross placed on the external orbital margin.

3. Two skiagrams are taken, one upon a plate with the anode of the Crooke's tube 40 millimetres behind the zero mark of the scale, or the centre of the wire cross, and the other upon another plate with the anode 40 millimetres in front of the zero mark, or of the centre of the wire cross.

4. On each plate is now placed a sheet of celluloid of the same size and shape as the plate, and on this the positions of the localising cross and of the foreign body are marked with a pencil. When both plates are thus dealt with, the distance between the shadow of the wire cross and that of the foreign body can be accurately measured. If the shadow of the foreign body be on the same side of the wire cross on each plate, the difference between the measurements must be taken as a basis for calculation, but if the shadows be on opposite sides of the wire cross the sum of the

PLATE XVII.

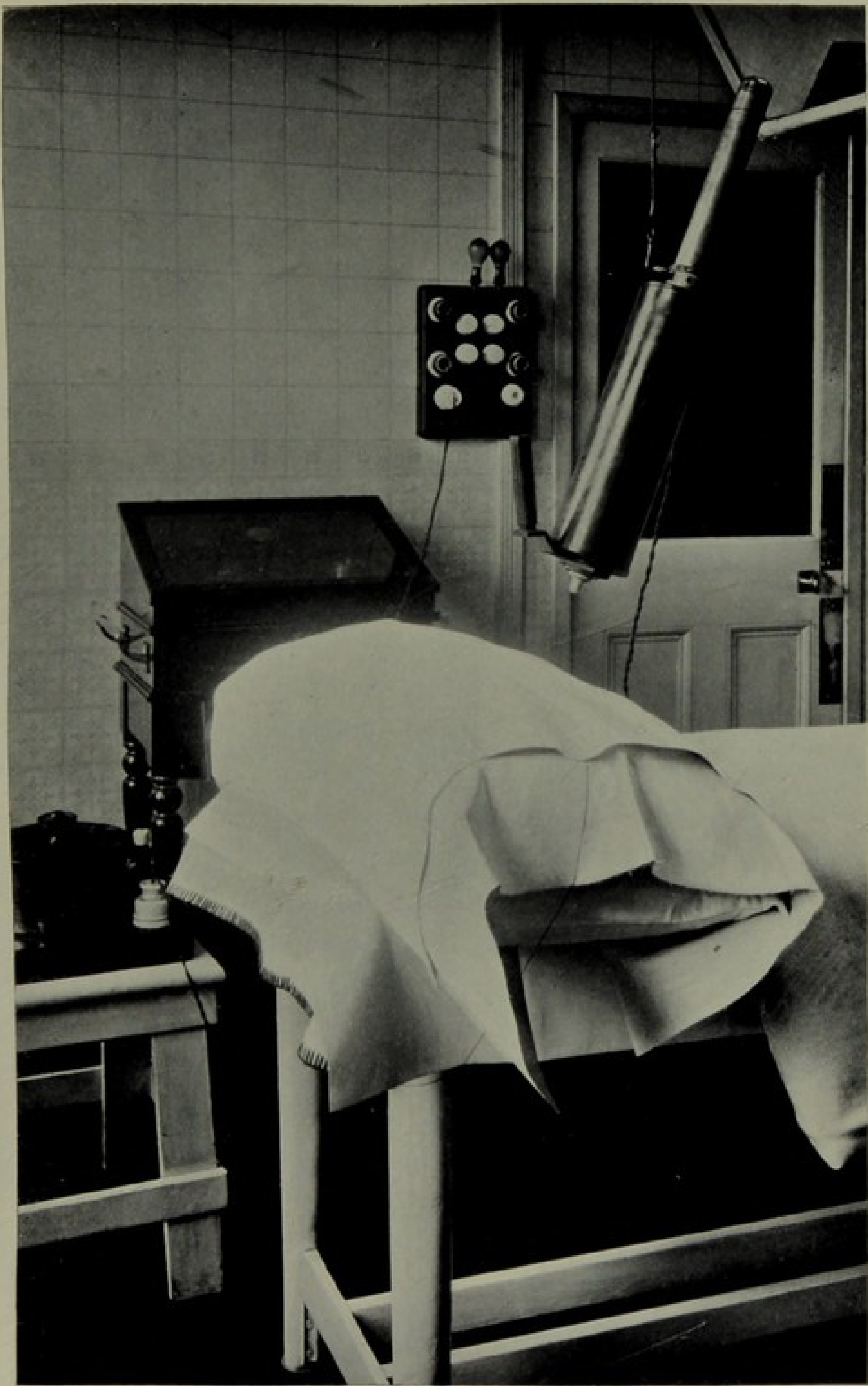
LARGE PORTABLE ELECTRO-MAGNET.

This plate shows a powerful electro-magnet, made for me by Mr. John Trotter, 40 Gordon Street, Glasgow, capable of supporting about two cwts., but designed rather to attract small pieces of iron or steel from a distance than to support a heavy weight in contact with it. It consists of a circular bar of soft Swedish iron, about two inches in diameter, round the lower half of which are wound thousands of turns of insulated copper wire. Outside these is placed a tube of vulcanite which prevents any risk of the patient or operator receiving a shock from the electric current by which the iron is rendered magnetic. At the lower end is a handle to aid in the ease and accuracy of manipulation.

The instrument is suspended from the roof by a light steel cable passing over pulleys to a balancing counterpoise weight. This allows the magnet to be moved freely over the operating table (the patient remaining quiescent), and the point introduced into the wound when required. The point is removable, and thus different sizes and shapes can be used. The current may be taken from any source of sufficient power ; and its amount is regulated by a rheostat which enables the operator to have the magnet completely under control.

The best known of all the great magnets is the one devised by Haab, who prefers to bring the patient up to the magnet (which is placed in a horizontal position) and to take full advantage of the natural mobility of the head and eye. I prefer to have the patient flat on a table and to bring the magnet to the eye. In the large portable magnet here described the instrument is so accurately balanced by the counterpoise that it can be manipulated with perfect ease.

PLATE XVII.



measurements must be taken. The distance of the anode of the tube from the centre of the eye is a known quantity, as is also the amount of the displacement of the tube on either side of the zero point of the graduated scale on the cross bar of the localiser. Three constants being thus obtained, it is easy from them to determine the position of the foreign body as measured from the centre of the wire cross fixed to the external orbital margin.

5. The simplest way to determine the position of the foreign body in its relation to the antero-posterior axis of the eyeball is to expose a third plate when the anode of the Crooke's tube has been fixed to the zero point and set so that the most active rays impinge upon the centre of the wire cross. If the shadows of the wire cross and foreign body are afterwards marked on the sheet of celluloid all that needs to be done is to measure the distance between them. The third plate, however, is not necessary, because from the two plates first taken the position of the shadows in their relation to the wire cross gives the antero-posterior location of the foreign body. If both shadows be on the same side of the wire cross, half the sum, and if they be on opposite sides, half the difference, of the distances must be taken.

6. To determine the vertical position of the foreign body all that requires to be done is to note whether the shadow be above or below the wire cross and then to measure the distance.

7. All that is necessary thereafter is to estimate as

nearly as possible the size of the foreign body, and as the distance between the anode of the tube and the shadow on the photographic plate is known, as is also the distance of the foreign body from the localising mark on the plate, a simple calculation from these data will give approximately the bulk required. (Plate XIX.)

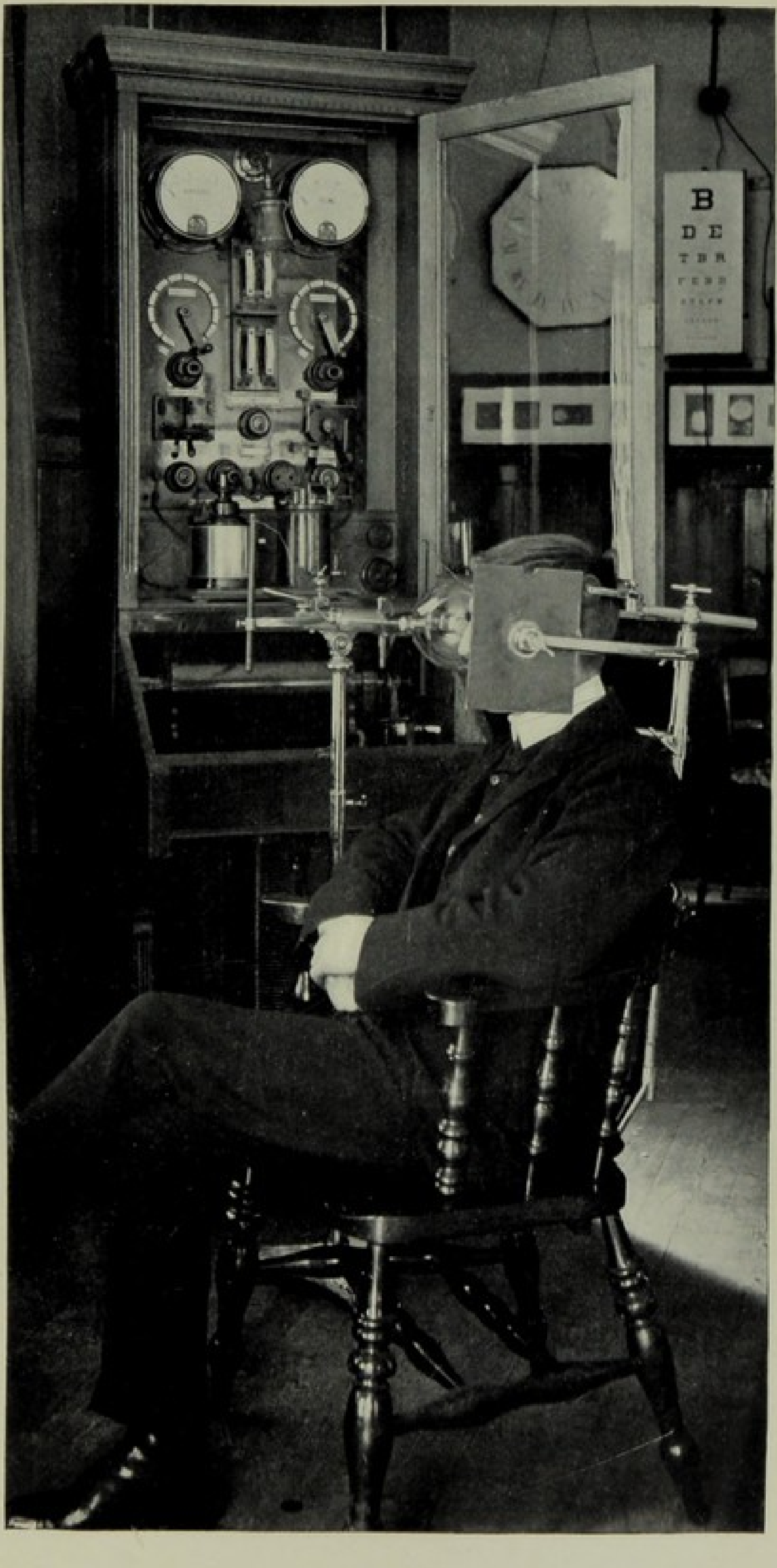
Even after a foreign body has been carefully localised, its extraction from the eyeball is always extremely difficult, unless it be a chip of iron or steel, and can therefore be attracted by a magnet. In every magnet operation the great secret of success lies in prompt intervention. If the case be dealt with within twenty-four hours of the accident the patient should be laid flat on a table with the head and shoulders comfortably supported by pillows. The eye should be thoroughly cleansed, the pupil dilated as fully as possible, and the conjunctiva made perfectly insensitive. A general anaesthetic is necessary only in the case of a very nervous or troublesome patient. If the wound be in the cornea an attempt ought to be made to extract the chip of metal through it, but if, as so often happens, it be situated at the corneo-scleral junction, or in the sclerotic farther back, it is safer to try to guide the metal from the vitreous chamber into the aqueous, rather than run the risk of injuring the ciliary body and choroid still further, and of disturbing the vitreous by dragging the foreign body through the perforation caused by the accident. Of course every now and again a case occurs in which the wound in the sclerotic is so situated that

PLATE XVIII.

RÖNTGEN-RAY AND LOCALISING APPARATUS.

This plate shows an apparatus for localising the position of foreign bodies in the eye. It consists (in addition to the usual X-ray outfit) of an upright brass tube (which can be raised or lowered) firmly fixed to a heavy base, and connected by a circular hinge joint with a horizontal bar graduated as a centimetre and millimetre scale running on either side of a central point marked zero. An upright vulcanite rod at either extremity supports the wires connecting the Crooke's tube with the terminals of the induction coil. It carries a travelling clamp to which the Crooke's tube is attached. The chair used has a support for the head, to the upright of which two curved arms are attached. One of these carries a pocket to receive the sensitive plate while the other serves as a support for the patient's chin. By means of this arrangement the photographic plate can be brought closely into contact with the parts surrounding the eye to be X-rayed, and any movement of the patient's head is effectually prevented by means of the chin rest. The position of the anode of the focussing tube can be varied at will by sliding the clamp along the graduated horizontal bar.

PLATE XVIII.



the splinter may be most readily extracted by enlarging the rent, if necessary, and applying the point of the magnet to its lips; but as a general rule the eye will be damaged less if the magnet be used in such a way as to draw the foreign body to the aqueous chamber along the path of least resistance. If then the point of the magnet be held against the centre of the cornea, and the current gradually increased by means of the rheostat, the patient will, as a rule, suddenly give a sharp cry of pain, and the metallic particle will be seen to pass in front of the lens and to bulge the iris forwards. If, as sometimes happens, there is difficulty in attracting the foreign body, the operator must exercise patience and apply the current in such a way as to act on the metal by a series of jerks. The splinter reaches the aqueous by passing behind the lens and perforating the zonule; and, indeed, provided that the lens has escaped injury at the time of the accident, it is very seldom injured during a skilful attempt to extract a piece of metal. It is most important that the field of operation be properly illuminated, so that every movement of the foreign body may be quickly seen and all damage from tearing of the iris prevented, and whenever the splinter reaches the aqueous the current ought at once to be shut off. As to further procedure the operator must be guided by experience. If the splinter possess sharp edges which have caught the iris, the safest way is, I think, to incise the cornea and cut out the piece of iris overlying the metal; but if the iris be not involved an attempt ought to be made to draw the chip gently into the pupil and to keep it there until the anterior chamber is opened. The particle can then be removed without an iridectomy.

In practice it is well to have a Hirschberg's magnet at hand in addition to the large portable one, because, if the rough edge of a chip of metal become entangled in the iris, there is great danger that the giant magnet will extract it so rapidly and forcibly that a considerable portion of the iris will be dragged out at the same time. It is better, indeed, after the foreign body has been displaced from the deeper parts of the eye into the aqueous chamber, to complete the operation for its removal with a less powerful instrument.

If, on the other hand, the patient be not seen till the wound in the cornea or sclerotic has had time to become firmly closed, the site of the splinter must be determined as accurately as possible, and an incision made through the sclerotic in its immediate neighbourhood. The point of the magnet can then be introduced within the lips of the wound and the metal extracted. After the operation the cut in the sclera must be carefully covered by conjunctiva to prevent infection, and the patient should be kept in bed for at least a fortnight. If no means be at hand for accurately fixing the position of the extraneous substance, the large magnet should be applied to the centre of the cornea and the chip of iron or steel attracted and drawn into the anterior chamber.

The procedure may be illustrated by describing the case of a stone-cutter who had been struck on the left

PLATE XIX.

LOCALISING APPARATUS—METHOD OF USE.

The localising apparatus is used as follows. At or near the outer canthus is fixed a small metal index which shows on the skiagram and is the point from which all measurements are made, except the distance of the X-ray tube, which is measured from the centre of the eye.[1] In *A* and *B* this index is shown as a dark cross. The patient is seated with his eye close to the photographic plate, which is in the pocket described in connection with Plate XVIII.; and the X-ray tube is set at any convenient distance, but a length of 300 millimetres will be found most suitable. Two skiagrams are then taken with the head rigidly fixed, one with the X-ray tube say 40 millimetres in front of the index, and the other with it 40 millimetres behind—*i.e.* with a distance of 80 millimetres between the central point of the tube in the one position and the central point in the other. On the developed skiagrams careful measurement is then made of the distances of the foreign body from the centre of the index. The difference of these is the distance between the images formed on the two plates. In the pictures here shown, the one measurement gives 14 millimetres and the other 5, so that the difference is 9 millimetres.

Referring now to the diagrams below, where *C* is the index, *A* the position of the one image, *B* that of the other, *O* the foreign body, and *R* and *S* the positions of the central point of the X-ray tube, we have, by similar triangles,

$$RS : SO :: AB : BO$$

or,

$$80 : 300 :: 9 : BO$$

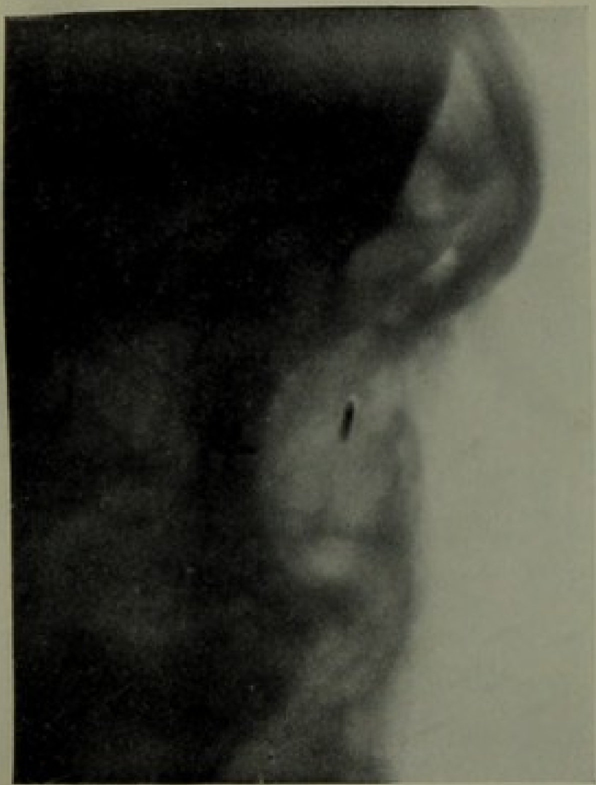
and therefore

$$BO = \frac{270}{8} = 33.75\,;$$

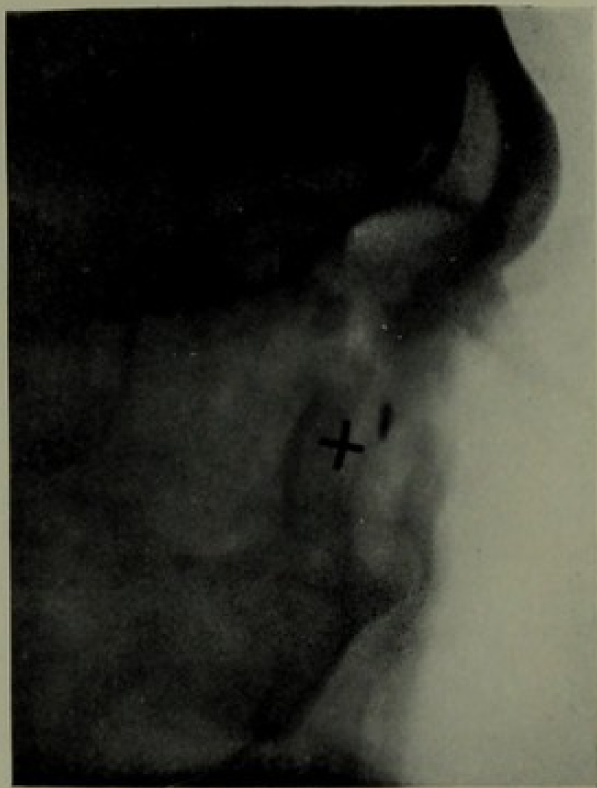
so that the foreign body is situated 33.75 millimetres to the nasal side of the outer canthus. The antero-posterior distance may be found by taking a third skiagram with the tube opposite the metal index, but it may be easily found without this, because it is opposite the middle point of *AB*, or in other words it is equal to $\frac{CA+CB}{2}$, *i.e.* in the case illustrated equal to $\frac{14+5}{2}$ millimetres, equal to 9.5 millimetres behind the line of the outer canthus. The vertical distance is obtained by direct measurements on the skiagrams. In the case illustrated it will be found to be three millimetres above the index. The measurements on the skiagrams are most easily made by means of a transparent celluloid scale.

[1] This distance should, for strict accuracy, be measured from the foreign body; but the error introduced by measuring from the centre of the eye is so small that it may be overlooked.

A.

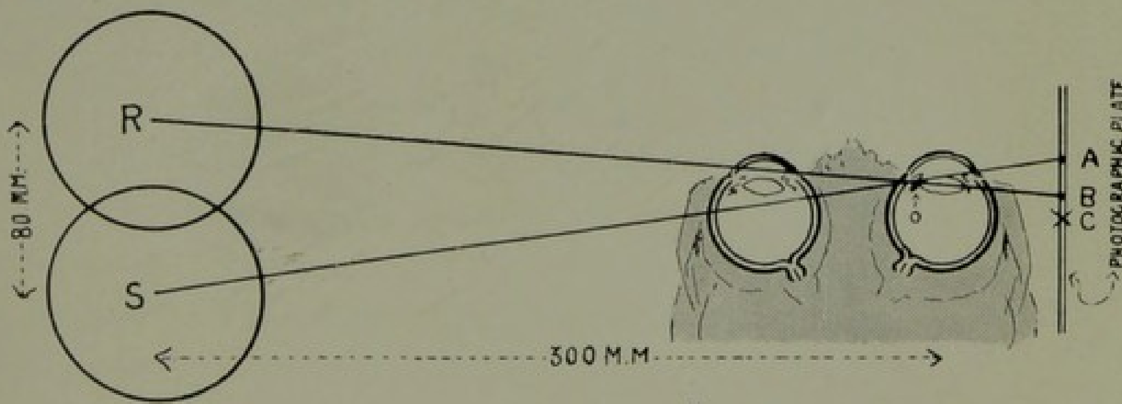


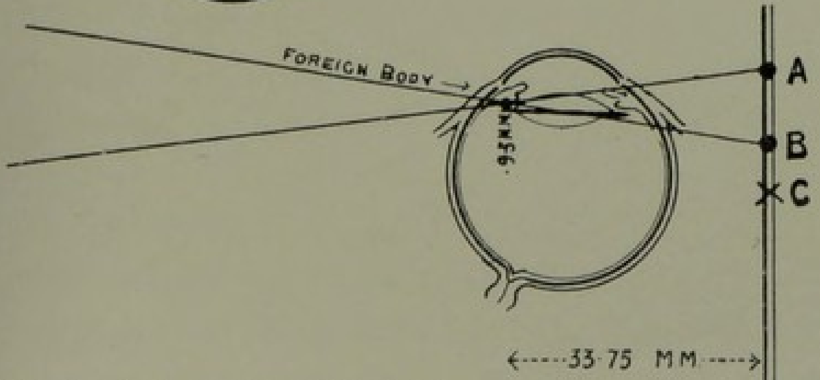
B.



X Ray Tube.
Position for
Skiagram B
40 mm. in
front of
index.

X Ray Tube.
Position for
Skiagram A
40 mm.
behind index.





A Image of Foreign Body as shewn on Skiagram A.

B Image of Foreign Body as shewn on Skiagram B.

C Index mark shewn on both Skiagrams.

Note.—The Skiagrams and lower Diagrams are full size. The upper Diagram is drawn to a reduced scale.

Position of Foreign Body in the Eye.
- 33·75 mm. to nasal side of index.
- 9.5 mm. in front of index.
- 3 mm. above index.

eye by a splinter from a fellow workman's chisel, while both were jointly engaged hewing a block of granite. I first saw him nearly two months after the accident. The iris was discoloured, the pupil irregular, the lens cataractous, tension normal, and light perception good. An X-ray photograph revealed a foreign body in the vitreous chamber, and although from the distinctness of the shadow on the sensitive plate this was diagnosed to be of metal, the patient himself insisted that it must be a chip of granite. On a powerful magnet being applied to the eye there was an immediate sensation of pain, the iris and lens bulged forwards, and a minute particle of metal darted into the aqueous chamber, from which it was easily extracted. The cataractous lens was afterwards removed by irrigation with sterile saline solution, and the adhesions between the iris and the capsule were divided by Carter's scissors. The operation was followed by no inflammatory reaction, and the patient recovered useful vision.

The sooner the foreign body is extracted, the greater the chance of preserving sight; and if the lens has escaped injury, obviously the prognosis is so much the more favourable. Under such circumstances a piece of metal of considerable size may be removed from the vitreous chamber, and the patient be not much the worse.

Take for example the case of an ironworker who was struck on the right eye by a piece of wire. He was at once brought to the Glasgow Ophthalmic Institution, where it was found that there was a wound penetrating the sclerotic on the inner aspect of the right eyeball, behind the ciliary region. Vitreous was exuding from the opening, the intra-ocular tension was much reduced, and sight was dim from effusion of blood. The fundus could not be illuminated, but the X-rays clearly revealed a piece of metal far back in the posterior chamber. After the eye had been disinfected, the conjunctiva was dissected from the wound, which was afterwards enlarged, and the metal was extracted by means of the magnet. The conjunctiva was then stitched, atropine instilled, the eye dressed, and an ice-bag applied. A calomel purge was administered, and quinine and aconite given in a mixture every three or four hours. No inflammatory reaction followed, and the patient made an uninterrupted recovery. When he left the Hospital three weeks after admission his sight was in no way impaired as a result of the injury.

Another case in point is that of a joiner, forty-eight years of age, who, when engaged in striking one hammer with another, knocked off a splinter of steel, which injured his left eye. There was a perforating wound of the upper lid, with a corresponding wound of the sclerotic beneath, three to four millimetres behind the corneal margin, and the intra-ocular tension was greatly reduced. The patient admitted that his sight was blurred, but regarded the accident as very trifling because he had no pain. Ophthalmoscopic examination revealed the existence of a large blood-clot at the lower and inner aspect of the vitreous chamber, and a skiagram showed that this concealed a splinter of metal.

As soon as the presence of a foreign body was thus rendered certain, the patient was placed on the operating table, the eyelids and conjunctival sac thoroughly cleansed, and the eye anaesthetised by means of cocaine and adrenaline solution. A large electro-magnet was then applied to the centre of the cornea, and the splinter at once passed quickly behind the lens, perforated the zonule, and entered the aqueous chamber. The piece of metal had sharp edges, and one of them caught the iris so firmly that there was great risk that further procedure with the large magnet would cause serious laceration. The chip being safely secured between the lens and the iris, the strong magnet was, therefore, laid aside, and, an incision having been made through the cornea with a keratome, the piece of iris covering the metal was excised, and the splinter lifted out by Hirschberg's small magnet. The lens was not wounded, no inflammatory reaction followed the operation, and, except for the iridectomy, one would not have known that the eye had suffered any serious injury. When the man left the Ophthalmic Institution, the blood-clot was being gradually absorbed and vision was steadily improving.

Still another example is afforded by the case of an ironworker, forty-two years of age, who, while chipping a metal plate, was struck by a splinter of iron, which cut the sclerotic on the outer side and penetrated the left eyeball. The intra-ocular tension was greatly reduced; but there was no complaint of pain, nor, though the case was dealt with only two hours after the accident, was any foreign body visible either to the naked eye or on ophthalmoscopic examination. An X-ray plate showed, however, that there was a large piece of metal inside the globe. With careful antiseptic precautions the strong magnet was applied to the centre of the cornea, and at once the splinter was drawn from the vitreous chamber into the aqueous, whence it was easily extracted. The wound in the sclerotic was thoroughly cleansed, cleared of all prolapse along its edges, and carefully covered by a conjunctival flap. No inflammatory reaction followed, and the patient's recovery was complete.

In many cases, however, in which the operation has been performed with promptitude and success, sight may afterwards be completely lost owing to detachment of the retina, or the globe may in the end be completely destroyed by plastic cyclitis. The eye is indeed damaged irreparably from the first. The shock, the large size of the foreign body, and the great liability of the vitreous to become infected by septic organisms, all contribute to bring about a disastrous result. (Plate XV., Fig. 3.) Hirschberg divides foreign bodies according to their weight: the small, weighing from twenty to thirty milligrammes, can usually be successfully extracted; while the medium, weighing from fifty to a hundred and fifty milligrammes, imperil the globe in proportion to their size, and raise the question whether it would not be wiser to enucleate than to make any attempt to save the eye. If the foreign body be one which is not attracted by the magnet (and it must be remembered, as has been pointed out by Snell, that there are now certain steel alloys which are non-magnetic), all we can do after accurately localising its position within the eyeball is to cut down upon it and attempt to extract it with forceps. It is not often, however, that those efforts are successful, and the operation is usually completed by enucleation: indeed under such circumstances the surgeon ought always to take the precaution to have beforehand obtained the patient's consent to remove the eye if he considers it advisable to do so.

Failure may sometimes also occur even although the foreign body be one which the magnet will attract, for it is not at all unusual for a particle of steel to become so embedded in the ocular tissues as to be completely insulated, and the more minute the particle the greater this danger. A good case in point is that of a patient who had a divergent squint following upon a traumatic cataract. He came to me to find out if it were possible to have the eye put straight and the cataract removed. Ten years previously his eye had been injured by a piece of metal; but although he had been under skilled treatment at the time of the accident, the presence of a foreign body within the eyeball had not been suspected. A Röntgen ray photograph, however, clearly revealed the small piece of metal in the ciliary region, but all attempts to remove it by the magnet failed. The cataract was easily extracted, and as soon as the patient had recovered from the operation another skiagram was taken, when the foreign body was found in exactly the same position as before.

In spite of such failures, however, there can be no doubt that the magnet and the Röntgen rays have rendered great service to ophthalmic surgery, for previous to their introduction into practice, there is not, as far as I am aware, a single instance on record of a foreign body having been removed from the vitreous chamber, and the sight at the same time saved.

CHAPTER VIII.

WOUNDS OF THE ORBIT, INJURIES TO THE EYE FROM DYNAMITE EXPLOSIONS, AND DEGENERATIVE CHANGES OCCURRING IN EYES AFTER PERFORATING WOUNDS.

A. WOUNDS OF THE ORBIT.

It is no uncommon thing for a patient to have the orbit injured by accidentally coming into contact with a carelessly-carried stick or umbrella as he walks along the street, by a foil in fencing, or by a pellet of shot, etc., etc. Such accidents are often extremely dangerous and in some cases have caused death, through fracture of the orbital walls. The eyeball may be ruptured, or, if the globe itself escape direct harm, the optic nerve may be injured. I remember once seeing a man who had attempted to shoot himself with a revolver, with the result that the bullet had passed right through the skull at the level of the orbits, and severing both optic nerves had caused complete blindness, but had done no other harm. A foreign body which has lodged in the orbit sets up in many instances acute inflammation, which may destroy the eye. It is usually advisable, therefore, to localise it by means of the X-rays and to extract it; but if it be causing no irritation (being probably encapsuled) it is usually most prudent to leave well alone, and not to expose the patient to the risks consequent on opening into the cellular tissue of the orbit. It is remarkable how large a foreign body may, at times, be retained in the orbit without causing any trouble. (Plate XX.)

B. INJURIES TO THE EYE FROM DYNAMITE EXPLOSIONS.

These form a class by themselves and usually occur among healthy labourers, who, through carelessness in firing a shot of dynamite, receive part of the charge in the face. The skin is burnt and impregnated with grains of explosive and sand. The lids are usually so much swollen that they cannot be opened voluntarily, and are separated only with difficulty by retractors. The surface of the cornea and sclerotic is, like the skin, bespattered with grains, and there is always more or less sub-conjunctival ecchymosis. There is great pain, accompanied by intolerance of light, and lachrymation; and in serious cases the lens is injured through foreign bodies having penetrated into the interior of the globe. There may be rupture of the cornea and sclerotic, and in all cases the eye suffers severely from shock. Superficial lesions gradually clear up, but sight is often more or less permanently impaired from opacities of the cornea. Whenever the globe has been perforated, the foreign bodies which have been driven into the eye set up iridocyclitis, which may go on to panophthalmitis.

PLATE XX.

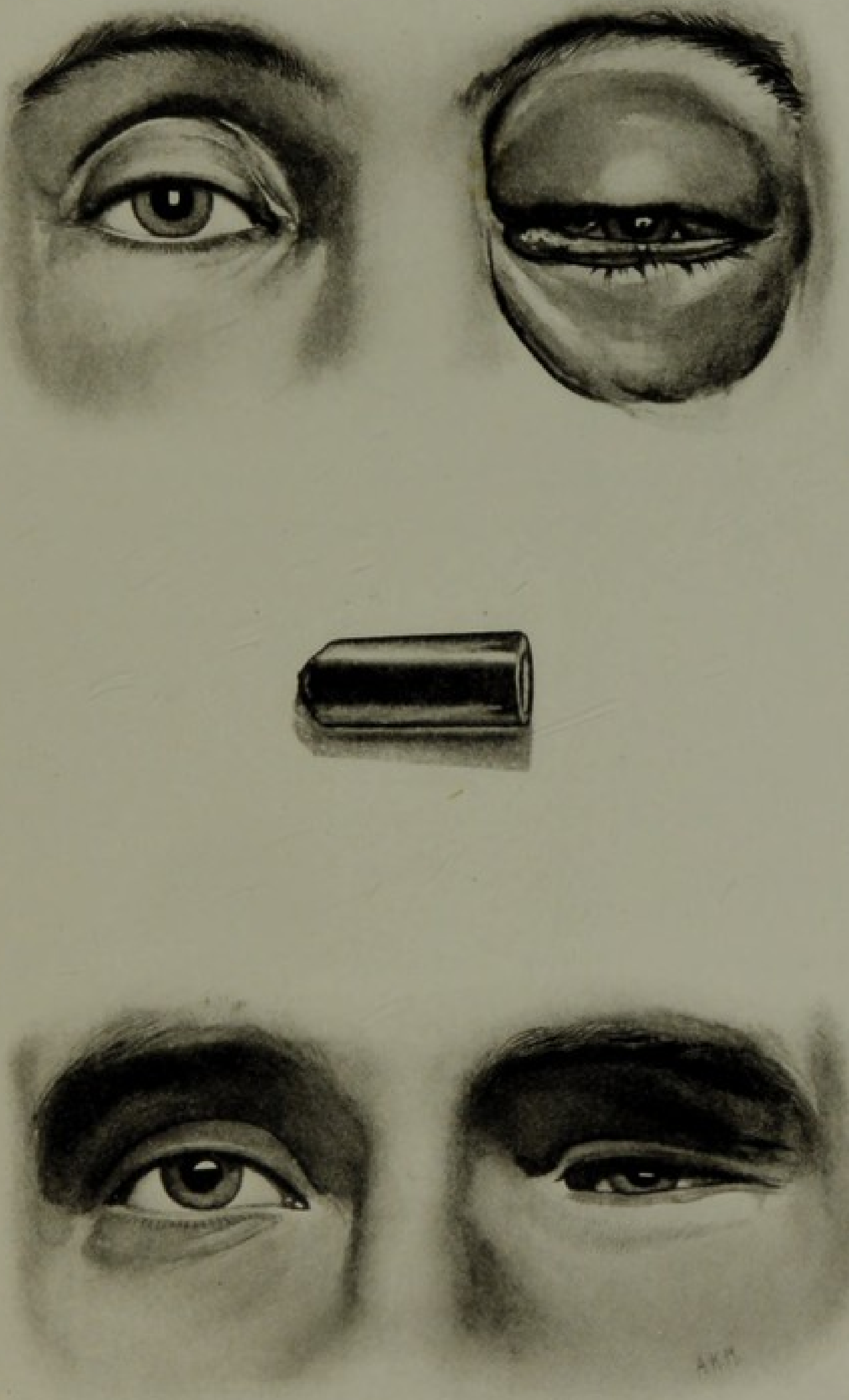
WOUNDS OF THE ORBIT.

Fig. 1 illustrates the case of a woman, forty-three years of age, who had been assaulted by her husband a few hours before she sought admission to the Glasgow Ophthalmic Institution. The left upper and lower eyelids were swollen and ecchymosed, and at the outer canthus there was a lacerated wound; there was marked subconjunctival ecchymosis; the eyeball was absolutely fixed, and protruded considerably owing to a large haematoma of the orbit; the pupil was dilated and oval in shape, and did not respond to light; and sight was reduced to a bare perception of light and shade. Ophthalmoscopic examination showed that the lens was dislocated downwards, and that there was a blood-clot towards the inner aspect of the ciliary region; but the media were transparent, and there seemed to be nothing amiss in the optic disc or retinal blood-vessels. No fracture of the bones of the orbit could be detected. The patient complained of severe pain, and stated that the skin of the left side of the forehead and the upper part of the face was quite numb.

Severe inflammatory reaction followed, and the chemosed conjunctiva projected beyond the palpebral fissure. The cornea was insensitive, became steamy, and was, by degrees, completely involved by an ulcer which began four days after the assault. Pain was severe and persistent, and it seemed as if an abscess was about to form in the orbit. The woman was repeatedly asked if she was sure that it was impossible for a foreign body to be present in the orbit; but she always replied that, so far as she knew, her husband had nothing whatever in his hand when he struck her. About thirty days after the accident, however, the husband came to see her, and lamented loudly that, during the quarrel, the bone mouthpiece of his pipe had been broken off; while just at the same time the patient, herself, began to complain of great tenderness on pressure over the outer canthus. To relieve the suffering thus caused poultices were applied, and when one of these was being removed the missing fragment of the pipe-stem was seen protruding from between the eyelids and was easily drawn out. Fig. 2 shows it of the natural size.

After the extrusion of the foreign body the pain lessened, the conjunctival chemosis subsided, the exophthalmos became much less marked, and slight power of movement returned to the ball. Whenever the pain was relieved the patient insisted on leaving the Hospital, and it is, therefore, impossible to tell what the final issue will be. Enophthalmos is, however, a common sequence to cases such as this, and of that condition Fig. 3 is a very typical illustration. The patient was a lad, nineteen years of age, who, three months before I first saw him, had been thrown from his cycle, with the result that the left upper and lower eyelids had been severely lacerated, and the orbital plate of the superior maxilla of the same side fractured. The accident seemed to have been followed by severe orbital cellulitis which left the eyeball greatly sunken; and when I saw him, the left upper lid drooped so much that it partially covered the eyeball, and the patient had very little power to raise it. The wounds in the lids, which had been carefully attended to, were completely healed; but the eyeball, though normal in size, had been pushed back in the socket, and was distinctly lower than its fellow, while its movements were restricted in every direction. The media were quite transparent, but there was complete atrophy of the left optic disc; and although the pupils were equal, the left responded feebly to the stimulus of light. The right eye was normal in every respect.

PLATE XX



Obviously under such circumstances there is no hope of saving the eye, and after a dynamite explosion the prognosis ought always to be very guarded, because, even although there may not be much apparent physical damage to the globe, the degree and effect of the shock cannot at first be fully appreciated.

The treatment consists in bathing the eyes thoroughly with hot sterilised water, removing as far as possible all foreign particles, and instilling into the conjunctival sac castor oil in which atropine and cocaine are dissolved. The patient ought to be put to bed as soon as possible, antiseptic fomentations applied to the eyes and face, a smart calomel purge administered, and anodynes given, if necessary, to relieve pain and induce sleep. Should there be a large lacerated wound of the cornea and sclerotic, it is wisest to enucleate at once. After inflammation has completely subsided, it may be expedient, should vision be impaired owing to corneal opacities, to make an artificial pupil and to tattoo the scars, while at other times a cataractous lens may require to be extracted.

C. DEGENERATIVE CHANGES OCCURRING IN EYES AFTER PERFORATING WOUNDS.

Although it is not always possible to preserve the function of an eye after a perforating injury, or after the successful removal of a foreign body, yet modern surgical technique and the advances of physical science enable the surgeon, greatly to the satisfaction of the patient, to preserve its form. Unfortunately, however, it often happens that after an apparently successful result degenerative changes supervene, and these give cause for much concern regarding the fate of the injured eye and the safety of its fellow. Roughly speaking, these retrograde processes result either in shrinking (Plate XXI., Fig. 3; and Plate XXII., Fig. 1), or in distention (Plate XXI., Fig. 2; and Plate XXII., Fig. 2), of the injured globe, and of these the former is by far the more frequent. An eye may seem for several weeks to be recovering quite satisfactorily, and the patient may even be able to see with it, but then the cicatrix of the wound begins to retract, while at the same time the sight first becomes weaker and then disappears altogether owing to detachment of the retina. The intra-ocular tension gradually diminishes, the cornea gets flatter and smaller, and the anterior chamber becomes so shallow that the iris at length lies closely against the posterior surface of the cornea. The globe loses its spherical shape and assumes a somewhat quadrilateral form, owing to flattening of its walls at the insertion of each of the recti muscles, and the upper eyelid tends to droop and fall in. Haemorrhage frequently occurs from the vessels of the iris and ciliary body, and the iris becomes much altered in colour from the absorption of blood pigment. All this time there is tenderness on pressure over the ciliary region, the eye readily flushes and waters on exposure, and there may be complaint of sympathetic irritation. Obviously enucleation is here the proper treatment;

PLATE XXI.

DEGENERATIVE CHANGES IN INJURED EYES.

Fig. 1 illustrates the case of a man, forty years of age, who, eight years before I saw him, had been struck on the left eye by a chip of steel. The subsequent history could not be made out; but the iris was tremulous, and was awanting at the upper part, where a prolapse had probably been excised at the time of the accident. The sight, though impaired from the outset, had been fairly good till, three weeks before he came to the Ophthalmic Institution, the patient had been accidentally struck on the eye by a man's elbow. Thereafter light perception had completely disappeared, and it was found that the intra-ocular tension was much reduced. Though the ball was injected it was quite painless. In the anterior chamber there was a peculiar deposit, the true nature of which became apparent when the eyeball was moved, for then a shower of golden cholesterine crystals was seen to pour from the vitreous chamber into the aqueous.

Fig. 2 shows an eyeball distended in all its diameters: the anatomical condition is illustrated in Plate XXII., Fig. 2. The surface is injected with large varicose vessels, one of which passes over the cornea to reach a cicatrix at the lower aspect. The pupil is irregular, the tremulous iris is adherent to the cicatrix, and the anterior chamber is deep. Two large ciliary staphylomata—dark slate-blue coloured patches—are seen projecting from the upper and inner aspect of the globe. There was no acute pain, but the eye felt weak and watered readily on exposure to light.

Fig. 3 illustrates the case of a boy, fourteen years of age, whose left eye had, two years before he came to the Ophthalmic Institution, received a perforating injury by a blow from a piece of wood. On admission it was found that the pupil was irregular after the instillation of atropine, the lens cataractous, intra-ocular tension slightly reduced, and light projection unsatisfactory; while there was a marked divergent squint. The cataract was, owing to its white colour, very conspicuous, and, as the patient's relatives were consequently anxious for its removal, it was washed out through a small section in the upper aspect of the cornea. The vitreous was as fluid as water, and the partially collapsed globe had to be filled up with sterile saline solution. Healing took place without the slightest interruption, and when the boy left the Hospital the eye had a natural appearance and was free from injection, and there was no tenderness over the ciliary region; but the intra-ocular tension was still below normal, and light perception had not increased. A few weeks after his return home the patient accidentally received a sharp blow on the eye, and immediately thereafter the anterior chamber became filled with blood, considerable pain and tenderness developed, and the surface of the globe became injected. Finally, as the ball began to shrink, it was enucleated.

PLATE XXI

Eye Injuries and their Treatment
A. Maitland Ramsay, M.D.

James Maclehose & Sons,
Publishers, Glasgow.

but should the patient (as is sometimes the case) refuse to allow the eye to be removed, there will be recurrent attacks of inflammation, accompanied frequently by much suffering, and lasting for many months. After they subside, the stump, now shrunken to a very small size, may remain quiescent for years; but as long as it remains it is, as a rule, unwise for the patient to wear an artificial eye, because the prothesis may cause irritation sufficient to precipitate the onset of sympathetic mischief. These shrunken globes are always the seat of constant pathological changes; deposits of lime take place in the ciliary body and lens, and the choroid gradually becomes converted into a shell of bone. (Plate XXII., Fig. 3.)

Distention of the eyeball, which is more likely to follow a punctured than an incised or a lacerated wound, is due to general inflammation of the uveal tract. The cornea and sclerotic may become uniformly distended, but more usually staphylomata form in the ciliary region and at the equator. The vitreous becomes quite fluid, and frequently contains numerous cholesterine and tyrosine crystals—synchisis scintillans (Plate XXI., Fig. 1)—the intra-ocular tension is increased, there is always liability to the occurrence of pain and inflammation from recurrent glaucomatous attacks, and sooner or later, owing to detachment of the retina, sight is completely lost. Such an eye is not only very disfiguring, but is also a serious menace to its fellow. It cannot be insisted on too strongly that every eye which is blind and painful ought to be enucleated, for not only is it a constant source of trouble to its possessor, but it may at any time give rise to sympathetic ophthalmitis, and it may, besides, become the seat of a malignant growth. If, however, the patient refuse to have the eyeball removed, the danger of sympathetic mischief may be diminished by dividing the optic and ciliary nerves; and the disfigurement may be lessened by performing the complete keratectomy operation as recommended by Panas.

PLATE XXII.

DEGENERATIVE CHANGES IN INJURED EYES.

Fig. 1 shows an eyeball of a lad, sixteen years of age, who was struck on the left eye by a piece of metal about the size of a small marble. Through the ragged wound at the upper and outer aspect of the cornea the aqueous had escaped and the iris had prolapsed. The lens was dislocated, and the anterior chamber was filled with blood. The metal was, by means of the electro-magnet, removed through the wound, and, in spite of the severe nature of the injury and the large size of the foreign body, healing took place without acute inflammation. Two months afterwards, however, the globe began to shrink, and as, at the same time, the right eye showed signs of sympathetic irritation, enucleation was at once resorted to. The ball is small and uniformly shrunken ; the cornea and sclerotic are thick in comparison with the size of the globe ; the wound in the cornea is seen near the periphery as a well-marked band of cicatricial tissue, continuous in its posterior aspect with the structures which lie underneath ; the anterior chamber is small, but not shallow, as the iris is tightly stretched to reach the region of the wound, where it is adherent to the cornea on the anterior, and to the lens structures on the posterior, aspect ; behind the tensely stretched iris is a large mass consisting of the cataractous lens, the capsule, and inflammatory exudation ; the retina is detached and thrown into tangled folds which meet the mass behind the iris, and are surrounded by inflammatory exudation ; the space between the retina and choroid is occupied by blood-stained exudation, and the choroid is partially detached from the sclerotic. The exudate has not at any time been purulent.

Fig. 2 is an example of extreme distention of the eyeball following post-traumatic inflammation : for the clinical history see Plate XXI., Fig. 2. The eyeball is very much larger than normal, elongation being especially marked in the line of the visual axis. Inflammation in the structures composing the walls of the globe has resulted in atrophy, and under the intra-ocular pressure numerous staphylomata have been formed at the places where the inflammatory mischief has been greatest. At these the wall is almost translucent. The retina is scarcely visible to the naked eye, its presence being indicated only by a thin membrane behind the ciliary region, scarcely distinguishable from the whitish exudate which is present in the anterior part of the eyeball. There is cupping of the optic disc, in addition to a large deep posterior staphyloma. The optic nerve is very small and the vessels thread-like. The choroid is much attenuated, and its presence at the staphylomatous areas is often marked only by a faint mottled deposit of pigment on the white sclerotic. The lens is much flattened in its antero-posterior diameter, and is in close apposition to the back of the iris which lies in its turn close behind the cornea. The latter is not so much thinned out as the sclerotic, and the staphylomata are more marked in the posterior chamber than in the anterior.

Fig. 3 illustrates advanced changes occurring as the result of injury—ossification of the choroid. The patient, a woman, sixty-five years of age, came to the Ophthalmic Institution suffering from severe kerato-iritis, with anterior staphyloma in one eye, while the vision of the other was beginning to fail. The clinical history was very meagre, and the interest lies chiefly in the pathological changes. There is well-marked ossification of the choroid, more pronounced in the posterior portion than in the anterior, and on probing the section with a needle spicules of bone can be detected. The retina has become detached and drawn into folds which pass along the centre of the eyeball. The space between it and the choroid is partially occupied by a dense reticulum which represents exudative products probably undergoing calcareous degeneration, and this passes almost imperceptibly into the band which represents the degenerating choroid. There are here and there large gaps where the choroid has become detached from the sclerotic, and the latter is in places somewhat thinned. The lens, which is but little displaced, is surrounded by a dense whitish exudate, and its anterior surface has the iris firmly sealed down upon it. The anterior chamber in the section appears shallow, the staphylomatous portion of the cornea being situated farther out towards the periphery.

PLATE XXII

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CHAPTER IX.

SYMPATHETIC OPHTHALMIA.

THE true nature of sympathetic ophthalmia, the most dangerous disease to which the eye is exposed, is still somewhat obscure; but recent investigations have shown that it is due to micro-organisms and their toxins travelling from the injured eye. It is usual to speak of the latter as the "exciter," while the one secondarily affected is called the "sympathiser." The morbid changes in the exciter which are likely to give rise to sympathetic inflammation may be enumerated under the following heads:

1. Penetrating wounds of the ciliary region, accompanied by prolapse of the iris and ciliary body, are, above all others, the most likely to cause sympathetic disturbance, and all the more readily should the wound be lacerated and should the instrument with which it was inflicted have been unclean. (Plate XXIII., Fig. 1.)

2. Foreign bodies lodged within the eyeball, more particularly if they lie near the ciliary processes, are a constant source of danger, since they keep up inflammatory reaction in the whole uveal tract.

3. Degenerative changes in an eye previously injured

are always accompanied by a certain amount of irido-cyclitis, and consequently an atrophied globe, tender and irritable through calcification of the lens and ossification of the choroid, is invariably a menace to the sound eye. (Plate XXIII., Fig. 2.)

4. Corneal ulcers which have perforated may form the starting point for a sympathetic ophthalmitis, but it is interesting to remember that an eye which has burst from within is not nearly so dangerous as one in which perforation has occurred from without. Moreover, all clinical experience goes to prove that after panophthalmitis the danger of a transference of infection from one side to the other is very slight.

5. Sarcoma of the choroid, or dislocation of the lens, accompanied by plastic iridocyclitis, may also induce sympathetic inflammation, but these are probably the only instances in which the disease arises apart from the existence of a perforating lesion of the "exciter."

The kind of eye which most frequently endangers the safety of the other is one which, in consequence of perforation through injury or ulceration, has been attacked by plastic iridocyclitis, and has become soft and tender to touch. The length of time which may intervene between the injury and the onset of sympathetic inflammation is very variable. It is very rarely less than three weeks, while, if the second eye escape until the one injured has healed, it will probably escape altogether, unless there be fresh inflammation or degenerative changes in the exciting eye. In the latter case the attack may not take place for many years.

PLATE XXIII.

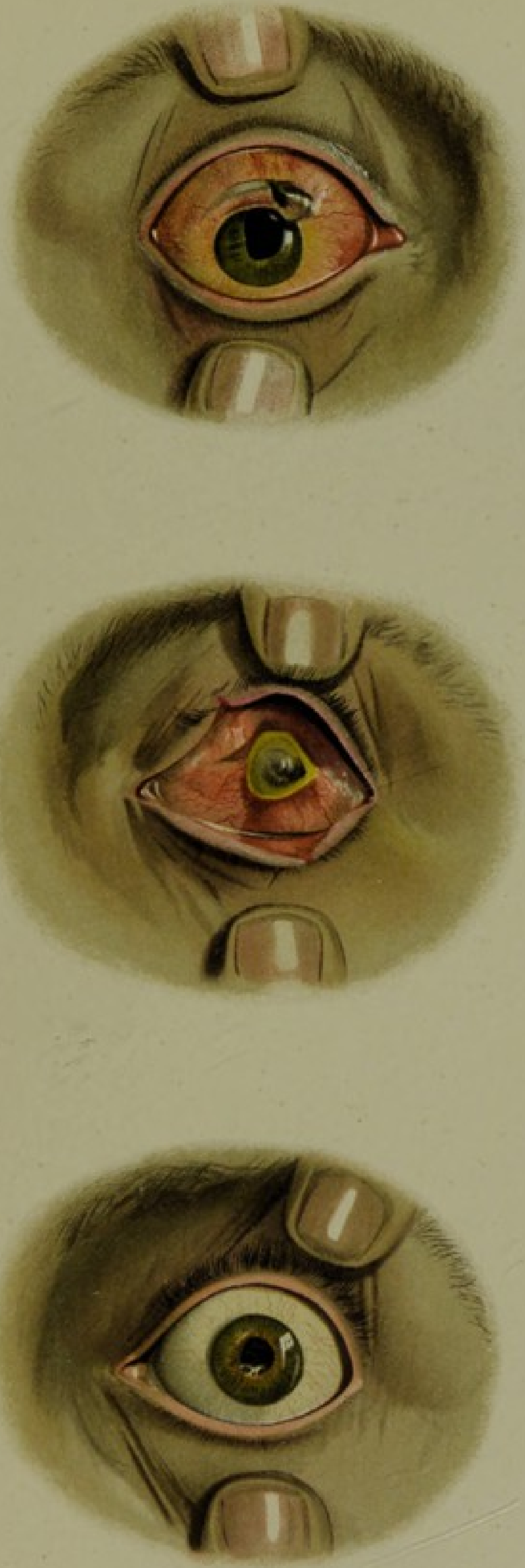
PENETRATING WOUNDS OF EYEBALL.

Fig. 1 illustrates the case of a man, forty-three years of age, who, during a drunken brawl, on the night before his admission to the Ophthalmic Institution, was struck on the right eye. Behind the cornea at its upper aspect there was a gaping wound, complicated by a large prolapse of the iris and ciliary body. The anterior chamber was full of blood, the intra-ocular tension was markedly diminished, the globe was partially collapsed, and sight was lost. Even at this early period the prolapse showed signs of infection, and was covered by a thin layer of purulent exudation; but as the patient was particularly strong and healthy the sepsis did not progress. In less than a week the aqueous was free from blood, and it was then seen that there was a large coloboma of the iris at its upper aspect. The iris was stained by blood-pigment; but there was very little iritis, and no tenderness on pressure over the ciliary region.

Fig. 2 illustrates the case of a man, forty-three years of age, who, a month before his admission to the Ophthalmic Institution, received on his eye a blow with a fist. There was a well-marked cicatrix and a notch in the edge of both upper and lower eyelids. The eyeball was shrivelled, soft, and painful; and at the upper aspect of the cornea there was a deeply indented cicatrix, marking the site of the rupture of the tunics of the globe. The cornea was small and flat. The other eye showed signs of sympathetic inflammation.

Fig. 3 illustrates the case of a man, thirty-two years of age, who, while cutting an iron nut, was struck on the left eye by a chip of the metal. There was a small scar on the cornea towards its upper and inner aspect. The pupil was contracted, but under the action of atropine dilated partially, revealing a cataractous lens. The anterior chamber was shallow. The circular fibres of the iris were notched at the upper and inner aspect of the pupil. The cataractous lens was washed out, but two months afterwards the patient was only able to count fingers at six feet, the poorness of sight being due to a thin opaque capsule which completely obliterated the pupil. When an opening was made in this with a Knapp's knife, vision improved at once, and became, with the aid of a lens, almost equal to $^6/_6$.

PLATE XXIII



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The insidious nature of the onset is one of its most outstanding characteristics, for, although it is occasionally ushered in by severe pain and other symptoms of acute inflammation, it usually develops in a manner so treacherous that serious results are not anticipated until the disease is thoroughly established. It may make its appearance at any age, but is more frequent in the young than in the old, and particularly so in children who are naturally delicate and of a highly neurotic temperament. When once it has started it is extremely difficult to arrest. Even under the most favourable conditions it runs a protracted course, and, though recovery occasionally takes place, the result is very often total blindness. The destruction of the sympathising eye is, indeed, often more complete than that of the one which received the injury, and the knowledge of this fact adds greatly to the responsibilities of the surgeon when he is called upon to treat a case in which sympathetic inflammation has fully developed and where the exciting eye still retains a fair amount of sight.

The principal points relating to the origin, progress, and termination of the disease were well illustrated in the case of a little girl I treated some years ago. She was a pale, delicate-looking child of ten years of age. Her sight had always been defective, but, as she was able to run about with other children, the full extent of her visual difficulties was not appreciated until she was sent to school at seven years of age. It was then discovered that she was suffering from double cataract. An operation performed on the right eye was followed by inflammation, and though she was detained in hospital for many weeks the eye was still red and tender-looking when she returned to her home. Shortly afterwards the left eye also became inflamed, and its sight began to fail. From that time both eyes were tender, intolerant of bright light, and subject to recurrent attacks of inflammation. There was not at any time much pain, and the redness of the eyeballs was never great, but vision grew steadily worse until the child became blind in both eyes.

When I first saw her she presented a typical example of chronic inflammation involving the whole uveal tract. Both eyeballs were soft, and the right globe was shrunk and misshapen from the pressure of the ocular muscles. There was no pain, but there was slight tenderness on palpation over the right ciliary region. For a short time after each examination of the eye, a faint pink blush surrounded the cornea, but at no other time was there any injection of the conjunctiva. The right cornea was clear, but the left had a few dirty greasy-looking spots on its posterior surface. Both irides were discoloured, and there was a coloboma upwards—the result of an iridectomy—in the right. They had a dull greyish-green appearance, and scattered over their surface were several brownish-black spots, due to exposure of the uveal pigment through stretching and wasting of the overlying iris stroma. This peculiar colouration and these atrophic changes caused the irides to look rotten. The pupils were fixed owing to complete posterior synechiae, and there was slight bulging of the iris into the anterior chamber. The right pupil was occupied by inflammatory exudation which was dense and white in its central portion, and bound to the iris by bands of fibrin. The left pupil was occluded by a membranous opacity to which the iris was firmly attached. It was impossible to illuminate either eye by means of the ophthalmoscope.

For more than a year there was little change in the appearance just described, but after that time the sympathiser began to shrink rapidly. There was no pain, but the sclerotic was covered by a pink injection, blood appeared in the anterior chamber, and the iris became green in colour from staining with blood. In the right eye there was still a perception of light, but the left was totally blind, probably owing to detachment of the retina.

It is always necessary to draw a distinction between sympathetic irritation and sympathetic inflammation; for the former is simply a neurosis and passes off without leaving any organic changes, but the latter is plastic and in the long run involves the whole of the internal structures of the ball.

1. SYMPATHETIC IRRITATION.

Sympathetic irritation is usually an early symptom, but it is often met with in cases where the injured eye has been blind for a long time, and is undergoing degenerative changes. The patient feels that his eye gets soon tired; he has difficulty in reading small print; and after prolonged work he suffers from transitory attacks of dimness of vision when he looks at distant objects, or it may be from momentary total blindness. He feels uncomfortable in a bright light, which may cause neuralgic pains to dart through his head, and induce injection of the conjunctiva accompanied by copious lachrymation.

If the field of vision be at this stage carefully examined by Bjerrum's screen the blind spot in the sympathising eye will in many instances be found to have assumed a spindle-shape (Plate XXIV., Fig. 2), and though I do not wish to insist too strongly on the value of this objective sign in the diagnosis of impending sympathetic mischief, I think it highly probable that, where there is an infected wound or degenerative changes in the other eye, it denotes active congestion of the optic disc, which may be regarded as a danger signal indicating the approach of genuine sympathetic disturbance. At this stage too the patient is sometimes found to suffer from a low degree of myopia, and the co-existence of both signs greatly strengthens the diagnosis. This temporary myopia may be due to spasm, but it sometimes persists under atropine, and then it can be explained only by supposing that congestion of the choroid has brought about an altered state of the media, whereby the refractive index has been increased. Whatever be the true significance of these signs this much is certain, that both disappear after the removal of the exciting eye. For a time after enucleation the blind spot may

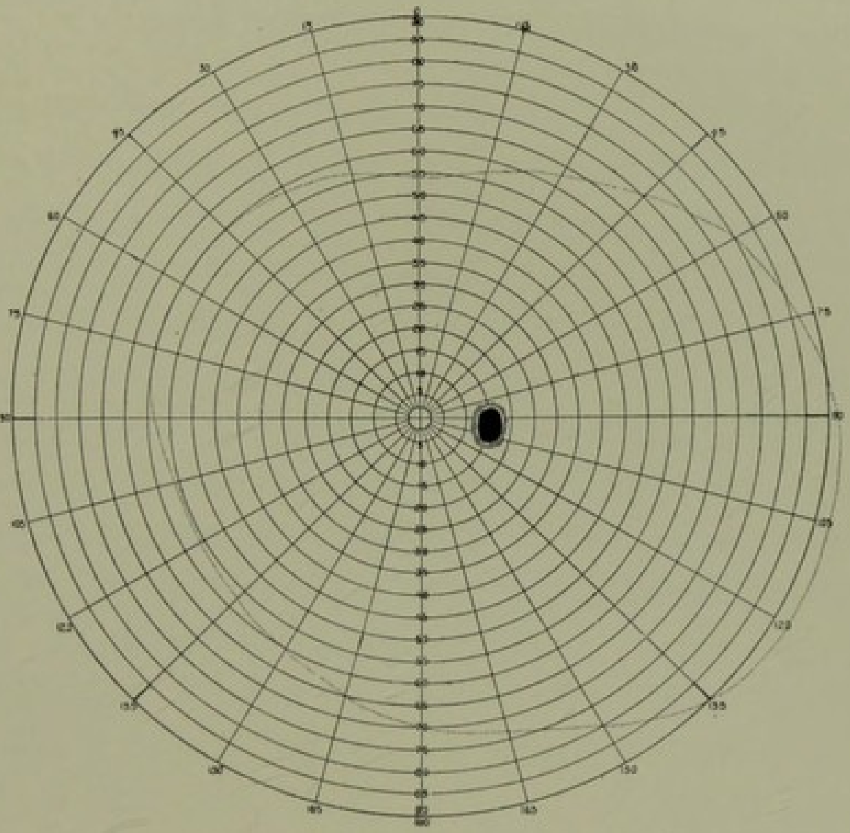
PLATE XXIV.

SPINDLE ENLARGEMENT OF BLIND SPOT.

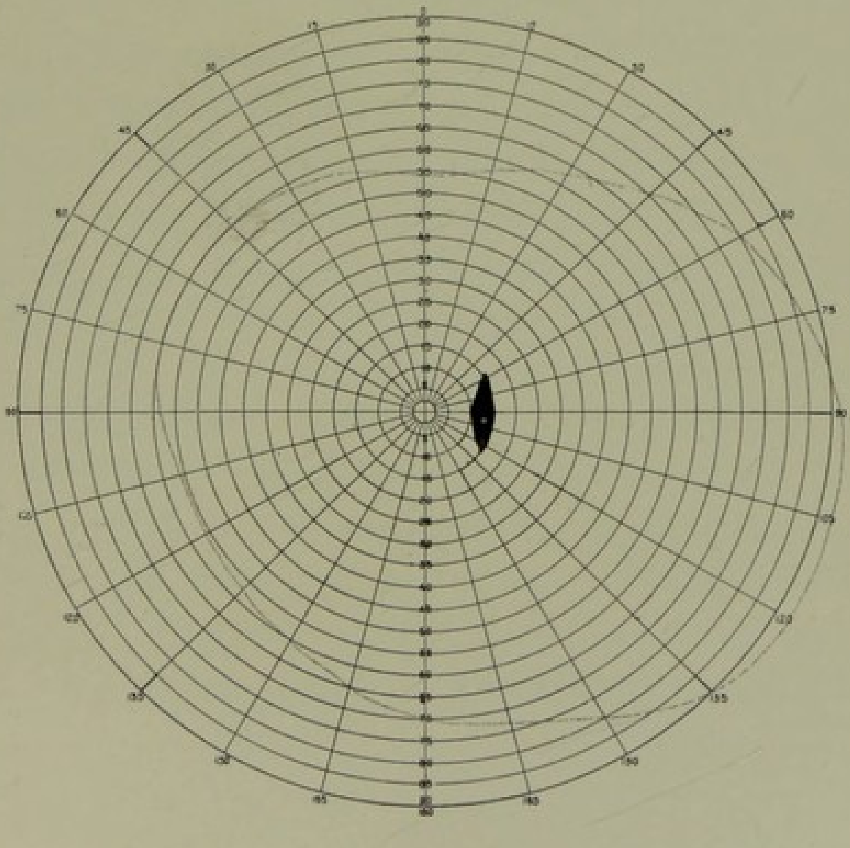
Normally, the blind spot of Mariotte, as shown in Fig. 1, is an oblong space with rounded corners, lying a little to the right or to the left of the fixation point. The rounding of the angles varies in different individuals, and the vertical length has to the horizontal breadth the proportion of six to four. About one-third of the whole space is above a horizontal line drawn through the fixation point. A narrow zone of relative or transitional amblyopia for white surrounds the area of absolute blindness, and outside this is the limit of the absolute scotoma for blue, then that for yellow, then that for red, and last of all that for green, the order being the same as that which obtains at the peripheral part of the visual field, and there seeming to be a zone of transitional amblyopia for all the colours. The absolute blind area for green is relatively very large, and its inner boundary almost reaches the point of central fixation.

Fig. 2 shows the spindle shape assumed by the blind spot in a patient, fifty-six years of age, who came to the Ophthalmic Institution suffering from a perforated wound in the left eyeball, in which a piece of metal was lodged. The man's story was that the sight of the injured ball had been completely destroyed five months before by a chip of metal. He complained that the globe which had been hurt was painful and that the vision of the sound eye was impaired. The left ball, on the cornea of which there was a large tri-radiate scar, had a prolapsed iris, was shrunken and tender to the touch, and showed marked ciliary injection. The tension was -3. The vision of the right eye was barely $^6/_6$, but when aided by a $+\cdot75$ spherical lens it became $^6/_5$; the pupil was circular and reacted normally; there was no redness; and tension was normal. On ophthalmoscopic examination it was found that the media were clear, but that there was marked congestion of the optic disc, and that the retinal vessels were decidedly tortuous and engorged. A Bjerrum's screen chart revealed that the blind spot was elongated and spindle-shaped, the length vertically being to the breadth horizontally as twelve to four. Two days later the injured ball was enucleated, and by the end of a fortnight after the operation all complaint as to the remaining eye had ceased; vision was $^6/_5$, the congestion of the optic disc was very much less, the vessels had become less tortuous, and the blind spot was normal. It is interesting to note that microscopic sections of the enucleated eyeball show the cellular infiltration and thickening of the choroid described by Fuchs in Volume LVIII. of Graefe's *Archives*, and believed by him to be frequently, if not constantly, associated with the onset of sympathetic inflammation.

PLATE XXIV.



NORMAL BLIND SPOT WITH THE ZONE OF TRANSITIONAL AMBLYOPIA AROUND IT.



persist in the form of a spindle, and so long as this is the case the patient continues to complain that his vision is weak and uncertain and that everything looked at appears "wavy" and "unsteady," but all these symptoms pass away as soon as the blind spot assumes its normal shape. Associated with the indications just noted ophthalmoscopic examination commonly reveals congestion of the optic disc, and increased fulness and tortuosity of the retinal blood-vessels. It is, however, always a difficult matter, when there is no healthy fundus for comparison, to determine by the ophthalmoscope alone whether the optic disc is, or is not, congested, hence the value of the confirmatory evidence afforded by the co-existence of all these signs.

2. SYMPATHETIC INFLAMMATION.

Sympathetic inflammation (Plate XXV., Fig. 2) may or may not be preceded by the symptoms just described; usually failing sight is the first warning that the patient receives of the development of the disease. When the eye is examined, a zone of pink hair-like vessels is seen surrounding the cornea; the iris is dull; and the pupil is small and sluggish, and dilates irregularly after the instillation of atropine. Even at this early stage there may be neuro-retinitis and floating bodies in the vitreous, but more frequently the details of the fundus are obscured by haziness of the media incidental to inflammation of the uveal tract. The cornea also becomes inflamed, spots form on its posterior surface—keratitis punctata—the aqueous is turbid, and the anterior chamber deep. The corneal signs are all the more marked when the inflammation assumes the serous type—serous iridocyclitis—but the plastic form is by far the more frequent and the more serious. Blood-vessels now develop upon the surface of the iris, whose substance thickens and bulges into the anterior chamber, the exudation filling up the pupil, and later on gluing the whole posterior surface of the iris to the capsule of the lens (complete posterior synechiae), matting the ciliary processes together, and implicating the choroid so extensively that the nutrition of the eye is gravely affected. As a result, the iris is retracted at its ciliary attachment, the tension diminishes, the lens becomes cataractous, and the shrinking vitreous causes detachment of the retina and of the anterior portion of the choroid. Up to this time there has been perception of light, but now blindness becomes total. The eye is liable to recurrent attacks of iridocyclitis; its blood-vessels degenerate, and, rupturing, give rise to intra-ocular haemorrhage; it steadily shrivels, and the final result is phthisis bulbi.

Mackenzie was the first to demonstrate that traumatic iridocyclitis of one eye is capable of inducing destructive inflammation of its fellow, and he considered that the noxious influence was transmitted from the one to the other by the blood-vessels, by the ciliary nerves, or by the union of the optic nerves. The last hypothesis was the one which claimed his special

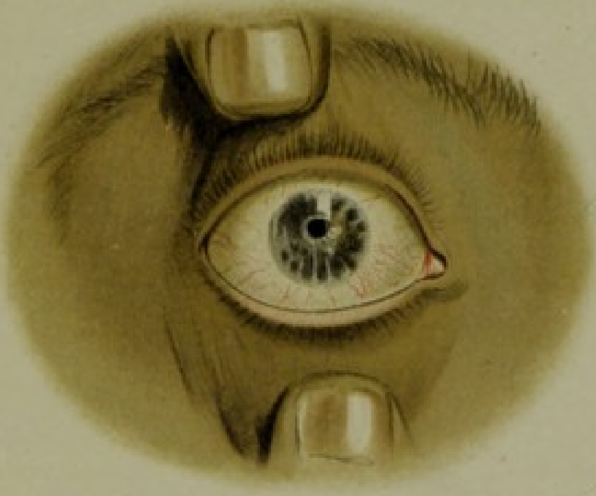
PLATE XXV.

SYMPATHETIC OPHTHALMIA.

Fig. 1 represents a section of the eye of a boy, five years of age, who, when cutting ferns, accidentally struck his left eye with the knife he was using. There was a large wound in the cornea through which the iris prolapsed, the anterior chamber was full of blood, and within forty-eight hours acute sepsis supervened. The eye was enucleated at the end of a fortnight, and three weeks later, when the child was sent home, there was no sign whatever of sympathetic trouble. In less than a month, however, the boy was brought back to the Ophthalmic Institution suffering from acute sympathetic iritis, said to have been induced by exposure to a bitterly cold wind during a long drive over an exposed moor. During the next twelve months, in spite of treatment, his condition became gradually worse, and, after repeated glaucomatous attacks, the right globe gradually softened and shrunk—phthisis bulbi. When the injured ball (the exciter) was hardened and bisected it was found to be the seat of acute plastic cyclitis. The iris and lens capsule were prolapsed and caught in a cicatrix extending across the cornea about its centre; the anterior portion of the vitreous chamber was filled up with a large mass of inflammatory exudation streaked with blood; and the retina was partially detached.

Fig. 2 shows the eye of a boy, eleven years of age, who was, eighteen months before I saw him, struck on the right eye with a stick. The injured globe was enucleated two months after the accident, and at that time it was believed that the left eye was quite healthy. Four months after this, however, the boy began to complain of failing sight, and sympathetic inflammation gradually supervened and steadily progressed until vision was completely destroyed.

Fig. 3 represents the eye of a boy ten years of age. The left eye had been injured eighteen months before I saw him, and had been enucleated, but not before symptoms of sympathetic inflammation had appeared in the right eye. For twelve months the child was under skilled treatment, and, when he was brought to me, all signs of inflammation had disappeared, but the lens was cataractous and the iris stretched, discoloured, and pigmented. The pupil remained of fair size, light perception was good, and intra-ocular tension was normal. The child was kept under observation for three months, and afterwards admitted to the Ophthalmic Institution, when a section was made at the outer aspect of the cornea and a large opening through the tough and thickened lens capsule. Through the rent thus made the point of an irrigating apparatus was introduced, and the cataract washed away as thoroughly as possible. The eye gradually improved, and the boy now sees so well that he is learning to read.



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favour, and he believed it "extremely probable that the retina of the injured eye is in a state of inflammation which is propagated along the corresponding optic nerve to the chiasma, and that thence the irritation which gives rise to inflammation is reflected to the retina of the opposite eye, along its optic nerve." Since Mackenzie's day there has been much speculation as to the pathogenesis of sympathetic ophthalmia, and numerous experiments have been made with a view to explaining it. Leber, for example, advanced the theory that sympathetic inflammation was the result of a septic infectious process in the injured eye, and that the micro-organisms travelled along the optic nerves to the sound eye; and his pupil Deutschmann set himself to prove these theories by experiments conducted on rabbits. He injected fluid containing staphylococci into the sheath of an optic nerve, and traced the micro-organisms across the chiasma in their course along the optic nerve of the one eye to reach the optic nerve of the other. He asserted further that when the staphylococci reached the sound eye they set up in it a typical sympathetic inflammation. For a time the difficulties of explaining the origin of ophthalmia migratoria, as the disease was now called, seemed to be ended, but, unfortunately, subsequent investigation failed completely to verify Deutschmann's observations.

Both laboratory experiments and clinical observations go to support the theory that infection is necessary before a wound of one eye can be the cause of inflammation in the other. Indeed, if it were possible to avoid sepsis, sympathetic ophthalmia would be altogether prevented. There seems, however, to be no reason for supposing that a specific micro-organism is necessary to produce the disease. Difficult though it be, it is desirable to endeavour to place the pathogenesis of sympathetic inflammation in line with the present day knowledge of the pathology of inflammation as a whole. At the very outset, however, the similarities of structure and of function existing between the two eyes must be emphasised, for it seems probable that many of the difficulties incident to such an attempt will be considerably lessened, when due importance is given to the close nervous and vascular connections subsisting between the one eye and the other. Of all the paired organs of the body the eyes are the most closely related, and so it is that the slightest injury to the one is almost immediately followed by sympathetic irritation of the other. Numerous experiments have conclusively demonstrated that irritation of the ciliary nerves in one eye produces not only dilatation of the blood-vessels, but also increased secretion of albumen into the aqueous humour, of the other. Such nutritional disturbances, however, although they favour, will not of themselves set up, inflammation, consequently we must look for some additional determining cause. There can be no doubt that this is to be found in the micro-organisms which have entered the eye at the time of the injury or subsequently through the perforation in the eyeball due to the accident. Operation wounds are made in the eye every day, and if these be aseptic they heal without the slightest trouble, and give rise to no risk of sympathetic inflammation. When, however, an operation wound is infected, it is as liable as any other to set up destructive sympathetic iridocyclitis, and should it be in the ciliary region disaster happens all the more readily.

Up to this point the problem is quite simple; the real difficulty lies in demonstrating the channels of communication between the two eyes along which this micro-biotic factor finds its way. There are three such passages, the blood-vessels, the ciliary nerves, and the optic nerves. Some weeks usually intervene between the occurrence of the accident and the onset of the secondary trouble, and if there has been acute suppurative inflammation of the injured eye there will probably be no sympathetic inflammation at all. This would imply that the condition of the exciter played a part in originating inflammation in the sympathiser apart from the presence of micro-organisms. The kind of eye most likely to excite sympathetic inflammation is one in which the acute symptoms have become quiescent, but which is tender on pressure and beginning to shrink. If such an eye is enucleated, and, after being hardened in preservative fluid, is bisected, it is seen that there has been a great outpouring of exudation from the iris and ciliary region, and that this has distributed itself behind the lens capsule so as to form, in some cases, a complete partition between the vitreous chamber and the aqueous. The terminations of the ciliary nerves are embedded in this exudation, which, as time goes on, begins to become organised, and, contracting, compresses and drags not only on the embedded nerves but also on the ciliary body and on the anterior part of the choroid and retina. In very acute cases the retina becomes detached completely, and extends like a fibrous cord between the inflammatory exudation in front and the optic nerve entrance behind. In some cases the ciliary nerves themselves shew signs of neuritis, and in all a constant irritation is kept up by the traction produced by the shrinking exudation. As a result of this, vaso-motor disturbance is set up, and maintained, in the second eye, and this renders it all the more vulnerable. The exciter produces this disturbance in the sympathiser partly through ciliary neuritis, but mostly through reflex action; and the destruction of the ciliary nerves in pan-opthalmitis explains in part at least why no such change occurs after acute suppurative inflammation.

Infection may be due either to the micro-organisms themselves, or, more probably, to the toxins which they have manufactured. For the former the most direct road from one eye to the other is along the optic nerves connected by the chiasma and along the lymph channels surrounding them, but that the microbes take this path has not so far been proved by experiment, and clinical experience is against the idea that they do so. If this were the line of passage papillitis ought to be the first sign of the disease in the sympathiser, but this is rarely the case, the ciliary region being as a rule that first attacked; while in abscess of the orbit, where both the optic nerve and its lymphatics are implicated, sympathetic inflammation never occurs. It would appear then that the infecting influence, be it microbe or toxin, reaches the sound eye through the blood stream, and that its virulence is concentrated locally upon the eye owing to the special vascular arrangements, and to the lowered resisting power of the ocular tissues. This last, as we have just seen, is due, in the sympathising eye, to vaso-motor disturbance in the vessels of the uveal tract brought about by the irritation of the ciliary nerves of the injured eye.

That there is a general toxæmia in cases of sympathetic inflammation cannot be doubted when one observes the disease as it is usually seen in children. Previous to the onset in many cases the child is dull, listless, drowsy, and disinclined for food. It is fretful although it is not suffering pain. The tongue is foul, the skin pale and somewhat clammy, and the pulse quick. All these symptoms, however, disappear after enucleation of the injured eye, and within forty-eight hours the appearance and demeanour of the child are completely changed. General symptoms not so pronounced may also be seen in the adult. I well remember one striking case where there were symptoms of sympathetic disturbance after enucleation, and where most careful investigation dispelled all suspicion of abuse of alcohol or tobacco. The patient felt and looked ill; his skin was clammy, his breath foul, and his fingers and tongue tremulous, while he complained bitterly of loss of sleep and appetite. The blind spot had become spindle-shaped. Active eliminant treatment not only rapidly improved the vision and restored the blind spot to its normal shape, but also effected a very remarkable improvement in the general health.

It is important then to ask, why is sympathetic inflammation so intractable, and why does it go on even after enucleation of the exciter? The ciliary processes are usually first attacked, and as it is upon the integrity of these that the nutrition of the globe for the most part depends, it follows that their implication by plastic inflammation interferes with the proper nourishment of the eye, and so the disease necessarily goes from bad to worse. The close anatomical and functional relation between the two eyes and the delicate and peculiar anatomical structure of the ocular tissues have also considerable influence, for after all a morbid process is the same no matter in what part of the body it occurs, and the results of a morbid process, while no doubt determined to a certain extent by the specific nature of the exciting cause, are also largely dependent on the anatomical structure of the organ attacked. If this view be correct there is no need to identify a specific micro-organism as the exciting cause of sympathetic inflammation, for any of the infective organisms found in wounds may produce it. Although different cases may present somewhat different clinical pictures, the special characters of the disease as regards onset, progress, and termination, are the result of ordinary pathological processes working in organs united to each other in the most intimate manner, and whose individual anatomical structure is wholly unlike that of any other organ of the body.

Since after sympathetic inflammation has fairly begun practically nothing can be done to check its progress, or to repair the damage which it has caused, the most effective treatment must be prophylactic, and we know that in the stage of irritation, and even in the early stage of serous iridocyclitis in the sympathiser, the removal of the exciter is followed by most beneficial results. Much of necessity depends upon the manner in which the injured eye has been treated immediately after the accident, and in the lecture on penetrating injuries of the eyeball, a full description has been given of how eyes seriously injured may be saved and sympathetic inflammation prevented. In many cases, however, enucleation is inevitable, and the following rules may serve as a guide:

1. Enucleate at once when the injury is so severe that the exciting eye is destroyed hopelessly from the beginning.

2. Enucleate at once on the slightest sign of sympathetic irritation should the vision of the exciting eye only equal a perception of light and darkness.

3. Enucleate at once if a foreign body is present in, and cannot be removed from, the exciting eye.

4. Enucleate at once when an injured eye is blind and suffering from recurrent attacks of acute inflammation, or when it is tender and irritable as a result

of the onset of degenerative changes—*e.g.*, ossification of the choroid.

5. Do *not* enucleate when there is still sight in the injured eye, and when there is no sign of sympathetic disturbance in its fellow.

6. Do *not* enucleate when sympathetic inflammation is in progress, and there is still sight in the injured eye, for under these circumstances the removal of the exciter will have no beneficial influence, and the probability is that in the end all the sight the patient will possess will be in the primarily injured eye.

Optico-ciliary neurotomy, simple evisceration, and, as suggested by Mules, evisceration and the implantation of a glass ball within the sclerotic, have all been proposed as substitutes for enucleation; but enucleation is, undoubtedly, the safest operation from the point of view of prophylaxis.

In the treatment of the sympathetically affected eye, no operation ought to be attempted until all acute symptoms have subsided, for any attempt to perform a sclerotomy, or to excise a piece of the iris, even if successful at the time, is followed by an accentuation of the symptoms, and by increased outpouring of inflammatory exudation. At the outset we must rely on the treatment suited to cases of chronic iridocyclitis. The eyes must be kept at rest, and this is best accomplished by shading them from the light and instilling atropine. If the inflammation be accompanied by great intolerance of light, lachrymation, and tenderness on pressure over the ciliary region, repeated leeching is useful in the early stages, but, in the later, blisters or the insertion of a seton in the temple are of more value. Turkish baths are always helpful, but the number and frequency of these must be regulated by the patient's ability to stand them. Large doses of salicylate of soda are strongly recommended by Gifford and others, but here again great care must be taken that they do not depress the patient unduly. Pain ought to be relieved by the local application of heat, and by the judicious use of opiates, aspirin, or other sedatives. In all cases the one drug to rely on is mercury, and this must be given until its physiological effects become apparent. It may be administered by the mouth, by sub-cutaneous or sub-conjunctival injections, by the calomel vapour bath, or by inunction. Of all these the last is probably the best, and a half to two drachms of mercury-vasogen should be rubbed well into the skin of the temple and brow every night. The action of the mercury is intensified by iodide of potassium, which may be given in ten or twenty grain doses once a day after a meal. It is very important, however, during this severe antiphlogistic treatment to attend carefully to the patient's general health. He must be well fed, and appetite promoted by tonics, especially those containing quinine and iron. In a few cases recovery of sight may take place as a result of this treatment, but as a rule the most that can be hoped for is that the active symptoms will subside, leaving the iris firmly adherent to the capsule of the lens, which in all probability is now cataractous.

After a sufficient time—a year or eighteen months—has elapsed, and if, during that interval, there has been no recurrence of inflammation, the intra-ocular tension has not diminished, and the patient's perception of light be satisfactory, operative interference may be considered. If it be resolved on, the iris should as far as possible be left alone. The lens must be got rid of, either by needling in the manner suggested by Critchett (Plate XXV., Fig. 3), or, in more favourable cases, by drawing it off with a curette after the toughened capsule has been divided with a knife. Once the cataract has been removed, an iridotomy may open up the pupil sufficiently to allow light to enter the eye and enable the patient to see as well as the damaged state of the retina will permit. In operating on such eyes, it must always be remembered that the vitreous is quite fluid and escapes readily, therefore it is important that all incisions be as small as possible and made wholly in the cornea. After operation, the eye must be carefully bandaged, and the patient kept quiet in bed in a darkened room; while the local application of ice, and the administration of sedatives internally, will do much to prevent the occurrence of inflammatory reaction.

CHAPTER X.

OCULAR THERAPEUTICS.

While the old masters in Ophthalmology made a great point of general treatment, the modern eye specialist tends to look upon ocular therapeutics as mainly local and operative. The tendency is in my opinion a mistake, for I think it is as important as ever always to lay down and carry out a definite plan of general treatment which will deal not only with the eye but with the patient's whole condition. The young graduate, fresh from the University and full of the most recent theories as to the cause of disease and the action of remedies, smiles in a superior way as he speaks of the old-fashioned practitioner, whom, nevertheless, he is only too glad to see at his bedside when he himself is ill. The strength of the older man lies in the fact that he treats his patient rather than the disease, recognising that he has a certain diathesis, a family history, hereditary proclivities, and the personal peculiarities which are termed idiosyncracies. As it is popularly expressed, he knows his patient's constitution, and he is also, in most instances, cognisant of his habits, consequently it is with recognised authority that at one time he whispers words of hope and encouragement and at another utters a timely and serious warning. The beginning and the end of his practice, therefore, is treatment, which is just what the medical student of to-day tends often to neglect; and by treatment I do not mean simply the administration of drugs, but the making use of every agency or circumstance which can help to bring about the patient's recovery.

The weakness of the older men lay in their idea that disease was a morbid entity that had to be driven out of the system at all hazards, and so they bled, they leeched, they blistered, they purged, they salivated, all to extremes. While, however, these methods were, when carried to the old excess, certainly worthy of the ridicule so often heaped upon them, we must remember that there is, for all of them, when properly employed, a sphere of great usefulness. In no branch of medicine is this more obvious than in the treatment of ocular diseases, where in many cases leeching, blistering, and purging are employed with advantage and success. For example, in a case of iridocyclitis, if blood be taken freely from the temple by either the natural or the artificial leech, in most cases a change for the better at once takes place, pain is relieved, the pupil dilates, and congestion diminishes. Again, in a case of keratitis, most gratifying results are often obtained by following the old-fashioned plan of blistering the eyelids with solid caustic; and in iritis, when the disease is tending to relapse time after time, the application of a blister often brings about such a change that recovery goes on afterwards without interruption. A more pronounced result still is obtained if the blistered surface be kept open by the application of an irritating ointment or by D'Albespeyre's paper, and in all deep-seated chronic inflammations an open blister contributes largely to the means of cure. When the inflammation is due to syphilis, the presence of an open sore is, in my experience, most helpful, and therefore, in such instances, I have not the slightest hesitation in inserting a seton in the nape, and keeping it there for several months. So strongly indeed am I convinced of the value of such measures that I feel that those who do not freely avail themselves of them deprive their patients of an important source of help. Then, again, how great is the improvement that often comes to an injured or inflamed eye after free purgation by a large dose of calomel, followed by a saline draught, and it can be demonstrated over and over again in iritis that the inflammation yields, and the pupil dilates to atropine, simultaneously with the slight soreness of the gums which indicates that the system is becoming affected by mercury. Oculists have never abandoned calomel and opium in the treatment of diseases of the uveal tract, no matter whether they be of syphilitic origin or not.

The want of familiarity with prescribing, and the consequent tendency to take refuge in the use of proprietary drugs, are often very unfortunate. A remedy which has been successful in one case may in another interfere with the digestion and assimilation of food, and so do nothing but harm. Whenever a doctor finds any medicine, no matter how high its reputation, causing gastro-intestinal disturbance, he should at once vary the preparation and the combination of the drugs to suit the peculiarity of the patient, and he will be the most successful who can do this and at the same time not depart in the least from the line of treatment he has laid down for himself.

Great, however, as was the clinical skill of the old masters, and much as we may learn from them, there can be no doubt whatever that the advance of science and the increase of knowledge have thrown an entirely new light on the treatment of eye diseases, and have placed at our disposal new and powerful means of dealing with them. Let us look at some of these.

ANTISEPTICS.

Long before anything was known of Bacteriology, the favourite drugs employed in the treatment of inflammation of the conjunctiva were nitrate of silver, sulphate of zinc, and perchloride of mercury. All these have powerful antiseptic action, and that property explains the favour in which they were held by the older ophthalmic surgeons, who, however, employed them wholly as a result of extensive clinical observation.

It was known that nitrate of silver was of special value in purulent ophthalmia, that sulphate of zinc was almost a specific in certain forms of catarrhal conjunctivitis, and that perchloride of mercury was generally useful in inflammation both of the lids and of the conjunctiva. A study of bacteriology affords a ready explanation, for it has been proved that salts of silver are fatal to gonococci, and sulphate of zinc to the bacillus of Weeks; and that perchloride of mercury is inimical to all forms of microbic life. This is a good example of how a method of treatment arrived at in the first instance by clinical experiment has been amply justified and confirmed by the increase of knowledge. The old ophthalmic surgeons are entitled to the credit of having been the pioneers in the use of antiseptics, though they could not explain how or why the beneficial results came about; while the general surgeon did not fully avail himself of these germicides till their action was explained by the study of bacteriology.

Ophthalmology got good in turn from the investigation and discussion of the germ theory. In the case of the eye, however, there is a difficulty in carrying out full antiseptic methods; owing to the extreme delicacy of the structures it is not possible to employ antiseptic solutions strong enough to kill the micro-organisms without at the same time injuring the conjunctiva. In ocular surgery, therefore, the field of operation is prepared by freely flushing the conjunctival sac with bland solutions. By that means the germs are mechanically washed away, and their numbers consequently so reduced that they are unable to exercise any injurious influence over the healing of a wound. If infection has taken place, however, an antiseptic is necessary, and of all those employed in ocular surgery none is so generally useful as silver. In the old form of the nitrate it has no doubt many disadvantages. Owing to its caustic action it causes a superficial eschar, and thus cannot penetrate deeply into the tissues; its use is accompanied by great pain; and after a time it produces dark staining of the conjunctiva—argyrosis. In spite of these drawbacks, however, the nitrate can still, in many cases, be employed with advantage, although it is now being, in great measure, supplanted by other salts of the same metal, which, while they are strongly bactericidal, possess fewer undesirable qualities.

Out of the large number of these which the manufacturing chemist has placed on the market, I shall select the three with whose clinical value I am most familiar—protargol, collargol, and argyrol. Although the first contains only 8.3 per cent. of metallic silver as contrasted with 30 per cent. in each of the others, it is by far the most irritating, as well as the one most liable to cause argyrosis. Each, however, has come to occupy a distinct place in my practice. In chronic inflammation of the conjunctiva and the edges of the eyelids, protargol, in from 10 to 25 per cent. solution or ointment, brushed vigorously over the affected parts, produces far quicker and better results than are to be obtained by any other method of treatment with which I am acquainted. In recent wounds of the eyeball I prefer collargol, and employ it for the most part in the form of gelatine wafers containing 10 per cent. of the drug; but I also use it in solution and as ointment, in strength varying from 5 to 10 per cent. If the injured surface be aseptic the collargol gelatine at once adheres to it, thereby sealing the wound and covering it up completely with an antiseptic plaster, under which healing goes on with great rapidity. If, however, there be sepsis the silver salt will not adhere to the wound, and consequently the presence or absence of the staining forms a trustworthy guide in prognosis. Collargol is almost always successful in its action, and it has also a wonderful power in clearing up recent opacities of the cornea, whether these be due to injury or to disease; but on very rare occasions it induces so much chemosis, and causes such severe pain, that its use requires to be discontinued.

In acute conjunctivitis argyrol gives the best results. Of the three it is the least irritating, and its value in lessening discharge and in relieving pain is very great indeed. It can be used in as great strength as 50 per cent., and, like the other preparations I am speaking of, it may be applied either in solution or as an ointment. Although it is said to penetrate deeply into the tissues, I have on only two occasions seen marked discolouration of the conjunctiva follow its use. It is so non-irritating that it may safely be injected into the anterior chamber to control intra-ocular suppuration, and in this connection I have obtained better results from it and from collargol gelatine than from the iodoform rods so highly recommended by Haab. In the treatment of purulent ophthalmia, in either the adult or the new-born child, it is, in my opinion, the most valuable remedy we possess, but the best results are obtained by brushing the whole palpebral conjunctiva once thoroughly with a 2 per cent. solution of nitrate of silver at the outset of the disease, and afterwards applying a 20 per cent. solution of argyrol every few hours, the frequency of these applications being regulated solely by the amount of the discharge. In blenorrhoea of the lachrymal passages, after the nasal duct is clear of obstruction, the injection of solution of argyrol into the tear-sac checks suppuration, and thereby hastens the cure of what in former days was one of the most tedious of diseases.

Concerning most of the drugs put on the market by manufacturing chemists in recent years for the purpose of preventing or controlling sepsis, I need only remark that the results obtained in a test-tube experiment are not always confirmed in actual practice, Two, however, can be confidently recommended—chinosol and trikresol. The former in the strength of 1 in 4000 is of undoubted value in the treatment of infected ulcers of the cornea, and the latter, 1 in 1000, forms an admirable lotion for removing discharge from an inflamed conjunctiva.

In the treatment of serpiginous ulcer which formerly used to be regarded with such grave apprehension, and in which the surgeon, having exhausted all the known resources of therapeutics, had to stand by and watch the cornea melt away, these newer salts of silver are of great value, and, should they fail, the thorough and timely application of the actual cautery will arrest the process of ulceration. After this, if care be taken to prevent reinfection, and if the tendency to the formation of anterior staphyloma be obviated by keeping the patient in bed till cicatrisation is complete, useful vision can, in many instances, be restored.

ANAESTHETICS.

Anaesthetics are "remedies by means of which the sensations of pain are dulled or abolished." They are divided into two classes, local and general.

(*a*) *Local anaesthetics.*—Of these, cocaine is, in my opinion, *facile princeps.* It was introduced by Köller in 1884, and its use has been an inestimable boon to ocular surgery. If any one has had a foreign body removed from his cornea without cocaine, and has had also, at a later period, the same operation performed with the eye anaesthetised by means of that drug, he will realise to the full the advance in therapeutics brought about by newer discoveries. The use of cocaine has, however, certain drawbacks. It dilates the pupil, disorders the accommodation, and acts injuriously upon the corneal epithelium, producing in some cases actual inflammation. Now in my opinion these disadvantages may for the most part be avoided if the solution employed be weak. I never for any purpose use a greater strength than 2 per cent., and I always make the patient keep the eye closed after the drops have been instilled. If the operation has been prolonged, I take the additional precaution of instilling a few drops of 5 per cent. chloretone oil into the conjunctival sac immediately before applying the bandage. In the case of a tarsal cyst, or in cauterising an ulcer of the cornea, however, I apply a small quantity of solid cocaine directly to the part about to be operated upon. The use of the drug in this way seems never to be followed by any bad result. If it be necessary to reach the deeper parts of the eye, for example the iris, a few drops of the 2 per cent. solution may be injected beneath the conjunctiva.

The drawbacks that I have mentioned have, however, led some to discard cocaine for holocaine, which in a 1 per cent. solution is a very trustworthy anaesthetic, though, as it possesses highly toxic properties, it cannot without danger be injected beneath the skin or conjunctiva, or along the tear-passages. In my experience, holocaine acts more slowly than cocaine, but penetrates more deeply; and I find it a most valuable addition to that drug in all operations in which it is necessary to cut the iris. My usual combination for this purpose is cocaine hydrochloride 2 per cent., holocaine hydrochloride 1 per cent., dissolved in solution of adrenaline chloride, 1 in 1000, freshly prepared immediately before being used. The employment of this mixture enables an operation for cataract to be performed without the slightest pain. Sometimes an oily solution is preferable to an aqueous one, but in that case the pure alkaloid must be used and not a salt.

I have just mentioned adrenaline, which is one of the most important of the additions that have been made in recent years to the resources of ophthalmic therapeutics. Its marvellous power of contracting blood-vessels enables the surgeon to carry out most operations on the eyeball almost bloodlessly, while the exsanguine condition of the conjunctiva which it produces facilitates the absorption of such drugs as cocaine, atropine, and eserine, and so renders their action more powerful. Stovaine, eucaine, alypin, novocain, and acoine are less toxic than cocaine, but their good qualities are not so outstanding as to make me prefer them in ordinary work to that drug used in the way I have described, although they are all of considerable service in practice.

(*b*) *General anaesthetics.*—In ophthalmic surgery, the use of local anaesthetics has to a large extent removed the need for general anaesthesia, but when dealing with a young child, or with a nervous refractory adult, or when operating on an inflamed eye, or enucleating the globe, a general anaesthetic is still necessary. Under these circumstances I prefer chloroform; but the patients must be brought thoroughly under its influence, for if they are only partially anaesthetised there is a risk of vomiting, or of awkward movements of the eye at a critical point of the operation, and in enucleation of the eyeball there is also the risk of dangerous collapse at the moment the optic and ciliary nerves are divided. For short operations where a general anaesthetic is deemed advisable, I prefer to employ chloride of ethyl, preceded by nitrous oxide gas. The use of this combination produces a profound quiet anaesthesia, lasting from one to two minutes.

The chloride of ethyl is, however, most suitable for women and children, for occasionally it causes men to become greatly excited before they pass thoroughly under its influence.

ANALGESICS.

Analgesics are "remedies which relieve pain." Of local analgesics I shall mention only dionine. It is a derivative of morphia (ethyl-morphine hydrochloride), and in 5 per cent. solution is one of the most valuable agents we possess for the relief of deep-seated pain—*e.g.* in glaucoma, iritis, sclerotitis, etc. When dropped into the eye it causes at first a smarting and burning sensation, accompanied by chemosis of the conjunctiva and swelling of the lids. These symptoms are sometimes very pronounced, and may alarm the patient greatly if he has not been forewarned of the probability of their occurrence, and told that they speedily pass off. This lymphagogue property of dionine is intimately associated with its power as an analgesic, because only after a good reaction is there much relief of the pain. This property also explains its power in promoting absorption of inflammatory deposits in the cornea. Its action in this way, very satisfactory in itself, is greatly increased if it be used along with collargol. In my experience, the best results are obtained when 5 per cent. solution of dionine is instilled in the morning, and a disc of 10 per cent. collargol gelatine is placed in the conjunctival sac in the evening. I am satisfied that this method of treatment hastens the clearing of the cornea after an attack of ulceration or of interstitial keratitis.

Pain following an operation does a great deal of harm owing to the restlessness it induces, and consequently, if I think there is likely to be much suffering, I give a small hypodermic injection of morphia before the patient is removed from the table. This insures several hours of continuous repose, and so gives Nature a healing chance of which she is never slow to avail herself to the utmost. Of all general analgesics morphia injected sub-cutaneously is the most satisfactory, but the physician ought to administer the dose himself, and not entrust the use of the hypodermic syringe to a nurse. Moreover the best results are got by small doses—from one-eighth to one-sixth of a grain—repeated if need be. Only under very exceptional circumstances should larger quantities than these be given. Sickness and digestive disturbance rarely follow the use of small doses.

Another drug of recent introduction that has been most beneficial in ophthalmic practice is aspirin. Given in 15 grain doses in iridocyclitis and other deep-seated inflammations of the eye, whether they be of rheumatic origin or not, it often acts like a charm. Should it tend to cause depression it is wise to combine it with caffeine, and when the patient is sleepless its efficacy is greatly enhanced by the addition of 10 grains of trional or 8 grains of veronal.

SERUM-THERAPY.

Serum-therapy, though it is typical of the trend of recent investigation, is in reality as old as Nature herself; for we now know that it is her own method of curing disease. The normal blood serum contains protective substances which prevent noxious micro-organisms from doing harm; and infection can take place only when bacteria are present in greater numbers than the natural antitoxins can overcome. The study of the subject is as yet in its infancy, but the researches of Wright and others have demonstrated "that there exists in the normal serum, and there exists in larger quantity in the serum of the successfully inoculated patient, an element which enters into chemical combination with the micro-organism in such a manner as to prepare it for phagocytosis." As this substance can be measured, the use of artificial serums is placed upon a truly scientific basis, and we can now employ them in perfectly determinate doses with exactitude and confidence. Hitherto the drawback in prescribing these powerful remedies has been the risk of doing harm, but there is no reason to doubt that, with the advance of science and the increase of knowledge, serum treatment will come to bulk more and more largely in medical practice. Here we have the exact knowledge of the new dealing with a problem that the old tried to solve in a blindly empirical way. The humoralists argued that every morbid process arose from a disordered state of the blood, and so they strove to restore this to a healthy condition. In modern times the discovery of micro-organisms led to the idea that they were the sole factors in causing disease, and the tendency was to attempt to destroy the bacteria by antiseptics. Both efforts resulted in failure, for in the first case all attention was given to the soil, and in the second to the germ. Now, however, that the true relation of these has been recognised, we know that the microbes can be fought successfully only by immunising the blood. When we remember how many eye conditions are simply the outcome of morbid constitutional states we can readily see how useful serum treatment may become in ocular therapeutics.

MYDRIATICS.

Mydriatics, drugs which dilate the pupil, have, owing to the use of the ophthalmoscope, and the estimation of refraction by the shadow test, become much more generally employed than was formerly the case. One of the commonest of them is atropine, which has, for long, occupied such a high place in ocular therapeutics that the uninstructed have come to look upon it as a panacea for all the ills that the eye is heir to, and consequently the abuse of the drug has done much harm. In simple conditions, where its administration was unnecessary, much inconvenience has been caused by paralysis of the accommodation, while in the elderly its use has precipitated an attack of acute glaucoma. It ought to be a golden rule, never to be forgotten by anyone who treats diseases of the eye, that atropine should in no case be instilled in a patient over forty years of age until the intra-ocular tension has been carefully tested and found to be normal. The caution that atropine ought never to be used in glaucoma cannot be repeated too often.

For examination purposes its disadvantages are obvious. It not only dilates the pupil but it paralyses the accommodation, and its effects remain for several days, greatly to the inconvenience of the patient, who, if he be suffering from an affection of the retina or choroid, and there has been an increase of the disease during the time the eyes are under the influence of the drug, may be easily tempted to blame the atropine used to faciliate an ophthalmoscopic examination for making his sight worse. A demand has, therefore, arisen for a mydriatic which will act quickly, and whose effects will pass off quickly, and which, while it will dilate the pupil to the maximum, will interfere as little as possible with accommodation. The manufacturing chemist has supplied several, of which the most important is the very expensive homatropine. This is both a mydriatic and a cycloplegic, but its effects pass off in a few hours. It is employed in a 1 per cent. solution, and is, in combination with cocaine, much used in the estimation of refraction by the shadow test. Other two excellent preparations are mydrine and euphthalmine, which dilate the pupil quickly and interfere but little with accommodation.

They are of great value for improving sight in nuclear cataract, or in central opacity of the cornea, as well as when one is making an ophthalmoscopic examination.

MYOTICS.

Myotics contract the pupil and are used chiefly to diminish intra-ocular tension. Eserine and pilocarpine are the two most generally employed, but iso-physostigmine and arecoline are also recommended. Of them all eserine is the most reliable, but when it is employed in from one-half to one per cent. solution its use is apt to be followed by supra-orbital pain, and it may cause acute follicular conjunctivitis and even inflammation of the iris.

SUB-CONJUNCTIVAL INJECTIONS.

For the purpose of controlling and arresting infection some have, in recent years, advocated the injection of weak solutions of mercurial salts beneath the conjunctiva, on the ground that the nearer to the site of the disease the remedy is applied the more likely is it to prove effective. My own experience of this method in the treatment of suppurative keratitis, or of infective iridocyclitis, does not warrant me in speaking strongly in its favour; but in some diseases—in choroiditis, for example, accompanying high myopia, and in detachment of the retina where the usual remedies have but little effect—I have obtained very encouraging results from the use of sub-conjunctival injections. The fluid I usually employ is 8 per cent.

chloride of sodium in a 1 in 2,000 solution of bicyanide of mercury, 5 to 20 minims being injected slowly beneath the conjunctiva, which, as the fluid enters, rises in a bleb. The great drawback to this method of treatment is its exceeding painfulness, but the suffering can be largely mitigated by using only chemically pure chloride of sodium, and by adding a few drops of a 2 per cent. solution of alypin or of a 1 per cent. solution of acoine to each dose immediately before injection.

THE APPLICATION OF HEAT.

The application of heat is of great value in all inflammations of the cornea, sclerotic, iris, ciliary body, etc. The effects vary according as the heat employed is dry or moist.

(*a*) *Dry heat* is applied to the eye by means of masses of heated cotton wool frequently changed, by a thermophore, by a Japanese muff-warmer, or by the electric heater devised by Maddox. The action is directly stimulant, and is consequently of great service in cases where the vitality is low—*e.g.* in rapidly progressive ulceration of the cornea, and in the later stages of purulent cyclitis.

(*b*) *Moist heat* is usually applied by means of fomentations. It diminishes the engorgement of the blood-vessels, and so, by reducing tension, relieves pain in all acute inflammations and suppurations. Unless the case be a very severe one, moist heat should be applied not continuously, but three or four times daily for periods of from half an hour to an hour. Between the applications the eye must be protected by a pad of cotton wool kept in position by a bandage. In very acute and deep-seated inflammations—*e.g.* subacute glaucoma—the heat must be as great as can be borne, and the periodic application kept up unremittingly.

Boracic acid fomentations.—A double layer of sterilised boracic lint, $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in., is laid on a sterilised towel in a basin, and boiling water, to which a solution of carbolic acid (1 in 20) has been added in the proportion of about four to six drachms to the pint—just sufficient to give an odour of phenol to the fomentation—is poured over it. The lint is then squeezed as dry as possible by wringing it in the towel, applied over the closed eyelids, and covered by a piece of jaconet or oiled silk $3\frac{3}{4}$ in. by $3\frac{3}{4}$ in. Over this is next placed a thick layer of absorbent cotton wool, which is kept in position by a roller bandage applied as lightly as possible. When pain is very severe, fomentations are used every two or three hours, day and night; but as soon as the pain begins to abate, they are applied only morning, noon, and evening, and during the night and early morning if the pain be sufficiently severe to prevent the patient from sleeping.

Corrosive sublimate fomentations are used of the strength of 1 in 5,000, and are prepared and applied in a manner similar to that just described. They are used, in cases of accident and of sloughy ulcer, to allay pain and to render the eyelids and surrounding parts as clean and aseptic as possible previous to operation.

Chamomile fomentations are prepared by boiling the flowers mixed with poppy heads (both should be rubbed down into a fine flour) for a quarter of an hour in a saturated solution of boracic acid. The infusion is then strained through sterilised muslin, and a fomentation prepared and applied to the eye in a manner similar to that already described.

THE APPLICATION OF COLD.

The application of cold is of great value in subduing pain immediately after accidental injuries to, or surgical operations upon, the eye; at the outset of all acute inflammations of the conjunctiva; and in some cases of iritis, when the pain is deep-seated, throbbing, and markedly nocturnal in character. The applications are generally made three or four times daily for periods varying from a quarter of an hour to half an hour, the methods most frequently employed being as follows:

(*a*) *An ice bag.*—A small bag is made of jaconet or gutta-percha tissue, filled with chips of ice, sealed carefully, and laid over the dressing, care being taken that the patient experiences no discomfort from the weight of the application.

(*b*) *Iced compresses.*—A lump of ice is allowed to float in a solution of boracic acid, and cotton wool sponges are dipped in this and applied directly to the closed eyelids, or the dressing is kept constantly wet by the iced water. Care must be taken that, in thus applying an iced compress, no septic material comes into contact with the eye.

(*c*) *Leiter's tubes.*—These consist of a flat spiral lead coil made to fit over the eye, and connected with two india-rubber tubes. The eye is protected by a moist compress, over which the lead coil is accurately adjusted. One of the rubber tubes is then placed in a jugful of water raised above the patient's head, when a stream of water runs through the apparatus, and is conveyed by the other rubber tube into a basin placed below the bed. These tubes may be used for hot as well as for cold applications.

BLOOD-LETTING.

General blood-letting is very rarely employed, but the local abstraction of blood is of great service in relieving pain in all acute inflammations of the uveal tract—*e.g.* iritis, cyclitis, choroiditis, etc. Local blood-letting is usually carried out either by natural leeches or by Heurteloup's artificial leech. Leeches are best applied round the external canthus, or over the mastoid region. Cleanse the part thoroughly, then take the leech in a narrow tube and place it over the spot, which may require to be moistened with a drop of milk to induce the leech to suck. It should be allowed to quit its hold of its own accord. If the subsequent bleeding be excessive, it may be checked by pressure over a pad of absorbent cotton-wool dusted with powdered alum. The amount of blood which should be withdrawn will vary according to the individual case, but, generally speaking, the bleeding should be continued until the pain is relieved. The patient, for some hours after the leeching, should be kept in bed in a dark room, and, if necessary, the bleeding encouraged by the application of fomentations. In acute iritis the pupil will often yield to the influence of atropine immediately after blood-letting, though previously the drug had been inefficacious, or had even caused increased irritation.

COUNTER-IRRITATION.

Counter-irritants are useful in many eye diseases, but must always be employed with caution, especially in dealing with children or elderly persons, lest they cause severe inflammation of the skin, or a sore which may prove very difficult to heal. They may be used as liniments or ointments, as blisters or setons. The liniments and ointments are useful in relieving photophobia due to inflammation of the cornea, sclerotic, or iris; but in the treatment of deep-seated inflammatory diseases of the eye, more especially when due to syphilis, better results are obtained from the use of an open blister or of a seton. Should a blister be employed, it is usually applied to the temporal region or over the mastoid process. The ordinary cantharidis plaster may be used, but canthos or Smith's blistering fluid will generally be found more convenient. If the object of the blister be to relieve pain, its efficacy is greatly increased by dressing the raw surface with an ointment of cocaine and morphine; but if continuous counter-irritation be desired, the best dressing is D'Albespeyre's No. 2 Papier Epispastique. A seton is even a more powerful counter-irritant than an open blister. It is usually applied to the temporal region or to the nape, and consists of a silk thread or a strand of lamp wick, which ought always to be introduced with antiseptic precautions. It is usually left in for weeks; but, if proper care be taken to dress the wound night and morning, the patient suffers comparatively little discomfort.

CHAPTER XI.

GENERAL DIRECTIONS REGARDING OPERATIONS ON THE EYE.

General preliminaries.—With regard to operations it may be useful to describe the methods in use at the Glasgow Ophthalmic Institution. As far as possible, patients are admitted to the hospital at least forty-eight hours before the time fixed for the operation; and in all cases in which the cornea requires to be cut, the adequacy of the tear-passages and the condition of the conjunctiva and margin of the eyelids is carefully observed, and fully noted in the ward journal. After the conjunctival sac has been thoroughly irrigated, a culture is taken. Should any septic discharge be found about the nostrils, lachrymal apparatus, conjunctiva, or edges of lids, the operation is postponed, and the patient at once placed under appropriate treatment.

General preparation of the patient.—On admission, each patient has a warm bath, puts on clean under-clothing, and is sent to bed, instructions being given to the nurse on night duty to observe and report if there be any cough, sickness, or unusual restlessness or nervousness. Early the following morning a purgative, generally one-half to one ounce of castor oil, is administered, to make sure that the bowels will be freely evacuated. The heart, lungs, and urine are examined in all elderly patients, or when there is any intention of administering a general anaesthetic. In the case of female patients the hair is divided and arranged in two plaits in order to prevent it from becoming matted or entangled in the bandage.

Preparation of the skin in the region of operation.—Twenty-four hours before the operation, the face, surface of the closed lids, eyelashes, and eyebrows are washed with hot water (in which 1 per cent. of carbosapol has been dissolved) and thoroughly scrubbed with a moderately hard nail-brush.[1] While this is being done, the eyelids must be kept tightly closed to prevent any irritation of the conjunctiva. After all the soap has been washed away with hot sterilised water, the conjunctival sac is douched with warm saturated solution of boracic acid, special attention being given to the outer and inner canthus and the edges of the eyelids. In every case the nostrils are thoroughly washed with a solution of Listerine (one ounce to a pint of warm water); and should there be any doubt as to the adequacy of the tear passages the parts are anaesthetised by cocaine and adrenaline solution, and the nasal duct carefully cleansed by washing with sterile saline solution.

On the morning of the day of operation, the patient

[1] If the eyebrows be shaggy and dirty, they are shaved off.

has a hot bath and puts on clean underclothing, and the eyelids and surrounding skin are again thoroughly washed and the conjunctival sac douched, every detail of the process, except the scrubbing with the nail-brush, being as carefully attended to as on the previous day. The patient is not allowed to eat too heartily, and the food is light and easy of digestion. For at least an hour before the operation the eyes are kept covered by a compress soaked in solution of perchloride of mercury (1 in 5,000), or, as White recommends, by a pad smeared by an ointment containing bichloride of mercury (1 in 3,000) which remains in place until it is removed by the surgeon. Half an hour before the time fixed for operating, a dose of bromide mixture (see Formula 25, page 188) is administered.

The operating room is thoroughly washed, carefully dusted, and well ventilated, some hours before it is to be used; and all tables, lamps, etc., are at the same time arranged in proper position.

The preparation of the instruments.—All coarse instruments, such as scissors, hooks, forceps, etc., are placed in the instrument steriliser and boiled from ten to fifteen minutes in a 2 per cent. solution of bicarbonate of soda. They are afterwards put in a bath of one per cent. carbolic solution, where they are kept submerged until required. Immediately before being used they are dipped in sterilised water. The more delicate instruments, such as iridectomy forceps, iris scissors, etc., are boiled for a shorter time. All cutting instruments, more especially the cataract and the iridectomy knives, are fresh from the cutler's; and, after the edge and point have been carefully examined, are, immediately before being handed to the surgeon, dipped for a moment in boiling water, and then cooled in the bath of sterilised water. When the operation is over, the instruments are never left in solution trays, but at once dried and replaced in the instrument cabinet, after all blood, etc, has been, if necessary, removed by brushing with soap and water.

The preparation of the dressings.—The special kind of dressing employed is modified according to circumstances, but all are sterilised by exposure to steam for thirty minutes. When dry, they are removed from the steriliser and placed in the dressing-trolley, no one except the staff-nurse being allowed to touch them. All towels for use in the operating room are also sterilised.

Preparation of the hands of the surgeon and his assistants.—The hands are thoroughly washed with hot water, an antiseptic soap and a nail brush being used. Any antiseptic which causes roughness of the skin is, however, to be avoided.

The operation.—When several operations are to be performed one after the other, the patients are, in order to prevent any unnecessary delay, brought from their wards to a room adjacent to the operating theatre. After the patient is on the operating table, the perchloride dressing is removed, a towel is adjusted like a turban round the head, and a mackintosh sheet covered by a towel is spread over the chest and tucked closely round the neck. The eye is now bathed with a solution of boracic acid which has been thoroughly boiled and cooled to the proper temperature, and anaesthesia is induced by instilling a few drops of a 2 per cent. solution of cocaine, which is prepared immediately before the operation by dissolving the hydrochloride in sterilised water. Adrenaline 1 in 1000 solution may also be added to control haemorrhage and favour the action of the cocaine. When the operation is completed, the eye is again bathed with the boracic solution, and the eyelids wiped dry with a pledget of absorbent cotton-wool and covered by an oval-shaped dressing of bicyanide gauze dipped in sterilised water and applied wet. Over this are laid several layers of absorbent wool, care being taken to fill up the hollow at the inner canthus, so that there will be no unequal pressure upon the eye. The dressings are retained in position by a bandage, and in all cases in which the lens has been interfered with both eyes are covered. The patient, after being warned to make no exertion or quick movements on leaving the operating table, is assisted by a nurse to walk to bed. Those, however, who have been operated on for cataract are not allowed to walk, but are carried, the bed having been previously warmed by hot bottles. The ward for these cases is kept at a temperature of 60° Fahrenheit, and is darkened. The patient is laid on his back, and enjoined to keep the head as still as possible, and not to rise or get out of bed *for any purpose whatever.*

Nursing after major operations.—For at least forty-eight hours after the operation the nurses keep the patient under continuous observation and see that he lies still, and they are particularly watchful that the bandages are not disturbed. They report to the house-surgeon at once if there be any restlessness, coughing, delirium, retention of urine, or complaint of pain or discomfort, but never under any circumstances administer either stimulants or narcotics, unless these have been specially ordered. If all goes well, the eyes are dressed on the second day after the operation, every care being taken to keep the parts aseptic. The lids are wiped by a piece of dry gauze, and then gently separated so that the wound may be examined. A single drop of a solution of 1 per cent. atropine and 2 per cent. cocaine is instilled, and a dressing, similar to the one removed, applied, the eyes thereafter being bound up for twenty-four hours. More light is now allowed to enter the ward. On the third day the dressings are again removed, the eye examined, and if the pupil be not dilated, another drop of atropine and cocaine solution is instilled. The eye which has not been operated upon may now be left unbandaged, but is protected from the light by a large brown-paper shade. On the fourth day the bandage is removed from both eyes (which are, however, protected by dark glasses), and the patient is allowed to sit up in bed for meals, while on the ninth day, if there be no sign of inflammation, he is permitted to get out of bed.

Food after cataract operations.—For the first three days the patient is fed by a nurse, and the following is the time-table and scale of diet, which is adhered to as far as possible. If, however, the patient be asleep at any of the hours noted, he is on no account to be disturbed.

5 p.m. On day of operation—the hour of operation at the Ophthalmic Institution is 2 p.m.—tea, with bread and butter.

9 p.m. Basin of gruel and milk.

4 a.m. Warm milk and bread.

8 a.m. Porridge and milk. Tea, with bread and butter.

12 noon. Strong hough soup, rice pudding with milk.

4 p.m. Tea, with bread and butter.

9 p.m. Basin of gruel and milk.

On the fourth day the morning meals are similar to those just mentioned, but the mid-day meal consists of hough soup and minced meat and potatoes. If there be no unfavourable symptoms, the patient is allowed to feed himself from the fourth day onwards.

If the bowels have not acted, a laxative is given early in the morning of the fourth day after operation.

FORMULAE

IN USE AT THE GLASGOW OPHTHALMIC INSTITUTION.

I. LOCAL APPLICATIONS.

A. COLLYRIA—EYE LOTIONS.

Used for the most part in cases of inflammation of the conjunctiva. Appended to Formula 1 is a general direction for the use of all collyria. Instead of ordinary distilled water, any of the aromatic waters, *e.g.*, rose water, fennel water, elder-flower water, camphor water, etc., may be used as a menstruum; and when there is pain or itching, cherry-laurel water is specially recommended.

The eyes should be carefully dried after being bathed with the lotion, and, for a short time, the patient ought not to expose himself to the open air. As the conjunctiva soon becomes accustomed to the use of a remedy, it is necessary, in order to obtain the best therapeutic results, to vary the lotions from time to time.

Pharmaceutically, collyria should be prepared with great care, and, with the one exception noted, filtered through paper: kaolin should be used if necessary.

I. ALKALINE LOTIONS.

Alkaline lotions are used for softening and facilitating the removal of encrusted discharge in blepharitis marginalis, lachrymal catarrh, etc. Before any definite treatment can be begun, all crusts must be removed.

1. Alkaline Lotion (Simple).

℞	Liquoris Potassae, - - - - -	ʒj
	Tincturae Catechu, - - - -	ʒij
	Aquae Laurocerasi, - - - -	℥ij
	Aquae Rosae, - - - - -	ad ℥viij
	Misce.	

Sig.—Equal parts of the lotion and boiling water to be mixed in a tea-cup previously warmed. With a piece of absorbent cotton, or soft sponge, bathe the eyelids with the mixture for a few minutes; and then incline the head back to allow a little to flow in upon the eye. Do this thrice a day, or more frequently if necessary.

2. Sodium Bicarbonate Lotion.

℞	Sodii Bicarbonatis, - - - - -	gr. lx
	Aquae Destillatae, - - - -	℥viij
	Solve.	

Note.—Useful where the eye has been injured by an acid, or for dissolving secretions from the edges of the lids.

3. Sodium Bicarbonate and Coal-Tar Lotion.

℞	Sodii Bicarbonatis, - - - - -	gr. lx
	Liquoris Carbonis Detergentis, - -	ʒj
	Aquae Destillatae, - - - - -	ad ℥viij
	Misce et cola per gossypium.	

Note.—Used in gouty and eczematous inflammations of the eyelids.

4. Sodium Salicylate and Borax Lotion.

℞	Sodii Salicylatis, - - - - -	gr. xx
	Pulveris Boracis, - - - - -	gr. lx
	Glycerini Purissimi, - - - -	℥ss
	Aquae Foeniculi, - - - - -	ad ℥viij
	Solve.	

Note.—Lotions 3 and 4 are useful in "watery eye," and Formula 4 is recommended in follicular conjunctivitis. If the lotions have to be injected into the tear passages, care must be taken not to employ too much force, as the lachrymal sac may rupture and the fluid extravasate into the surrounding tissues.

5. Sodium Sulphate and Hyoscyamus Lotion.

℞	Sodii Sulphatis, - - - - -	gr. xvj
	Tincturae Hyoscyami, - - -	℥ss
	Liquoris Potassae, - - - -	ʒj
	Aquae Destillatae, - - - - -	ad ℥viij
	Misce.	

Note.—Used as a mild stimulant in conjunctivitis with opacity of the cornea.

II. ANTISEPTIC LOTIONS.

Antiseptic lotions are used for cleansing the conjunctiva, eyelids, and surrounding skin, before operations on the eye; and in all inflammations accompanied by purulent discharge. The patient's friends ought to be informed that eye diseases accompanied by discharge are contagious, and that cleanliness is the most important factor in the treatment. It is necessary, therefore, that the patient should have his own towels and washing utensils. In adults suffering from purulent ophthalmia the healthy eye should be protected by a Buller's Shield. Every patient suffering from severe inflammation of the eye ought to be kept in bed, and, while there is profuse purulent discharge, a nurse ought to be in constant attendance. The whole success of the treatment depends upon the fidelity with which the eyes are cleansed.

1. Boric Acid Lotion.

℞ Acidi Borici, - - - - - - gr. lx
Aquae Destillatae, - - - - ℥viij
Solve.

Note.—The safest and most generally useful of all eye lotions. Barff's Boro-glyceride in 5 per cent. solution forms a convenient vehicle for many collyria.

2. Calomel Lotion.

℞ Hydrargyri Subchloridi, - - - gr. xxiv
Glycerini Purissimi, - - - - ℨiij
Mucilaginis Tragacanthi, - - - ℥j
Liquoris Calcis, - - - - - ad ℥viij
Misce.

Note.—Commonly known as "Black Wash"; useful application for syphilitic sores, and foul ulcers of the eyelids.

3. Carbolic Acid Lotion.

℞ Phenol Purissimi, - (5 per cent. solution in water).

Note.—It is important to use pure phenol for all lotions to be applied to the conjunctiva. Ordinary preparations of commercial carbolic acid cause considerable irritation.

4. Chinosol Lotion.

℞ Liquoris Chinosol, - - - - - (1 in 4000)

Note.—Chinosol, a bright lemon-yellow powder soluble in water, is a powerful antiseptic, and is strongly recommended for use in cases of serpiginous ulceration of the cornea.

5. Chlorine Lotion (Labarraque).

℞ Liquoris Sodae Chlorinatae, - - ℥j
Aquae Destillatae, - - - - ad ℥viij

Note.—Berry recommends the injection of chlorine water into the vitreous in purulent inflammation of the globe. It ought always to be prepared immediately before it is used.

6. Formalin Lotion.

℞ Liquoris Opii Sedativi (Battley), - ʒvj
Liquoris Formalin (1 in 2000), - - ad ℥viij
Misce.

Note.—Causes considerable irritation even in weak solution, but is sometimes of great value in hypopyon ulcers, septic wounds of the cornea, and ophthalmia neonatorum.

7. Mercury Lotions.

(*a*) ℞ Solutionis Hydrargyri Perchloridi, - (1 in 5000)
(*b*) ℞ Solutionis Hydrargyri Biniodidi, - - (1 in 20,000)

Note.—The former is the solution most commonly employed, but the latter is strongly recommended by Panas. The following is a convenient approximate formula :

℞ Hydrargyri Biniodidi, - - - - gr. ¼
Potassii Iodidi, - - - - - gr. j
Spiritûs Rectificati, - - - - ʒij
Aquae Destillatae, - - - - ad ℥xij
Solve.

8. Phenosalyl Lotion.

℞ Phenosalyl, - (1 per cent. solution in water)

Note.—A German specific, said to consist of a solution of carbolic, salicylic, and lactic acids, with menthol and eucalyptol. It is a more powerful antiseptic than phenol, and in 1 per cent. solution does not irritate the conjunctiva. Its application frequently prevents the recurrence of styes.

9. Potassium Permanganate Lotion.

℞ Potassii Permanganatis, - - - - gr. iv
Aquae Destillatae, - - - - - ℥viij
Solve.

Note.—Should always be freshly prepared, and never used after it has changed colour.

10. Quinine Lotion.

℞ Quininae Hydrochloridi, - - - - gr. xxiv
Aquae Destillatae, - - - - - ad ℥viij
Solve.

Note.—Used in diphtheritic and croupous conjunctivitis, and in ulcer of the cornea.

11. Zinc Chloride Lotion.

℞	Zinci Chloridi, - - - - - - -	gr. vj
	Alypin, - - - - - - - - -	gr. viij
	Aquae Destillatae, - - - - - -	℥viij
	Solve.	

Note.—Used in purulent ophthalmia; but, as it is a powerful irritant, it ought to be employed with caution.

III. ASTRINGENT LOTIONS.

Astringent lotions are used in inflammations of the conjunctiva, but are never employed when the deeper structures of the eyeball are involved. Such a mistake, which might be attended with disastrous results, may be easily avoided if it be remembered that, in deep-seated inflammation, the conjunctival injection is, for the most part, circumcorneal, that the pupil does not re-act readily to the stimulus of light, and that the pain complained of is characteristically throbbing, markedly nocturnal, and usually circumorbital.

1. Alum and Boric Acid Lotion.

℞	Pulveris Aluminis, - - - - - -	gr. xx
	Acidi Borici, - - - - - - -	gr. lx
	Glycerini Croci (Squire), - - - -	ʒij
	Aquae Rosae, - - - - - - -	ad ℥viij
	Solve.	

Note.—When used too freely, or in too concentrated solution, alum causes the conjunctival discharge to coagulate and adhere to the inner surface of the eyelids, thus giving rise to appearances suggestive of croupous conjunctivitis. In ulcer of the cornea, alum is contra-indicated, as it tends, by dissolving the cement substance, to cause the ulceration to increase.

2. Chrome Alum Lotion.

℞	Chrome Alum, - - - - - -	gr. xvj
	Aquae Destillatae, - - - - -	℥viij
	Solve.	

Note.—Used in chronic conjunctivitis.

3. Lapis Divinus Lotion.

℞	Lapidis Divini, - - - - - -	gr. xxx
	Vini Opii (sine Aromat.), - - -	ʒiij
	Aquae Destillatae, - - - - -	ad ℥vii
	Solve.	

Note.—Used in follicular and in granular conjunctivitis.

4. Lead Acetate Lotion.

℞	Plumbi Acetatis, - - - - -	gr. xx
	Spiritûs Rectificati, - - - - -	ʒij
	Aquae Sambuci, - - - - -	ad ℥viij
	Solve.	

Note.—Can be used only if the cornea be sound, as the lead is readily deposited on any abraded surface, and leaves a permanent opacity (*white lead*).

5. Lead Acetate and Opium Lotion.

℞	Plumbi Acetatis, - - - - -	gr. xxxvj
	Pulveris Opii Puri, - - - - -	gr. xlviij
	Aquae Bullientis, - - - -	℥viij
	Misce.	

Note.—Used in contusions of the eyelids.

6. Mercuric Chloride Lotion (Simple).

℞	Hydrargyri Perchloridi, - - - -	gr. j
	Ammonii Chloridi, - - - - -	gr. vj
	Pulveris Cocci Cacti, - - - -	gr. ij
	Spiritûs Rectificati, - - - - -	ʒj
	Aquae Destillatae, - - - - -	ad ℥viij
	Solve.	

Note.—This is generally known as Mackenzie's Eye Lotion.

7. Mercuric Chloride and Belladonna Lotion (Compound).

Same as 6, with ʒij of Tincture of Belladonna added to the formula, the Cochineal being omitted.

Note.—Used in all forms of conjunctivitis, but as the perchloride of mercury sometimes irritates, Formula 7 is to be preferred. If, however, the Belladonna cause inconvenience by dilating the pupil, it may be reduced in quantity, or omitted altogether, and Battley's Sedative Solution of Opium substituted.

8. Tannic Acid Lotion.

℞	Glycerini Acidi Tannici, - - - -	ʒj
	Pulveris Boracis, - - - - -	gr. lxxx
	Glycerini Purissimi, - . - - -	ʒij
	Aquae Camphorae, - - - - -	ad ℥viij
	Solve.	

Note.—Used in chronic conjunctivitis, more especially in the later stages of the follicular and granular forms.

9. Witchhazel Lotion.

℞	Liquoris Hamamelidis, - - - -	ʒiv
	Aquae Destillatae, - - - - -	℥viij

Note.—Used in conjunctivitis and simple epiphora.

10. Zinc Sulphate Lotion (Simple).

℞ Zinci Sulphatis, - - - - - - gr. xvj
Vini Opii (sine Aromat.), - - - ℥ss
Aquae Destillatae, - - - - - - ad ℥viij
Solve.

11. Zinc Sulphate Lotion (Compound).

℞ Zinci Sulphatis, - - - - - - gr. xij
Ammonii Chloridi, - - - - - - gr. vj
Spiritûs Rectificati, - - - - - ʒiij
Glycerini Croci (Squire), - - - - ʒij
Solutionis Boroglyceridi in Aquâ Camphorae (5 per cent.), - - - - ad ℥viij
Solve.

Note.—Formulae 10 and 11 are favourite lotions in simple catarrhal conjunctivitis.

IV. EVAPORANT LOTIONS.

Cold applications are of much service in relieving pain after operations upon the eye, or immediately after injuries involving its deeper structures. Ice-cold compresses should be applied only for ten or fifteen minutes every hour, as their continuous use tends to lower the vitality of the part.

1. Arnicated Lotion.

℞ Tincturae Arnicae, - - - - - - ʒiij
Liquoris Ammonii Acetatis, - - - ℥j
Aquae Sambuci, - - - - - - ad ℥viij
Misce.

Note.—Arnica is a favourite application in contusions of the eye, but it is doubtful whether it is of any real value in promoting absorption of effused blood.

Da Costa has suggested the following paint to prevent ecchymosis of the eyelid after injuries:

℞ Mucilaginis Acaciae, - - - - - ℥ss
Tincturae Capsici, - - - - - - ʒj
Glycerini Purissimi, - - - - - ad ℥j

Note.—In applying either of these, care must be taken not to allow them to come in contact with any part over which the skin is abraded.

2. Evaporant Lotion (Simple).

℞ Acidi Acetici, - - - - - - - ♏ xxiv
Spiritûs Ætheris Nitrosi, - - - - ℨiss
Aquae Rosae, - - - - - - - ad ℥viij
Misce.

Note.—Pour out half a wine-glassful of this fluid: with a small piece of clean soft sponge dipped into it, and gently wrung, bathe the eyelids, side of the nose, eyebrow, forehead, and temple for a few minutes, and then allow these parts to dry of themselves. Repeat this three or four times daily, or as often as the eyes feel painful, hot, or weak on exposure to light. The fluid does not require to go into the eye. May also be used as a spray.

3. Lead Subacetate and Spirit Lotion.

℞ Liquoris Plumbi Subacetatis, - - - ℨj
Spiritûs Rectificati, - - - - - - ℥ij
Aquae Destillatae, - - - - - ad ℥viij
Misce.

Note.—Used with a compress after contusion injuries and in chronic blepharitis marginalis, but to be avoided if there be any ulceration of the cornea.

V. MISCELLANEOUS LOTIONS.

The uses of these collyria are indicated by notes appended to the formulae.

1. Alumnol Lotion.

℞ Alumnol, - - - - - - - - gr. xx
Boroglyceridi (Barff), - - - - ℨiij
Aquae Rosae, - - - - - - - ad ℥viij
Solve.

Note.—Antiseptic and astringent. Used in chronic conjunctivitis.

2. Belladonna Lotion.

℞ Extracti Belladonnae, - - - - gr. cxx
Aquae Bullientis, - - - - - ℥viij.
Solve.

Note.—Used with a fomentation to relieve pain.

3. Physostigmine Lotion.

℞ Extracti Physostigminae, - - - - gr. xxx
Spiritûs Rectificati, - - - - - ℨij
Aquae Destillatae, - - - - - ad ℥viij
Misce.

Note.—Used in cases where the intra-ocular tension is increased, but inferior in its action to Eserine eye drops (*see* Formula 2, page 162). Also a valuable stimulant when applied with a fomentation in indolent ulcer of the cornea.

4. Potassium Chlorate Lotion.

℞ Solutionis Potassii Chloratis Saturati, - ℥viij

Note.—Recommended by Bergeon in the treatment of rodent ulcer.

5. Saline Lotion (Physiological).

℞ Sodii Chloridi (Purissimi), - - - gr. lx
Aquae Bullientis, - - - - - Oj

Note.—Used as a sterile saline solution to wash the eye before and during operations, and in the irrigation of the anterior chamber to facilitate the removal of pus, lenticular matter, etc. Saline solution is even less irritating to the conjunctiva than sterilised water, and in ophthalmic operations is much to be preferred to the mercurial and other antiseptic solutions in ordinary use.

B. GUTTAE—EYE DROPS.

Eye drops contain the remedy in more concentrated solution than collyria, and are most conveniently dispensed in Chalk's drop bottles, from which the solution can be easily instilled into the conjunctival sac by means of the pipette. As these solutions rapidly decompose, they should always be freshly prepared with sterilised distilled water; or a mild antiseptic may be added, and the solution thereafter carefully filtered. Camphor water is a favourite menstruum.

I. ANAESTHETICS.

Unless one be dealing with young children, chloroform or ether is seldom used for operations upon the eye, as, except for enucleation, extensive plastic operations on the lids, and iridectomy in acute glaucoma, it is unnecessary to induce general anaesthesia. For minor operations on the lids and tear passages in children, or in nervous adults, chloride of ethyl is a safe and reliable anaesthetic. Its effects pass off in about two minutes, and, as a rule, there are no disagreeable after-results. In ophthalmic surgery cocaine is the anaesthetic *par excellence.* It may be applied locally to the conjunctiva as a 2 per cent. aqueous solution of the hydrochloride, or from a quarter to half of a grain may be injected subcutaneously. When it is necessary to open an abscess of the lid or of the lachrymal sac, the overlying skin may be frozen by spraying it with anestile, care being taken to protect the eye from the irritating effects of the vapour.

1. Alypin Solution.

℞ Alypin, - - - - - - - - gr. ij
Acidi Borici, - - - - - - gr. iv
Aquae Destillatae, - - - - - ℥ij
Solve

Note.—Alypin (benzoyl-tetramethyl-diamino-ethyl-di-methyl carbinol hydrochloride) is a white crystalline powder, very soluble, and not precipitated by the alkaline fluids of the body. It is equal to cocaine hydrochloride in anaesthetising effect, but causes neither mydriasis, nor derangement of accommodation.

2. Cocaine Hydrochloride Solution.

℞ Cocainae Hydrochloridi, - - - - gr. ij
Acidi Borici, - - - - - - gr. iv
Aquae Destillatae, - - - - - ℥ij
Solve.

Note.—Used chiefly to induce local anaesthesia before operations upon the eyeball and palpebral conjunctiva. The solution should be freshly prepared, as a fungus is always present when it is too long kept. If used too freely it is apt to cause dryness of the corneal epithelium, and even slight keratitis. If the conjunctiva be inflamed, the anaesthetic action of cocaine is much less perfect, but is greatly aided by the use of adrenaline solution; which can also be prescribed in combination with atropine sulphate, alypin, dionine, eucaine, etc.

3. Cocaine and Morphine Hydrochloride Solution.

℞ Cocainae Hydrochloridi, - - - - gr. vj
Morphinae Hydrochloridi, - - - gr. iij
Aquae Destillatae, - - - - - ℥ij
Solve.

Note.—Used to relieve pain—a good dressing after a blister.

4. Dionine Solution.

℞ Dionine, - - - - - - - - gr. iij to v
Aquae Destillatae, - - - - - ℥ij
Solve.

Note.—Dionine (ethyl-morphine hydrochloride) is a white crystalline powder soluble in 1-10 water, 1-8 of alcohol (90 per cent.). It is used to relieve deep-seated ocular pain, to clear up opacities of the cornea, and to promote the absorption of lenticular matter.

5. Eucaine (β) Hydrochloride Solution.

℞ Eucainae Hydrochloridi (β), - - - gr. iv
Aquae Destillatae, - - - - - ℥ij
Solve.

6. Eucaine (β) Lactate Solution.

℞	Eucainae (β) Lactatis, - - - -	gr. iv
	Sodii Chloridi Purissimi, - - - -	gr. ⅛
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Eucaine (β) is a synthetic compound allied to cocaine, but less active, the solutions requiring to be double the strength of those of cocaine. The solutions may be sterilised by boiling, as, unlike cocaine solutions, they are not decomposed in the process. Eucaine (β) must always be used, as Eucaine (α) causes far too much irritation to be of any service in ophthalmic work.

7. Holocaine Hydrochloride Solution.

℞	Holocainae Hydrochloridi, - - -	gr. j
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Holocaine is another substitute for cocaine prepared from phenacetin and para-phenetidin. A one per cent. solution is equal to a two per cent. solution of cocaine. It produces anaesthesia of the eye without dilating the pupil or paralysing the accommodation.

Great care is necessary in the preparation and storing of this solution. Freshly distilled water must be slightly warmed and gradually added to the salt in a glass mortar. Both the mortar and glass-stoppered bottle in which it is to be kept must be thoroughly dealkalinised by being boiled in dilute hydrochloric acid before commencing operations. The presence of an alkali appears to throw down the base.

8. Novocain Solution.

℞	Novocain, - - - - - - -	gr. v
	Acidi Borici, - - - - - -	gr. iv
	Sol. Adrenalin. Chlor., - - - -	ʒj
	Aquae Destillatae, - - - -	ad ℥ij

Note.—Novocain is a derivative of the new class of amino-alcohols. It is non-irritant and non-toxic, while the anaesthetic action is said to be more rapid than that of cocaine. It causes neither mydriasis nor derangement of accommodation.

9. Stovaine Solution.

℞	Stovaine, - - - - - - -	gr. ij
	Acidi Borici, - - - - - -	gr. iv
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Stovaine in a solution of 1 in 200 has an anaesthetic action identical with that of cocaine; but it is much less toxic, and it has the advantage of being clinically a vaso-dilator. Patients do not lose their colour, and there is no fear of syncope. A valuable combination is 2 parts of stovaine and 1 part of cocaine.

II. MYDRIATICS.

The dilators of the pupil are used to improve vision when it is obstructed by a central opacity of the media—*e.g.* nuclear cataract—to prevent the iris from becoming adherent to an ulcer or a wound near the centre of the cornea, to relieve spasm of the ciliary muscle, and to subdue pain. Their use is contra-indicated in glaucoma, and they should always be employed with caution in treating persons over forty years of age.

1. Atropine Sulphate Solution (Strong).

℞	Atropinae Sulphatis, - - - -	gr. ii
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Atropine must be avoided in glaucoma, and ought never to be used for the purpose of making an ophthalmoscopic examination in patients over forty years of age until it has been first ascertained that the tension of the eyeball is normal. It is the chief remedy in iritis, keratitis, and scleritis; but it must be remembered that in some few persons the drug acts as an irritant, producing redness and swelling of the eyelids, accompanied by an eczematous eruption of the skin in the neighbourhood of the eye. When this occurs the use of the drug must be stopped, and one of the other mydriatics substituted for it. Strong solutions of atropine are necessary to break down iritic adhesions; but if they require to be instilled repeatedly, care must be taken to watch for the first symptoms of general intoxication due to absorption of the drug. In old persons its use may cause acute mania.

2. Daturine Sulphate Solution.

℞	Daturinae Sulphatis, - - - -	gr. ¼
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Daturine sulphate is a salt of an alkaloid obtained from stramonium leaves.

3. Duboisine Sulphate Solution.

℞	Duboisinae Sulphatis, - - - -	gr. ¼
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Daturine and duboisine are useful in those cases where atropine produces irritation. It must, however, be remembered that, although duboisine rarely produces any local irritation, it requires to be used with caution, as it possesses markedly toxic properties. The following combination of mydriatics is highly recommended:

℞	Duboisinae Sulphatis, - - - -	gr. ¼
	Atropinae Sulphatis, - - - -	gr. j
	Cocainae Hydrochloridi, - - - -	gr. j
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

4. Euphthalmine Solution.

℞ Euphthalminae, - - - - - - gr. iij
Aquae Destillatae, - - - - - - ʒij
Solve.

Note.—Euphthalmine is a mandelic acid derivative. It dilates the pupil, but does not disturb the power of accommodation. Very useful in nuclear cataract, or to dilate the pupil for the purpose of making an ophthalmoscopic examination.

5. Homatropine Hydrobromide Solution.

℞ Homatropinae Hydrobromidi, - - -
Acidi Borici, - - - - - - - āā gr. j
Aquae Destillatae, - - - - - - ʒij
Solve.

Note.—When atropine is acted on by a mild alkali it breaks up into tropic acid and tropine. Homatropine hydrobromide is a salt of an alkaloid obtained from tropine. The white crystals are soluble in absolute alcohol, acetone, and chloroform, and in water, 1 in 6. Solutions of one-half to two per cent. have been tried, and two drops of a one per cent. solution produces a dilatation of the pupil which passes off within four hours. It dilates the pupil more quickly than atropine and the dilatation passes off sooner. It is frequently, therefore, employed to facilitate ophthalmoscopic examination, and to paralyse the ciliary muscle previous to the estimation of errors of refraction. It acts more powerfully when combined with cocaine (see Formula 6).

6. Homatropine Hydrobromide and Cocaine Solution.

℞ Homatropinae Hydrobromidi, - - - gr. j
Cocainae Hydrochloridi, - - - - gr. ij
Acidi Borici, - - - - - - - gr. ij
Aquae Destillatae, - - - - - - ʒij
Solve.

7. Hyoscine or Scopolamine Hydrobromide Solution.

℞ Hyoscinae Hydrobromidi vel Scopolaminae, gr. ½
Aquae Destillatae, - - - - - - ʒij
Solve.

Note.—Acts more powerfully than atropine upon old iritic adhesions; but, being very poisonous, it must be cautiously employed, and the lachrymal passages should be compressed for a few minutes after instillation. The patient ought to be kept at rest in the recumbent position for a short time after the use of the remedy. It is safer to employ this drug in the form of an ophthalmic disc.

8. Mydriasine Solution.

℞ Mydriasinae, - - - - - - - gr. i to ij
Aquae Destillatae, - - - - - - ʒij
Solve.

Note.—Mydriasine, or atropine methyl-bromide is used instead of atropine sulphate, and is frequently combined with cocaine hydrochloride (see Formula 9).

9. Mydriasine and Cocaine Hydrochloride Solution.

℞	Mydriasinae, - - - - - - -	gr. i to ij
	Cocainae Hydrochloridi, - - - -	gr. j
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—Is less expensive than homatropine and almost equally efficacious.

10. Mydrine Solution.

℞	Ephedrinae Hydrochloridi, - - -	gr. iv
	Homatropinae Hydrobromidi, - - -	gr. $\frac{1}{4}$
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—Ephedrine hydrochloride is a salt of an alkaloid obtained from *Ephedra vulgaris*. The solution dilates the pupil without affecting the accommodation, and its effects pass away in a few hours. It is a convenient drug to use for diagnostic purposes.

III. MYOTICS.

The contractors of the pupil are used in glaucomatous states of the eye, in mydriasis, in ulceration of the cornea due to malnutrition, and in wounds and ulcers situated at the margin of the cornea. They act more rapidly than the mydriatics, but their effects pass off more speedily.

1. Arecoline Hydrobromide Solution.

℞	Arecolinae Hydrobromidi, - - -	gr. j
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—Contracts the pupil more quickly than eserine, but its action passes off within a few hours.

2. Eserine Sulphate Solution.

℞	Physostigminae Sulphatis, - - -	gr. $\frac{1}{2}$ to 1
	Acidi Borici, - - - - - - -	gr. 1
	Aquae Destillatae, - - - - - -	℥ii
	Solve.	

Note.—The myotic most commonly employed to reduce intra-ocular tension in glaucoma; to contract the pupil and restore the power of accommodation after the use of atropine, or in paralysis due to disease, *e.g.* diphtheria; to prevent or reduce the prolapse of the iris after wounds of the cornea; to prevent perforation and promote the healing of marginal ulcers of the cornea. When the iris is inflamed, the use of eserine will aggravate the iritis.

As a general rule, eserine is to be preferred when a wound or an ulcer of the cornea is peripheral, and atropine when it is central.

The long-continued use of either atropine or eserine is apt to set up acute follicular conjunctivitis.

3. Eserine Sulphate and Cocaine Solution.

℞	Physostigminae Sulphatis, - - - -	gr. $\frac{1}{8}$
	Cocainae Hydrochloridi, - - - - -	gr. iij
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—The combination of cocaine with eserine prevents the occurrence of the pain in the eye and brow so common after the instillation of the latter drug in simple solution. The dilatation of the pupil produced by cocaine can readily be overcome by eserine; and the combination of eserine with cocaine is often most efficacious in subduing pain in glaucomatous affections, more especially when combined with dionine.

4. Iso-Physostigmine Sulphate Solution.

℞	Iso-Physostigminae Sulphatis, - - -	gr. $\frac{1}{2}$ to j
	Acidi Borici, - - - - - - -	gr. iv
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—More pure chemically but not any more efficacious clinically than eserine.

5. Pilocarpine Nitrate Solution.

℞	Pilocarpinae Nitratis, - - - - -	gr. j
	Aquae Destillatae, - - - - - -	℥ij
	Solve.	

Note.—Contracts the pupil like eserine, but its action is much weaker. It is useful in those cases where eserine causes acute pain.

IV.—STIMULANTS.

Stimulants are useful in many forms of conjunctival inflammation, but only after the acute stage has passed. They promote the absorption of the products of the inflammation, and hasten the healing of phlyctenulae and indolent ulcers of the cornea. They ought always to be avoided when photophobia, lachrymation, and circumcorneal injection are pronounced. They are employed for the most part as ointments (see page 168 *et seqq.*).

1. Alcohol.

℞ Alcohol Absoluti, - - - - - - ℥ij

Note.—Used as an instillation in herpes of the cornea.

2. Argyrol Solution.

℞	Argyrol, - - - - - - - -	gr. x to lx
	Aquae Destillatae, - - - - - -	ad ℥ij
	Solve.	

Note.—Argyrol, a brown amorphous salt, soluble in its own weight of water, contains the equivalent of 30 per cent. of silver combined with a proteid obtained from wheat.

3. Collargol Solution.

℞	Collargol, - - - - - - -	gr. vj
	Aquae Destillatae, - - - - -	ℨij
	Solve.	

Note.—Collargol is a colloid salt of silver containing about 30 per cent. of the metal. In wounds and ulcers of the cornea can be used in the form of gelatine wafer discs impregnated with 10 per cent. of the drug. To make the discs, rub up collargol in a mortar with melted gelato-glycerine until dissolved, taking great care to use a gentle heat because a high temperature causes the collargol to change colour, probably as a result of partial reduction to metallic silver. The resulting mixture is spread on a warm tile, allowed to cool, and cut into discs of a suitable size.

4. Fluorescein Solution.

℞	Fluorescein, - - - - - - -	gr. iiss
	Sodii Bicarbonatis, - - - - -	gr. iv
	Aquae Destillatae, - - - - -	ℨij
	Solve.	

Note.—Used in the diagnosis of ulceration of the cornea, which it stains green wherever the epithelium is absent. Resorcin in a 10 to 20 per cent. solution stains an abrasion of the cornea red immediately after instillation.

5. Hetol Solution.

℞	Hetol, - - - - - - - -	gr. iij
	Aquae Destillatae, - - - - -	ℨij
	Solve.	

Note.—Hetol, sodium cinnamate, is used as a sub-conjunctival injection to clear up opacities of the cornea.

6. Ichthargan Solution.

℞	Ichthargan, - - - - - - -	gr. vj
	Aquae Destillatae, - - - - -	ℨij
	Solve.	

Note.—Contains 20 per cent. of silver combined with ichthyol.

7. Jequirity Solution.

℞	Jequirity Seeds, - - - - - -	3 parts
	Cold Distilled Water, - - - - -	500 parts
	Marcerate for 24 hours, then add Boiling Water, -	500 parts
	Filter when cold.	

Note.—In obstinate cases of granular ophthalmia with pannus, paint the everted eyelids with above solution; and, after two or three applications, a purulent ophthalmia is set up which occasionally cures the granular condition and clears the cornea.

8. Protargol Solution.

℞ Protargol, - - - - - - - gr. iv to xx
Aquae Destillatae, - - - - - - ℥ij
Solve.

Note.—Protargol is a combination of silver with protein, containing 8.3 per cent. of silver. It is a powerful germicide, and penetrates more deeply into the tissues than nitrate of silver. It causes slight discomfort when instilled into the eye. It is very useful in ophthalmia neonatorum, blennorhoea of the tear sac, sloughy ulcer of the cornea, and obstinate ophthalmia tarsi.

9. Pyoktanin Solution.

℞ "Methylene Violet," - - - - - gr. iv
Spiritûs Rectificati, - - - - - ♏ xxx
Aquae Destillatae, - - - - - ad ℥ii
Solve.

Note.—Used in ulceration of the cornea and as an antiseptic in injuries of the eyeball. Should be freshly prepared and kept in a dark bottle, as it is decomposed by light.

10. Silver Nitrate Solution.

℞ Argenti Nitratis, - - - - - - gr. iiss
Aquae Destillatae, - - - - - - ℥ij
Solve.

Note.—Used to paint the everted eyelids in conjunctivitis with discharge. Any excess must be washed away with a solution of table salt and water. The solution should be applied thoroughly with a brush to the palpebral conjunctiva and the retrotarsal folds, the frequency of the applications depending upon the amount of the discharge. If possible, nitrate of silver should not be used shortly before going to bed, as the pain to which it gives rise may interfere with sleep.

Solutions containing nitrate of silver ought to be kept in actinic bottles.

Nitrate of silver should not be employed continuously over a long period of time, since it produces a discoloration of the conjunctiva (*Argyrosis*), due to a deposit of oxide in its substance.

11. Silver Nitrate and Atropine Solution.

℞ Argenti Nitratis, - - - - - - gr. ii
Liquoris Atropinae Sulphatis B.P., - - ℨj
Aquae Destillatae, - - - - - - ad ℥ij
Solve.

Note.—Used to subdue pain and promote the healing of corneal ulcers accompanied by muco-purulent or purulent discharge from the conjunctiva.

12. Zinc Sulphate Solution.

℞ Zinci Sulphatis, - - - - - - gr. ¼
Sol. Suprarenalin, - - - - - - ʒj
Aquae Destillatae, - - - - - - ad ʒij
Solve.

Note.—Used in superficial injections of the conjunctiva and in follicular conjunctivitis.

13. Zinc Sulphate Solution (Strong).

℞ Zinci Sulphatis, - - - - - - gr. j
Sol. Suprarenalin, - - - - - - ʒj
Aquae Destillatae, - - - - - - ad ʒij
Solve.

Note.—A valuable astringent in many cases of conjunctivitis, and especially in those associated with the Morax-Axenfeld bacillus—angular conjunctivitis.

C. OLEA—OILY SOLUTIONS.

The following advantages are claimed for oily solutions of drugs used in ophthalmic practice: (1) they can be readily rendered aseptic; (2) their instillation causes very little irritation to the eye; (3) when the drug is employed in an oily vehicle its action is more prompt, powerful, and lasting, than in an aqueous solution.

1. Atropine Oil.

℞ Atropinae, - - - - - - - gr. ½
Olei Ricini Purissimi, - - - - - ʒij
Solve.

Note.—Used in abrasions of the cornea—a valuable lubricating and sedative application in granular inflammation and xerosis of the conjunctiva.

2. Cajuput Oil (Cleland).

℞ Olei Cajuputi, - - - - - - - ʒi
Olei Olivae Optimi, - - - - - ad ʒij
Misce.

Note.—Useful in chronic blepharitis and in hyperaemia of the eyelids due to eye-strain.

3. Chloretone Oil.

℞ Chloretone, - - - - - - - gr. viij
Olei Olivae Optimi, - - - - - - ʒij
Solve.

Note.—Used as an anaesthetic and antiseptic. Valuable after a burn.

4. Cocaine Oil.

℞	Cocaine Alkaloid, - - - - - -	gr. ij
	Olei Ricini Purissimi, - - - - -	ʒj
	Olei Amygdalae, - - - - - -	ad ʒij
	Solve.	

Note.—Used to subdue pain in burns of the eyeball and in inflammations of the cornea, the sedative action of the drug being much increased by the lubricating effects of the oil.

5. Eserine Oil.

℞	Physostigminae, - - - - - -	gr. ⅛
	Cocaine Alkaloid, - - - - - -	gr. ij
	Olei Ricini Purissimi, - - - - -	ʒj
	Olei Amygdalae, - - - - - -	ad ʒij
	Solve.	

Note.—This, unlike the watery solution, does not become red (*rubreserine*) on exposure to the air.

6. Mercuric Iodide Oil (Panas).

℞	Hydrargyri Biniodidi, - - - - -	gr. ½
	Olei Olivae Optimi, - - - - -	ʒij
	Solve.	

Note.—Used as a dressing for the eye before operations to disinfect the skin of the lids and the roots of the eye-lashes.

D. GLYCEROLES.

Some cases of granular ophthalmia with much congestion of the palpebral conjunctiva are benefited by the application, twice a day, of one or other of the first *four* following glyceroles.

1. Glycerole of Copper.

℞	Cupri Sulphatis, - - - - - -	gr. xxx
	Glycerini Purissimi, - - - - - -	ad ʒij
	Solve.	

2. Glycerole of Iodine.

℞	Iodi, - - - - - - - - -	gr. j
	Glycerini Purissimi, - - - - - -	♏ xxx
	Vaselini Albi Purissimi, - - - - -	ad ʒij

Note.—Iodine vasogen 10 per cent. is a most efficacious local application in some forms of sloughy ulcer of the cornea.

3. Glycerole of Iodoform.

℞	Iodoformi Praecipitati, - - - - -	ʒiss
	Pulveris Amyli, - - - - - -	ʒss
	Glycerini Purissimi, - - - - -	ʒx
	Aquae Destillatae, - - - - - -	ʒvj

Note.—Mix the glycerine and water together and add to the powders previously mixed. Heat gradually to 240° Fahr. A useful injection in suppuration of the tear passages, complicated by extensive necrosis of bone.

4. Glycerole of Lead Subacetate.

℞	Glycerini Plumbi Subacetatis, - - - -	♏xv
	Glycerini Purissimi, - - - - -	ad ʒij
	Misce.	

Note.—Must never be employed if the cornea be ulcerated.

5. Glycerole of Tannic Acid.

℞	Acidi Tannici, - - - - - - -	gr. xxx
	Glycerini Purissimi, - - - - - -	ʒj
	Syrupi Simplicis, - - - - - -	ad ʒij
	Solve.	

Note.—A valuable astringent in chronic forms of conjunctivitis.

E. UNGUENTA—OINTMENTS.

Vaseline or lanoline forms the best basis for the ointments employed in ophthalmic practice, but, before mixing, all alkaloid salts must be dissolved in a few minims of water. Some prefer yellow vaseline to the white, which is said to be more irritating; but in my own practice I have not found this to be the case. Ointments are preferable to "drops" in the case of children and where there is profuse lachrymation, as watery solutions are liable to be washed out of the eye before they have time to take effect. They are conveniently dispensed in collapsible tubes, or when pure oil of theobroma is used as a base they can be cast into crayon-shaped moulds and mounted in a celluloid handle. Such pencils are of great service in the treatment of chronic forms of conjunctivitis.

1. Aristol Ointment.

℞	Aristol, - - - - - - - -	gr. ij
	Olei Olivae Optimi, - - - - -	♏xxx
	Lanolini Purissimi, - - - - - -	ad ʒij
	Misce secundum artem.	

Note.—Useful in burns of the eyelids and conjunctiva, and, if pain be severe, may be combined with cocaine and atropine.

2. Argyrol Ointment.

℞ Argyrol, - - - - - - - - gr. viii
Vaselini Albi Purissimi, - - - - ʒij
Misce.

Note.—A powerful antiseptic in conjunctivitis and in ulceration of the cornea.

3. Atropine and Boric Acid Ointment.

℞ Atropinae Sulphatis, - - - - gr. j
Pulveris Acidi Borici Subtilis, - - gr. xv
Vaselini Albi Purissimi, - - - - ad ʒij
Misce secundum artem.

4. Atropine and Quinine Sulphate Ointment.

℞ Atropinae Sulphatis, - - - - gr. ½
Quininae Sulphatis, - - - - - gr. ij
Aquae Destillatae, - - - - - ♏ xxx
Lanolini Purissimi, - - - - - gr. xxx
Vaselini Albi Purissimi, - - - - ad ʒij
Misce.

Note.—Useful in phlyctenular conjunctivitis complicated by sloughy ulceration of the cornea.

5. Atropine Sulphate Ointment.

℞ Atropinae Sulphatis, - - - - gr. j
Vaselini Albi Purissimi, - - - - ʒij
Misce secundum artem.

Note.—As to the use of atropine, see p. 160.

6. Atropine Sulphate and Cocaine Ointment.

℞ Atropinae Sulphatis, - - - - gr. j
Cocainae Hydrochloridi, - - - - gr. iij
Vaselini Albi Purissimi, - - - - ʒij
Misce secundum artem.

Note.—Useful in phlyctenular conjunctivitis for the relief of intolerance of light. Children suffering from photophobia due to phlyctenular keratitis should have their eyes protected by a shade, but not bandaged. The hands and face ought to be washed several times a day, and, as far as possible, the patient should be prevented from rubbing the eyes and burying the face in a pillow. Attention must also be given to keeping the nasal cavities free from discharge.

7. Atropine Sulphate Ointment (Compound).

℞ Atropinae Sulphatis, - - - - gr. ½
Hydrargyri Oxidi Rubri, - - - - gr. ij
Olei Amygdalae, - - - - - ♏ iij
Vaselini Albi Purissimi, - - - - ʒij
Misce secundum artem.

Note.—Useful in phlyctenular conjunctivitis after the acute symptoms of irritation have subsided.

8. Boric Acid Ointment.

℞ Acidi Borici Subtilis, - - - - partes iij
Unguenti Paraffini Albi, - - - - partes xv
Misce.

Note.—Used in blepharitis and conjunctivitis and as a dressing for the eye after operation. Carefully prepared and thoroughly sterilised, this ointment causes no irritation.

9. Boric Acid and Cocaine Ointment.

℞ Unguenti Acidi Borici (Formula 8), - - ʒj
Unguenti Cocainae Hydrochloridi (Formula 14), ʒj
Misce.

Note.—Used in abrasions of the cornea.

10. Cade Oil Ointment.

℞ Hydrargyri Oxidi Rubri, - - - gr. ij
Olei Cadini, - - - - - - ♏ x
Pulveris Camphorae, - - - - gr. x
Vaselini Albi Purissimi, - - - - ad ʒij
Misce.

Note.—Useful in eczema of the eyelids.

11. Cadmium Iodide Ointment.

℞ Cadmii Iodidi, - - - - - gr. j
Vaselini Albi Purissimi, - - - - ʒij
Misce.

Note.—Used in opacities of the cornea.

12. Calomel Ointment.

℞ Hydrargyri Subchloridi, - - - - gr. iij
Vaselini Albi Purissimi, - - - - ʒij
Misce.

Note.—Used to promote the absorption of opacities of the cornea. The bulk of a barley corn of the ointment having been introduced into the conjunctival sac, the cornea should be gently massaged through the closed eyelids with the thumb and index finger, the patient being directed to look straight in front of him.

13. Cassaripe Ointment.

℞ Cassaripi, - - - - - - gr. xij
Vaselini Albi Purissimi, - - - - ad ʒij
Misce.

Note.—Cassaripe is the inspissated juice of the cassava plant which is highly antiseptic. It is used for sloughy ulcers of the cornea, and has sometimes excellent results (Risley).

14. Cocaine Hydrochloride Ointment.

℞ Cocainae Hydrochloridi, - - - - - gr. ij
Vaselini Albi Purissimi, - - - - - ℥ij
Misce secundum artem.

Note.—Useful application after the removal of foreign bodies from the cornea, and in superficial ulcerations and injuries. The eye ought always to be protected by a bandage until the epithelium has been restored.

15. Collargol Ointment.

℞ Collargol, - - - - - - - gr. ij to xv
Vaselini Albi Purissimi, - - - - ℥ij
Misce.

Note.—Used in blepharitis marginalis.

16. Copper Citrate Ointment.

℞ Cupri Citratis, - - - - - - gr. ij
Vaselini Albi Purissimi, - - - - ℥ij
Misce.

Note.—Used in conjunctivitis.

17. Creolin Ointment.

℞ Acidi Cresylici, - - - - - - ♏ i
Aquae Destillatae, - - - - - ♏ xxx
Lanolini Purissimi, - - - - - ad ℥ij
Misce.

Note.—Used occasionally in ulcerative blepharitis.

18. Dionine Ointment.

℞ Dionine, - - - - - - - - - gr. xij
Vaselini Albi Purissimi, - - - - ad ℥ij
Misce.

Note.—Used to subdue seated pain in the eye, and promote the absorption of opacities of the cornea following ulceration, or inflammation.

19. Eserine Sulphate Ointment.

℞ Physostigminae Sulphatis, - - - - - - gr. $\frac{1}{10}$
Unguenti Cocainae Hydrochloridi (Formula 14), ℥ij
Misce.

Note.—Used in ulcers situated at the margin of the cornea. Must not be employed if the iris be inflamed. For note on the use of eserine, see page 162.

20. Gallic Acid Ointment.

℞	Acidi Gallici,	gr. viij
	Olei Lavandulae,	♏ i
	Olei Ricini Purissimi,	♏ xxx
	Vaselini Albi Purissimi,	ʒij
	Misce.	

Note.—Used in blepharitis marginalis after loss of the eyelashes.

21. Ichthyol Ointment.

℞	Ichthyol,	gr. i
	Olei Olivae Optimi,	♏ xxx
	Glycerini Purissimi,	♏ xxx
	Lanolini Purissimi,	ad ʒij
	Misce.	

Note.—Useful in eczema of the eyelids and for conjunctivitis with fissure of the external canthus.

22. Iodoform Ointment.

℞	Iodoformi Precipitati,	gr. v
	Vaselini Albi Purissimi,	ʒi
	Lanolini Purissimi,	ad ʒij
	Misce.	

Note.—Used in follicular conjunctivitis, ulcers, and burns. Iodol, which is odourless, may be substituted for iodoform. Atropine may be added to the mercurial or iodoform ointments in those cases where it is necessary to cause dilatation of the pupil, and in cases of phlyctenular ulcer accompanied by distressing photophobia, or in burns of the conjunctiva. Cocaine may be added to relieve pain.

23. Iodoform, Atropine, and Cocaine Ointment.

℞	Iodoformi Precipitati,	gr. xv
	Atropinae Sulphatis,	gr. ½
	Cocainae Hydrochloridi,	gr. iij
	Vaselini Albi Purissimi,	ad ʒij
	Misce secundum artem.	

Note.—Useful application in burns of the conjunctiva.

24. Iodol Ointment.

℞	Iodol,	gr. iv
	Acidi Tannici,	gr. viij
	Olei Olivae Optimi,	♏ xxx
	Lanolini Purissimi,	ad ʒij
	Misce.	

Note.—Used as an application to the nasal mucous membrane when inflamed and ulcerated in connection with phlyctenular conjunctivitis. The crusts must first be removed by means of a nasal douche (see page 177).

25. Lead Acetate Ointment.

℞	Plumbi Acetatis, - - - - - -	gr. ij
	Cocainae Hydrochloridi, - - - - -	gr. ij
	Vaselini Albi Purissimi, - - - - -	ʒij
	Misce.	

Note.—Useful to relieve the itching in blepharitis marginalis.

26. Lead Ointment.

℞	Emplastri Plumbi, - - - - -	āā partes xx
	Olei Lini, - - - - - - -	
	Balsami Peruviani, - - - - - -	partem j
	Misce.	

Note.—This is the pommade anti-blépharatique of De Wecker. It should always be freshly prepared, and is applied to the eyes at bedtime, smeared upon discs of old linen. The application ought to be repeated every night for several weeks. Very efficacious in blepharitis hypertrophica.

27. Menthol and Cocaine Ointment.

℞	Menthol, - - - - - - - -	gr. ½
	Cocainae Hydrochloridi, - - - - -	gr. iij
	Dermatol, - - - - - - - -	gr. viij
	Olei Eucalypti, - - - - - -	♏ viij
	Vaselini Albi Purissimi, - - - - -	ʒj
	Lanolini Purissimi, - - - - - -	ad ʒij
	Misce.	

Note.—Used to anoint the nostrils in cases of "watery eye" accompanied by swelling of the nasal mucous membrane.

28. Mercuric Oleate Ointment.

℞ Unguenti Hydrargyri Oleatis, - - - - ʒij

Note.—A good application for killing pediculi.

29. Mercuric Oleate and Morphine Ointment.

℞	Morphinae, - - - - - - - -	gr. ij
	Unguenti Hydrargyri Oleatis, - - - -	ʒij
	Misce.	

Note.—Used to relieve pain round the orbit. Forms a good dressing after the epidermis has been removed by a fly blister.

30. Mercury Ointment.

℞ Unguenti Hydrargyri, - - - - - ʒj

Note.—Used as an inunction—one drachm to be rubbed into the skin below the armpit, one night on one side of the body and the next on the other. The ointment should not be washed off till morning. The patient should be clad in flannel and carefully protected from cold during the course of the treatment.

31. Mercury and Lead Ointment (De Wecker).

℞ Hydrargyri Oxidi Rubri, - - - - gr. j
Liquoris Plumbi Sabacetatis, - - - ♏ x
Unguenti Paraffini Albi, - - - - ʒij
Misce.

Note.—Useful in ophthalmia tarsi associated with acne and seborrhoea of the face generally.

32. Mercury and Belladonna Ointment.

℞ Extracti Belladonnae, - - - - - gr. v
Hydrargyri Ammoniati, - - - - - gr. x
Unguenti Paraffini Albi, - - - - ad ʒij
Misce.

Note.—Smeared on the brow in cases of neuralgia due to intra-orbital disease. In addition to the above, leeches, blisters, and the application of heat are all employed to subdue pain. Hot fomentations may be applied either with water alone, or with water medicated with poppy heads or chamomile flowers. In very severe cases a Leiter's tube ought to be employed with boiling water, and the apparatus should be applied to the eye frequently for ten or fifteen minutes at a time, the lids being protected by folds of moist flannel.

33. Mercury Vasogen.

Vasogen is an oxygenated petroleum. Mixed with mercury in the proportion of two-thirds vasogen and one-third mercury it forms a cleaner and more active preparation than ordinary mercury ointment.

34. Mercuric Chloride Ointment (White).

℞ Hydrargyri Perchloridi, - - - - - gr. $\frac{1}{24}$
Sodii Chloridi Purissimi, - - - - - gr. $\frac{1}{4}$
Vaselini Albi Purissimi, - - - - - ʒij
Misce.

Note.—Used as a dressing for the eyes before operation, to disinfect the skin of the lids and the roots of the eyelashes. Dissolve the mercury and the chloride of sodium in a few drops of alcohol and add to the vaseline which has previously been sterilised by boiling. Stir till cold, and put up in a pot, which ought to be hermetically sealed. A separate pot should be used for each patient.

35. Mercury Ointments (Various).

(*a*) *Ammoniated Mercury Ointment.*

℞ Hydrargyri Ammoniati, - - - - - gr. ij
Vaselini Albi Purissimi, - - - - - ʒij
Misce.

(*b*) *Red Mercuric Oxide Ointment.*

℞	Hydrargyri Oxidi Rubri, - - - - -	gr. ij
	Olei Amygdalae, - - - - - -	♏ viij
	Trite bene. Deinde adde	
	Vaselini Albi Purissimi, - - - - -	ad ℥ij
	Misce.	

(*c*) *Yellow Mercuric Oxide Ointment* (*Pagenstecher*).

℞	Hydrargyri Oxidi Flavi, - - - - -	gr. iv
	Vaselini Albi Purissimi, - - - - -	℥ij
	Misce.	

Note.—The mercurial ointments are favourite applications in all forms of inflammation of the conjunctiva and of the edge of the eyelids. The salve containing the white precipitate is the mildest, and is useful in those cases when the others cause undue irritation. Children are more tolerant of the use of those ointments than are adults. The salve containing the yellow precipitate, commonly known as Pagenstecher's Ointment, is the strongest, and is specially recommended in pustular ophthalmia, and when massage is applied to the cornea for the purpose of clearing up old opacities. The red oxide is the active ingredient of the popular remedy, "Singleton's Golden Eye Ointment."

36. Orthoform Ointment.

℞	Orthoformi, - - - - - - - -	gr. xv
	Unguenti Acidi Borici, - - - - -	ad ℥ij
	Misce.	

Note.—Orthoform, obtained from the amido derivative of oxybenzoic acid, is a substitute for cocaine, but it has little action on healthy mucous membrane. It is non-toxic and powerfully antiseptic. Useful in superficial ulceration of the cornea, as, on account of its sparing solubility, its action is maintained for a considerable time.

37. Potassium Iodide Ointment.

℞	Potassii Iodidi, - - - - - - -	gr. ij
	Vaselini Albi Purissimi, - - - - -	℥ij
	Misce secundum artem.	

Note.—This ointment, as well as those containing calomel and iodide of cadmium, dionine, etc., are used to promote absorption of opacities of the cornea after ulceration.

38. Protargol Ointment.

℞	Protargol, - - - - - - -	gr. viij
	Acidi Borici Subtilis, - - - - -	gr. xv
	Aquae Destillatae, - - - - - -	♏ xxx
	Lanolini Purissimi, - - - - - -	ad ℥ij
	Misce.	

Note.—Useful in ophthalmia neonatorum, granular conjunctivitis, and serpiginous ulcer of the cornea.

39. Sulphur Ointment.

℞ Sulphuris Precipitati, - - - - - gr. viij
Vaselini Albi Purissimi, - - - - - ad ℥ij
Misce.

Note.—Used in phtheiriasis ciliorum and blepharitis marginalis.

40. Suprarenaline Ointment.

℞ Extracti Suprarenalis Siccalis, - - - - gr. ½
Chloretone, - - - - - - - - gr. vj
Vaselini Albi Purissimi, - - - - - ℥ij
Misce.

Note.—Suprarenaline is dried suprarenal. This ointment is used for the relief of red and irritable eyes. It may be combined with alypin.

41. Stavesacre Ointment.

℞ Olei Staphisagriae, - - - - - - ♏ xv.
Adipis, - - - - - - - - - ℥ij
Misce.

Note.—Used to destroy pediculi.

42. Thiosinamin Ointment.

℞ Thiosinamin, - - - - - - - gr. xij
Vaselini Albi Purissimi, - - - - - ad ℥ij
Misce.

Thiosinamin is "formed by warming oil of mustard with alcoholic solution of ammonia."

Note.—Used to clear up opacities of the cornea, owing to its power to dissolve scar tissue.

43. Veratrine Ointment.

℞ Veratrinae, - - - - - - - gr. xx.
Adipis, - - - - - - - - - ℥ij
Misce.

Note.—Applied to the forehead to relieve pain in iritis and more particularly in neuralgic affections of the eye.

This ointment is much stronger than that of the B.P., but it may be safely used when there is no abrasion of the skin.

F. COLLUNARIA—NASAL DOUCHES.

For nasal douches ten ounces of fluid are generally sufficient. Their temperature, when they are injected into the nostrils, ought to be 95° Fahrenheit, and care should be taken not to employ too much force. In ophthalmic practice these douches are of service in phlyctenular conjunctivitis, and before operations on the eyeball, when there is much discharge from the nasal mucous membranes.

1. Alkaline Douche (Simple).

℞	Sodii Bicarbonatis, - - - - -	āā gr. xl
	Pulveris Boracis, - - - - -	
	Aquae Destillatae, - - - - -	℥x
	Solve et misce.	

Note.—Cleansing alkaline douche.

2. Alkaline Douche (Compound).

℞	Sodii Bicarbonatis, - - - - -	āā gr. xl
	Pulveris Boracis, - - - - -	
	Sodii Chloridi Purissimi, - - - -	
	Sacchari Albi, - - - - - -	
	Aquae Destillatae, - - - - -	ad ℥x
	Solve et misce.	

Note.—Cleansing alkaline douche.

3. Alkaline Antiseptic Douche.

℞	Sodii Bicarbonatis, - - - - -	āā gr. lx
	Pulveris Boracis, - - - - -	
	Glycerini Acidi Carbolici, - - -	ʒij
	Aquae Destillatae, - - - - -	ad ℥x
	Solve et misce.	

Note.—Cleansing alkaline douche in cases where there is acrid, foul-smelling discharge from the nostrils.

G. CAUSTICAE—CAUSTICS.

Caustics are substances which destroy the parts to which they are applied.

1. Alum.

℞ Aluminis Crystallini, - - - - q.s.

Note.—Used as a crayon in many forms of chronic hyperaemia of the palpebral conjunctiva. May be safely employed by the patient.

2. Chromic Acid.

℞ Acidi Chromici, - - - - - - q.s.

Note.—Used in the treatment of morbid growths of the eyelids. The pure acid fused on the point of a probe is applied to the part to be destroyed.

3. Copper.

℞ Cupri Sulphatis, - - - - - - q.s.

Note.—Select a suitable crystal, and shape into a point on fine emery paper. Mount in quill or use in port-crayon.

4. Lapis Divinus (Cuprum Aluminatum).

℞ Cupri Sulphatis, - - - - - -
Aluminis, - - - - - - - - partes aequales.
Potassii Nitratis, - - - - - -

Fuse together in a glazed earthenware crucible, and then add camphor equal to one-thirtieth of the whole.

Note.—In using the sulphate of copper, or the lapis divinus, care should be taken to touch only the retrotarsal fold. The lapis divinus seems to give the patient more pain than the pure sulphate of copper. Employed in the treatment of granular ophthalmia and other forms of conjunctivitis.

5. Silver Nitrate.

℞ Crayon Argenti Nitratis.

Note.—May be used pure or mitigated by dilution with nitrate of potash. Nitrate of silver is to be preferred to sulphate of copper when there is much discharge from the conjunctiva. Before applying the nitrate of silver, the parts should be carefully dried, so that the action of the caustic may be limited as far as possible to the part touched. Any excess should be washed away at once with a solution of salt and water. Forms a convenient mode of blistering the skin of the eyelids in interstitial keratitis.

6. Sodium Ethylate.

℞ Liquoris Sodii Ethylatis, - - - - - q.s.

Note.—Used in the treatment of naevi. It may be applied by means of a glass rod, the skin surrounding the naevus being carefully protected.

7. Zinc Chloride Paste.

℞ Liquoris Zinci Chloridi c̄ Opio, - - ℥j
Farinae Tritici, - - - - - - gr. cxx

Note.—Mix smoothly in a mortar, and heat over a water-bath until of a proper consistence. The following is a formula for the chloride of zinc and opium liquor.

℞ Zinci Chloridi, - - - - - - - ℥xvj
Extracti Opii, - - - - - - - ʒiss
Acidi Hydrochlorici Diluti, - - - ℥vj
Aquae Bullientis, - - - - - - ad Oj

Triturate the extract of opium with twelve ounces of hot water, add the acid, and filter. In this dissolve the chloride of zinc, and make up the filtrate to twenty ounces with distilled water.

Note.—Used to destroy those portions of a malignant tumour of the orbit which has escaped excision by the knife. The paste should be spread on pieces of lint, which are to be smoothly applied to the walls of the orbit, care being taken to prevent sloughing of the eyelids.

H. LINIMENTA—LINIMENTS.

Liniments are not applied to the eye, but to the surrounding skin, and are commonly employed to relieve circumorbital pain.

1. A.B.C. Liniment.

℞ Linimenti Aconiti, - - - - - } partes aequales.
Linimenti Belladonnae, - - - - }
Linimenti Chloroformi, - - - - }
Misce.

Note.—Used to relieve circumorbital pain.

2. Liniment of Ammonia.

℞ Liquoris Ammoniae Fortis, - - - ℥j
Olei Lavandulae, - - - - - ʒj
Spiritûs Rectificati, - - - - - ad ℥iv
Misce.

Note.—Useful to relieve pain after bites or stings of insects.

3. Liniment of Extract of Belladonnae.

℞ Extracti Belladonnae, } partes aequales.
Glycerini Purissimi, }
Lanolini Purissimi, }
Misce.

Note.—When applied to the brow affords great relief in purulent ulcers of the cornea, iritis, etc. This method of treatment sometimes causes the pupil to dilate when atropine instillations have failed.

4. Liniment of Belladonna with Chloroform.

℞ Linimenti Belladonnae, - - - - ℥ij
Chloroformi Belladonnae, - - - ad ℥iv
Misce.

Note.—Used to relieve circumorbital pain.

5. Liniment of Iodine.

℞ Liquoris Iodi Fortis, - - - - - q.s.

Note.—Used as a counter-irritant.

6. Liniment of Lime.

℞ Liquoris Calcis, - - - - - - ℥ij
Olei Olivae Optimi, - - - - - ad ℥iv
Misce.

Note.—Used as a dressing in burns and scalds of the eyelids.

7. Liniment of Soap and Carbolic Acid (Carbosapol).

℞ Saponis Mollis, - - - - - - } āā ℥viij
Saponis Duri, - - - - - - - }
Acidi Carbolici Liquefacti, - - - ℥xvj
Misce secundum artem.

Note.—A valuable cleansing agent; used to disinfect the skin of the face previous to operations.

J. OPHTHALMIC TABLOIDS.

All the drugs usually employed in ophthalmic practice are now to be had in the form of minute tabloids or gelatine discs readily soluble in the lachrymal secretion. In this form they are very convenient, as they can be easily carried about, and the dose administered with great accuracy. The following is a list of those in ordinary use, as prepared by Burroughs, Wellcome & Co.:—

Atropine Sulphate, - - - - - - gr. 1/200

Note.—Mydriatic.

Atropine Sulphate, - - - - - gr. 1/200
Cocaine Hydrochloride, - - - - gr. 1/200

Note.—The cocaine aids the atropine, and tends to prevent conjunctivitis.

Cocaine Hydrochloride, - - - - gr. 1/20

Note.—Local anaesthetic, and slight mydriatic.

Duboisine Sulphate, - - - - - gr. 1/250

Note.—Mydriatic; more powerful, but less prolonged in action, than atropine.

Eserine Salicylate, *see* Physostigmine, - gr. 1/500

Note.—Myotic.

Fluoresceïn, - - - - - - - gr. 1/2000

Note.—Used to diagnose corneal lesions.

Homatropine Hydrochloride, - - - gr. 1/400

Note.—Homatropine is a more rapid mydriatic than atropine, but more transient.

{Homatropine Hydrochloride, - - - gr. 1/240
{Cocaine Hydrochloride, - - - - gr. 1/24

{Homatropine Hydrochloride, - - - gr. 1/50
{Cocaine Hydrochloride, - - - - gr. 1/50

Note.—These combinations of homatropine and cocaine dilate the pupil and relieve pain.

Hyoscine Hydrobromide (Scopolamine Hydrobromide), - - - - - gr. 1/600

Note.—Mydriatic; more rapid than atropine, and effects last longer.

Mydrine, - - - - - - - - gr. 1/50

Note.—Rapid mydriatic. A combination of the alkaloids ephedrine and homatropine.

Physostigmine Salicylate, - - - - gr. 1/600

Note.—Myotic; increases glandular secretions; neutralises effect of atropine.

{Physostigmine Salicylate, - - - - gr. 1/500
{Tropacocaine Hydrochloride, - - - gr. 1/100

Note.—Myotic; relieves pain of distension.

Pilocarpine Nitrate, - - - - - - gr. 1/400

Note.—Myotic; less active than physostigmine.

{Pilocarpine Nitrate, - - - - - gr. 1/500
{Cocaine Hydrochloride, - - - - gr. 1/200

Note.—Myotic; the cocaine acts as an anodyne.

Suprarenal Extract or Hemisine.

Note.—Used as an adjuvant to cocaine where there is much congestion of the eyeball.

Tropacocaine Hydrochloride, - - - gr. 1/30

Note.—Anaesthetic; more rapid and transitory than cocaine. Does not affect pupil.

Zinc Sulphate, - - - . - - gr. 1/250

Note.—Astringent; used in acute and chronic ophthalmia.

K. DUSTING POWDERS.

Dusting powders are flicked into the eye from a dry camel-hair brush.

1. Boric Acid.

℞ Acidi Borici Subtilis, - - - - q.s.

2. Borotannic Powder.

℞ Pulveris Acidi Borici Calendulati, - - partes iij
Pulveris Acidi Tannici, - - - - partem j
Misce.

Note.—Useful in chronic conjunctivitis.

3. Calendulated Boric Acid Powder.

℞ Tincturae Calendulae Florum B.P.C., - ℥ij
Evaporate Sec. Art., and add Pulveris Acidi Borici Subtilliss., - - ℥iv
Misce.

The essential oils, *e.g.* Cajuput, Neroli, Fennel, or Otto of Roses, may be added to the powder in the proportions of 2 minims to the ℥i.

Note.—Useful in all forms of conjunctivitis. A small teaspoonful of the powder to be dissolved in a tea-cupful of warm water.

4. Calomel.

℞ Hydrargyri Subchloridi, - - - - q.s.

Note.—Useful in phlyctenular conjunctivitis, and in all cases of passive congestion of the conjunctiva; ought not to be used when iodides or bromides are being administered internally. It must be thoroughly dried.

5. Iodoform.

℞ Iodoformi Praecipitati, - - - - q.s.

Note.—Useful in sloughy corneal ulcers (the surface of which should be carefully dusted with the powder), and in massage of the conjunctiva in granular ophthalmia. Crystalline iodoform should never be used in ophthalmic practice.

6. Iodoform and Sugar of Milk.

℞ Iodoformi Praecipitati, - - - - partem j
Sacchari Lactis, - - - - - partes ij

Note.—Useful in the fleshy condition of the conjunctiva which frequently follows purulent ophthalmia.

7. Orthoform.

℞ Orthoformi, - - - - - - - q.s.

Note.—Local anaesthetic as well as a powerful antiseptic; it acts better when diluted with boric acid. It may also be combined with dried calomel, which intensifies its antiseptic properties.

II. CONSTITUTIONAL REMEDIES.

On account of their special application, local remedies naturally occupy a foremost place in ocular therapeutics, but as diseases of the eye are, in most instances, related to some constitutional condition, the general treatment of the patient must never be neglected. Indeed, in syphilis, tubercle, rheumatism, or gout, constitutional remedies are as important as local.

A. MISTURAE—MIXTURES.

(*a*) *Alteratives*:—This group includes such remedies as arsenic, calcium, mercury, and the iodides.

1. Ammonium and Iron Iodide Mixture.

℞	Ammonii Iodidi, - - - - - -	gr. lxxx.
	Syrupi Ferri Iodidi, - - - -	℥ij
	Spiritûs Chloroformi, - - - -	♏ clx
	Aquae Destillatae, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day after meals.

Note.—Useful in diseases of the uveal tract in old and anaemic subjects.

2. Arsenical Mixture.

℞	Liquoris Sodii Arsenatis, - - - -	ʒj
	Glycerini Purissimi, - - - - -	℥iij
	Aquae Destillatae, - - - - -	ad ℥viij
	Misce.	

Dose.—A tablespoonful in water three times a day after meals.

Note.—Useful in many diseases of the cornea.

3. Calcium Chloride Mixture.

℞	Calcii Chloridi, - - - - - -	gr. cxx
	Syrupi Aurantii, - - - - -	℥ij
	Aquae Destillatae, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day after meals.

Note.—Useful in phlyctenular conjunctivitis with enlargement of the lymphatic glands. Tincture of perchloride of iron can be added to the calcium chloride in those cases where there is much anaemia (*see* Formula 4).

4. Calcium Chloride and Iron Mixture.

℞ Calcii Chloridi, - - - - - - gr. clx
Tincturae Ferri Perchloridi, - - - ♏ lxxx
Glycerini Purissimi, - - - - - - ʒiv
Aquae Chloroformi, - - - - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three times a day after meals.

5. Mercuric Chloride Mixture.

℞ Liquoris Hydrargyri Perchloridi P.B., - ʒij
Infusi Gentianae Compositi, - - - ad ℥viij
Misce.

Dose.—A tablespoonful in water three times a day after meals.

Note.—Useful in syphilitic diseases of the eye.

6. Mercuric Iodide Mixture.

℞ Hydrargyri Perchloridi, - - - - gr. j
Potassii Iodidi, - - - - - - gr. xlviij
Infusi Gentianae Compositi, - - - ad ℥viij
Solve et misce secundum artem.

Dose.—A tablespoonful in water three times a day between meals.

Note.—A valuable combination in all chronic affections of the uveal tract, more especially when of syphilitic origin.

7. Potassium Iodide Mixture.

℞ Potassii Iodidi, - - - - - - ʒij
Spiritûs Chloroformi, - - - - ♏ clx
Aquae Menthae Piperitae, - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three times a day between meals.

Note.—Useful in the late stages of syphilis.

8. Potassium Iodide and Acetate Mixture.

℞ Potassii Iodidi, - - - - - - gr. cxx
Potassii Acetatis, - - - - - - gr. clx
Spiritûs Chloroformi, - - - - ♏ clx
Aquae Menthae Piperitae, - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three times a day between meals.

Note.—In all mixtures containing iodide of potassium the addition of pepsencia seems to be helpful in promoting the assimilation of the drug and in preventing iodism.

9. Potassium Iodide and Sodium Bicarbonate Mixture.

℞	Potassii Iodidi, - - - - - -	gr. cxx
	Sodii Bicarbonatis, - - - - - -	gr. clx
	Spiritûs Chloroformi, - - - -	♏ clx
	Aquae Menthae Piperitae, - - -	ad ℥viij

Solve et misce.

Dose.—A tablespoonful in water three times a day between meals.

10. Syrup of Iodide of Iron.

℞ Syrupi Ferri Iodidi, - - - - - q.s.

Dose.—A teaspoonful or less, according to age.

Note.—A convenient form of administering an iodide to children.

(*b*) *Alterative and Sedative.*

11. Potassium Iodide and Bromide Mixture.

℞	Potassii Iodidi, - - - - - -	gr. xlviij
	Potassii Bromidi, - - - - - -	gr. clx
	Spiritûs Chloroformi, - - - -	ʒiij
	Decocti Sarsae Compositi, - - -	ad ℥viij

Solve et misce.

Dose.—A tablespoonful in water three times a day after meals (*see* Note under No. 13).

(*c*) *Alterative and Tonic.*

12. Mercuric Chloride, Quinine, and Iron Mixture.

℞	Liquoris Hydrargyri Perchloridi, B.P., -	ʒij
	Quininae Sulphatis, - - - - - -	gr. viij
	Tincturae Ferri Perchloridi, - - -	♏ lxxx
	Glycerini Purissimi, - - - - -	ʒiij
	Aquae Chloroformi, - - - - - -	ad ℥viij

Solve et misce.

Dose.—A tablespoonful in water three times a day after meals.

Note.—Valuable combination in the late stages of interstitial keratitis, and in chronic diseases of the deep structures of the eye, especially when these are due to syphilis.

13. Potassium Iodide with Nux Vomica Mixture.

℞	Potassii Iodidi, - - - - - -	gr. xlviij
	Tincturae Nucis Vomicae, - - -	♏ lxxx
	Spiritûs Chloroformi, - - - -	♏ clx
	Decocti Sarsae Compositi, - - -	ad ℥viij

Solve et misce.

Dose.—A tablespoonful in water three times a day after meals.

Note.—This mixture and Formula No. 11 are of use in inflammation of the deep structures of the eyeball, especially when due to syphilis.

(*d*) *Antiseptic.*

14. Sodium Sulphocarbolate Mixture.

℞ Sodii Sulphocarbolatis, - - - - - ʒiv
Tincturae Zingiberis, - - - - - ʒiij
Syrupi Zingiberis, - - - - - - ℥ij
Aquae Menthae Piperitae, - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three or four times a day as required.

Note.—Used to relieve flatulence, which often causes great trouble in cases where it is necessary for the patient, after operation, to lie on his back. Under such circumstances this mixture is usually most helpful in removing the discomfort.

(*e*) *Diuretic.*

15. Potassium Acetate and Iron Perchloride Mixture (Basham).

℞ Potassii Acetatis, - - - - - - gr. cl
Tincturae Ferri Perchloridi, - - - ʒij
Liquoris Ammonii Acetatis, - - - ℥iss
Spiritûs Chloroformi, - - - - ʒij
Glycerini Purissimi, - - - - - ʒvj
Aquae, - - - - - - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three times a day.

Note.—Used when a chalybeate is to be given along with an eliminant.

16. Potassium and Caffeine Mixture.

℞ Potassii Citratis, - - - - - - ʒv
Potassii Acetatis, - - - - - - gr. clx
Caffeinae Citratis, - - - - - - gr. xlviij
Glycerini Purissimi, - - - - - ʒiij
Aquae Destillatae, - - - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water three times a day.

Note.—Promotes elimination. Useful in cases of toxic amblyopia.

(*f*) *Saline:*—This group includes the salts of magnesium and sodium, and their chief physiological action is to unload the portal circulation.

17. Magnesium Sulphate Mixture.

℞ Magnesii Sulphatis, - - - - - - ℥j
Sodii Sulphatis, - - - - - - ʒiv
Acidi Sulphurici Diluti, - - - - ʒiij
Glycerini Purissimi, - - - - - ʒiv
Aquae Menthae Piperitae, - - - ad ℥viij
Solve et misce.

Dose.—A tablespoonful in water two or three times a day before food.

Note.—Mild aperient.

18. Magnesium and Ferrous Sulphate Mixture.

℞	Magnesii Sulphatis, - - - - -	℥j
	Ferri Sulphatis, - - - - - -	gr. xlviij
	Sodii Sulphatis, - - - - - -	ʒiv
	Acidi Sulphurici Diluti, - - - -	ʒiij
	Glycerini Purissimi, - - - - -	ʒiv
	Aquae Menthae Piperitae, - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water two or three times a day before food.

Note.—A valuable saline and chalybeate.

19. Magnesium Sulphate and Quinine Mixture.

℞	Magnesii Sulphatis, - - - - -	℥j
	Quininae Sulphatis, - - - - -	gr. xvj
	Acidi Sulphurici Diluti, - - - -	ʒiij
	Syrupi Aurantii, - - - - - -	℥j
	Aquae Chloroformi, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water two or three times a day before food.

Note.—Tonic and aperient.

20. Magnesium Sulphate, Quinine, and Iron Mixture.

℞	Magnesii Sulphatis, - - - - -	℥j
	Quininae Sulphatis, - - - - -	gr. xvj
	Ferri Sulphatis, - - - - - -	gr. lxxx
	Acidi Sulphurici Diluti, - - - -	ʒij
	Glycerini Purissimi, - - - - -	ʒiij
	Aquae Menthae Piperitae, - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day before food.

Note.—Useful in chronic conjunctivitis, in asthenopia associated with anaemia, and as a general tonic.

21. Magnesium Sulphate and Sodium Bicarbonate Mixture.

℞	Magnesii Sulphatis, - - - - -	℥j
	Sodii Bicarbonatis, - - - - -	ʒiiss
	Spiritûs Chloroformi, - - - - -	ʒiij
	Aquae Menthae Piperitae, - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day before food.

Note.—Saline and antacid.

22. Sodium Salicylate and Aloes Mixture.

℞	Sodii Salicylatis, - - - - -	gr. lxxx
	Sodii Sulphatis, - - - - -	gr. ccclx
	Potassii Bicarbonatis, - - - -	gr. clx
	Glycerini Purissimi, - - - - -	ʒiv
	Decocti Aloes Compositi, - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day.

Note.—To relieve the portal system in congestive inflammations of the uveal tract.

23. Sodium Sulphate and Iron Mixture.

℞	Sodii Sulphatis, - - - - - -	ʒvj
	Tincturae Ferri Perchloridi, - - -	ʒiij
	Glycerini Purissimi, - - - - -	ʒiv
	Aquae Destillatae, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day between meals.

Note.—Saline and chalybeate.

(*g*) *Sedative*:—This group of remedies is of great service in ophthalmic practice, for overcoming nervousness, for subduing pain, and for promoting sleep.

24. Bromidia (Battle).

℞	Bromidiae, - - - - - - -	q.s.

Dose.—A teaspoonful as required, and repeated as directed.

Note.—Useful as a sedative after operations.

25. Combined Bromide Mixture.

℞	Potassii Bromidi, - - - - - -	ʒiv
	Sodii Bromidi, - - - - - -	gr. clx
	Ammonii Bromidi, - - - - - -	gr. lxxx
	Spiritûs Chloroformi, - - - -	ʒiij
	Aquae Destillatae, - - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water as directed.

Note.—Sedative. Useful as a soothing draught previous to operations.

26. Chloral Mixture.

℞	Syrupi Chloral Hydratis, - - - -	ʒj
	Sodii Bromidi, - - - - - -	gr. xxx
	Tincturae Chloroformi Compositi, - -	♏ x
	Nepenthe (Ferris), - - - - -	♏ v
	Aquae Destillatae, - - - - -	ad ℥j
	Solve et misce, fiat haustus.	

Note.—A sleeping draught.

27. Gelsemium and Butyl-Chloral Hydrate Mixture.

℞	Tincturae Gelsemii, - - - - -	ʒiiss
	Butyl-Chloral Hydratis, - - - -	gr. clx
	Spiritûs Rectificati, - - - - -	℥j
	Syrupi Tolutani, - - - - -	℥ij
	Aquae Chloroformi, - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water, and repeated in an hour if pain is not relieved. If a third dose be required this mixture is not likely to prove serviceable.

Note.—Valuable combination in cases where pain radiates from the eye along the branches of the fifth cranial nerve, and more especially when the supramaxillary branches are affected.

(*h*) *Tonic*:—This group, including such important remedies as iron, quinine, and strychnine, should be employed in the case of anaemic and debilitated patients.

28. Compound Syrup of the Hypophosphites.

℞ Syrupi Hypophosphitum Compositi, - - q.s.

Dose.—A teaspoonful in water three times a day before food.

29. Compound Syrup of the Phosphate of Iron (Parrish).

℞ Syrupi Ferri Phosphatis Compositi, - - q.s.

Dose.—A teaspoonful in water three times a day after meals.

Note.—When combined in equal parts, these two syrups form a valuable tonic.

30. Quinine and Iron Citrate Mixture.

℞	Ferri et Quininae Citratis, - - -	gr. clx
	Aquae Chloroformi, - - - - -	℥viij
	Solve.	

Dose.—A tablespoonful in water three times a day before food.

Note.—General tonic.

31. Quinine, Iron, and Strychnine Mixture.

℞	Quininae Sulphatis, - - - -	gr. xvj
	Tincturae Ferri Perchloridi, - - -	ʒiiss
	Liquoris Strychninae Hydrochloridi, -	♏ xlviij
	Glycerini Purissimi, - - - - -	℥ss
	Aquae Destillatae, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day before food.

Note.—General tonic.

32. Quinine Sulphate Mixture.

℞	Quininae Sulphatis, - - - - - -	gr. viij
	Acidi Hydrochlorici Diluti, - - -	ʒij
	Spiritûs Rectificati, - - - - - -	℥j
	Syrupi Limonis, - - - - - -	℥ij
	Aquae Destillatae, - - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day before food.

Note.—Quinine is useful not only as a general tonic, but when administered at regular intervals in doses of from one to three grains, it appears to have a specific influence in overcoming suppurative processes.

33. Strychnine Hydrochloride and Strophanthus Mixture.

℞	Liquoris Strychninae Hydrochloridi, -	āā ♏ lxxx
	Tincturae Strophanthi, - - - -	
	Glycerini Purissimi, - - - - - -	℥i
	Aquae Destillatae, - - - - - -	ad ℥viij
	Misce.	

Dose.—A tablespoonful in water three times a day.

Note.—Useful in some forms of degeneration of the optic nerve, and in incipient chronic glaucoma.

34. Syrup of the Lactophosphate of Lime (Dusart).

℞ Syrupi Calcii Lactophosphatis, - - q.s.

Dose.—A teaspoonful in water three times a day after food.

Note.—Valuable tonic in many cases of phlyctenular conjunctivitis in children.

35. Syrup of Phosphate of Iron with Quinine and Strychnine.

℞ Syrupi Ferri Phosphatis cum Quininâ et
Strychninâ, - - - - - - - - q.s.

Dose.—A half to one teaspoonful in water three time a day before meals.

36. Trinitrin and Strychnine Mixture.

℞	Liquoris Trinitrini, - - - - - -	♏ xvj
	Liquoris Strychninae Hydrochloridi, -	♏ lxxx
	Spiritûs Rectificati, - - - - - -	℥i
	Syrupi Simplicis, - - - - - -	℥ij
	Aquae Destillatae, - - - - - -	ad ℥viij
	Misce.	

Dose.—A tablespoonful in water three times a day before food.

Note.—Used in embolism and thrombosis of the retinal vessels and in atrophy of the optic nerve.

(*i*) *Tonic and Sedative.*

37. Aconite and Quinine Mixture.

℞	Tincturae Aconiti, - - - - -	♏ xvj
	Quininae Hydrobromidi, - - -	gr. xvj
	Acidi Hydrobromici Diluti, - - -	ʒvj
	Aquae Chloroformi, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day between meals.

Note.—Useful in averting inflammation after injuries or operations.

38. Potassium Bromide and Nux Vomica Mixture.

℞	Potassii Bromidi, - - - - -	ʒiiss
	Tincturae Nucis Vomicae, - - -	ʒij
	Spiritûs Chloroformi, - - - -	ʒiiss
	Infusi Calumbae, - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day between meals.

Note.—Useful in painful conditions of the eyeball associated with chronic inflammation of its deeper structures.

39. Quinine and Potassium Bromide Mixture.

℞	Quininae Hydrobromidi, - - - -	gr. xvj
	Potassii Bromidi, - - - - -	ʒiiss
	Acidi Hydrobromici Diluti, - - -	ʒiv
	Aquae Anethi, - - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day after food.

Note.—Valuable sedative, prescribed in many cases of chronic glaucoma.

40. Valerian and Henbane Mixture.

℞	Tincturae Valerianae Ammoniatae, - -	ʒiss
	Tincturae Hyoscyami, - - - -	ʒj
	Tincturae Cardamomi Compositae, - -	ʒij
	Aquae Carui, - - - - - -	ad ℥viij
	Solve et misce.	

Dose.—A tablespoonful in water three times a day between meals.

Note.—Valuable sedative in nervous and hysterical cases.

B. PURGATIVES.

In ophthalmic practice, castor oil, black draught, Gregory's powder, and calomel are the best purgatives.

C. HYPODERMIC INJECTIONS.

It is sometimes advisable, in order to influence the system rapidly, to administer remedies by means of hypodermic injections. The following are the chief drugs thus employed in ophthalmic practice:

1. Acoine and Mercuric Cyanide Subconjunctival Injection.

(*a*)	℞	Acoine,	gr. j
		Aquae Destillatae,	℥ij
		Solve.	
(*b*)		Hydrargyri Cyanidi,	gr. $\frac{1}{80}$
		Sodii Chloridi Purissimi,	gr. x
		Aquae Destillatae,	℥ij
		Solve.	

Note.—One part of *a* mixed with two parts of *b* to be injected beneath the conjunctiva in detachment of the retina, and in some forms of choroiditis of the macular region. Alypin may be substituted for the acoine.

2. Antipyrine Hypodermic Injection.

℞	Phenazoni,	gr. iiiss
	Cocainae Hydrochloridi,	gr. $\frac{1}{8}$
	Aquae Destillatae,	♏ x
	Solve.	

Note.—Relieves pain rapidly, but produces diffuse swelling around the site of puncture.

3. Iodipin or Iodinal Hypodermic Injection.

Either as straw-coloured oily liquid containing 10 per cent. iodine, or yellowish-brown viscid fluid containing 25 per cent. iodine.

Note.—A convenient method of administering iodine—℥j to be injected beneath the skin between the shoulder blades, and repeated once a week.

4. Mercuric Cyanide Hypodermic Injection.

℞	Hydrargyri Bicyanidi,	gr. j
	Aquae Destillatae,	℥ij
	Solve.	

Note.—Contains one-sixteenth of a grain in seven and a half minims. A fleshy part, such as the buttock, ought to be chosen for the puncture, and the needle ought to be plunged deeply into the muscle. If the operation be performed carefully, the discomfort to the patient is slight. Is also used as a subconjunctival injection, see formula 1.

5. Morphine Hypodermic Injection.

℞	Morphinae Hydrochloridi, - - - -	gr. iv
	Aquae Chloroformi, - - - - - -	℥ij
	Solve.	

Note.—Five minims contain one-sixth of a grain. Sometimes it is advisable to combine from $\frac{1}{150}$ to $\frac{1}{60}$ gr. of atropine with each morphine injection.

6. Pilocarpine Hypodermic Injection.

℞	Pilocarpinae Nitratis, - - - -	gr. vj
	Aquae Destillatae, - - - - -	℥ij
	Solve.	

Note.—Inject from two to six minims. Used to produce profuse diaphoresis in cases of separation of the retina, of choroiditis, and of retinitis. It is well to begin with a small dose once a day, and, if larger doses are indicated, to repeat the small dose night and morning, so as to avoid any danger of cardiac depression. The patient should be in bed between flannel sheets, and have the bedclothes well tucked in all round the body to keep off currents of air. A mug or a large towel should be placed at his mouth to catch the saliva.

7. Saline Hypodermic Solution (Dor).

℞	Sodii Chloridi Purissimi, - - - -	gr. xxvj
	Sodii Carbonatis Purissimi, - - -	gr. ij
	Sodii Sulphatis, - - - - - -	gr. ij
	Potassii Sulphatis, - - - - -	gr. ij
	Sodii Phosphatis, - - - - -	gr. $\frac{1}{2}$
	Aquae Destillatae, - - - - -	ad ℥ij
	Solve.	

Note.—The use of this combination is always attended by very severe pain, and often followed by adhesion of the bulbar conjunctiva to the globe.

8. Gold and Potassium Cyanide Hypodermic Injection.

℞	Auri et Potassii Cyanidi, - - - -	gr. iv
	Aquae Destillatae, - - - - -	℥ss
	Solve.	

Note.—At first inject five minims daily, and gradually increase the dose to fifteen minims. To relieve the burning pain caused by the injection, apply an ice-cold compress to the site of puncture.

Recommended by Galezowski in cases of atrophy of optic nerve, especially when associated with tabes dorsalis, but in my experience the therapeutic results are not encouraging.

9. Sozoiodol-Mercury Hypodermic Injection.

℞	Hydrargyri Sozoiodol, - - - -	gr. v
	Sodii Iodidi, - - - - - -	gr. x
	Aquae Destillatae, - - - - -	♏ cc
	Solve.	

Note.—Ten to fifteen minims for an injection. Produces very slight local reaction.

10. Strychnine Hypodermic Injection.

℞ Liquoris Strychninae Hydrochloridi, - ʒij

Note.—Begin with two minims, and gradually increase the dose. Recommended in cases of atrophy of the optic nerve.

11. Tuberculin Kochii.

Initial dose, - - - - - - - ·001 c.c.

Note.—Used in tubercular affections of the eye. The patient's tuberculo-opsonic index ought to be determined before the treatment is begun, and regularly examined during the course of the treatment, before the dose of tuberculin is increased.

D. PULVERES—POWDERS.

1. Aspirin Powder.

℞ Aspirin, - - - - - - - - gr. xv

Note.—Aspirin, a white crystalline powder soluble in alcohol and glycerine but almost insoluble in water, is the acetic ester of salicylic acid. Valuable in relieving deep-seated ocular pain, especially in cyclitis or iritis.

2. Calomel and Compound Jalap Powder.

℞ Hydrargyri Subchloridi, - - - - gr. iij to x
Pulveris Jalapae Compositi, - - - gr. xl
Misce.

Note.—Valuable purgative.

3. Calomel and Dover's Powder.

℞ Hydrargyri Subchloridi, - - - - gr. iij
Pulveris Ipecacuanhae Compositi, - - gr. x
Misce, fiat pulvis.

Dose.—One at bedtime.

Note.—Useful in rheumatic iritis.

4. Phenacetin and Trional Powder.

℞ Phenacetini, - - - - - - - gr. x
Trional, - - - - - - - - gr. xv
Misce, fiat pulvis vel cachet.

Dose.—One every eight hours.

Note.—Useful for subduing pain and promoting sleep after operations upon the eye.

5. Quinine and Grey Powder.

℞ Quininae Sulphatis, - - - - - } āā gr. j
Hydrargyri c̄ Cretâ, - - - - - }
Misce, fiat pulvis.

Dose.—One three times a day.

Note.—Useful in cases where an alterative and tonic are both indicated, *e.g.* in interstitial keratitis and in sympathetic inflammation. The dose must be regulated to suit the patient.

6. Rhubarb and Antimony Powder.

℞ Pulveris Rhei Optimi, - - - - - gr. v
Antimonii Tartarati, - - - - - gr. $\frac{1}{6}$
Misce, fiat pulvis.

Dose.—One at bedtime *after a hot bath.*

Note.—Useful in phlyctenular conjunctivitis with great intolerance of light. Must always be given in slightly nauseating doses. When the tongue is very foul, a little grey powder may be added to each dose as in the next formula.

7. Rhubarb, Antimony, and Grey Powder.

℞ Pulveris Rhei Optimi, - - - - - gr. v
Antimonii Tartarati, - - - - - gr. $\frac{1}{6}$
Hydrargyri c̄ Cretâ, - - - - - gr. j
Misce, fiat pulvis.

8. Sodium Salicylate Powder.

℞ Sodii Salicylatis, - - - - - - gr. xx
Trite, fiat pulvis.

Dose.—One at bedtime.

Note.—As a diaphoretic administered in hot tea. Useful in choroidal and retinal inflammations, and in much larger doses in sympathetic ophthalmia (Gifford).

9. Sodium Salicylate and Dover's Powder.

℞ Sodii Salicylatis, - - - - - - gr. xv
Pulveris Ipecacuanhae Compositi, - - gr. xij
Potassii Nitratis, - - - - - - gr. v
Misce, fiat pulvis.

Dose.—Repeat as required.

Note.—Useful to relieve pain in rheumatic affections of the eye.

10. Veronal Powder.

℞ Veronal, - - - - - - - - gr. viij

Note.—A trustworthy hypnotic.

E. PILULAE—PILLS.

1. Alterative Pill.

℞	Aloes Barbadensis, - - - - -	gr. iij
	Hydrargyri Subchloridi, - - - -	gr. $\frac{1}{6}$
	Ferri Sulphatis Exsiccati, - - -	gr. $\frac{1}{4}$
	Pulveris Saponis Duri, - - - -	gr. $\frac{1}{2}$
	Ebor Usti, - - - - - - -	gr. $\frac{1}{12}$
	Misce, fiat pilula.	

Dose.—One every night at bedtime.

Note.—A mild mercurial pill, used in disease of the deeper structures of the eye, especially when due to syphilis. Commonly known as Anderson's Pill.

2. Calomel and Opium Pill.

℞	Hydrargyri Subchloridi, - - - -	gr. ij
	Extracti Opii, - - - - - - -	gr. j
	Misce, fiat pilula.	

Dose.—One every night at bedtime, as directed.

Note.—In iritis continue the pills until the gums become slightly tender, and then gradually diminish the dose. Four to six pills are usually sufficient.

3. Digitalis and Squill Pill.

℞	Pulveris Digitalis, - - - - -	āā gr. j
	Pulveris Scillae, - - - - -	
	Pilulae Hydrargyri, - - - - -	
	Extracti Hyoscyami, - - - -	
	Misce, fiat pilula.	

Dose.—One thrice daily.

Note.—Useful as a diuretic in some forms of retinitis associated with cardiac disease.

4. Digitalis, Blue, and Squill Pill (Bailey).

℞	Pulveris Digitalis, - - - - -	gr. ss
	Pilulae Hydrargyri, - - - - -	gr. iij
	Pulveris Scillae, - - - - -	gr. iss
	Syrupi Glucosi, - - - - -	q.s.
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Diuretic pill. Useful in some forms of toxic amblyopia, and in retinal and choroidal affections associated with cardiac disease.

5. Donovan's Pill.

℞	Hydrargyri Iodidi Rubri, - - - -	gr. $\frac{1}{16}$
	Arsenii Iodidi, - - - - -	gr. $\frac{1}{20}$
	Potassii Iodidi, - - - - -	gr. j
	Pulveris Glycyrrhizae, - - -	gr. ss
	Aquae Destillatae, - - - - -	q.s.
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Used in chronic inflammation of the eyeball, especially when due to syphilis.

6. Compound Gelsemium Pill.

℞	Gelsemin (resinoid), - - - -	gr. ss
	Butyl-Chloral Hydratis, - - - -	gr. j
	Camphorae Monobromatae, - - -	gr. j
	Extracti Cannabis Indicae, - - -	gr. $\frac{1}{4}$
	Glycerini Tragacanthae, - - - -	q.s.
	Misce, fiat pilula.	

Dose.—One every two or three hours until three doses have been taken.

Note.—To relieve pain in the head, associated with asthenopia or with inflammation of the ciliary body.

7. Iron Pill.

℞	Pilulae Ferri, P.B. 1898, - - -	gr. v

Dose.—One three times a day.

Note.—Useful in anaemia.

8. Iron Pill with Arsenic.

℞	Pilulae Ferri, P.B. 1898, - - -	gr. v
	Sodii Arsenatis Anhydrosi, - - -	gr. $\frac{1}{20}$
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Useful in anaemia.

9. Mercury Pill.

℞	Pilulae Hydrargyri, - - - - -	gr. v

Dose.—One three times a day, as directed.

Note.—Used in diseases of the eye due to syphilis. Should be continued until the physiological effects of the drug begin to manifest themselves.

10. Mercury, Arsenic, and Iron Pill.

℞	Hydrargyri Iodidi Rubri, - - -	āā gr. $\frac{1}{32}$
	Acidi Arseniosi, - - - - - -	
	Ferri Iodidi, - - - - - - -	gr. iij
	Pulveris Glycyrrhizae et syrupi, - -	q.s.
	Misce, fiat pilula.	

Dose.—One three times a day after food.

Note.—Used in syphilis when a tonic effect is desired.

11. Mercury and Quinine Pill.

℞	Pilulae Hydrargyri, - - - - - -	gr. j
	Quininae Sulphatis, - - - - -	gr. j
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Used as a tonic and alterative in syphilis.

12. Phosphorus Pill.

℞	Phosphori, - - - - - - -	āā gr. j
	Pulveris Tragacanthae, - - - -	
	Pulveris Acaciae, - - - - - -	gr. vj
	Pulveris Glycyrrhizae, - - - -	gr. vij
	Carbonis Bisulphidi, - - - -	♏ iij
	Confectionis Rosae Gallicae, - - -	gr. xxxiv or q.s.

Mix the powders in a mortar; dissolve the phosphorus in the bisulphide of carbon in a test-tube; add to the mixed powders, and with the confection of roses make into a mass which is to be divided into thirty pills.

Dose.—One three times a day.

Note.—The strength of the phosphorus may be altered to suit individual cases, but it is advisable to adhere to the other quantities of the formula.

Used in degeneration of the optic nerve.

13. Phosphorus and Nux Vomica Pill.

Prepare as No. 12, adding
Extracti Nucis Vomicae, - - - - - - - gr. $\frac{1}{4}$
to each pill.

Dose.—One three times a day.

Note.—Used in optic atrophy.

14. Plummer's Pill.

℞ Pilulae Hydrargyri Subchloridi Compositae, gr. v

Dose.—One at bedtime.

Note.—Useful in chronic iritis and in affections of the uveal tract generally. Can be borne in cases where stronger mercurials disagree.

15. Quinine and Iron Pill.

℞	Quininae Sulphatis, - - - - -	ää gr. j
	Ferri Sulphatis Exsiccati, - - -	
	Extracti Aloes Socotrinae, - - -	gr. j
	Pulveris Capsici Subtilissimi, - - -	gr. $\frac{1}{8}$
	Extracti Hyoscyami, - - - -	gr. j
	Syrupi Glucosi, - - - - - -	q.s.
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Useful in weak atonic conditions, *e.g.* retinitis pigmentosa.

16. Compound Rhubarb Pill.

℞ Pilulae Rhei Compositae, - - - - gr. v

Dose.—One or two as required.

Note.—A mild laxative.

17. Thiosinamin Pills.

℞	Thiosinamin, - - - - - - -	gr. $\frac{1}{2}$
	Extracti Gentianae, - - - - -	q.s.
	Misce.	

Note.—Prescribed along with Thiosinamin Ointment to promote the absorption of opacities of the cornea.

18. Triple Valerianate Pill.

℞	Quininae Valerianatis, - - - -	ää gr. j
	Ferri Valerianatis, - - - - -	
	Zinci Valerianatis, - - - - -	
	Syrupi Glucosi, - - - - - -	q.s.
	Misce, fiat pilula.	

19. Zinc Phosphide Pill.

℞	Zinci Phosphidi, - - - - - -	gr. $\frac{1}{12}$
	Sacchari Lactis, - - - - - -	gr. ij
	Extracti Gentianae, - - - - -	gr. j
	Misce, fiat pilula.	

Dose.—One three times a day.

Note.—Used in degeneration of the optic nerve.

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