had a "rheumatic diathesis." There was a history of exposure to cold, and she developed the familiar Bell's palsy, apparently coupled with slight but definite 6th nerve paresis. He could not prove the nature of the case pathologically, because it cleared up under anti-rheumatic remedies; nevertheless, he suggested, in the absence of any other aetiological factor, that one was justified in thinking it might be a transient polyneuritis cranialis unilateralis. The other case was that of a slightly older girl, in whom the 5th, 6th, and 7th were involved, and he had held a similar view of her case. On examining her at the end of six months, however, he found the opposite abdominal reflex absent, and he suggested in this case there may have been a small plaque of disseminated sclerosis. He only quoted it as a contrast to the others, in order to show how difficult it was to determine the aetiological factor in these cases. Unilateral cranial polyneuritis ought to be regarded as a clinical possibility. Several cases of the kind had been described in the literature. One was by Forli, in an Italian journal. It was that of an engine-driver, who always stood and worked on the right side of his engine, and was constantly exposed to wind and rain while on his journeys. Ultimately he developed a multiple paralysis of cranial nerves on the right side, with some pain, involving the 3rd, 4th, 5th, 7th, 8th, and 12th. The symptoms disappeared following the use of anti-rheumatic remedies. There was no question of syphilis in the case. When on minute review of such cases known infections could be excluded, and when the symptoms cleared up under treatment, it was fair to suggest a slight polyneuritis. Cases of unilateral neuritis of the arm, for example, were certainly known to occur, and if accepted as a clinical possibility, why should a cranial polyneuritis unilateralis not occur similarly?

CONTACT-ILLUMINATION IN THE EXAMINATION OF THE CORNEA AND ANTERIOR PART OF THE EYE

BY

BASIL GRAVES

SENIOR HOUSE SURGEON, ROYAL LONDON OPHTHALMIC HOSPITAL.

Continued from page 224.

Owing to the entire absence of any reflex from the clear cornea, it is not easy, for anyone unaccustomed to the method, to focus with the loupe the normal cornea under contact-illumination; it is best first to focus the pupil, and then to withdraw the loupe to the focus of the cornea, the plane of which is generally indicated by some small air-bubble or irregularity of fluid on the surface.

Ointment on the surface of the eye is a disadvantage; as is also oil, *e.g.* if an oily solution of cocain be employed, because the contours of fluid irregularities formed at the junction of water and oil themselves become illuminated. Though this is generally to be avoided I have found the use of oil on occasions serves to localise the plane of the corneal surface for purposes of appreciation of the comparative depth of a small object in the substance of the cornea; it will be found, however, that there is usually a chance air-bubble, or some fluid irregularity even of a watery surface sufficiently evident, with careful focussing, to serve for identification of surface level. Should doubt exist as to whether a given object is merely on the surface (*e.g.*, mucoid fluid) or in the substance of the cornea, the lid should, as is usual, be allowed to move over the cornea; if then there is still doubt, the contact-illuminator may be withdrawn about a centimetre from the surface, and its light falling on the corneal surface will reveal the material in its ordinary aspect, especially if the illuminator be moved until the object in question comes within the bright zone of the reflected corneal image of the source of illumination.

Of superficial conditions, the very early stage of a superficial punctate keratitis—when the patient comes up with little more than a ciliary flush, and the detection of the corneal condition is not very easy—is one which is readily revealed by peripheral contact-illumination. One may here say that minute superficial bullae, if they contain clear fluid enclosed by unbroken epithelium, are not revealed any more clearly by contact-illumination than by ordinary oblique illumination; this is to be expected because the surface reflexes of oblique illumination—usually an impediment to observation—are helpful in the detection of surface bullae in virtue of the distortion which they undergo in the presence of irregularities of surface contour. There are some forms of comparatively superficial keratitis of a diffuse nature, insidious and non-vascularized, which in their early stages, at first glance, look not unlike the surface haze of raised tension, but in which it will be readily recognized that the distribution is not uniform; and where examination with the loupe shows the haze to be just deep to the surface. The haze in some cases of keratitis of this nature shows a honeycombed type of distribution to a very pronounced degree.

I have referred to the surface haze of raised tension. If a drop of 1 per cent. cocain be instilled into an eye in which rise of tension is impending—at a stage so early that it is difficult, if it is even possible to assert, by ordinary oblique illumination, that the cornea shows definite loss of lustre, and certainly at a stage in advance of that in which the raised tension is readily appreciable to palpation with the fingers—there develops, at once or *within 5 or 6 seconds*, on the lids being held apart, a constant and characteristic appearance of

the corneal surface to peripheral contact illumination. I emphasize the rapid development of this haze; it is in no sense to be confused with a harmful drying of an unduly exposed cocainized cornea. The latter takes an appreciable time to develop; it does not develop if occasionally in the examination the lid is momentarily allowed to traverse the cornea; and lest this be used as an argument against the adoption of the method, even a careless observer is not likely to so expose a cornea as to produce severe cocain drying, since, before sufficient time can elapse for this to develop, either the patient, or the observer who is holding the lids open with the fingers, must needs relax for a momentary respite.

The rapid development of this pathological haze is one of its characteristics. As the cocain (presumably) plays a part in its production or its intensification, and as, in the mildest cases, it diminishes on momentary traverse of the moist lid over the cornea—to return with its customary rapidity on the process being repeated—one might be led to assume that the condition is analogous to a mild degree of cocain drying; but this would, one infers, be disproved by the fact that the haze develops abruptly and only to a degree commensurate with the rise of tension, and also that even though the cornea be subjected to a single exposure of longer duration than is ordinarily necessary for recognition of the condition, the intensity of the haze nevertheless does not increase beyond that degree which it assumes at its first inception. Again, the haze of a glaucoma patient increases when the eye is cocainized and exposed by insertion of a speculum on the operating table; yet the very marked dulness instantaneously gives place to a bright corneal reflex when tension is relieved even before either moisture or the lid overruns the cornea.

The haze of true cocain drying commences as scattered discrete small white patches, resembling, when magnified, flakes of rice-paper with torn edges; it leads to a swelling of the epithelium, with uneven contours, coarse and irregular in its distribution; its intensity increases with prolonged exposure of the cornea. The haze of slightly raised tension is fine, and is generally present over the whole cornea; it may or may not display the occasional clear islands in its midst so often seen in the very obvious coarse surface haze of eyes with definitely high tension. With the exception of these islands, the haze in question is very uniform, showing a faint even granulation which resembles in its degree the granulation of very finely ground glass. This appearance is generally most characteristic when the eye is first examined; after protracted examination, in at any rate the mildest cases, this haze becomes for a time less obvious—the intensity apparently lessens, and with this much of the appearance so suggestive of finely ground glass. It may be that this deferred alteration results from a physical

CONTACT-ILLUMINATION IN EXAMINATION OF CORNEA 353

change in the corneal epithelium brought about by the cocain, or that, in part, manipulation of the lid over the globe exerts pressure sufficient to bring about a temporary diminution of intraocular tension. The latter possibility suggests itself because I have so often noticed the diminution of this characteristic haze when observing it in those eyes in which the slight rise of tension can be presumed to be due to defective drainage of a rather viscid aqueous, e.g., cases of iritis of moderate degree in which there is no occlusion of the pupil.

It is not suggested that this haze seen in very early cases of raised tension by contact-illumination under cocain is any different in its nature from the coarse haze of steamy cornea which is clinically familiar in more advanced cases; the only difference that exists is one of degree. I certainly think that the haze is readily detectable by contact-illumination at a stage far earlier than that at which it becomes apparent to oblique illumination, and that the routine examination of a large number of various clinical cases by this method reveals the presence of slight pathological rise of tension with greater frequency than is commonly adduced from other methods for its detection. In a large number of these cases, e.g., iritis and post-operative conditions, the tension is readily brought down to normal limits—as indicated by disappearance of the corneal haze—by simple treatment, it may be only rest in bed, perhaps with the application of heat, or, in severer cases, of leeching. The condition may frequently be seen in cases of iritis before treatment is started. After a needling of lens in an adult, almost before there is swelling of the lens to a high degree or vascular injection of the eye has become very pronounced, and certainly before tension to fingers may have become definitely full, the characteristic haze may commonly be seen by contact-illumination in its earliest prodromal stage in a comparatively quiet eye, perhaps four or five days before the case abruptly attains the stage of pronounced glaucoma. Occasionally after a recent cataract extraction, an eye may exhibit slight irritability as indicated by undue lacrimation and a slight circumcorneal flush on examination. Peripheral application of the illuminator may reveal a faint haze; the rise of tension may be due to no obvious cause, and simple treatment may readily abolish it, or perhaps deeper focussing may reveal a minute tag of capsule or some fibrils of vitreous running up towards the site of the section.

The presence of this haze in its finest degree is commonly an early sign of clinical value in incipient primary glaucoma; and in these cases the haze is especially visible against the dark background which results from the accentuated tendency exhibited by most cases of chronic primary glaucoma—even at an early stage—to ready mydriasis under the influence of weak cocain.

After the prolonged persistence of pathological tension this haze may assume appearances which are not characteristic, or it may disappear; but this does not usually occur until the affection has attained a stage at which the glaucoma is readily obvious to other clinical methods employed for its detection. The haze is an accompaniment of the early stage of pathologically raised tension; and its early detection at that stage by peripheral contact-illumination is of practical utility. The character of the haze is constant, and when its appearance has been familiarized by the examination of a few cases of fairly high tension, no difficulty will be experienced in recognizing it in the earlier stages of incipient tension. Loss of transparency of the substance of the cornea from any cause, e.g., infiltration, is no hindrance to the detection of an associated surface haze of raised tension; the two can be distinguished when present together.

There are certain pathological conditions of the cornea from which the haze in question needs discriminating, though to the observer who has familiarized himself with the appearance of the surface haze of raised tension, these do not closely simulate it. The haze of cocaine drying has been referred to. Eyes in which high tension has been present over a long period may attain a permanent faint superficial nebulous condition of the cornea just beneath the epithelium. The corneae of eyes with pathologically low tension usually exhibit to a slight degree, by contact-illumination, a uniformly impaired transparency affecting, however, not the surface but the substance of the cornea. In the only three cases* of palpebral spring catarrh which I have been able to examine by this method, there has been a granular stippling over the whole cornea. The plane is superficial, though it is a little difficult to decide whether it is truly epithelial, or just sub-epithelial in level. The distribution is uniform over the cornea; the loupe reveals it as a faint and fine punctate speckling without any coalescence of its constituents, which, though minute, are discrete. The suggestion that this condition of the cornea is due to the mechanical contact of the hard fibrous elevations of spring catarrh would not seem quite to correspond with the fact that the disposition of the corneal peculiarity is uniform, being neither limited to nor intensified over that area of the cornea which is the more in contact with the affected parts of the palpebral conjunctiva. On the other hand, the explanation on mechanical grounds would seem supported by the absence of this condition in one case of bulbar spring catarrh examined.

The deep, rather pronounced haze in the substance of the cornea prone to occur in those eyes in which keratitis punctata has been present over a long period is readily distinguishable in its appearance,

*The remarks throughout this paper are on observations made solely upon ward in-patients.

apart from the fact that its distribution is generally limited to an area corresponding with that region of the corneal endothelium which is affected by the keratitis punctata. Another source of imperfect corneal transparency, deep and, I believe, only transient, is to be seen occasionally in trephined eyes, when, through long delay in re-formation of the anterior chamber, the lens has been in unduly prolonged contact with the back of the cornea.

Contact-illumination is also useful in revealing very faint superficial nebulae. Grosser conditions of the surface of the cornea, such as dense nebulae or the superficial vessels of pannus, are revealed to as great advantage, or greater, when the conditions are pronounced, by ordinary oblique illumination.

Regarding the observation of conditions in the substance of the cornea, contact illumination is best suited for the examination of fine changes. The primary detection of certain fine conditions may be difficult by oblique illumination, as for example the small track, passing through the whole corneal thickness, left after traumatic perforation by a thin object such as a needle or a small intraocular foreign body. Such a track presents when on end but little surface to oblique illumination, whereas it scatters light throughout its length if the source be one of peripheral contact. A fine nebula in the substance may be seen by oblique illumination, but it will be more readily visible by contact-illumination, and often thereby more extensive than was suspected by oblique illumination or by retinoscopy. This increase in the extent of the affected area is especially well seen around a commencing small infective focus, or an early deep ulcer, which may display a fine granular haze advancing centrifugally into the neighbouring substance. The persistence of such extended haze might account for a slight reduction in the visual acuity of an eye in which, to casual observation, the corneal nebula does not appear to encroach on the path of the central visual axis.

Perforations of the cornea which have been but mildly infected leave permanent traces which are more easily detectable than the sequelae of aseptic (e.g., surgical) penetrations; but I believe that no complete perforation, even fine and aseptic, of the clear cornea occurs which does not leave a permanent trace detectable no matter how long after. I add one reservation, that I have not made subsequent examination of cases in which the strong reparative powers of the very young infant have been able to operate; but the traces of keratome sections are to be found in adults whose history notes record operation in childhood. Keratome sections through the cornea leave a scar in which the perforations of both epithelium and endothelium are plainly visible as two distinct, slightly curved lines from the ends of which, not uncommonly, a short comma-like tail branches off at an obtuse angle. I recall

one case in which two successive operations were performed on the same eye at an interval of about ten days; the first included a keratome section through the cornea, and the second a procedure in which loss of the aqueous was inevitable. When the anterior chamber subsequently re-formed after the second operation, the pupil was not circular, and the iris in its sector opposite the keratome section was on a forward plane close against the cornea. With a light iris so close to the back of the cornea it was not easy to discriminate the component parts of the keratome scar; but contact illumination readily showed these, and also the fact that the anterior face of the iris had a linear adhesion to the gap in Descemet's membrane with which, as a result of the second operation involving loss of aqueous, it had been brought in contact before adequate time had elapsed for the endothelium to heal. A similar condition may be met with in an eye in which a forward corneal section has been made for cataract extraction, with subsequent delay in re-formation of the anterior chamber. The attachment of the iris stroma to the cornea may be linear or crenated; in the latter case a number of little conical tendrils run to the cornea, their pointed apices terminating sharply at the gap in Descemet's membrane where they are stuck to, though not incorporated with, the "wound-plug." These may each resemble in shape a bell-tent of which the thin attenuated stromal wall becomes reticulated, admitting a view in miniature of an enclosed space floored by the uveal pigment. This condition is very striking when viewed under contact-illumination with the binocular corneal microscope. The recognition that the synechiae are no more than adherent to the deep aspect of the corneal scar is of surgical significance because if, for the relief of a secondary glaucoma, their separation from the cornea is necessary, it may be effected without an actual cutting of the stromal attachments and with the minimum of maltreatment to the iris. The adhesion to the cornea, if its occurrence is not of too long standing, is so light that pressure with a flat surface or blunt edge of an instrument (e.g. Ziegler needle) inserted into the anterior chamber readily detaches it in a manner that is not effectual if the iris-stroma is entrapped in the depth of the corneal substance.

Corneae which are apparently clear to naked eye examination sometimes reveal fine structural peculiarities by contact illumination, such as faint grey lines in the depth of an otherwise normal cornea. Greyish stippled dots, closely crowded and apparently in the plane of Descemet's membrane, are not uncommonly seen. Most of the cases of this latter condition which I have observed have been in elderly people whose eyes were under examination for some other and incidental reason, such as senile cataract. Mr. R. Affleck Greeves tells me that he has observed these dots in the eyes

of old people, and that he has been accustomed to regard them as a senile change of a degenerative nature. One case in particular, showing orange coloured dots plentifully diffused throughout the cornea is of some interest. It was suggested that these orange dots were on the back of the cornea, and were merely detached uveal pigment; but after careful examination with the binocular corneal microscope I came to the conclusion that the orange dots in this case were in the deeper part of the cornea—and this raises the question of colour. As far as I am aware, no false artificial colour effects are produced by contact-illumination. The two coloured substances most commonly seen in abnormal situations in the anterior part of the eye are uveal pigment and blood pigment, and the appearance of these is characteristic and unmistakable—the light to chocolate brown of uveal pigment; the maroon brownish-red of reduced haemoglobin associated with blood-débris. In both instances, even though the deposits of these are very minute, the colour is vivid and conspicuous. It is by no means uncommon to see a fine peppering or dusting of uveal pigment on the back of the cornea after intraocular operations; it may or may not be associated with the commoner condition of a corresponding deposition on the anterior lens-capsule. How long it can remain unchanged I am unaware, but in some cases I have found it unaltered on re-examination several weeks afterwards; in others it has disappeared in a week or two. Blood pigment very commonly persists on the back of the cornea as a very fine peppering, of characteristic colour, long after the clinical disappearance of the hyphaema from which it took origin; its composition is very fine but uniform, and it is distributed over a greater area of the cornea than that bounded by the original hydrostatic level of the hyphaema. It may perhaps be detected by retinoscopy as a fine cloud impairing the transparency of the cornea, its composition being readily revealed by the loupe under suitable illumination.

Keratitis punctata shows very plainly by this method. When present only as a few spots at the extreme lower periphery it is apt to be overlooked unless the illuminator is placed on the sclerotic with its edge at least three or four millimetres from the limbus. From this position diffusion of light into the cornea from the illuminated substance of the sclerotic will reveal the spots of keratitis punctata against a relatively dark background. An isolated spot in this position is also apt to be overlooked unless it be borne in mind that this part of the cornea is, owing to its curvature, on a deeper focal plane than the more central part. A loupe of relatively low magnification, e.g. $\times 8$, given good illumination is, owing to its enhanced focal depth and size of field, commonly more suitable than one of higher power for the detection of minutiae. Inflammatory keratitis punctata may be simulated by the deposition of detached

fragments of soft lens matter on the back of the cornea after needling or extraction of cataract; but such deposits are less dense in consistency, are less prone to illumination, are fainter, more fluffy and ill-defined. They are commonly associated with fragmentary detachments of soft lens matter in the aqueous to which a buoyant movement can be imparted if the end of the illuminator makes gentle pressure on the periphery of the cornea.

It may be taken as a general rule that deposits on the back of the cornea, e.g., blood pigment, uveal pigment, inflammatory keratitis punctata, reveal themselves in their natural colour aspect by contact-illumination except that under certain circumstances dependent on contrast phenomena, the depth of their colouration will vary; and the conditions determining this variation may be grouped under two headings, firstly, the illumination of the deposits and, secondly, the illumination of the background. The former depends on various factors, such as the density, translucency, relucency and colour-properties of the deposit; the latter is divided into two areas either of which may vary in its illumination—the iris according to its colour, the lens according to its transparency. Again, the amount of circumfused light reaching objects on or in the cornea will not vary much whether the illuminator be applied peripherally (on sclerotic) or more centrally on the cornea. On the other hand, these two positions of the illuminator will embrace a wide variation in the illumination of the background ranging respectively from a minimal dimness to a maximal brilliance. White translucent inflammatory keratitis punctata always appears light by contact-illumination. Its primary detection is best facilitated by the peripheral position of the illuminator with a consequently dimly lit background. This is especially the case when looking for the sparsely disseminated fine keratitis punctata that is associated with a background formed by a bleached iris stroma and a white cyclitic cataract; or for keratitis punctata against a background of white flocculent soft lens-matter. Deposit which is denser and of dark colour is well seen when the illuminator is more central and the background consequently vivid. Intermediately there may occur faintly coloured partially translucent deposit which will appear light or dark in the same eye according as the illuminator is applied peripherally or centrally. I have seen faintly coloured keratitis punctata in an eye from which a cyclitic cataract had recently been extracted with iridectomy; as may occur after iridectomy, a sparse fine dusting of brown uveal pigment could be detected on the back of the cornea and some of this appeared to have aggregated itself in greater density to the pre-existing spots of inflammatory keratitis punctata which, though before the operation they were white, now exhibited a tinge of colour.

There is a particular method of using the illuminator when it is

desired to ascertain the depth of a small object in the cornea. The observer looks, from the side, tangentially across the cornea, at the same time applying the illuminator to the cornea close to but on the far side of the object under observation; he can then with the loupe see the corneal thickness from the flank magnified to a far greater extent than is possible when it is viewed in foreshortened perspective from the front. This method is useful to estimate the depth of a foreign-body in the cornea, especially when there is some overlying infiltration of the tissue between the foreign-body and the surface. When the anterior chamber is very shallow, it may be difficult to differentiate between keratitis punctata on the back of the cornea and white spots (inflammatory exudate, localized capsular proliferation) on the anterior lens capsule, but the distinction is greatly facilitated by this tangential view.

The conditions of the cornea so far referred to are fine ones. Contact-illumination is not suitable for the examination of coarse changes in the cornea, be they superficial or deep, *per se*; but where there are gross corneal changes into the depth of which or deep to which it is desired to seek for other and finer changes, this illumination is of good service. For example, a foreign body will show up in its natural colour—coal-dust black, steel bright and glistening—when the superficial infiltration liable to follow the unsuccessful attempt at its removal renders ordinarily its detection difficult. Siderosis in the cornea may much obscure the fragment of steel to which its presence is due. In these cases the illuminator is applied to the cornea with its edge within about three or four millimetres of the spot where the suspected foreign body lies; and, as stated above, a tangential direction of the observer's gaze is commonly helpful. The deep vessels of interstitial keratitis or their old tracks may generally be detected when the associated nebulation is even dense. An anterior synechia attached to the back of an extensive and dense corneal leukoma can well be seen if, with the illuminator applied to the leukoma, the observer takes his view of the anterior chamber (which is thereby brightly lit up) tangentially through any clearer peripheral part of the cornea. The observation, behind the infiltration surrounding a small corneal wound, of a tag of lymph in the anterior chamber running up to the wound may indicate that the wound is of recent occurrence; and in demonstrating the penetrating nature of the wound it may serve as inferential evidence of the presence of an intraocular foreign body.

There is one class of case in which this illumination is of value—those borderline cases in which, with raised tension and hazy cornea, evidence of inflammatory products in the anterior chamber is being sought to decide whether or not the glaucoma is primary or secondary, and consequently which of such opposite alternatives, miotic or

mydriatic, shall be chosen in treatment. Keratitis punctata, hyperaemia, vascularization and inflammatory nodules of the iris, posterior synechiae—which may take the form of merely the minutest tapering tag of brown uveal pigment—detached pigment and inflammatory exudate on the anterior lens-capsule may all be seen by contact-illumination through a cornea which is hazy to a fairly intense degree. I recall one patient in particular who gave a history of recurrent mild attacks of lachrimation and redness; when seen in one of these attacks, the eye had the aspect of a mild subacute primary glaucoma—hazy cornea and shallow anterior chamber, with a small pupil resulting from eserine which had been instilled for some days before he attended the hospital. The other eye had been lost as the result of an accident, and therefore presumptive evidence for or against an anatomical predisposition to primary glaucoma from examination of the second eye was not available in this case. Contact-illumination revealed, through the corneal haze, two very small spots of keratitis punctata on the back of the cornea, and a very small comma-like tag of pigment on the lens capsule, too slender to distort the circular shape of the pupil. First homatropin tentatively, and then atropin, were used with rapid improvement, dilatation of the pupil at the same time revealing a few detached specks of uveal pigment on more peripheral parts of the lens capsule. The case was kept on atropin and eventually recovered, with V. 6/6 and a full field. In the case quoted, and in some others which I have seen of a similar nature, the finer evidence in the anterior chamber of irido-cyclitis was not easily detectable by oblique illumination. It is true that however hazy the cornea may be, it is generally possible by oblique illumination to detect distortion of the pupillary shape; but posterior synechiae sufficiently pronounced to distort the pupil are not a necessary accompaniment of an irido-cyclitis which is capable of causing glaucoma. It does seem that glaucoma, to which a certain eye is perhaps anatomically more disposed from having a shallow anterior chamber, may be precipitated by a very mild degree of irido-cyclitis which, occurring in a more normally constructed eye, would produce no such effect. If the keratitis punctata and posterior synechiae are gross, they are evident by oblique illumination, which, however, may in these cases fail if the glaucoma surface haze is superimposed on that haze which is prone to occur in the corneal substance after the prolonged presence of coarse keratitis punctata.

Any small objects in the anterior chamber are very favourably seen by direct contact-illumination on the cornea; such are tags of lens capsule or vitreous running up to the wound after extraction, curette evacuation or needling; foreign bodies, lens matter, etc., in the aqueous. Vitreous may not uncommonly be seen protruding

CONTACT-ILLUMINATION IN EXAMINATION OF CORNEA 361

through the gap in the capsular remains in an aphakic eye, as a hyaline refractile wavy material oscillating when slight pressure is exerted on the globe; it is all the more evident if entangled in it there are, as is not infrequently the case, numerous minute red specks of blood pigment similar to those so commonly to be seen adherent to the capsular remains a few weeks after extraction.

I have previously alluded to the fact that small objects such as pale fine deposits on the lens capsule are not necessarily seen at their best by the maximal illumination resulting from application of the illuminator near the centre of the cornea; a more vivid picture of a minute object on the lens is generally procured when the illuminator is placed more towards the peripheral part of the cornea in a position furthest removed from the object observed. This is particularly the case when the object is pale and colourless. More than one elementary principle recognized in art is involved in this. A photographer appreciates the value of side illumination to accentuate an object such as a tree-trunk or mountain, the object standing out much more boldly when one side of it is illuminated brightly and the other dimly, than when, with the sun behind the photographer, the bright illumination is uniformly distributed on the particular object. Again, in the absence of colour contrast, unduly vivid illumination is not always suitable for the full appreciation of effects in low relief, a fact long since recognized in sculptural art (e.g., the frieze of the Parthenon) when carvings were to be made on surfaces dimly lit. If the illuminator be placed at the edge of the cornea at say nine o'clock and the part of the iris furthest removed from it (at three o'clock) be examined with the high-power of the corneal microscope, a very beautiful picture is seen of the stromal crypts of the iris in strong relief—a picture far more striking although the illumination is dimmer than it would be with the illuminator placed on that part of the cornea more directly overlying the field under observation.

These factors also apply when a clear lens forms the back-ground to a minute object on the anterior capsule, such as the not uncommon congenital pigmented specks grouped like clumps of bacilli. If the object be fine and colourless it is seen to greater advantage with a semi-peripheral position of the illuminator, and, when the object is near the centre of the lens, with a small pupil; this is probably in part explainable by diffusion of light into the lens because, given a dilated pupil, improved visibility of the object on the lens was obtainable experimentally by rendering the rays from the illuminator convergent.

The examination by this illumination of the iris in iritis of moderate degree does suggest that much of the lack-lustre appearance of the iris is due to altered conditions of the interposed media,

such as haze of the cornea and turbidity of the aqueous. This is easily comprehended when it is considered how great may be the apparent alteration of colour (bright-green) of an iris as seen through aqueous in which a small quantity of blood-serum is disseminated.

Penetration of light into deeper planes is very effectual by contact-lighting. I have already referred to the visibility of inflammatory products in the anterior chamber when viewed through an imperfectly transparent cornea. Mr. Herbert Parsons has suggested that polarization of the light may play some part in this; at least, it is not wholly to be explained by an absence of exterior surface scattering because, for example, the iris is seen to good advantage by this method when the intervening impediment to its observation lies deep to the surface, such as increased turbidity of the aqueous or exudative casts in the anterior chamber. There are various other examples of this penetration. Often after needling of capsular remains following extraction, fine superimposed gossamer-like translucent films may be seen deep back in a pupillary region which to retinoscopy is apparently transparent. In one case with traumatic mydriasis and iridodonesis, the anterior lens capsule was visible by contact-illumination at a depth indicating backward dislocation of the lens; retinoscopy was of no avail to reveal the edge of the lens, because, presumably owing to haemorrhage into the posterior part of the vitreous, there was no red reflex. This was an isolated case; contact-lighting of the cornea is generally of no more value than are the commoner methods of observation to reveal a dislocated lens.

There is one class of case in particular where the effective penetration of this lighting is of considerable practical value, viz.: in the detection of a metallic foreign body in the lens or immediately subjacent vitreous, when the foreign body is viewed through a lens rendered semi-opaque by perforation or by siderosis about the anterior capsule. In these cases I believe that contact-lighting on the cornea seldom fails to give a striking effect, the fragment of metal standing out, clear and decisive, as a sharply defined object easily recognizable in its natural form and outline. The colour, as thus seen, is its natural one; steel is, perhaps, grey and glistening, perhaps dull-black, according to its condition. It may be confirmed that the object is metallic in that, being non-transluminous, it stands out sharp and black on scleral transillumination. Opacities of the lens of all ordinary degrees—such as mature senile cataract and those due to traumatic perforation—do not impair the red reflex of strong transillumination; even calcareous deposits do not wholly interrupt it. I believe that no other material than uveal pigment produces, by its resistance to the transillumination reflex, a blackness equal to that of an opaque foreign body in the lens.

For scleral transillumination to be efficient, when a 4-volt. lamp-filament is employed, it is best for the appliance to be so constructed that the lamp filament comes very close to the scleral surface, say within 5 millimetres; if the intervening distance is to be greater, a more powerful filament than a 4-volt. one is desirable. The use of the illuminator here described for contact-lighting is inseparably connected with its use for scleral transillumination, for which purpose, having its filament close up to the termination, it is very suitable. The whole subject of efficient transillumination is of interest, and has more practical aspects than might be inferred from the comparative infrequency with which the method is employed.

The only other abnormalities in the lens which show to advantage by contact-lighting on the cornea are localized and defined opacities; diffuse opacities of the lens show to no advantage by contact-lighting. A very effective view is to be obtained of dotted opacities scattered on different planes. The more posterior ones, often disposed in a cone corresponding with the curvature of the posterior surface of the lens, show up bright and white, as do those situated more anteriorly. Their comparative level is the more emphasized through the monocular loupe—which must be held very close to the observed eye if it is desired to focus posterior opacities—when the observer introduces parallax by oscillation of his head.

Contact-lighting on the cornea is not suited for the examination of vitreous changes unless the objects be close up behind the lens. Fibrous material when thus seen appears white, not black as by retinoscopy. An anteriorly situated malignant growth is sometimes visible by this method.

Before concluding, there are a few general points I would allude to. As regards the use of contact-lighting with the corneal microscope, an assistant is required to apply the illuminator. Some conditions seen thus are very striking, but I do not suggest that the corneal microscope serves as more than a convenient "loupe" for observation of minutiae at some leisure, except that the appliance may have a usefulness of its own on questions relating to level or depth. My impression is that nothing should be observed by the use of the binocular corneal microscope that is not primarily detectable with the monocular corneal loupe.

It may be asked if there are abnormal reflexes by contact-lighting. Only two reflex images are met with, and they are of little import. One is a small image of the face of the illuminator formed, when the pupil is large, by that sector of the lens which is furthest removed from the point of application of the illuminator. It moves with movement of the illuminator. The second is fainter, and occurs when contact is peripheral and scleral. The diffusion of light from the substance of the sclerotic around the illuminator faintly illuminates that surface of the loupe facing the sclerotic; a

faint image of the loupe is formed by the lens and can be focussed about the plane of the anterior capsule. This image undergoes distortion when the loupe is slightly twisted, and is further recognized by its intensification on the illuminator being slightly withdrawn from contact with the globe, more light being thereby reflected from the surface of the globe on to the face of the loupe. It is almost abolished if the rim of the metal mount of the loupe is blackened instead of being bright. These images are present when the eye is examined by oblique illumination, but in comparison with the bright corneal images of oblique illumination, the presence of at any rate the fainter of the two images is not always remarked.

It may be said that the plane mirror in the ophthalmoscope suitably serves for the detection of minutiae. The plane-mirror depends largely on a good red reflex being present; the picture presented by it is a colourless silhouette, passive rather than active, on one apparent plane and devoid of stereoscopic depth. Both methods have their limitations and their uses.

There is reasonable incentive to aim at any improvement in or addition to existing methods of illumination. In clinical ophthalmology, where objective examination plays such a major part, and where subtle refinement in diagnosis depends so often on the observation of minutiae, illumination is primarily the most important factor. It is not so difficult to say that a given condition is present as to confidently affirm that it is absent, consistently with quickness, and without undue mental and physical effort.

The use of the illumination here suggested should only succeed or supplement a more general survey, e.g., by oblique illumination. With a little practice in the use of the contact-illuminator it will be found that the method is one very easily manipulated. Efficiency of the apparatus is essential; though simple, it must be well made, especially at its contact end, which must have no irregularity or roughness. The glass contact piece should be thin; the lamp should abut close to it. The bulb of the lamp should be round and thin at its end through which the light must pass, and should not here present a globular thickening of glass impairing transmission of light. The filament of the lamp should lie reasonably close to the end of the bulb, and should be capable of burning brightly off a two-celled accumulator without fusing, or causing rapid carbon deposition on the inner aspect of the glass. Selection is necessary—not all the small lamps of the shape illustrated in this article, and alleged to be of a 4-volt strength, satisfy these requirements. The accumulator should be kept fully charged.

In conclusion, I may say that because, being interested in this method of illumination I have reviewed various aspects of the subject at some length, I am not thereby asserting an

THE OCULAR MENACE OF WOOD ALCOHOL POISONING 365

exaggerated sphere of its usefulness; nor do I imply any disparagement of the ordinary methods in respect of which contact-illumination may serve as a useful adjunct on particular occasions. Such occasions are the detection of fine corneal opacities and of early keratitis punctata against a light background, or the detection of the surface haze of slightly raised tension, or the investigation of small abnormalities in the anterior chamber and lens.

I am indebted to the Surgeons of Moorfields Hospital for their courtesy in permitting me to examine and to quote from the records of their cases.

I have frequently referred both to Mr. Treacher Collins and to Mr. Herbert Parsons for their opinions and advice; the readiness with which they have accorded these is a kindness for which I am very grateful.

THE OCULAR MENACE OF WOOD ALCOHOL POISONING*

BY

DR. S. LEWIS ZIEGLER

PHILADELPHIA.

THE adoption of the National Prohibition Amendment in the United States, and the possible advent of similar restrictions in Great Britain, make the ocular complications of wood alcohol poisoning a live topic for discussion. The more we restrict the use of ethyl alcohol the greater is the temptation to substitute methyl alcohol, and so long as methyl alcohol remains the most deadly poison of daily commerce so long will human eyesight, if not life itself, be menaced by ignorant, careless or criminal handling of this toxic product. As ophthalmologists we have a double duty to perform:—(1) to make an intensive study of the toxic effects of methyl alcohol on the delicate ocular tissues, and (2) to establish a propaganda in "preventive medicine" that will protect possible victims, whether guilty or innocent.

Three fateful factors have increased the dangers of wood alcohol: (1) its *refinement* from a nauseous, vile smelling compound to one as clear and palatable as ethyl alcohol, (2) its fatal *cheapness*, which has naturally resulted from the increased output and the improved methods of manufacture, and (3) its *unusual solvent power*, which has so greatly encouraged its use in the Arts.

In America we have (1) *ethyl alcohol*, which is either absolute (99 per cent.) or rectified (90 per cent.); (2) *methyl alcohol*, which

* Read at the Oxford Ophthalmological Congress, July 15, 1920.