Many other points require explanation, *e.g.*, as to why nystägmus usually gives rise to intolerable symptoms about the age of presbyopia, and (*b*) as to the effects of posture on the function of the extra-ocular muscles. These are to be the subject of later experiments together with an analysis of the binocular vision under such low illumination that the fovea cannot respond.

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SLIT-LAMP MICROSCOPY*

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IN the years that immediately followed the first world war, a great deal of enthusiasm was aroused in these islands by the work of Vogt and others with what was then a novelty—the slit-lamp and corneal microscope. A number of British ophthalmologists went on pilgrimages to Switzerland, fired by ambition to equip themselves with knowledge of the new weapon. It was perhaps only natural that these crusaders should become intoxicated by the thrilling new world of phenomena unfolded before their eyes, and we need feel no surprise that some of them launched into extravagant claims. They even suggested—greatly to the consternation of the non-crusaders—that evidence given in a Court of Law by ophthalmic surgeons could not thenceforth be regarded as expert unless it included facts derived from slit-lamp observation. Here was a chance for the enemies of the new toy, as they derisively dubbed the slit-lamp. “What is the use,” they asked, “of all this pampering and bottle-feeding? You will only succeed in producing a generation of ophthalmologists unable to see anything without the help of intricate and costly devices.” Another upholder of traditional methods was heard to say: “Show me

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something that I can't already see with my loupe, and then I'll begin to consider peering down those new-fangled tubes."

Now that we are once again passing through the aftermath of a world war, it seems fitting to review the status of slit-lamp microscopy, and the chances of arriving at a reasonable estimate of its value should be brighter than they were in the 1920's, because the instrument is no longer a novelty, and the words already written by its devotees run into millions. In the first place, however, it will be necessary to mention some of the main objections urged by the opponents of slit-lamp microscopy. Then we must ask: "To what extent are these objections justified?" Next we should consider how the beginner can avoid the fallacies and abuses which do admittedly arise from injudicious use of the slit-lamp. Afterwards it will be possible to summarise the chief benefits to be gained from using the instrument, but the problem will be easier to understand if that summary is preceded by a brief account of the evolution of technique.

Turning then to the clinical details, let us consider the importance of recognising certain benign varieties of pre-senile cataract. Finally, metallic impregnation of the structures accessible to slit-lamp microscopy will come under notice together with the colour-changes induced by non-metallic agents.

1—Main objections to slit-lamp microscopy

Many ophthalmologists have argued that the high cost of a slit-lamp renders it a useless luxury for all except research workers, because the lower ranges of magnification are ample for routine work, so long as the observer has been adequately grounded in his specialty. Moreover they can quote instances of serious conditions unrecognised by the volatile microscopist, though his old-fashioned colleague had no difficulty in detecting them with a loupe. Furthermore the slit-lamp enthusiast is accused of raising unnecessary scares. Early iridocyclitis, and even sympathetic ophthalmia, we are told, have been wrongly diagnosed on the score of a few stray pigment granules settled on the back of the cornea, or floating about in the anterior chamber.

With a few unimportant exceptions, they go on to say, the phenomena revealed by slit-lamp microscopy can perfectly well be appreciated by means of focal illumination and the monocular loupe; and the main result of using higher magnifications is to blunt the faculty of perception, so that the microscopist will be seriously handicapped when he has to do without his beloved machine, as, for instance, in examining a bed-ridden patient. Another alleged disadvantage is that the ordinary work of an out-patient department is delayed by slit-lamp enthusiasts laboriously

searching for minutiae. Finally it is pointed out that the teaching programme is already overburdened, and that instruction in slit-lamp microscopy is bound to curtail the time available for more important methods of investigation.

2—Comments upon the foregoing objections

Concerning the expense of the instrument, we may retort that a good slit-lamp will last for many years if it is properly tended, and the running costs are negligible. It must be conceded that a slovenly clinician undergoes no miraculous transformation merely by virtue of gazing down a microscope, and clearly we shall obtain far more valuable guidance from a sound ophthalmologist without knowledge of the slit-lamp, than an unskilled observer could give us with the aid of the most elaborate machine. If, however, an instrument is to be judged by the errors of its least experienced wielders, what methods of examination will remain at our disposal? Gigantic blunders are perpetrated every day with the ophthalmoscope and the perimeter, and many a large keratic precipitate has escaped detection through a loupe. Nor is the raising of unnecessary scares a monopoly of slit-lamp enthusiasts. Indeed this instrument has been known to allay scares by contradicting the sinister impressions derived from a loupe.

It will presently be shown that the number of phenomena revealed by the slit-lamp but hidden from the loupe is not negligible, and it is certain that, although access to higher magnifications may blunt the perceptive faculty of some, yet others are thereby stimulated to seek more detailed information with their loupe, when once the finer changes have been revealed by slit-lamp microscopy. With regard to the argument of out-patient delay, it may be replied that most of the cases in ordinary practice do not need to be scrutinised with the slit-lamp, and that the extra time required for examination of suitable ones will be negligible, so long as the observer has gained facility in rapid focusing. Finally the use of the instrument can be rapidly taught to anyone with moderate intelligence and a grounding in elementary ophthalmology. One recognised item in such grounding is the scrutiny of histological specimens, fragments of dead tissue which have been plunged into a succession of protoplasmic poisons, as well as being transformed by aniline dyes. The student then proceeds to look at inverted images of these mutilated, meretriciously coloured fragments with the aid of a monocular microscope. Every ophthalmic surgeon is deeply indebted to the pioneers of morbid histology, whether he knows it or not, but recognition of this debt should not prevent us from wondering why some of the experts in that branch of medical science should have seen fit to discourage the inspection

of living eyes under relatively slight magnification, with the aid of a binocular instrument furnishing an erect image.

3—Discrimination in slit-lamp microscopy

In order to avoid some of the pitfalls which beset the path of a beginner, the student of slit-lamp microscopy should constantly bear in mind two sources of fallacy. First is the mistake of interpreting harmless phenomena as pathological. Secondly the signs that may be manifested in a number of different conditions have been described as pathognomonic of one disease.

One good example of the first mistake was supplied by slit-lamp novices who solemnly diagnosed ariboflavinosis in hundreds of people who merely exhibited the normal vascular loops at the limbus. Another instance—whose consequences would have been more serious if the patient had accepted the original advice—was furnished by the surgeon who advocated excision of an eye alleged to be suffering from melanotic sarcoma of the iris. In that particular case the real condition was senile atrophy of the mesodermal stroma, whereby the pigment layer was left exposed over a sector of the iris. Other obvious examples are *slight* aqueous flare, and peripheral bedewing of the corneal epithelium. Both of these physiological phenomena have undergone sinister interpretations in the mind of the tyro.

Unfortunately there is no sovereign recipe to prevent such mistakes, but the slit-lamp observer is more likely to keep a sense of proportion if he resolves to regard the instrument not as a means of escape from the simpler methods of examination, nor yet as a slot-machine designed for snap-diagnosis, but rather as an accessory weapon, which can be exploited in certain cases only—and not even then, except in co-operation with the older methods of attack. In the first place, therefore, let the microscopist be familiar with the normal anatomy of the eye, and especially of its anterior segment. Knowledge derived from naked-eye study of anatomical specimens and scrutiny of histological slides must be correlated with the facts of physiology and with the results of observation upon the living-eye with and without the aid of lower magnification. The binocular or monocular loupe, or both, should always be exploited before we resort to slit-lamp inspection, and it is essential to examine hundreds of eyes in order to recognise the range of difference within normal limits, as well as the harmless congenital defects and atrophic manifestations which have so often been misinterpreted as danger-signals.

With regard to the mistake of imagining non-specific signs to be pathognomonic of one particular disease, many instances are enshrined in the literature. Conjunctival varices have been

wrongly accepted as conclusive evidence of old injury by mustard-gas. Syphilis has been held responsible for patches of iris atrophy among people free from venereal disease. Many of the generalisations confidently propounded by early workers in this field have been disproved by the growth of knowledge, and it would appear that the best way to guard against false assumptions of pathognomonicity is to acquire wide clinical experience—including *pooled* experience, so that obscure and difficult cases can be illuminated by free discussion.

4—Evolution of the apparatus

Let us now consider the main landmarks that mark the advance of technique in slit-lamp microscopy. It is nearly fifty years since Czapski succeeded in obtaining erect images by the incorporation of prisms in a binocular microscope. Further improvements in this instrument were designed by Zeiss, but its utility could not fully be exploited until a method was devised for concentrating light upon the object under scrutiny.

This problem of adequate illumination was simplified by the slit-lamp which Gullstrand demonstrated at the 1911 International Congress of Ophthalmology. Light from a homogeneous Nernst filament was focused by a system of lenses upon a slit, so as to constitute a secondary source of light, which could in its turn be concentrated upon the structure under examination by means of a condensing-lens balanced in the observer's hand. So long as the remainder of the room was kept moderately dark, Gullstrand's apparatus enabled any part of the anterior segment of the globe to be displayed in striking contrast with the unlit neighbouring tissues.

Five years later the patient's comfort and the convenience of the observer were promoted by Henker's device, whereby the slit-lamp and the illuminating lens were both mounted upon the same articulated metal arm. Thus he secured the advantages of steadiness and mobility, making it possible to survey details in more leisurely fashion.

Gullstrand found himself handicapped, at the close of the first world war, by inability to obtain the Nernst lamp. The Nitra lamp, which he adopted as a substitute, consisted of a spiral filament of tungsten, so that the light focused in the slit was no longer homogeneous. It consisted of a bright image of the filament, and the same spiral source of confusion was evident at the focal portion of the beam passed onwards by the illuminating lens. Nevertheless Gullstrand learned to ignore this image of the filament when he wanted to use the focal part of the beam. Moreover he began to exploit the pre-focal and post-focal portions, in which the light was homogeneous.

The next advance was due to Vogt, whose inventiveness was spurred by his dissatisfaction with Gullstrand's method of illuminating the eye. By moving the lamp forward, he contrived that the slit became full of homogeneous light. Homogeneous also became the focal portion of the beam, when the illuminating-lens exerted its focusing power upon this secondary source of light. One result was a more-than-fifty per cent. increase in the intensity of illumination, but another and more important advantage accrued. The method of optical section was rendered possible.

Under Gullstrand's system of illumination the spiral image only filled a portion of the fully-extended slit, so that the light was little influenced when the aperture underwent moderate contraction. Further narrowing soon reduced the efficiency of the illumination without offering any compensatory increase in the distinctness of structures under observation. If, on the other hand, the homogeneous strip of light which fills the slit under Vogt's system of illumination is constricted, it not only retains its brilliance, but also permits the appreciation of details difficult to discern under the brilliance of the wider beam. Thus certain architectural features of the lens are thrown into relief, and accurate judgments concerning the depth of corneal lesions facilitated.

One minor supplementary device consisted of a blackened tube between the slit and the illuminating-lens, designed to trap scattered light which else would dazzle the patient and confuse the observer. Another useful aid was obtained by transmitting the light through a small circular hole instead of the slit. The resulting conical beam shows up stray particles floating in the aqueous, or enables us to appreciate abnormal degrees of opalescence in that medium.

Perhaps the most important step of recent years has been the harnessing of slit-lamp methods to gonioscopy. It will be remembered that Trantas tried to explore the secrets of the anterior chamber with the aid of his ophthalmoscope nearly fifty years ago, at the time when Czapski was achieving erect images with his binocular microscope. Then Salzmann carried the work onwards with the aid of a contact glass, making numerous discoveries in spite of his primitive apparatus. Koeppe, Troncoso and others afterwards began to use various types of monocular microscope in conjunction with a contact glass. Several observers in the 1920's made attempts to enlist the aid of the binocular corneal microscope, but no simple and satisfactory technique was evolved until the problem was attacked by Goldmann.

In 1938 Goldmann devised an adjustable contact glass providing a ninefold magnification, and fitted with a mirror in which could be scrutinised an image of the anterior chamber lit by the slit-

lamp. This method enabled the patient to be examined sitting at the slit-lamp in the same way as for ordinary microscopy of the eye. Under the older systems of gonioscopy the patient had to be lying down, and the technique was relatively cumbersome; but Goldmann made it possible for examinations to be swiftly undertaken in the course of the out-patient clinic, and without any need of any additional equipment besides the adjustable contact-glass. He soon found that many gonioscopic problems were simplified by varying the width of the slit during examination of the chamber-angle. His next refinement was to incorporate a special camera in the apparatus.

5—Advantages to be gained from slit-lamp microscopy

When it is used with discrimination, the slit-lamp can supply valuable help in the following aspects of ophthalmology :

(1) *Diagnosis*. There are certain forms of disease whose earliest stages cannot be detected without recourse to the slit-lamp. Fuchs' so-called epithelial dystrophy furnishes a good example, because the first signs of this malady implicate the endothelium, whose mosaic design cannot be seen with a loupe. It can only be appreciated by slit-lamp examination in the zone of specular reflection. The slit-lamp also permits absolute certainty concerning certain features which cannot be authoritatively established under smaller magnification. We can, for instance, answer the question whether a corneal scar has penetrated the whole thickness of that membrane. Admittedly the correct answer is in many cases obtainable by means of a loupe and focal illumination, but there is a certain proportion of cases in which the issue can only be decided with the aid of the slit-lamp.

(2) *Prognosis* must, of course, be intimately linked with diagnosis, because obviously we cannot offer a reasonable forecast unless we recognise the nature of a given lesion. Careful study of the differential morphology of lenticular opacities will enable us in a large proportion of instances to indicate whether an opacity is stationary or progressive. In the case of a progressive opacity, it will often be possible to say whether the advance is likely to be slow or rapid. Similarly in corneal lesions a careful survey of the depth, situation, size and shape of the opacities, together with the presence and disposition of adventitious vessels and the state of the fellow-eye, will often enable us to predict the likely outcome, so long as these phenomena are studied in the light of previous clinical experience.

(3) *Treatment*. Unfortunately the cases in which the slit-lamp is likely to be most useful in establishing an early diagnosis are only too often examples of incurable conditions, such as corneal

dystrophy of unknown origin. Therefore slit-lamp microscopy cannot always give a positive lead in the matter of treatment. It can, however, supply warnings against unnecessary or harmful remedies, which have so often been applied by reason of mistaken diagnosis. Further the effects of treatment stand a greater chance of being accurately assessed, especially in cases of iridocyclitis, because of the detail in which the anterior segment of the eye can be viewed.

(4) *Academic research.* Although this aspect is mentioned low down on the list, because the present lecture is mainly intended for clinicians, yet it must be emphasised that no sharp distinction separates academic from other kinds of slit-lamp microscopy. The recognition of embryological vestiges and aberrations of development concerns—or should concern—the practising ophthalmologist as closely as it does the academician.

6—Benign forms of pre-senile cataract

Insults to the well-being of the lens, whether they arise from sudden violence, from malnutrition, toxic substances or the slow deterioration of old age, produce one common result—impaired transparency. When opacity has spread to involve the whole structure, we speak of *total* or *mature* cataract, and it is not always possible for the observer to deduce what was the main initial provocation; but unfortunately we find a different set of conditions in cases of *partial* cataract. Certain types of opacity display characteristic morphological grouping, or exhibit a predisposition for special layers of the lens fibres. Some follow a typical series of steps in their progress towards maturity. Others remain stationary. It is in these cases of partial cataract that we can gain so much from the cumulative experience of older clinicians, because there is no self-evident feature, such as would permit sharp, radical distinction between the benign dot and the flake which heralds total cataract. Differentiation is largely empirical.

Some forms of partial cataract are intrinsically beautiful when we see them with the aid of the microscope under the slit-lamp's concentrated beam. Embryologists gain additional delight from the apt way in which these opacities may illustrate various stages in development. From the standpoint of clinical practice, however, there are two main facts that must be borne in mind. In the first place, lack of knowledge concerning the differentiation of partial cataracts has often been responsible for the delivery of a needlessly bad prognosis. Secondly, such ignorance has led to erroneous opinions concerning the causation of certain cataracts. Thus it is clearly desirable, for medico-legal as well as purely medical reasons, that ophthalmologists should strive to distinguish between

the various types of cataract. Admittedly we cannot attain absolute certainty in every instance, but certain we can be in a large proportion of cases, and, where some doubt exists, we can at any rate offer opinions in an ascending scale of probability, if only we learn how to detect the relevant details.

(1) *Anterior capsular cataract* in its pure form is a rarity, and most of the cataracts so-called implicate some superficial lens fibres as well as the capsule. Pure capsular opacities are of minute size, and exhibit around their circumference an unshagreened halo when they are examined in the zone of specular reflection.

(2) *Anterior capsulo-lenticular cataract* is often situated at the axis of the lens, in which case it is described as an *anterior polar cataract*. Strands of persistent pupillary membrane are often found anchored to the front of these opacities, and another commonly associated feature is a bunch of epicapsular stars, which can easily be identified by their slender branching processes.

(3) *Anterior axial embryonic cataract* is the name given to any irregular collection of opacities situated near the anterior Y-shaped suture, which marks the front of the foetal nucleus.

(4) If the opaque dots are disposed in such a way as to map-out the anterior or posterior Y-shaped sutures, or both, we speak of *suture cataract*.

(5) *Floriform cataract* is a less common condition, in which the limbs of the anterior Y may show an efflorescence of petals.

(6) *Dust-like cataract in concentric layers* is the somewhat cumbersome title given to dots scattered at different levels of the lens.

(7) When dots of opacity are confined exclusively or chiefly to the foetal nucleus, we speak of *cataracta centralis pulverulenta*.

(8) *Coronary cataract* is present in at least 20 per cent. of young adults, but remains undetected in a large proportion of cases, because the opacities are chiefly situated towards the periphery of the lens, which is not exposed to view until the pupil is dilated. The most characteristic opacity is club-shaped, and each club usually displays an expanded end pointing toward the axis of the lens. Associated opacities, chiefly in the form of round dots and biconcave discs are always present, and may be coloured green, blue or yellow, as well as white. Cholesterin crystals are another common finding.

The subject of coronary cataract may, of course, come to exhibit superimposed signs of senile cataract by the time he reaches an age that renders him liable to the latter condition, but, so far as the coronary opacities are concerned, he should not be exposed to a discouraging prognosis. Many authentic cases are on record in which excellent vision was enjoyed more than twenty years after

this form of cataract had been originally noted. It seems abundantly clear that this type of opacity advances so slowly that it does not constitute an appreciable menace to sight. The other above-mentioned varieties are even more benign, being practically stationary. None of them is likely to entail any appreciable impairment of vision, except those instances of anterior capsulo-cuticular cataract which encroach sufficiently upon the axis to obstruct the victim's view.

7—Metallic impregnation

Characteristic changes arise in certain structures of the eye as a result of impregnation with metals, and it is interesting to note that these substances may gain access to the globe in a number of different ways. Intra-ocular metallic foreign bodies are one obvious source, but changes may also occur from the implantation of metallic dust scattered by certain industrial processes. Another possible origin is the therapeutic use of metallic salts, either in the form of local applications, or systemically administered. The metals now to be considered are iron, copper, gold, mercury and silver.

(1) *Iron* is responsible for the halo of rust which so commonly surrounds metallic fragments embedded in the cornea, but this form of staining disappears soon after removal of the foreign body. If, however, a steel or iron particle is retained for many months inside the globe, characteristic pigmentary changes develop. The corneal substance shows an orange or yellow tint, more marked at the periphery than at the axis. Rustiness of the iris offers a striking contrast with the colour of the unaffected fellow-eye in cases of siderosis. Generalised atrophy of the lens is betrayed by blurring or effacement of the zones of discontinuity, and the anterior epithelial cells, especially at the equatorial region, are pricked out in a cluster of brownish dots. Moreover the whole lens is tinged yellow, with a noticeable deepening of tint at the anterior band. As a rule the vitreous displays broken bundles peppered with reddish granules.

(2) The changes provoked by *copper* are most clearly evident when the intra-ocular foreign body is very small. Larger fragments are apt to incite a destructive reaction before the characteristic changes have had time to unfold. The cornea exhibits a vivid blue coloration of Descemet's membrane, most intense in the neighbourhood of the limbus, and fading towards the axis. Often it will be found that only a portion of the thickness of the membrane is implicated. Some observers have reported a reddish-brown stain in the same situation, but all the instances seen by the writer were blue.

In the lens we find sunflower cataract, which consists of a thin layer of opacity situated immediately behind the anterior capsule, and characterised by an axial disc from which petals jut outwards in the manner suggested by its name. The usual colour of a copper cataract is greyish-blue, and its most striking feature is a brilliant polychromatic lustre in the zone of specular reflection. Greenish vitreous fragments are sometimes visible. Cases of chalcosis from copper medication have been described by several authors, and Butler (1929) reported corneal changes in a polisher of copper, although, he located the blue coloration in the deeper layers of the substantia propria, not Descemet's membrane.

(3) *Gold* salts employed in the treatment of tuberculosis were held responsible for a peculiar pigmentation of the cornea in a case described by Bonnet and his colleagues (1936, 1937, 1939). On the anterior surface of Descemet's membrane they found minute grains of gilt associated with a brilliant lustre.

(4) Lenticular changes from absorption of *mercury* were reported by Atkinson (1943), who surveyed 70 patients occupationally exposed to mercury vapour. Slit-lamp microscopy showed at the level of the anterior capsule a coloured reflex, with its maximum intensity in the pupillary area. Among different subjects the tint varied from light brownish-grey to deep rose-brown, and in some instances the reflex was interrupted by round holes or irregular cracks reminiscent of defects in the silvering of a mirror. Atkinson came to the conclusion that ocular hydrargyrosis must be an early manifestation of mercurialism, because a number of his cases were symptom-free, and manifested no other signs of impregnation with mercury.

(5) *Silver* nitrate and the various organic silver preparations, *e.g.*, argyrol and protargol, impart a slate-grey stain to the conjunctiva after prolonged instillation. Associated corneal changes, so far as the writer's experience goes, consist of (a) grey or grey-green discoloration of the peripheral zone of Descemet's membrane, and (b) broken reticulation in the deeper layers of the corneal substance. Some authors have described a golden coloration of Descemet's membrane. Others have mentioned a blue change in that layer. It may well be that the same metal in different chemical combinations may convey various tints to one particular tissue. Another possibility is that a patient may unwittingly mislead the surgeon, and omit to mention that he had been treated with some other preparation, *e.g.*, copper-stick as well as silver-containing drops.

Corneal argyrosis may also result from endogenous medication, as recorded by Ascher (1924), in a woman whose anti-syphilitic treatment had consisted of silver-salvarsan injections. A number

of different observers have also mentioned peripheral coloration of Descemet's membrane among silver-foundry workers. The conjunctiva seems to remain unstained, except in those who have been in the habit of rubbing their eyes with fingers contaminated with silver. Larsen (1927) reported a greenish punctate deposit immediately behind the anterior capsule of the lens, as well as greenish-gold lustre of Descemet's membrane. Bischler's (1942) case of occupational argyrosis in a silver-engraver showed more pronounced changes in one eye than in the other, but the deepest pigmentation was consistently peripheral.

8—Other pigmentary changes

The expression "pigmentary change" is often taken to mean change consisting of a black or brown coloration of the structures concerned, but it is proposed now to extend the signification of "pigment" so as to embrace all conspicuous changes in colour. Although this section is primarily concerned with non-metallic pigmentation, it may as well be admitted at the outset that iron-containing products derived from the breakdown of haemoglobin may be responsible for some of the conditions presently to be described.

Before we proceed to consider instances of definite pigmentation, it is worth while to emphasise that some of the signs evident on slit-lamp microscopy must be accepted with a pinch of salt. In other words the optical conditions are in many respects illusory. Thus, for instance, oedematous corneal epithelium viewed under retro-illumination may appear brown, simply because the reflecting screen in that particular case happens to be a brown iris. Furthermore we may find that certain lenticular opacities take on a different tint, according to whether they are viewed under direct or indirect illumination. Which is the real colour? Of course all colour is real, in the sense that it represents a subjective experience. On the other hand, common-sense insists on discriminating between sensations artificially isolated in the laboratory, and the evocative experiences of ordinary life.

Superficial pigmentary lines, whose exact composition has not yet been demonstrated, are exemplified by *Hudson's line*, which is not uncommonly found in the lower half of a hitherto healthy cornea. Similar markings may be found in association with any longstanding opacity, whether the latter was a consequence of trauma or of inflammation. A broken ring of superficial pigment is also characteristic of conical cornea.

Scattered pigment granules on the back of the cornea, or entangled in the iris stroma, or clinging to the anterior capsule of the lens are common features of an elderly eye, because the

pigment layer of the iris constantly disintegrates as time goes on. Occasionally such granules are concentrated on the posterior surface of the corneal axis to form a Krukenberg's spindle, especially in myopes. Coloured crystals are sometimes found in connection with old corneal scars. Superficial blood-staining may arise from rupture of an adventitious corneal vessel, but the expression "blood-staining of the cornea" is usually reserved for those cases where hyphaema in association with raised intra-ocular pressure leads to prolonged changes in the substantia propria. In reality the successive shades of brown and green developing in such corneae are not due to blood itself, but rather to an invasion of the substance by haemoglobin derivatives. These products pass through Descemet's membrane from red corpuscles undergoing disintegration in the anterior chamber.

The Kayser-Fleischer ring consists of closely-set golden granules occupying a part of the thickness of Descemet's membrane at the corneal periphery. It is a constant feature of Wilson's disease, or hepato-lenticular sclerosis.

Anomalies and irregularities of iris pigmentation are commonly found on routine examination. Clumps of pigment cells in the stroma constitute benign melanomata, and can be found in a majority of the subjects examined. Total congenital heterochromia is rare, but a sector of differently coloured stroma is by no means uncommon. Deepened pigmentation of the stroma is usual in the neighbourhood of congenital ectropion of the uvea. Hyperpigmentation and verrucosity of the stroma is a self-explanatory term. In heterochromic cyclitis the affected iris acquires a washed-out blue colour, and it is interesting to note that the keratic precipitates laid down in the course of this disease usually remain grey, in contrast with the brownish hue acquired by old precipitates deposited during other kinds of iridocyclitis.

Pigmented deposits upon the anterior capsule of the lens include congenital epicapsular stars, scattered granules from disintegration of the posterior layer of the iris, and larger clumps of iris pigment left sticking to the capsule after mydriatics have pulled an inflamed iris away from the axial region. Vossius' ring consists of pigment granules imprinted upon the capsule by sudden backward thrust of the iris, the result of aqueous compression from the impact of a blow upon the eye. In most instances the ring undergoes spontaneous absorption within a few weeks. Senile exfoliation of the zonular lamella may produce pale-blue débris in the peripheral region of the anterior capsule.

The senile lens usually exhibits a pronounced golden glow in the zone of specular reflection near the level of the posterior capsule. Not uncommonly we find a faint play of colours,

especially in connection with the cupuliform variety of senile cataract, but this phenomenon should not be confused with the true polychromatic lustre of a complicated cataract, because the latter exhibits comparatively large and vivid splashes of colour, alternating with each other in a manner reminiscent of differently coloured countries on a map. Coloured crystals are a frequent finding in the type of cataract associated with Mongolian idiocy, cretinism, or dystrophia myotonica. We have already noted that suture-cataract may be coloured blue, yellow or green, and the same applies to dilacerated opacities, and to the club-shaped and other elements of a coronary cataract.

Brownish granules entangled in the cobweb-like framework of the vitreous are a normal feature, as may be ascertained by any one who looks at vitreous protruding into the anterior chamber after the operation of capsulotomy for after-cataract. In old age the broken vitreous bundles may be profusely sprinkled with granules resembling brick-dust. The non-crystalline opacities that constitute synchysis scintillans are usually white, but coloured cholesterol crystals are occasionally found in cases of injury, or as a consequence of non-traumatic haemorrhage and exudates, retinal detachment or intra-ocular neoplasm. In many instances of Eales' disease we find nothing but whitish curds in the vitreous, even though preliminary focal illumination has led us to expect otherwise, by reason of a pronounced red glow coming back through the darkened pupil. There may, however, be clumps of red blood corpuscles adhering to the posterior capsule of the lens.

General conclusions

When the teaching of slit-lamp microscopy was beginning to spread through the world of ophthalmology in the 1920's, many of its devotees maintained that no further problems were likely to be solved by the scrutiny of microscopic sections. One result of this attitude was to multiply mistakes which might have been avoided if the information gained from slit-lamp microscopy had been correlated with facts assembled by generations of morbid anatomists. Now that another quarter-of-a-century has elapsed, many an eager surgeon would like to relegate slit-lamps as well as monocular microscopes to the rubbish-heap. The main field of description has been so thoroughly mapped-out, especially by Vogt in his brilliantly-illustrated—and unobtainable—encyclopaedia, that the chances of a new clinical entity being discovered by the average ophthalmic surgeon are indeed small. Meanwhile the process of acquiring technical facility with the slit-lamp does demand a certain amount of intelligent concentration, and offers no spectacular rewards.

It is therefore inevitable that many of the younger ophthalmologists are turning to radiology and biochemistry in the hope of finding an answer for their unsettled problems. Wonder-drugs and the magic of vitamins, haematological data of ever-increasing complication, and elaborate X-ray photography, are only a few of the present-day requirements for treating and investigating the bewildered patient. Of course all these advances are desirable, in so far as they are applied with discrimination and with due regard to the facts established by older methods. What must be stressed, however, is the vital necessity of careful routine examination by instruments capable of being handled without summoning the specialists from half-a-dozen other departments. Admittedly we must try to maintain close relations with other kinds of specialists, and, more important still, with the family practitioner and the general physician, but it is quite certain that such contact will be far more fruitful if we do our share of gathering the relevant facts.

In conclusion it is suggested that the slit-lamp has been abundantly proved to be a valuable weapon for the practising ophthalmologist, especially in the realm of diagnosis. At the present time, however, the accumulated facts of slit-lamp microscopy are in danger of being neglected, with consequent loss of clinical accuracy. The table upon which the instrument rests is normally flanked by two stools—one for the patient and one for the observer. Is it not perhaps true, metaphorically as well as literally, that the slit-lamp has fallen between two stools? On the one hand it has suffered the sidelong glances of many an older clinician, whose apprentice-days were completed before the slit-lamp era. On the other hand is the rising generation eager to sharpen a new set of weapons. All success to them—and to their patients!

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This paper contains numerous references to the various forms of metallic impregnation of the cornea.

POST-OPERATIVE INTRA-OCULAR INFECTION CONTROLLED BY PENICILLIN *

BY

F. S. LAVERY

DUBLIN

AS cases which develop intra-ocular infection following upon cataract extraction almost invariably do badly I am reporting the following case which, as a result of using penicillin, has proved an exception to the rule.

J. D., aged 65 years, had a combined extra-capsular extraction done on his right eye on September 27, 1947. Although there was some cortical remains no wash-out was employed. The appearance of the eye was satisfactory until four days later when the cornea became hazy and the iris presented a muddy appearance. He was put on sulphadiazine tablets, four as an initial dose, and two four-hourly as maintenance dose. Penicillin drops (5000 units per c.c.) were instilled hourly. Next day the condition of the eye showed a marked deterioration. There was pus in the anterior chamber and the wound edges were infected. 50,000 units of penicillin were injected sub-conjunctivally, and 500,000 intra-muscularly every four hours. The sub-conjunctival injections were repeated on the two days following, and the intra-muscular injections were continued for four days. On the third day after the first sub-conjunctival injection of penicillin the condition of the eye showed a marked improvement. The wound edges were now healthy and the pus had been absorbed from the anterior chamber. He was discharged from hospital four weeks from the date of operation. The eye was quiet. The projection of light was accurate, and it is expected that capsulotomy will give him good vision in the eye. When the patient was re-admitted in December, 1947, it was found that a capsulotomy was not required, the corrected vision in the eye being 6/6.

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