FIG. 5

Mr. D. A. Heterochromic cyclitis right eye. B. Normal left eye of same patient. The diagram shows atrophy of the superficial layer of the iris, and none of the retinal pigmented layer. Mrs. C., age 56. Heterochromic cyclitis. Fig. C shows the iris examined by direct illumination. The sphincter iridis is evident and there is obvious atrophy of the superficial layers. Fig. D shows the same iris under retro-illumination showing numerous large defects in the retinal layer.

FIG. 9.

A. H., age 33. $V = \angle 6/60$ $V < 6/60$. Subluxation left lens. Partial aniridia, the greater part of the anterior iris layers absent. Mere tags of suspensory ligament. The second diagram shows membranes in the vitreous on which are specks of pigment. All seen with loupe and point o' light.

FIG. 14.

W. F., age 42. *Cataracta coerulea punctata*, abnormal type. A case of legal interest. The eye was said to have been punctured by a copper wire. The central cataract, greenish in colour, was ascribed to the puncture. Its position, on the surface of the adult nucleus, negated this theory. A few blue deposits were visible deeper in the lens, and the other eye showed deposits of cataracta coerulea, but less regular and small in amount. The corneal scar was superficial.

FIG. 23.

Pigment " stars " seen with loupe on anterior capsule.

FIG. 24.

The same under a magnification of 35 diameters.

FIG. 38.

Mr. S., age 30. Followed up for 9 years. Progressive.

FIG. 39.

Cataracta coerulea.

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COMMUNICATIONS

THE DOYNE MEMORIAL LECTURE, 1924*

BY

T. HARRISON BUTLER

BIRMINGHAM

*Focal Illumination of the Eye with special reference to the clinical
use of Gullstrand's Slit-Lamp.*

[After expressing his thanks for the honour conferred upon him the lecturer proceeded:]

I render homage to Robert Doyme our founder and first Master. The Oxford Ophthalmological Congress is a lasting tribute to the foresight and breadth of mind of him who gave it birth, and it is no exaggeration to say that by its conception Doyme kindled a torch which not only sheds its rays within its immediate range but diffuses its radiance to remote corners of the earth. I would that he were here with us to-day for I know that he with his unrivalled powers of accurate observation would have taken full advantage of the instruments that we are about to discuss.

The primeval savage who in the far distant stone age held a splinter of blazing pine to his comrade's eye to search for a fragment of flint was the parent of *oblique illumination*, a method which, starting in such simple wise, culminates to-day in that triumph of optical art, Gullstrand's slit-lamp.

* Read at the Meeting of the Oxford Ophthalmological Congress.

History does not relate the name of the sage who first used a lens to concentrate the light of a candle upon an eye. Whoever he may have been, we can credit him with the invention of *focal illumination*.

By focal illumination I understand the power to throw a beam of light into the eye and to concentrate it upon any point in a punctal or linear focus. This is the antithesis of illumination with a diffuse light.

The use of a candle or oil lamp preserved some approach to a punctal focus, and it is probable that the many discoveries made in the early part of the 19th century in respect of the pathological and normal conditions of the anterior segment of the eye are partly due to the fact that our forefathers quite innocently made some use of the focal method. The introduction of the Argand burner and of the incandescent electric lamp tended to a more diffuse light and retarded progress.

The ability to concentrate upon the eye a beam of light whether in pencil or ribbon form has many advantages over the use of a diffuse light from a lateral source. Many of us, long before we realized the full value of the focal beam, instinctively found that we obtained a clearer view of the cornea and iris if we removed our lamp to a distance. Couper in the 19th century taught his pupils not to place the lamp close to the lens; he was striving after focal illumination.

The superiority of focal illumination is due to several factors which we may analyze with benefit, for a clear conception of the merits of a punctal focus will enable us the better to appreciate the possibilities of the slit-lamp, and to use it to the best advantage. In the first place a focused light, however powerful, is not nearly so dazzling as diffuse illumination. It is possible to examine a patient with an inflamed photophobic eye with the narrow ribbon of the slit-lamp who could not tolerate diffuse light of an intensity sufficient to reveal necessary detail.

A pupil which contracts strongly to diffuse light will remain sufficiently dilated for us to examine the lens with the slit-lamp beam. So tolerant is the pupil to focused light that I have made by far the majority of my slit-lamp examinations with an undilated pupil, and such have included the vitreous.

Few of my patients, aged and young, have raised objection, or manifested discomfort, when examined by this apparatus, so long as a definite time limit was not exceeded, a limit which varies greatly with different individuals.

A good example of the dazzle caused by diffused light is known to most of us. If we sit round the fire in the twilight till we have become dark-adapted, and then proceed to light a pipe, the stimulation caused by the intermittent flare of the match is almost

unbearable if the eyes be closed, but quite tolerable with them open. Another example is the well-known intolerance of bright light exhibited by patients with complete cataract. Secondly a focused beam of light has greatly enhanced penetrating power as compared with diffuse illumination. Quite recently I examined a patient with old-standing interstitial keratitis and semi-opaque corneae. Using for oblique illumination a so-called focus-bulb I could see nothing beyond the cornea. I then switched on a 100 candle-power gas-filled lamp in the ceiling of my dark-room, and concentrated the light with an ordinary lens upon the eyes. I was at once able to see that in one eye the pupil was occluded and very small, that the other pupil was free from exudate, and that the posterior layer of the iris round the pupil margin was atrophic.

The high penetration of the focal beam enables us to examine the whole of the lens, the anterior third of the vitreous, and, with special arrangements, the entire vitreous and the retina.

A further advantage of the focused pencil lies in the fact that we can use five methods of illumination. By advancing our lens and throwing the beam out of focus we obtain ordinary *diffuse oblique illumination*. We can focus upon the object under observation and see it in reflected light, *direct illumination*. We can throw the focus beyond our object and view it by light reflected from behind, by what Graves very aptly calls *retro-illumination*, examination by transmitted light. Thus we can observe the cornea in light reflected from the iris, a property we minimize if we dilate the pupil. We can see the iris in lens light, and the anterior part of the lens can be illuminated by light from the posterior capsule. The ability to examine the transparent parts of the eye by transmitted light, and by an alternation of reflected and transmitted light is of great value. Fine changes and minute objects invisible by direct illumination are revealed by retro-illumination, and their more intimate structure laid bare by the alternating method. Retro-illumination is especially useful for the differentiation of deposits upon the back of the cornea, for detecting oedema both of the epithelium and the endothelium, and for examining the actual circulation of the blood in corneal and limbal vessels. Its value in the examination of the iris will be mentioned later.

Focal illumination allows us to utilize the method of examination in *specular or mirror light*, demonstrating the endothelial cells of the cornea, the lens shagreen with its epithelial cells, the lens figures and sutures, and the posterior lens shagreen. The fifth method, which we may call *sclerotic scatter*, will be described later in this paper.

Finally, focal illumination allows us to make an accurate *estimation of the position* of an object within the eye both as regards depth and lateral situation. Accurate localization is

possible only with the slit-lamp, but in a lesser degree can be attained by simpler methods of focal illumination.

Localization. — The stereoscopic image furnished by the binocular microscope enables us to localize roughly by mere inspection. The micrometer eye-piece affords a ready means of localization upon a vertical bilateral plane. Thus we can measure by the micrometer the distance between punctate opacities in the cornea, or the lateral extent of larger deposits. Measurements can be made of the relative position of objects along the optical section both in the cornea and lens. This reading can be reduced to an actual depth measurement by measuring the angle between the axes of the lamp and the microscope, and solving the triangle by the usual tables. A correction must be made for refraction. Vogt, using this method, has made accurate determination of the thickness of the various lamellae of the lens, and has obtained useful information regarding its growth.

The focusing screw of the microscope is fitted with Ulbrich's micrometer drum, a slip-ring which records in tenths of a millimetre the travel of the tube along the slide. This, corrected for refraction, gives the distance between any two objects successively focused.

These methods are somewhat academical and take up time, but fortunately we possess another which gives a relative localization sufficiently accurate for all clinical purposes. If the lamp be moved in such wise that the beam of light crosses the object we wish to localize we can at once see what part of the beam first lights up the object. Thus if in the cornea the object is first lighted by the posterior edge of the prism of light formed by the beam in the cornea it is on the endothelium. Using this method we can at once say that an object is on the epithelial surface, at different positions within the stroma, or on the endothelial surface. Under a magnification of twenty-three the projected aspect of the section of the cornea is about three-quarters of a centimetre across and affords sufficient space for considerable accuracy in localization. A lucid account of this method will be found in the March number of THE BRITISH JOURNAL OF OPHTHALMOLOGY, 1924. (Translated from Vogt.)

We can attain focal illumination either by the simplest means at the command of every surgeon, or by the use of more or less complicated apparatus.

For various and obvious reasons the slit-lamp will not be our sole source of the focal beam. It cannot be carried about, and in many cases its high initial cost precludes its use. Fortunately many of the properties conferred by the slit-lamp can be attained in a modified but still efficient form at no great expense. It is for this reason that the subject of this lecture was not confined to the *slit-lamp* but embraces the whole aspect of *focal illumination*.

The humblest and yet very efficient source of focal illumination is the ordinary 40-watt gas-filled bulb, the so-called "half-watt" lamp. Even better is a small motor-car bulb with a thick short filament. This runs at a low voltage and needs a resistance if the current is taken from the town supply. I am now using with great satisfaction the small operating lamp made by Rayner and Keeler. I remove the lens system, and with the lamp alone I get a really good clean shaft of light. A similar lamp made by Hamblin is equally effective.

If we use the half-watt lamp it must be located at a distance of about three feet for the 40-watt and eight feet for the 100-watt. It must be so placed that the plane of the ring-shaped filament lies in the plane of a line joining the bulb to the eye. By this arrangement we eliminate the circle and project a line of light. Focused upon the cornea the filament gives a crenellated line. A similar line can be focused upon the anterior capsule and a beam of light thrown into the interior of the eye. A third focus forms a mirror upon the posterior capsule. The Rayner lamp can be fitted with a slit and then it gives a fair ribbon, but I find it more practically useful without this attachment.

It will be advantageous to describe what can be attained with these simple methods of focal illumination, as regards localization, the examination of the cornea, the anterior chamber, the iris, the lens and the vitreous.

Localization.—If we focus the light upon the cornea we shall see a second mirror upon the anterior capsule. The length of the dark interval between the two is a measure of the depth of the anterior chamber.

If we see any opacities in the lens we move the beam or shaft of light from side to side and note what portion of its length first illuminates the opacity. If the opacity, for example, is illuminated first by the mirror or light formed by the posterior capsule we have an opacity in or near that structure. An anterior capsular opacity will flash into view at the same level as the illumination on the iris. We can by this means say with certainty that the opacity is near the anterior capsule, near the posterior capsule, or within the substance of the lens. I think that in most cases this is the limit of our power. More accurate localization needs the slit-lamp.

Cornea.—We must first examine the cornea by ordinary oblique illumination. This can be done efficiently with the half-watt by pushing in the condensing lens till the light is out of focus. We get a far more effective light than with an ordinary frosted bulb. We now direct the beam into the limbus, and obtain what Graves calls *sclerotic scatter*. The light passes along the cornea by

alternate reflection from the anterior and posterior surfaces and strongly illuminates the limbus at the opposite side (see Fig. 7). The cornea itself glows with internal light, and small and tenuous opacities spring clearly into view. These can be more minutely examined by directing the focus first upon them and then upon the iris, which for this purpose should not be under the influence of a mydriatic. We thus can see opacities and foreign bodies by alternate direct and retro-illumination. Many small objects invisible by direct light are easily seen by transmitted light. The presence of fine deposits upon the endothelium, "K.P.," can be best detected by retro-illumination.

The Blood Circulation can be seen under certain favourable conditions by the light from a simple source and the ordinary loupe which magnifies about six times.* It is useful to attempt to see it, for it forms the best test of perfect application of the methods I am describing. Choose a case with vascularization of the cornea, such as a fascicular ulcer, and with a yellowish iris. Throw the light upon the iris in such wise that it is reflected back to the observing eye traversing the vessel under review. When the eye has become fully dark-adapted and the lens focus is absolutely sharp the blood column in the vessel will appear segmented in the smaller vessels. After a time it can be noted that the segments have changed their place although no actual movement has been seen. About this time we observe that the blood stream in a larger vessel has become moniliform, and then quite suddenly and for no apparent reason a rapid streaming is seen in the vessels. It is much more difficult but possible to obtain the same appearance in an ordinary limbal vessel, but it calls for the most meticulous care in adjusting the focus of light and loupe, and it is possible that it may even demand unusual visual acuity. Focus the light upon the sclera close to a conjunctival vessel choosing a long thin vein, and wait patiently till the phenomenon appears. It is probable that no one will succeed with the limbal vessels till he has a clear conception formed by observation with the slit-lamp of what he is looking for. On the other hand, in a case of pannus it may be comparatively easy. One of my house surgeons who had never seen a slit-lamp was able to see the phenomenon and accurately to describe to me what he saw. In another apparently similar case the circulation cannot be seen, but the same is true with the slit-lamp. I have even seen the circulation in daylight in a leash of vessels supplying a healed traumatic ulcer.

* This phenomenon was first seen with a loupe in 1888 by Dr. H. Friedenwald, now of Baltimore, U.S.A.. *Centralblatt für praktische Augenheilkunde*, February, 1888. Coccus in 1852 examined the limbal vessels with a system of lenses and saw the circulation.

Anterior Chamber.—Focal illumination with simple apparatus will render useful service in the anterior chamber, but in this respect it gives results far less valuable than the slit-lamp. As I have stated, when a focal beam is thrown into the eye it makes a mirror on the cornea and a second on the anterior capsule. The beam glows in the lens and is faintly relucet in the vitreous. This appearance is shown in Fig. 1, a slit-lamp picture. The

FIG. 3.

FIG. 1.

FIG. 2.

Fig. 1 shows the pencil of light from the slit-lamp traversing the anterior chamber. Fig. 2. The same pencil crossing an albuminous aqueous. Fig. 3. Particles glistening across the pencil in the anterior chamber.

aqueous is perfectly dark. In a case in which the aqueous is albuminous it renders the beam visible as in Fig. 2.

If the shaft of light passes from the corneal surface to the posterior capsule showing no change of luminosity between the two mirrors of light, then it is obvious that there is no alteration of optical quality in the media through which it passes. Either the lens touches the back of the cornea or the anterior chamber is full of vitreous, or of highly albuminous aqueous. Fig. 4 illustrates a case of this kind. The eye had sustained a severe blow causing subluxation of the lens. To the left, the iris has become infolded and the ciliary processes are visible. The lens itself is tilted backwards as on a hinge on the right side. The focal beam, in this case from a point o'light lamp, forms a mirror on the cornea and another on the posterior surface of the lens. There is no break in

the continuity or alteration in the luminosity of the shaft of light. We were able to see that the lens was pushed backwards in this situation so it was obvious that the vitreous had come forward and filled the anterior chamber. The red streaks on the periphery of the lens indicate the spots where the suspensory ligament has been torn away. The condition was equally evident when examined with a half-watt lamp. It is often of great value to know that the vitreous has entered the anterior chamber, as for example after a dissection, and in at any rate some cases the diagnosis can be made with a half-watt lamp and loupe. With the slit-lamp and corneal microscope the diagnosis is much more certain for

FIG. 4.

Traumatic dislocation of lens backwards on left side showing vitreous in the anterior chamber giving an unbroken shaft of light from the cornea to back of lens. Cyclitic membrane showing striations which appear to be thickened suspensory ligament fibres. Haemorrhages on lens possibly at site of attachment of suspensory fibres. Visible ciliary processes.

NOTE.—Lens has no bright or dark edge as it has vitreous in front of it. Lens tilted.

we can detect small localized hernias of the vitreous which, as Vogt points out, are not uncommon after operations upon the lens capsule.

Iris.—The iris consists of three layers: the posterior pigmented layer derived from the secondary optic cup, and the two superficial mesodermic layers. These latter may be fused together, but in most cases the superficial leaf ceases at a spot about one-third of the distance from the periphery to the pupil margin. Here we find a well-defined thickened line, the *Krause* of the Germans. As we have no convenient term for this important line I propose to call it the "frill." The *circulus iridis minor* is found here. In general the connections between the two mesodermic layers are very loose and the outer layer takes little part in the movements of the iris. As a result when the pupil is dilated the frill lies close to the pupil margin. The space between the two is often very

evident when we examine it with the slit-lamp. It is called the *cleft of Fuchs*. The outer leaf may be absent over large areas and often has large holes through which we can see the deeper and darker layers. A case has been recorded in which it became completely detached and floated free in the anterior chamber.

In cases of heterochromic cyclitis the outer leaf becomes atrophic, in others the pigment layer is atrophied. Fig. 5 (see coloured plate) shows an early case of this disease. The superficial leaf of the iris is atrophic, but there is no evidence of any change in the retinal layer. In *Figs. 5c and 5d, we have a case in which the

FIG. 6.

Atrophy of iris and pupil ruff. Focal illumination with half-watt lamp and ordinary condenser. Case of chronic iritis.

pigment layer is full of holes and tears. The superficial layer is also atrophic. It would appear that the superficial layer suffers first, but I have not examined a sufficient number of cases to be sure on this point.

We have no name for the pupil margin nor for the ruff of uveal tissue which surrounds it. I shall call the prominences round it the "*mamelons*," using the French word. The *mamelons* are larger in the upper half of the pupil, and we may find a double row. They are more developed in the horse than in man.

There is a form of quiet iritis which causes a slow atrophy of the uveal layer unaccompanied by any visible alterations in the anterior layers. By direct illumination the iris appears to be

* 5c seen by reflected light. 5d seen by retro-illumination.

normal. In the senile iris a similar change is very common, and it is especially prone to attack the pupil margin. If we throw the focal beam into the lens and examine the iris in lens-light these changes become obvious, the light shines through the thin pigment layer. In some cases especially where there are tears in the posterior layer we get the appearance of holes in the iris through which we see a red light. Perforations invisible by direct reflected light are plainly seen by retro-illumination. In Fig. 6 we have an iris in which there has been a localized iritis. There is pigment upon the anterior capsule. The light from a point o'light lamp has been focused into the lens, and we see that the iris margin is atrophic and that there are transparent areas in

FIG. 7.

Mr. H., age 45. Blow on eye six weeks ago. Ruptures in peripheral portion of iris. *Same on both sides.* Lighted up by "sclerotic scatter." Illuminates lens vividly by retro-illumination.

the region of the sphincter through which the light shines. The *mamelons* have disappeared from the atrophic region. Fig. 7 is a very interesting case. He had received a severe blow upon the eye. I had examined him some time before I became interested in focal illumination and had entirely missed the fact that the iris was severely injured at the periphery. When a focal beam was thrown into the lens it was obvious that there was a series of radial slits on each side at the periphery. These showed a red reflex when light was thrown upon the limbus, in fact they were more obvious by sclerotic scatter than by lens-light. I am quite unable to explain why this should be the case, and Mr. Graves is unable to help me in this respect. See also Fig. 5D. It is possible that the peripheral slits may account for the oval pupil.

Lens.—In cases of subluxation of the lens, and where there are colobomata, either congenital or from operation, we can see the

suspensory ligament with the loupe and half-watt lamp, and can decide whether it is perfect, imperfect or wanting. This information is of supreme importance because a subluxated lens with a perfect ligament is not likely to alter its position. Fig. 8 shows a subluxated lens with a perfect ligament drawn with an ordinary focus-bulb and a loupe. It will be noted that on most of the filaments there is a nodule of brown pigment. The slit-lamp picture will appear later. Fig. 9 (see coloured plate) portrays another dislocated lens seen by point o'light illumination and the loupe. Here the suspensory ligament is very rudimentary, being represented by a few tags only, and the iris is only partially developed. The vitreous membranes are clearly seen. This case was never examined with the slit-lamp.

To see the lens shagreen with the loupe it is necessary to obtain two conditions of illumination. The patient's gaze must bisect

FIG. 8.

the angle between the incident and the reflected ray, and all three lines must lie in the same plane. Beginners fail to see the shagreen because their line of sight is above or below the plane made by the incident ray and the patient's optical axis. Place a half-watt lamp well to the right of the patient, concentrate the light upon his lens with a lens and give him an object to fix straight in front, and observe from the left with the loupe, raising and lowering the head and slightly altering the position of the loupe till it receives the ray reflected from the anterior capsule. In a young subject with a dilated pupil the shagreen looks like the surface of recently cast aluminium, and is a very beautiful subject for study. In older persons the reflex is not so bright, and on occasions it gives diffraction effects, a mother-of-pearl sheen. This iridescence is said to indicate commencing cataract. I have frequently seen iridescence of the lens shagreen in normal young cases examined with loupe and focal light, but this effect is probably not seen with the slit-lamp under normal conditions. Careful focusing of the shagreen will often bring vacuoles into view which lie just under the capsule.

If while viewing the shagreen we advance the lens so as to get a more diffused light we can make out the sutures on the surface of the cortex, those that lie only slightly deeper than the capsule.

Opacities in the lens can be seen and roughly localized by the simple shaft of light, and it is possible to study cataract deep in the lens and posterior capsular cataracts (*cataracta complicata*).

The young lens does not show any lamellation when examined by simple focal methods, but in older subjects a definite nucleus can be distinguished. When the nucleus becomes sclerosed the shaft of light shows very distinct colour bands, which vary from yellow to deep brown in the case of cataracta brunescens and nigra. Under such conditions a distinct mirror can be obtained from the surface of the adult nucleus, and the relief sutures of this nucleus can often be detected here and there. Not infrequently it is

FIG. 10.

FIG. 11.

L.M., Leamington. Lamellar cataract. (1) View with loupe and 100 watt gas-filled lamp showing "Y." (2) Section of lens.

possible to see the separation or dissociation of the lamellae (*lamelläre zerkluftung*) in an early stage in senile cataract. I have not so far been able to see in the normal lens the embryonic anterior or posterior "Y," but in lamellar cataract both the adult sutures and the "Y" can be seen, generally the anterior, occasionally the posterior. Fig. 10 shows a lamellar cataract observed with a 100 half-watt lamp at ten feet distance and a loupe. The anterior "Y" is plainly visible. The same lens is shown in optical section in Fig. 11.

Vitreous.—The simple focal beam and the loupe allow us to see the vitreous membranes quite clearly and large punctate opacities can be distinguished with certainty (see Fig. 9 coloured plate). Quite recently with the ophthalmoscope I saw some large black punctate bodies floating in the vitreous. With the point o'light beam focused upon them they were beautifully seen as white glistening particles. In some cases the vitreous structure can be made out as well with the loupe as with the slit-lamp because we can approach our visual line closer to the axis of the beam of light than

is possible with the slit-lamp used without Koeppé's mirror. In aphakic eyes and in cases of subluxation the vitreous structure is clearly seen with the loupe. It can occasionally be distinguished in a normal eye with a dilated pupil.

I think that I have said enough to convince you that there is much that can be seen with quite ordinary methods without the use of a slit-lamp or other expensive apparatus, but I may add that I personally had seen few of the appearances that I have mentioned before I used a slit-lamp, and was in fact quite unaware of the real powers of the simple loupe. If I never see a slit-lamp again I shall have gained enormously because the corneal microscope has discovered the dormant capabilities of the loupe, and the slit-lamp has enabled me to utilize the possibilities of a half-watt bulb.

In Gullstrand's slit-lamp the principle of focal illumination reaches its highest development. We are able to project into the eye a powerful, clearly defined, ribbon of light, to modify the width of this beam, and to focus it at will upon any desired spot. By using the pin-hole we obtain a pencil of light which is very useful in the search for cellular elements in the aqueous and for demonstrating reluctance of the aqueous. It is also of service for accurate localization in the lens.

I do not intend to describe the construction of the slit-lamp, nor to treat of the methods and technique involved. There are, however, a few practical points which have become obvious from the use of the four slit-lamps that I have at my disposal.

I am quite certain, and here I am in disagreement with Vogt, that the type with the glass top is far better than that with the cross-slides for moving the microscope. With the former one can move the microscope to any desired spot, raise and lower it, and focus it, all with one hand, while the other is occupied with the slit-lamp. The glass top is also cheaper.

Ocular A2 and eye-piece 2 giving a magnification of 23 is almost exclusively used, higher and lower powers are a luxury, but not really necessary for ordinary clinical work.

Finally, the switch supplied with the slit-lamp is quite impossible and must be discarded at once. The best plan is to cut off the cable close to the lamp and introduce a push-through switch which cuts off with a click. Beyond this switch the cable must be cut again and a plug or adapter fitted.

The cable must drop from a hook in the ceiling otherwise it is constantly in the way. The plug is then necessary to enable the cable to be broken for covering the apparatus with a suitable fabric, which must be large enough to include the whole table and prevent dust settling upon the glass top.

The slit-lamp opens up such a wide field that in the time at

my disposal I can mention but a few interesting and typical subjects. I have dealt with the "Normal Anatomy of the Lens" in a paper which I read to the Congress of the Ophthalmological Society at Glasgow, which will be found in the next number of the *Transactions of the Ophthalmological Society*, 1924. Further general information will be found in another paper which I read to the Royal Society of Medicine last January. This appeared in the *British Medical Journal* for May 31, 1924, entitled "The Practical Value of the Slit-lamp." These papers may be considered to be introductory to this lecture.

Inflammation.—The slit-lamp is indispensable in the study of the inflammatory conditions of the eye, but the subject is so far-reaching that it calls for a lecture to itself. Changes take place in the cornea, the aqueous, the iris, and the vitreous all of which are seen with the corneal microscope. The first sign of an inflammation is bedewing of the cornea, but it is such a sensitive sign that it must be used with the greatest caution. The varieties of keratic precipitates can be investigated with the higher powers of the microscope, and probably we may in the future gain valuable help from a classification of these deposits. Koeppe has drawn up a table showing the characteristics of deposits in different diseases, but probably he has gone much farther than present knowledge warrants.

Increased reluctance of the aqueous is a valuable sign of an inflamed ciliary body, and when the aqueous contains cellular elements we obtain still more valuable information. Gelatinous masses may appear in the aqueous and are said to favour a gonococcal origin of the inflammation. Cellular elements in the aqueous are seen in Fig. 3.

Contusions of the Eye.—After a severe contusion no blood may be seen in the anterior chamber with the loupe but examination with the small pencil of light will show that the whole aqueous is full of shining particles, blood corpuscles. These stream along in the vortex currents caused by the heat of the beam, and may remain visible for several days. After a perforating wound which has involved the iris the aqueous may be full of iris pigment which after some days begins to settle upon the posterior surface of the cornea and upon the iris. Often after an iridectomy in elderly subjects the whole anterior surface of the iris is peppered with black dots.

After a contusion it is not uncommon to find folding of Descemet's membrane and folds may be found in the anterior capsule of the lens. Fig. 12 shows an appearance that was noted with the ophthalmoscope after a severe blow upon the eye. Seen with plus 20 there were a series of parallel rugæ like the sand ridges left by an ebbing tide. It was impossible to localize them,

but the slit-lamp picture (Fig. 13) showed that the rugae were due to folds of the posterior lens capsule. Red particles were seen in the retro-lental space, probably pigment cells.

Often the vitreous becomes quite opaque after a blow which has caused a haemorrhage into the retro-lental space. Seen with the slit-lamp we find a most beautiful picture. The whole field is filled with golden particles which sparkle like the golden-rain firework. Behind we see a dense background like burnished bronze. Here the Czapski microscope may clear up a difficult diagnosis. The vitreous may become opaque from haemorrhage, from dense exudate, or by a new growth. In one case of this kind the slit-lamp at once showed that there was a haemorrhage.

FIG. 12.

FIG. 13.

J.C. Contusion of eye. Folds of posterior capsule. Erythrocytes in vitreous.

We have already seen that a contusion may cause ruptures of the posterior layer of the iris which can be detected only by retro-illumination. Small tears in the pupil margin may be overlooked if the iris be not examined with the corneal microscope.

Wounds.—The slit-lamp will play an important rôle in compensation and medico-legal cases. An examination of the cornea will tell us that a wound has or has not perforated the cornea, and we may be able to prove that a so-called traumatic cataract has no connection with the accident. Fig 14 (see coloured plate) illustrates a very instructive case of this nature. There was a central stellar cataract apparently capsular in position. It had a greenish colour. Centrally in the cornea there was a corneal scar. The man gave a history that some time previously he had been wounded in the eye with a bit of copper wire. The inference was that the cornea had been perforated by the wire and that the anterior capsule had been injured. The copper might, it was suggested, be responsible for the green colour of the cataract. The slit-lamp showed that the

corneal scar extended only half-way through the cornea which had not been perforated. The star-shaped figure was situated not on the anterior capsule but on the surface of the adult nucleus. The drawing shows that the arms of the star just touch and are first lighted up by the posterior edge of the lens prism. Deeper in the lens there were bluish punctate opacities, and a few were found in the other eye. It was at once obvious that we had a cataract which had developed during the first ten years of life, a modification of a cataracta punctata coerulea. Such evidence produced in court would have at once lost the case for the workman and an opposing witness who argued that the cataract was due to

FIG. 15.

FIG. 16.

Mrs. S.H., Dec. 23. V.L. 6/60. Trivial accident. Nebulae gradually developed during six months. March 24. Has cleared considerably, but still central rounded nebula, vascularization active. ? Keratitis disciformis. Note distortion of corneal surface.

the injury and who had not used the slit-lamp, would have been discredited.

Wounds of the cornea may give rise to a condition not very dissimilar to discoid keratitis. Kraupa has figured cases of the kind, and another has come under my notice. The patient whose cornea is shown in Fig. 15 had six months previously sustained a trivial abrasion of her cornea. There was a central, deeply placed, discolored opacity, with some outlying superficial nebulae. The periphery of the cornea was vascularized and some of the vessels passed nearly to the centre of the cornea. Apparently the vascularization was of a superficial type. The optical section (Fig. 16) made by the narrow ribbon of the slit-lamp showed that the centre of the cornea was umbilicated. Situated in the anterior quarter of the stroma there was a disc-shaped fibrous plate. The whole depth of the cornea was vascularized. I have not yet had the opportunity to examine a case of true keratitis disciformis and to compare it with this traumatic discoid formation.

New Growths and Tuberculosis

Gallimaerts and Kleefeld in the *Annales d'Oculistique*, Vol. CLVII, 1920, page 134 and plate 4, figure a case of sarcoma of limbus which is throwing out a spray of growths into the corneal tissues. Unfortunately, it is not stated in which stratum of the cornea the growths were seen. Fig. 17 illustrates a case which may be of this nature. There was at the corneal margin a vascular, nodular, softish, flat, tumour. Attached to it there was a pedunculated outgrowth. The tumour was regarded as malignant and had been treated with radium at the Radium Institute. Examined with the slit-lamp I found a spray of

FIG. 17.

Mrs. A. C. Dr. Wheeler's case. Growth on limbus with pedunculated outgrowth. Extension of growths of infiltrated areas superficial in cornea. Section of growth said to be innocent.

opacities in the superficial layers of the cornea, probably superficial to Bowman's membrane. These extended about half-way to the pupil margin (the pupil in the drawing is too far to the right). This discovery seemed to me to confirm the theory of malignancy. I advised Dr. Wheeler of Rugby, who sent the case to me, to remove the pedunculated growth and have it examined. Professor Dudgeon of St. Thomas's Hospital reported that the growth was an angioma, a naevus. I have not seen the patient again, but Dr. Wheeler tells me that she has had one more radiation, and that the growth has disappeared. The question arises: was the corneal appearance due to the radium treatment. This must be a subject for future observation.

I have found the slit-lamp of great value in cases of suspected tuberculosis of the iris. I have a case in which a small nodule

appeared at the iris margin in a case of irido-cyclitis of doubtful origin. This nodule was small and had a white gelatinous aspect. The corneal microscope showed that it was not vascularized, and that there were other nodules invisible with the loupe. Careful observation showed that they disappeared and that others took their places. They were exudative and not tubercles.

Glaucoma.—The slit-lamp may render useful services in the diagnosis of glaucoma. Koeppe describes an infiltration of the iris with pigment which he considers to be pathognomonic of glaucoma. I have noted this in all the elderly cases of glaucoma, but not in a younger patient shortly to be described. I found it in the glaucomatous eye of an elderly woman but not in her sound eye. On the other hand Vogt and others have pointed out that an exactly similar condition is present in many aged persons in whom there is no question of glaucoma. I have been able to confirm this view, and we may conclude that this pigment deposit is a sign of iris degeneration and not of glaucoma. It is a well-known fact that degeneration and atrophy of the iris are very common in glaucoma.

In many cases there is great difficulty in deciding whether a case is one of idiopathic or secondary glaucoma. It has been suggested that all glaucomas are due to a cyclitis, but clinically we can and must classify them as primary and secondary, for the treatment of the two classes is diametrically opposite. Examination with the slit-lamp will often show signs of inflammation of the cyclitic type which were difficult to observe with the loupe: we may find fine "K.P." and increased reluctance of the aqueous, or cells in the aqueous. The exact interpretation of these signs calls for considerable research. Can they be present in a glaucoma which is not secondary to a cyclitis? Must we be guided by the intensity of these signs, or can we at once say that because we find them, therefore there is a cyclitis causing a secondary glaucoma? I, personally, am not yet in a position to answer these questions. Figs. 18 to 22 illustrate a very interesting and unusual case of glaucoma. The patient was a woman, aged 30 years, who came to the Coventry Hospital for glasses. I was carefully examining her retinal arteries to try to see the circulation of the blood. I have never yet succeeded in this, but my house surgeon at Birmingham, Mr. Hughes, tells me that in a case of partial embolism he has seen the blood streaming along a retinal artery. (Since writing the above we have, at the Birmingham Eye Hospital, been able to see the actual blood stream in the retinal vessels on several occasions.) I noted that there was a faint but distinct arterial pulsation. Examination with the Schiötz Tonometer showed that the tension was raised to 25. I kept the patient under careful observation and eventually the field began to

contract, pain was complained of, and the tension steadily rose in spite of the use of pilocarpin, and I trephined the eye. The conjunctiva was excessively thin and the sclera very soft. I lost the disc in the eye.

On the second day the conjunctiva gave way over the trephine hole leaving a triangular defect (Fig. 22). The slit-lamp showed that the hole was covered with a delicate membrane, but that the

FIG. 18.

FIG. 19.

FIG. 20.

FIG. 22.

FIG. 21.

Miss W., age 30. Glaucoma. *Trephined* April 9, 1924. Aperture 1/3rd in cornea, very thin conjunctiva. Triangular defect developed over hole covered by thin membrane. This eventually healed up. *Disc* lost in a.c. No a.c. re-formed. April 23, 1924, central nebula developed. Due to an adhesion between cornea and lens capsule. *Apparently a solid adhesion*. April 26, a.c. re-formed. No sign of adhesion, but loss of definition of endothelial cells. A tiny fold of iris adherent to cornea in lower third. This gave way in a week leaving a pigment dot on the cornea.

main thickness of the conjunctiva formed the sides of the triangle. The tension of the eye was very low and the anterior chamber had not re-formed. A fortnight after the operation, during which time the eye had been free from any injection, a dense opacity formed in the centre of the cornea as seen in Fig. 18. At the same time a small fold of iris became attached to the cornea as shown in Fig. 21. Examination with the slit-lamp revealed an apparently desperate condition. The cornea appeared to be greatly thickened and to be compactly fused with the lens. The lens

capsule was drawn up at the sides tent-like to join the cornea. The cornea in this situation was ivory-white and showed no translucency. There was no change in texture between the cornea and the lens at the point of junction. Fig. 19 gives the appearance in the centre of the opacity. Fig. 20 represents the edge of the opacity. Three days later the anterior chamber re-formed and the cornea and lens had resumed their ordinary appearance. A week later the small iris tent broke away from the cornea leaving a spot of pigment. The eye did perfectly well, and now has fair vision and normal tension.

The Pupillary Membrane.—Remnants of the tunica vasculosa lentis anterior are frequently found during examination with the

FIG. 25.

E. G. P., age 18. V. R. and L.C. - 1.25 = 6/3 partly. "Stars" in a.c. Note filaments free in a.c. One reaches right across the chamber. Discovered accidentally in routine slit-lamp examination.

slit-lamp. They may take a great variety of forms. We very frequently see in the centre of the pupil a collection of brown dots. The common appearance is shown in Fig. 23 (see coloured plate). Under a magnification of 35 they are seen to consist of stellate deposits of pigment, generally tripolar (Fig. 24). The points of the brown stars are continued as delicate grey filaments which often anastomose with neighbouring stars to form a fine net-work. The mere fact that the pigment assumes the stellate form does not exclude an inflammatory origin. Vogt emphasizes the fact that all pigment deposits upon the anterior capsule tend in time to take this shape. Quite recently I have seen two cases of old congenital syphilitic iritis in which there were masses of pigment spreading from synechiae on to the capsule. Under high magnification the thin layer on the capsule was entirely composed of stars very similar to the pupillary membrane stars. There were also grey filaments but no network formation. The congenital stars are more regular and not accompanied by any massive deposit. With care and

some experience the two should not be confused, but cases may arise in which it is very difficult to decide with certainty that the stars are not due to old iritis. Fig. 25 shows another not unusual type of persistent pupillary membrane. The boy came to my rooms for refraction and had an acuity of 6/4.5. A branching filament arose from the iris frill and floated free in the anterior chamber. One branch reached right across the chamber. At the

FIG. 26.

FIG. 27.

FIG. 26. J. H., age 13, V. = 6/18. Persistent pupillary membrane. Anterior capsular and posterior capsular cataract.

FIG. 27. A. B. F., age 26. Large fibres obviously originally blood vessels passing from "frill" to anterior capsular cataract. "Stars" all over the anterior capsule. Nystagmus. Cornea faintly nebulous.

end of each filament was a knob. There was also a group of stars.

Figs. 26 and 27 are examples of similar conditions.

The anomaly in Fig. 27 was probably due to intra-uterine gonococcal infection which gave rise to an anterior polar cataract and retarded the absorption of the pupillary membrane.

The condition shown in Fig. 28 has been considered as a pupillary remnant, but Vogt insists that it is not of this nature but is due to intra-uterine iritis. The thick filaments at the iris periphery do not arise from the frill but from the pupil ruff. In addition there was a group of stars and part of the capsule was covered with a gossamer-like film, like the substance in a cocoon. The fact that the filaments do not arise from the frill appears to be almost conclusive evidence that they are of inflammatory origin. When I saw the case and drew it I was under the impression that I had before me an atypical example of persistent tunica vasculosa, but after reading Vogt's remarks I am convinced of their validity.

The Suspensory Ligament forms an interesting study for the slit-lamp. It can be seen only when there is a natural coloboma or when the lens is dislocated. Generally speaking, the coloboma

FIG. 28.

FIG. 29.

formed by an iridectomy is not sufficiently peripheral to show the ligament. We have already seen a perfect suspensory ligament drawn from an examination with the loupe (Fig. 8). The slit-lamp picture of the same lens is shown in Fig. 29. The corneal prism

is seen on the right followed by the illuminated part of the lens which in the microscope gives the impression of a large grindstone. The edge of the lens is brightly lighted up because here the rays of light strike the back of the lens at an angle greater than the critical angle and are in consequence totally reflected up the back of the lens giving rise to the caustic-like curve seen between the posterior capsule and the lens edge.

Below we see the fibres of the suspensory ligament which appear like trees in a forest, row upon row. Behind the filaments

FIG. 31.

FIG. 30.

FIG. 32.

J. B. Subluxatio lentis. Right has been needled. Shows suspensory ligament, incomplete in right eye. Small figure; view with ophthalmoscope with +20 lens shows faint striation. Large figures R. and L. slit lamp X 24.

we note the vitreous framework and to the extreme left some red reflex from the retina. In this case many of the filaments of the ligament were branched at the lens end, and most of them had a shining nodule of brown pigment attached to some part of their length. These nodules were detected with the loupe and simple focal illumination. The edge of the lens in this and the succeeding pictures is too circular. The actual lens edge consists of a series of irregular almost flat surfaces, in fact the lens is a rough polygon. A study of the suspensory ligament enables us to classify dislocated lenses in respect of the degree of development of the fibres. The ligament may be perfect, rudimentary or absent. I suggest that those cases with a perfect ligament be

called "*decentred lenses*"; those with a rudimentary ligament "*ectopia lentis*"; and those with none "*subluxated lenses*."

Fig. 30 shows a familial case of ectopia lentis as seen with the ophthalmoscope and a plus 20 lens. A faint striation can be made out in the region of the ligament by very careful focusing. The slit-lamp picture of the right and left lens is found under Figs. 31 and 32. It will be noted that the ligament is badly developed and in one place torn away. This rupture was probably caused by a needling operation. The marks of the capsule rupture are seen

FIG. 33.

FIG. 34.

J. A. Age 5. Congenital subluxation of lenses. Father had "bad eyes." Left dissection twice. Lens became opaque but did not absorb. Shows right, fibres of tunica vasculosa; left, fibre network of tunica vasculosa. No trace of any suspensory ligament.

in Fig. 31, and it will be observed that the lens has become opaque but unfortunately not absorbed.

Another familial case showing no trace of a ligament is figured in Figs. 33 and 34. The left lens has been needled three times and is opaque. This case shows remnants of a pupillary membrane. We can find traces of the pupillary membrane in about 20 per cent. of all cases of congenital dislocation of the lens. Whether they are more frequent when the suspensory ligament is wanting I cannot say, but we have here a field for research. I have already shown in Fig. 9 an example of subluxatio lentis with a functionless and rudimentary ligament, and in this case the anterior layers of the iris were only partially developed.

An examination of the ligament and a classification founded upon its degree of development is of great clinical value. It is quite unlikely that cases of decentration will pass into complete dislocation, whereas a lens with no suspensory ligament may be

expected to alter its position in the eye, to enter the anterior chamber or to fall into the vitreous. Those with a badly developed ligament will occupy a middle position in this respect. The liability to dislocation will vary according to the development of the ligament. Again had I known the condition of the ligament in cases 33 and 34 I should have hesitated to carry out the operations that I performed. No case of congenital lens dislocation

FIG. 35.

L. V. B. J., age 21. $V = 6/5 \text{ } 6/5 \text{ } \bar{c} - 2.5, - 2.5$. Each lens shows a minute scintillating opacity at centre of infantile nucleus. *Bogenlinie* clearly seen. Note yellow cortex and blue nucleus. A second opacity in posterior cortex.

should be submitted to operation until the eye has been carefully examined with the slit-lamp.

Cataract.—The subject of cataract from the standpoint of the appearances seen with the slit-lamp is so vast that a whole lecture might well be devoted to it, and then it would but touch the fringe of the whole garment. All that I can do in the time at my disposal is to show you some drawings of typical cases.

Fig. 35 illustrates the lens of a boy, aged 21 years, who came to my rooms for refraction. With a low minus glass he had normal acuity. I examined him with the slit-lamp as a routine practice and found certain abnormalities. The cortex was of a yellowish hue whereas the rest of the lens was unusually blue. The infantile nucleus was sharply differentiated by a yellowish condensation line. In the centre of the anterior limit of this

nucleus there was a scintillating opacity of the type found in lamellar cataract. This threw a dense shadow back into the lens as every opacity must do. There was a similar opacity placed eccentrically in the posterior surface of the adult nucleus. On

FIG. 36.

L. B., age 44. Opacification of right lens. Showing large "fluid-clefts" in cortex. One invades the adult nucleus and the reduplication line.

FIG. 37.

H. T., age 21. Close to a flash of lightning. Capsular opacity: V = 6/6 partly.

the posterior capsule there was a well-marked semicircular arc-line (*Bogenlinie*). This I have merely indicated by the white semicircle behind the lens. In Fig. 36 we see a fluid-cleft (*Wasserspalt*) in a case of rapidly developing cortical cataract. It will be observed that the reduplication line is becoming absorbed

and that the adult nucleus is penetrated. This shows that the reduplication line is in no sense a kind of internal capsule, but is composed of ordinary lens material.

Fig. 37 exhibits a case of *cataracta electrica*. The patient was quite close to a flash of lightning. The cataract is, as is usual in these cases, capsular. The ray-like out-growths may be due to the path taken by the current along the anterior capsule. The vision was normal and the patient came for refraction.

A case of *cataracta punctata coerulea* is shown in Figs. 38 and 39 (see coloured plate). This type of cataract has generally been regarded as congenital and non-progressive. The section shows that the opacity is entirely outside the infantile nucleus and

FIG. 40.

FIG. 40A.

Mrs. M., age 43. R.V. = 6/9. I.V. = 6/18. Both similar pictures. Snow white lace-work just in front of posterior capsule. Fig. 40. View with + 20. Fig. 40A Slit-lamp picture.

cannot therefore be congenital. I have seen this type of cataract develop in a patient whom I had examined some years before and had noted that his media were clear. In another case I have seen a decided increase of the cataract with marked deterioration in acuity.

A *posterior capsular cataract* is portrayed in Figs. 40 and 40A. The ophthalmoscope with plus 20 showed a lace-like dark opacity deep in the lens. The slit-lamp localized it in the posterior cortex and the posterior capsule. The figure shows the white opacity as seen with the broad ribbon somewhat out of focus which gives a more diffuse illumination and allows a larger area to be lighted up.

Figs. 41 and 42 illustrate a very unusual type of cataract. It is chiefly located in the posterior cortex, but it is continued round the equator and appears in the anterior cortex as a lace-like opacity.

In Fig. 42 it will be noted that the edge of the adult nucleus is strongly differentiated from the rest of the lens, so much so that we get total internal reflection at its edge. This shows that even in a boy aged 21 years there may be a great increase of the index

FIG. 42.

FIG. 41.

Boy, age 21. Lamellar cataract of cortex. The posterior cortex is affected and the lace-like opacity curls forward to form the iris-like appearance. Note in the $\times 35$ picture the appearance of a lens edge with bright border. This is the edge of the adult nucleus. The iris is not shown in the figure.

FIG. 43.

FIG. 44.

FIG. 45.

Familial cataract. G. A., age 12. V.R. = 6/36. V.L. = 6/60 Aunt and great aunt similar cataract. (43) Ophthalmoscope + 20. (44) Slit-lamp section. (45) The slit-lamp view with broad ribbon.

of refraction between the adult nucleus and the cortex. Freitag has shown that this difference is often greater in the young than in the old lens. The same phenomenon can be seen in lamellar cataract.

A case of *familial cataract* is presented in Figs. 43, 44 and 45. The ophthalmoscope picture shows the usual marble-like central

opacity. The slit-lamp shows that the central opacity is surrounded by a halo and that both the anterior and posterior "Y's" are unusually prominent. This is the rule in lamellar and familial cataracts. The section shows a central scintillating almost stone-like opacity surrounded by an area of condensation which corresponds to the infantile nucleus. The central opacity comprises the whole of the embryonic nucleus.

A study of *lamellar cataract* with the slit-lamp brings out the fact that generally in addition to the wreath of opacity in the infantile nucleus, an area that suggests a mass of machine-made ice, there are other concentric layers of condensation which account for the halos that so frequently surround the main opacity.

The Vitreous. The anterior part of the vitreous can be examined with the slit-lamp and the ordinary microscope. The deeper portions cannot be seen without considerable modification of the apparatus. If the pupil is undilated the narrow beam must be used. Considerable experience is needed rightly to interpret the picture and to separate normal from pathological states. The strand-like figures are in general not fibrils but the edges of the folds in the membranes which make up the architecture of the vitreous. These wave about with the movements of the eye.

If they return to the same place the vitreous is in this respect normal, but if they change their position it is pathological. The presence of detached fibrils and of small particles is evidence of a degenerated vitreous. Generally the strands do not appear to reach the back of the lens. There is a definite clear space, the retro-lental space. The actual existence of this space is proved by the fact that blood sinks to the bottom as in a hyphaema and moves its position if the patient lie on his side for a time. Red dots in the vitreous are not blood corpuscles but pigment masses. Blood cells have a golden yellow colour.

The Retina. The retina can be examined with the slit-lamp and microscope under a high magnification. A contact glass must be placed upon the cornea to abolish its curvature. This can be done without the use of cocaine and appears to cause no discomfort. If the ordinary microscope be used it must be hung vertically upon a gallows (Gallimaerts and Kleefeld, *Annales d'Oculistique*, 1922, page 264), and the light reflected into the eye with a horizontal mirror, or a microscope with a single ocular must be used. This instrument called the "*bitumi*" was invented by Siedentopf. It gives an inverted image and is difficult to use. It is better to employ an arc-lamp instead of the nitra lamp. A full account of the examination of the vitreous and the retina will be found in Koeppe's book.

Vogt points out that it is by no means clear that the arc-lamp is free from risk. It is possible that it may injure the lens. In all cases the narrow beam must be used.

Rabbits' eyes have been exposed without injury for several hours to the full beam of a slit-lamp furnished with an arc-lamp, but it is not certain that the human lens would be equally tolerant. The examination of the retina with the slit-lamp is useful for research, but is almost outside the scope of clinical work. In certain cases of doubtful tumour of the choroid it has proved useful.

The drawings illustrating this lecture have in the main been made at home in the evening from rough sketches, and in consequence cannot be regarded as absolutely accurate. In some cases they have been corrected by subsequent examination of the patient, but lack of time has not permitted this to be done in all cases.

COUNCIL OF BRITISH OPHTHALMOLOGISTS

Administration of Optical Benefits under the National Insurance Act

A brief account of the steps taken by the Council with regard to the above appeared in the February number of the journal.

On May 15 last a conference was held at the house of the Royal Society of Medicine with representatives of the British Medical Association. It was agreed to appoint a joint committee to consider the question.

This joint committee made the following recommendations:

(a) That the so-called "Optical Benefit" shall be designated "Ophthalmic Benefit."

Ophthalmic benefit would include examination and prescription for spectacles, if required, and such operative treatment and advice as can be given at a single consultation at the consulting room. A report, when necessary, shall be given for the guidance of the private practitioner.

(b) That in order to ensure the satisfactory working of the proposed scheme, it is essential that the insured members of every approved society, should in any case of ocular disorder or visual defect, apply to their insurance practitioner.

(c) If the insurance practitioner considers the case one requiring special advice or treatment, he should give the applicant a certificate which would enable him to consult a specialist at a reduced fee, and, at the same time, a list of the ophthalmic medical