ERRORS OF REFRACTION*

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I DESIRE to start my opening address by thanking you for the great compliment which your Council has paid me by inviting me to deliver it. I am very conscious of the responsibilities it involves, and it has seemed to me, after careful thought, that I can best serve the interests of this Congress not so much by putting forward views of my own, as by indicating the broad lines along which I think that discussion can most profitably be indulged in.

I should like, first, to point out that the subject chosen for to-day is one in which every ophthalmologist has an interest, and on which every ophthalmologist can claim to be an expert. There are many branches of our science, the practice of which is confined to a comparatively small number of men. This is not so with refraction. It is the mainstay of our practice, both professionally and financially. The general public judge our capacities more by our success in this line than by anything else. This is only natural, since it furnishes them with such a ready standard. Moreover, the subject is very far from being one that has been well thrashed out. It teems with points of burning interest. There is much for everyone of us to learn, and let us not forget in a discussion like this that we may learn it when and where we least expect.

At the very outset of the discussion there is one point which should be made quite clear, viz., that the methods which suit one man's practice may be quite unfitted for that of another. The surgeon who has to examine a large number of school children in a limited time, or he who must finish off a room full of out-patients before he leaves for the day, will be bound to employ different methods from those of a consultant who has ample leisure for his practice, and who is suitably remunerated for his labour. There is nothing in this statement to infringe the highest standard of ethics. Each man in his work must aim at doing the greatest good to the greatest number of those who intrust the care of their health to him. Were the out-patient surgeon to follow the leisurely methods of the consultant, a very large number of his patients would perforce be deprived of his services. On the other hand, were the consultant to treat his patients on the lines of the out-patient room, he would certainly not be a financial success; nor can one think that such action could be justified on any possible grounds. This is a very important matter, and one, which, it is suggested, speakers should keep constantly before them.

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There is another preliminary point I should like to bring forward. The discussions at the Oxford Congress have often been among the most interesting one has listened to, for the simple reason that they have shown a freedom from restraint and a disregard for criticism which are often absent from the debates of more formal societies. Men do not feel that every word they are saying is going to be recorded in print, and they also display a confidence in the charity and tolerance of their audience, which has, I believe, been well justified in the past. I hope that this discussion will be no exception and that the speakers will venture boldly to tell us what they actually do in their practice, and not what they would like to do, or what they would like others to think they do. If this is the tone of the discussion, we shall get down to bed-rock, and our Session will be a most fruitful one. May I now suggest a few of the leading points round which discussion might, in my opinion, gather?

The use of cycloplegics. It is important to distinguish between cycloplegic and mydriatic drugs, the more so because, though the terms are not synonymous, they are often used as if they were by writers, who really know better. Up to what age should we employ atropin? and from what age onward may we safely use homatropin with the confident security that it will effect our purpose? Should cycloplegia be obtained in *all* cases before fitting a patient with spectacles, and if not, where are we to draw the line? I cannot help thinking that this should make one of the most interesting subjects for discussion. There are those who will urge that cycloplegia often involves a needless expenditure of time and energy on the part of the surgeon, and of fees on that of the patient. There are others who will contend that a refraction estimated without cycloplegia is of very doubtful value in a material percentage of cases, and that it is not always possible to pick the cases beforehand. Some, no doubt, have tried both methods and compared them. It would be interesting to hear their results. I have taken a little trouble to do this myself, and my personal experience has been, that whilst in a certain number of cases the astigmatism recorded is the same with and without cycloplegia, there are important, and by no means infrequent exceptions to this rule. I would ask: Is the method without cycloplegics sufficiently reliable to justify its continuance, and, if so, within what limits?

Spasm of the accommodation. Is this frequently met with? or is it a rare condition? Are we to distinguish between it and "a state of permanent excessive tonus of the ciliary muscle, which is directly prejudicial to vision?" Is the latter condition a common one? and how are we to distinguish it from the former?

We all meet with cases, especially in the hyperopic, in which a

tonic ciliary spasm leads a patient to prefer the addition of a minus sphere to his correction, as soon as the muscle has regained its tone, after the passing away of cycloplegia. Perhaps this condition is most frequently met with in eyes with mixed astigmatism. If after a reasonable trial with theoretically correct glasses, the patient is still uncomfortable, and still demands the addition of minus spheres to his spectacles, are we acting wrongly if we accede to his wishes? It may be unorthodox to say so, but I think there are times when this is the right procedure. What do the members of the Congress think?

May an anomalous contraction of the ciliary muscle alter the meridional strength of a lens and thereby compensate for an astigmatism, which is due to a defect in some of the other media of the eyes, especially the cornea?

This subject has been long debated, and it could not fail to be of interest if the members of this Congress would devote some of their attention to it during the discussion. We are all aware that the refractive correction indicated by a retinoscopy under a cycloplegic may not be tolerated by the patient once the accommodator muscle has returned to full action, and this sometimes in spite of the fact that whilst accommodation was still paralysed, the correction was well borne. I am excluding for the moment the cases of hyperopia with spasm of the ciliary muscle in which the addition of a concave sphere to the indicated cylinder suffices to bring vision up to the full standard. It is to be borne in mind, in considering these cases, that all cycloplegics are mydriatics and that the refraction of the media in the visual axis of a contracted pupil is by no means necessarily the same as that over the whole field of a dilated pupil. We know this from the scissor movement seen in the shadow test, and we also have abundant evidence of it when using the astigmatometer. This, however, will not cover a class of case with which, I have no doubt, many of us here are familiar. I personally have kept accurate records of the notes of my refraction cases for well over twenty years, and amongst them I can refer to patients who when they were young found no advantage from the use of a cylinder, *though cycloplegic retinoscopy indicated its application*. As years went on and the activity of the accommodator muscle lessened, generally about the time of advent of presbyopia, they were glad to accept the erstwhile refused cylinder. This squares with the widely accepted experience that about the time presbyopia begins to give trouble, patients are glad to accept an astigmatic correction which they did not want before. My notes show that in some cases at least this has not been due to the development of an astigmatism, but to the manifestation of one which has hitherto lain latent. I frequently met, in my Indian practice, with Europeans who, after a long term of service in the country, or after

parturition or some debilitating illness, came to me for the relief of a premature presbyopia, associated with slight astigmatism ; such patients gladly availed themselves of the help conferred by correction of the refractive error, even though it might be a low one. When they went back on furlough to Europe they soon found they could discard spectacles, but they took to them again when they had been back in the plains for a hot season or two. The relation between the tone of the muscles and the trouble given by these low errors in refraction is well seen in many of the young fellows we have to treat for wounds nowadays ; their need for glasses is a signal of their impaired bodily tone, and passes away as soon as they get really fit again.

These considerations lead us naturally to the discussion of an allied topic : Do the physical changes which manifest themselves in astigmatism ever really *develop* as life advances ? I put aside traumatic cases and those in which there is a pathological yielding of the coats of the globe ? The subject is full of interest, practical as well as theoretical, but it is not possible for me to follow it further now.

Arising out of what has gone before, I would suggest another question for your consideration : In the great majority of our cases, we can perform a retinoscopy with a confidence that the patient will accept our estimate to a quarter diopter or less. On the other hand, we all meet from time to time with cases in which our valuation of the error fails us miserably. How is this to be explained ? The answer is neither single or simple, and I hope those present will help to elucidate this very practical problem.

I have the record of a patient who came to me with asthenopia. I found he had 2.5 D. of astigmatism, but after cycloplegia had passed away, he found no benefit from any higher correction than one of 1.0 D. I gave him this and waited ; after some months I was able to increase it slightly. This was done on two subsequent occasions. Finally, he wrote to me that he would like to take the full correction ; he did so successfully. I believe that the patient wore down the irregular action of his ciliary muscle, and so exposed the full measure of his astigmatism, which till then was concealed by a meridional tonic contraction of the muscle. The other possibility that suggests itself is the compensative pressure of the lids. During an astigmometric examination, one may see the astigmatism in a young eye vary by from one to several diopters, according to the state of closure or opening of the lids, but I doubt whether this will explain my case and others, for the alterations one sees under the astigmometer are so frequent and so transitory that they would not be likely to hold the vision at one steady level as happened in these cases.

The use of low-power spheres and cylinders. The last few years

have seen the introduction of low-power spheres and cylinders. I refer to the one-eighth diopter glasses. Most of us have given these a good trial, and there will undoubtedly be different opinions as to the value of this innovation. It has always to be carefully remembered that there is an element of faith-healing at the bottom of the success attained by most therapeutic measures. Few if any of the means at our disposal can vie with the fitting of glasses in this respect. The Indian native practitioner relies much on "jadu" or magic to compel the confidence of his patients. We smile at him, but do we not often unconsciously do the same? It is the more highly strung of our patients who feel most severely the lower grades of errors in refraction, and it is precisely such people who are most influenced by suggestion. I wish to be clearly understood that I am not attacking the practice of using low cylinders, and that I am wholly and unreservedly in favour of making the most accurate correction that it is possible to make in each refraction case that comes before us. One sometimes hears the practice of fitting to an eighth of a diopter ridiculed as pernicky faddism. Let me employ a simile to rebut this suggestion. If we ask a patient to lift a five pound weight and to put it on the table, he will do so without conscious effort, but if we should ask him to carry that weight for the whole of a working day, he would become very tired of it. Similarly, I would suggest that whilst a small refinement in correction does not appear of much value before the test types, the summated saving of strain throughout a working day may prove of great value to a highly strung patient. Incidentally, I would remark that it is sometimes the custom to look down on these people, who are spoken of as neurotic or neurasthenic, and I would protest against such criticism. I think that the world's best work is done by nervous men and women. Its poets, its painters, its thinkers, not a few of its great soldiers and sailors, its distinguished men of science, and to fall to an appreciably lower level, its great lawyers and politicians are very often of this type. We cannot, therefore, afford to neglect them in our calculations. At the same time I would not be understood to be advocating the indiscriminate use of low-power glasses. There is, however, another side to the question. There are surgeons who hold that Grandpa's spectacles are the best possible for his descendants, and who spend their time in throwing the elaborately calculated products of other surgeons' work into a glorified waste-spectacle basket. I would not dispute that they do good to a certain number of patients who have been made the victims of faddisms; but I think that in this, as in everything else, the best motto is *in medio tutissimus ibis*—reason, judgment and sane balance are here, as elsewhere, the surgeon's salvation. The subject is one on which we should hear many interesting opinions.

The resemblances in the defects in refraction found in parents and their offspring, and in siblings.

I have been greatly struck by the resemblances between the refractive errors found in the eyes of members of the same family; so much so, that whenever later members of a family come to me, I always look up the records of the earlier ones. Not only is the nature of the defect (e.g., compound hyperopic or myopic astigmatism, etc.), often the same, but the degree and the axis of the astigmatism show remarkable resemblances. What is still more interesting is that the nature of the defects in muscular balance (heterophoria and hyperphoria) often show a close similarity. It is quite clear that the tendency to the defects is inherited. I hope that others will be able to support me in this. I am confident that any of those who keep careful records will do so if they will look through their case sheets with this point before them.

The treatment of myopia in the young should prove an attractive and highly debatable subject. I commend it to your notice.

The routine method adopted in refraction.—Here again we find the greatest variety. There are surgeons who contend that it is quite unnecessary to see a patient after the visit under cycloplegia. There are others, who believe, and in the majority of cases I agree with them, that a final examination should invariably be made after the eyes have returned to their normal condition again. The environment of the surgeon and of his patient are important factors in the decision. Moreover, different classes of cases must be dealt with on different lines. There is room for the expression of many opinions.

Tests for Heterophoria.—It will be interesting to learn how many surgeons make a routine practice of testing for disturbances of the muscular equilibrium of the eyes both in the lateral and in the vertical sense. We all see each other's failures, and my own experience is that a very large proportion of the patients who come to me because they have been elsewhere without relief, are suffering from some form of heterophoria. In this connection it would be interesting to learn the experience of members of the correction, not only of the hyperphorias, but also of the exophorias and esophorias. One more question in this connection. How many surgeons make a routine practice of testing the muscular balance at the reading distance as well as at 6m? I raise this question as I think it is one of great importance. The extraordinary discrepancies between the two sets of readings in the vertical as well as in the lateral meridian would of itself open up a large field for discussion. Lastly, what instruments do members prefer for such near vision tests?

Instrumentation in the estimation of refraction.—I think that it will be admitted as a rule that the more complete and exhaustive we make our examination of a patient, the less likely are we to

overlook important elements in his case. If we desire to make our examination thorough, I do not think we can afford to dispense with the assistance of the modern improvements in instrumentation. The great objections one hears made to such instruments are (1) their initial cost, (2) the difficulty of their upkeep, and (3) that the results obtained from them are not of sufficient value to compensate the surgeon for the expense and trouble involved. In order to provoke discussion on the subject, I shall so far depart from the rule I have laid down, as to draw in some measure on my own personal experience in these matters.

(a) In the estimation of refraction a vast amount of time is saved by the use of one of the very beautiful modern *refractometers*. It takes but a fraction of a second to change one glass for the next, to the great advantage alike of the surgeon and of his patient, for it saves the former's time, whilst it gives the latter the greatest possible facility in distinguishing between two glasses which are nearly alike. In retinoscopy, too, the advantage of being able to go backward and forward rapidly over a range of glasses needs only to be tried to be appreciated.

(b) *Retinoscopes*.—It is a good many years since Hugo Wolff brought out his electric retinoscope with a single line of light, and developed its *technique* in a monograph of truly Teutonic thoroughness, and yet his instrument is still almost unknown in Great Britain. I have used it now certainly for more than a decade, and I should indeed feel lost without it, so much so that I have tried to get an English instrument made on similar lines, nor should I have the slightest scruple in pirating his ideas for the service of British ophthalmologists. To my mind, the advantages of the instrument cry aloud for recognition.

(c) *Astigmometers*.—I have often heard surgeons assert that these instruments are useless. May I speak from over twenty years' experience of them? I began with the crude apparatus whose mires were lit with daylight, and have worked up, steadily "scrapping" each older model as a better came out, to the beautiful instruments of the present day, *none* of which to my mind is superior, if any indeed is equal, to the Meyrowitz astigmometer. The uses of an astigmometer, as they appear to me, are as follows: (1) The instrument will often give the exact axis of the astigmatism. (2) When the axis of greatest and least astigmatism are not at right angles with each other, it will point out the discrepancy and give both readings. (3) Though it only measures the corneal astigmatism, and though a correction has almost invariably to be made to its readings, it furnishes valuable data in a large number of cases. (4) In asthenopic patients, with low astigmatism against the rule, it will point out the defect unerringly, and indicate the need for a cycloplegic retinoscopy, even though the

vision is fully normal. (5) In cases of high hyperopic and myopic astigmatism, which present great difficulties for satisfactory retinoscopy, its indications prove more than valuable in a large number of instances. (6) In cases with deep medial opacities, sufficiently dense to make retinoscopy unsatisfactory, the correction of the corneal astigmatism, made by the aid of the astigmometer, may prove of much use. (7) In the routine examination of presbyopes, before prescribing a reading correction, astigmatometry shortens the examination and adds precision to it. (8) In children, restless patients, and imbeciles, it sometimes proves a valuable auxiliary to, or even a substitute for, retinoscopy. (9) As a means of ascertaining whether any surgical procedure or corneal affection alters the corneal astigmatism, it is unrivalled. Incidentally, its use in this connection sometimes furnishes information of great interest. May I cite one example? The corneal astigmatism, found after cataract extraction as shown by the astigmometer, is markedly in excess of the total astigmatism present. There is, therefore, a compensatory factor in action, and this, I think, is to be sought at the anterior surface of the vitreous. I am not aware that this observation has ever been put on record, but any of you can confirm it for yourselves. (10) It will unerringly and immediately show the presence of slight nebulae of the cornea, irregular corneal astigmatism, disparities between the curvature of one and another part of the cornea, such as produce scissor movements in retinoscopy, and the existence of conical cornea.

I want to make it clear that, after twenty years of use of the instrument, I would make no extravagant claims for it. To my mind, it will never replace retinoscopy, for it measures a part only of the astigmatism, and that too a variable part. What I do claim for it is that it is a valuable instrument, which gives the ophthalmologist important indications which I do not think he can obtain as rapidly or as well by any other means. Please note carefully that I do not say that he cannot obtain them at all. I have chosen my words carefully. Were I to lose the assistance of an astigmometer to-day my work would be poorer, and I should constantly feel the loss of a henchman whose services I both value and trust. The crucial objective test in the hands of the refractionist is retinoscopy; the final arbitrament is the subjective test with the test-type, but I at least could not afford to dispense with other and valuable aids such as those which this instrument affords.

It could not fail to be of interest if those who have used this instrument would give their experience of it, and especially of its limitations and of its value. It would also be most important if we could hear of anyone, who after giving it a full trial, say for a year, or over a series of 1,000 cases, has then given it up. I have never come across any such myself. Those I have met who have

objections to the instrument, either have never used it, or else have confessed they have not succeeded in mastering it. The latter accomplishment is easily acquired even by students, and is within easy reach of any trained ophthalmologist.

The *Corneal Microscope*.—It may seem to some superfluous to press the claims of so proved and beautiful an instrument as Czapski's corneal microscope, as made by Zeiss; but I have met with instances, both in private consulting rooms and also in large hospitals, in which this instrument has been allowed to fall into complete disuse, on account of the alleged difficulties in obtaining sufficient illumination from its lamp. The difficulties are in reality easily overcome, and the instrument can be arranged to stand ready for use at a moment's notice. There are, I believe, a number of these instruments lying idle in Great Britain at the present time. The view a good corneal microscope gives of the details of a corneal opacity, of iris changes and of superficial, and even sometimes of deep, opacities in the lens, has only to be seen to be appreciated. The expense of a corneal microscope is not prohibitive; the working is really quite simple, and the use is a luxury to the clinical observer who wishes to learn a little more than can be revealed by the ordinary methods. It may be suggested that this form of microscopy has no direct relation with refraction work. To this I would reply, that if one desires to avoid overlooking important points in a case, each patient must be examined by a routine method, and that if we are at all in doubt as to the cause of a difficulty in bringing a patient up to the visual power which we should expect to reach, it is of importance to have at our disposal the best possible means of obtaining full information as to the condition present. Do not misunderstand me to mean that every case that comes for refraction requires examination under a corneal microscope. My point is that wherever the least doubt exists, the cornea, the iris, and the front of the lens should be carefully looked at by oblique illumination, and this be followed up, if necessary, by a more elaborate examination.

One could easily speak in the same strain of many other of the modern devices for full examination of the eye. The objections that they cost money, that they take time to use, that in many cases they are unnecessary, and so on, do not require to be answered. To any thoughtful mind they will answer themselves. It is sometimes claimed that one surgeon, whose instruments are few and antiquated, will do as good or better work than another with every modern appliance at his disposal. I would submit that this is not the point. We each of us desire to do the best work that is in our power, and it is for each of us to decide how that can be done. We would not equip our navies or our armies for a strife like that which is raging at the present time with anything but the best weapons,

and our Government adopts the maxim to try all things and hold fast that which is good. The plea that I am urging to-day is that the members of this Congress, and especially the younger members, should give the newer instruments a full and patient trial in their practice. It is the younger men who have time to do this, and it is they, too, who will find the least difficulty in adapting themselves to new conditions. One point more I would urge upon them. More elaborate methods of examination open up a field for research in the course of their daily clinical duties, and thus give a zest and an interest to their work, which is otherwise inclined to become humdrum and mechanical. I would specially press the need of cultivating the spirit of research on the younger ophthalmologists, "For the soul is dead that sleepeth," is as true of science as it is of spirituality.

I do not venture to criticise, and much less to condemn, those who do not agree with me as to the value of the appliances I am advocating. What I do urge is, that each one should get from himself the best that is in him, and in so doing, should do the best for those towards whom his royal motto is that of our Prince, "I serve." Kipling, with one of those touches of insight that will for ever endear him to his readers, has crystallized our aims for us in two lines :

" But each for the joy of the working, and each, in his separate star,
Shall paint the Thing as he sees It for the God of Things as They Are."

In conclusion, permit me to offer one last plea. We are discussing to-day a subject in which all of us take a keen interest ; a subject, in which the lines of cleavage of opinion are wide and bold ; a subject, on which many of us feel very strongly. Let us remember the possibility that despite our convictions, we may not be wholly in the right, that there are many sides to look at the question from, that others are as honest of purpose and as earnest for truth as we are ourselves, and that we may all of us make mistakes, even the oldest of us. Nothing will be more profitable and nothing will do more good, than that we should speak out our mind, and give our experience fully and freely, but let us do so throughout with that courtesy and consideration, which has always added to the charm of these Oxford meetings, and which is the best guarantee for that highest aim of our Congress the increase and the widening of the knowledge of all its members.