nearer the retina the eccentric visual rays are more excluded; (7) and most important, the more extended use of the eyes obtained by the patients; in all cases a new world having been opened to their view. Detachment of the retina has not occurred in any of these cases, and even if it should happen, the German statistics show that its occurrence is only in 5 per cent., and this is the percentage of cases of high myopia in which detachment occurs without operation. We will repeat the résumé given in our previous paper, which we have had no occasion to change:

**Resume.**

1. Surgical treatment of myopia should be limited to those cases over —12.00 D. who suffer great inconvenience from their correcting lenses. The ideal cases for operation are those of —17.00 to —18.00 D.

2. The operation is mainly indicated in young adults.

3. Cases having active disease and changes in the ocular structures, such as progressive myopia, chorioiditis, fluidity of the vitreous or detachment of the retina are not applicable.

4. The dangers of operative interference are more than counterbalanced by the results to be achieved, which are mainly, increase of visual acuity and of the visual field, and more extended use of the eyes which accompany diminishment of the refraction.

**The Causes, Prevention and Management of Myopia.**

J. Herbert Claiborne, M.D.

New York.

In presenting this subject for consideration, I feel that it is neither fitting nor just that I should discuss every phase of it. It is my purpose, however, to draw your fire, and in this way to have the subject thoroughly ventilated.

In the beginning, permit me to say that I shall discuss the management of myopia in those who are under the presbyopic age, for I conceive that it is during this period that we are confronted by the serious problems in the management of the shortsighted eye.

The initial proposition which I wish to set forth is: that the condition of emmetropia is the normal and natural refractive condition of the human eye. It is true that infants, as a rule, are born hyperopic, and, therefore, it must be true that if they happen to arrive at the condition of emmetropia, an elongation of the eyeball along its anteroposterior axis occurs.

Emmetropia, therefore, under these circumstances, is an acquired condition. Now, if it is the purpose of Nature that all infants should be born hyperopic, it must be her purpose further either that the growth of the eye anteroposteriorly should cease at this moment at which the emmetropic length is attained, or that the final destination of the eye should be myopia.

Since no thing or condition in Nature is stationary, it follows that constant change in the length of the eyeball is natural, and that the condition of emmetropia is a fleeting and a transitory one. This line of reasoning places our philosophy almost in the realm of transcendentalism, and it is the basis of those who claim that the ideal eye is hyperopic; that emmetropia is a step, an intermediary one indeed, if not the first step toward myopia. I can not accept this interpretation as a practical basis, and I feel compelled to regard the emmetropic eye as the ideal one to which all eyes that differ from it should be reduced. This conclusion is not strictly logical, but is eminently practical, and is necessary in this discussion.

I regard the myopic eye as a vicious, diseased organ, with a constant tendency to increase in its anteroposterior diameter. It is likewise more subject to structural changes at its posterior pole than other eyes. It is a part of a reasonable therapeutics, therefore, to prevent the occurrence of myopia, to prevent its increase when it has occurred, or to reduce its increase to the minimum.

As has been stated, the physical cause of myopia is the elongation of the eyeball in its anteroposterior axis. The causes of this can be divided into those which are predisposing and those which are direct.

Permit me first to refer to the direct cause. I think it is safe to say that two theories are held on this point. One may be called the accommodative hypothesis and the other the convergence hypothesis.

Antecedent to the paper of Foerster, which appeared in *Knapp and Schwerger's Archives*, in 1884, the accommodative hypothesis had universal sway; but in 1884 Foerster set forth the reasonable claims of the convergence hypothesis as opposed to the accommodative hypothesis, in explanation of the cause of the development of myopia.

For my own part, I can not see how any one can adhere to the accommodative theory, either on the ground of philosophy or practical experience. In discussing the relative merits of these two theories, Foerster pointed out that if the elongation of the eye were caused by the muscular action of the tensor of the choroid, myopia would carry with itself its own infallible and invincible remedy; for the simple reason that work demanded of the accommodative apparatus decreases as the myopia increases. All this ceases the moment we look for the origin and increase of myopia in the excessive convergence of the visual axes. As the nearsightedness increases, the convergence of the visual axes increases, while simultaneously its claims on the tensor of the choroid decreases, which is practically the corollary to the initial proposition.

The persistent increase of myopia the moment it has attained a relatively high degree harmonizes, therefore, precisely with the increased angle of convergence. Foerster discarded the accommodative theory, and plainly pronounced himself in favor of the convergence hypothesis. His article contained the histories of a large number of cases which tend to support his views.

In convergence of the eyes for a near point there is pressure on the sides of the ball by the external muscles, and the nearer the object looked at the greater is the pressure. At the same time, there is necessarily a determination of blood to each eye, in conformity with that physiologic rule which demands the presence of a greater quantity of blood during physiologic activity than during physiologic rest. Unquestionably, then, these conditions might reasonably tend to produce myopia.

We are, perhaps, in some respects indebted to Von Graefe for the accommodative view of the cause of increase in myopia. He observed that in the effort to accommodate there occurred an increased pulsation of the retinal veins. He reasoned from this that the active condition increased interoculai tension and thereby conducted to increase the length of the ball.

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*Read at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Ophthalmology, and approved for publication by the Executive Committee: Drs. J. A. Lippincott, Frank Alport and John E. Weeks.*
That the eyeball itself should be increased in length by the act of accommodation in which there is a pull from the front on the back of the globe by an interior structure, is to me as unreasonable as that a man should be able to raise himself from the ground by pulling on his boot straps. I, therefore, accept the convergence hypothesis as the only reasonable one extant for the direct cause of increase in the length of the eyeball; and it is on this basis that I purpose to treat this subject.

It has been stated that the majority of eyes at birth are hyperopic. I think it is not straining a point to say that all eyes that are not macrophthalmic are hyperopic at birth. If the condition of myopia is to arise in these eyes, of course the condition of emmetrope is to be attained first.

Myopia rarely occurs in very early life; very rarely, indeed, does it occur under five years of age. And, in fact, I believe it can be said that in a large majority of cases it occurs after the child has commenced to use its eyes at school. The active study involves convergence of the visual axes; but I do not believe for one instant that this act alone will produce myopia. This reflection leads me to consider the predisposing causes of myopia.

I fancy no one will deny that myopia is particularly apt to occur in childhood after one or more of the exanthemata. I think scarlet fever and measles can be cited among these as claiming the largest number of victims. Subsequent to these diseases, the vitality of the patient is very much lowered. The entire muscular power of the body is diminished and, I think, particularly the accommodative power. The natural impulse to convergence degenerates into an effort. Along with that comes the congestion of tissues whose vitality has been weakened.

Most children are inclined to hold their books nearer than is necessary, and the younger the child, the nearer is the book apt to be held. The squeezing of the lateral muscles supplemented by congestion of naturally yielding tissues incident to childhood, fulfills the necessary conditions that favor the increase in the length of the eye. I cite the exanthemata because they, I believe, are the most frequent of the predisposing causes of myopia in childhood, and I cite them as types. Similar causes will produce similar conditions.

It is an accepted fact that heredity is a predisposing cause in the development of myopia. If a mother or a father in a family be myopic, and there are several children, myopia is most likely to develop in one or more of them. And it appears to be a fact, in my experience, that the mother is more apt to transmit myopia than the father.

Illumination and a proper text for books may be cited here. In schoolrooms the desks should be so arranged that the light, if possible, should always fall from the left, for obvious reasons. Moreover, the inclination of the desk should be such that the visual lines from the eyes when the head is held in almost an erect posture should strike the plane of the desk at right angles. This will obviate and possibly remove the habit so many children have of bending over their books.

This leads me to mention the importance of posture. The head should not be bent; it should be held almost erect; and the book, if it is read in the hand, should be held in front of the eye, and very nearly on the same plane as the eye.

The character of the illumination by night I conceive to be of the greatest importance. I can not condemn too strongly the use of the unfrosted electric bulb, which permits the eye to see the carbon wire. This, under all circumstances, will produce an after-image which is wearisome and irritating, and produces congestion of the entire ocular structures. If the electric bulb is used, and the bulb is within the field of vision, it should be at least frosted so that the carbon wire can not be seen.

I also desire to register here my condemnation of the Welsbach white light, which produces an exceedingly fierce light, in which I can not fail to detect some of the blue elements of the spectrum. This light is to me exceedingly disagreeable and produces distinct discomfort when used as an illumination for reading.

The best illumination for study, in my opinion, is the so-called German student's lamp, or the Argand gas burner, over which a green shade is placed. The source of illumination should be toward the left of the individual and below the level of the eyes, so that the light is reflected on the paper and again reflected to the eyes.

The slightly yellow light of the oil lamp, and even the Argand burner, give a wave length which is apparently grateful to the eye; and further it is from the red end of the spectrum, without becoming green, the more grateful it appears to be.

The characteristic text of our schoolbooks and other books is gradually becoming larger and the linear spaces greater. There is to-day no longer any need or necessity for the small forms of print, and it will be an advantageous thing for the human eye when they have been relegated to the historic past.

I firmly believe that the high percentage of myopia in Germany is due as much to the universally abominable illumination there as to the German type. Luckily, nowadays, a large number of the German scientific books are being printed in the Latin text, and if the homes of the people could be illuminated so well even as the homes of our poorer classes, I believe there would be seen a diminution of myopia in Germany in the near future.

As a matter of course, an attempt to read in a reclining posture is a frequent cause of the increase of myopia. In this position there is the greatest possible strain on the lateral muscles.

Any general systemic condition which is inclined to cause congestion of the head tends to favoring the production of myopia; eminently, for example, constipation; and in early childhood this irregularity should be carefully watched and abated.

Owing to the vigilance and wisdom of our surgeons in this country, much has been done to prevent conditions at school and in home life which lead to the production of myopia in our children. A continued crusade along these lines will effect still more beneficent results.

Heredity, however, is harder to be combated, so far as it itself is concerned. But it behooves every intelligent surgeon who has under his care children with this predisposition to lay down the most rigorous rules for the care and conduct of the eyes of such children.

During convalescence from any form of sickness, children should not be permitted to go to school until all symptoms and signs have disappeared, and until they have regained their former strength and vitality. Even then their study should be graduated in quantity, and the number of hours of study should be cut down.

In this connection I can not refrain from condemning that which is so prevalent to-day in our schools,
TREATMENT OF MYOPIA—CLAIBORNE.

JOUR. A. M. A.

The treatment of children of demands inconsistent with reason and their ability, so that by the time a girl or a boy retires for the night, she or he has in one way or another employed the eyes from eight to twelve hours a day. Physicians should instruct parents and families in this matter; and the sight should be spared at the expense of useless and superfluous information. A fair amount of knowledge and perfect eyesight is preferable to extraordinary knowledge with strained eyesight and amblyopia.

The matter lies more in the hands of the general practitioner than in those of the specialist, for it is to the latter that the victim first comes.

Let us, then, assume that myopia has arisen in a child under the age of 15 years. What course should we pursue? So far as the correction of the refraction is concerned, three courses lie before us: the total correction of the myopia, the under correction, or no correction.

The total correction of this error is demanded on the convergence hypothesis, and is directly contraindicated on the accommodative hypothesis. Conversely, the under correction of the error or its non-correction is demanded on the accommodative hypothesis and contraindicated on the convergence hypothesis. Which one is to be pursued? It is fair to assume that this treatment is the best which is dictated by reason and fortified by statistics and authority.

I have already declared myself a distinct believer in the convergence hypothesis, and have given the reasons for my belief; therefore, by virtue of opinion I am compromised to the convergence hypothesis and the treatment by full correction. I shall not consider the question of non-correction at all. It appears to me that sufficient statistics have been compiled even at present in favor of the convergence hypothesis to demand the earnest attention of those who oppose it, if not to bring conviction, as to its correctness. The weight of authority, I believe, today is in favor of full correction. In the Heidelberg Congress of 1901, the majority of those present spoke in favor of full correction, and it is my ardent desire that a full discussion of this important subject should set forth the views of all those present. Dr. Edward Jackson has presented to this Society the results of his investigations along these lines as far back as 1892. He reported the histories of 92 cases treated by full correction—the average period of observation for each case being about 1/2 years. In these cases there were 123 eyes, one being blind with congenital cataract. During the above-mentioned period of time, 93 out of 123 eyes remained practically unchanged in the matter of refraction. In 10 eyes there was an increase, .50 D.; in 3, the myopia was diminished, .50 D.; in 13, the myopia increased more than .50 D., the average being 5.15 D.; in 4 eyes, the myopia was diminished more than .50 D., the average being 1 D. The visual acuity diminished in 6 eyes to a very slight degree; in 16 the visual acuity was markedly increased, and in a few it was doubled. These statistics have latterly been supplemented by others equally striking.

Over against these let us place those of Schreiter, Roscher and Meyerhof, in uncorrected or under-corrected myopia. Their patients were mostly under 20 years of age. Schreiter found less than 21 per cent. stationary in an average of 6 years of observation. Roscher found 39 per cent. of non-increase and Meyerhof 38 per cent. The latter two had their patients under observation for about four years. If one compares these statistics with those of Jackson, in which 75.6 per cent. remained stationary, such figures will carry their own weight and need no support.

These facts are supplemented forcibly by the statistics of Pfalz and Heine, presented at the Heidelberg Congress in 1901. The statistics presented by these men were overwhelmingly in favor of full correction. Fuchs, von Hippel, Axenfeld, Uthoff and many others spoke in favor of full correction. When we remember that the former treatment of under correction or no correction of myopia found its greatest supporters among Germans, the incident becomes singularly significant.

Knapp has expressed himself in favor of full correction of myopia when there is good vision and no fundus changes present.

Over against this weight of evidence stands the views of Koenigshofer, who is a strong advocate of under correction.

Liebreich has expressed some original views as to the physical cause of myopia. He considers it due to increased interpupillary distance caused by a separation of the orbits. He claims that this bony malformation produces a disturbance in the correlation between accommodation and convergence which, of course, causes an increase in the angle B. He thinks total correction achieves good results only in those cases in which the angle B is either very small or normal.

It is safe to say that sufficient statistics have not been brought forward in this matter, and herein is a loophole for the disciples of under correction. It is hoped that the interest in the matter will be so stirred that careful statistics of all cases of myopia under treatment will be compiled, and the principles at issue be settled beyond peradventure.

Widmark of Stockholm has called attention to the influence of corneal opacities in causing an increase of myopia when it is present or its production when astigmatism is associated with the opacities. He has observed, however, that the production of myopia or its increase generally occurs in that eye which is free from opacities, and in case there is astigmatism in each, he has observed that myopia arises in the less astigmatic eye. While he favors the convergence rather than the accommodative hypothesis, he conceives that myopia produced by opacities of the cornea, as above described, can not be explained on the convergence hypothesis. It appears to me that his observations were strong proof in favor of the convergence hypothesis. The opacities in the cornea induce the patient to hold the work nearer to the eye; this perforce increases the convergence of the visual axes and excessive congestion of the better eye—ideal conditions for the production of myopia on the basis of the views expressed in this paper. His conclusions seem to me to negative his reasoning and his observance.

Foerster concluded that three things were necessary in correcting myopia: the first was a full and proper correction, the second, the proper position of the eyes in work, and the third, the use of abducting prisms to force the near point outward in binocular vision.

The first two propositions are eminently reasonable, but the third I consider superrogatory, and this latter suggestion of his is characteristic of all those who propose new ideas. It seems reasonable enough that there should be a full and complete correction, but the use of abducting prisms points, in my opinion, lies in the direction of overdoing the matter.
For my own part, I regret I have not kept my records carefully enough to enable me to back my opinion concerning the full correction of myopia, by statistics. Yet, after all, statistics are in many ways deceptive because it is practically impossible to collate uniformly similar cases. The weight of the evidence, in my experience, has been overwhelmingly in favor of full correction, though I do not think the rule can be said to be hard and fast.

I commenced to give the full correction in myopia in 1886, and I have continued to do so under proper conditions to this date. It requires no patriarchal experience to remember the day when the full correction was never given and when even the myopic laity entertained definite views on the subject. To-day at times one meets patients who still give some evidence of their attachment to those views.

It has frequently happened to me to be compelled to combat these views in the mothers and fathers of children—so strongly and widely was the old idea of under correction promulgated by the elder practitioners. It is not possible for me to say to what degree I correct myopia in all cases. Each case I consider a law unto itself. I have known some people, even adults, who accept and wear with perfect ease for distance, glasses which would not for a moment be tolerated by another with an equal error.

Suffice it to say, I correct myopia in children to the limit, if possible, and I force them to wear the glasses for reading and for near work. I consider this necessary in low degrees of myopia as well as in high. Now, I do not mean that every individual should be forced to wear the full correction glass which is indicated by retinoscopy or the direct method, but he should be made to wear the weakest glass found by the test case with which he gets the best vision with the most comfort; this I consider full correction.

It is obviously absurd to force on a patient a correction which is estimated by objective methods of examination alone. The functional method with the test case is the crucial test, and its decision should guide us. There must, however, be a reasonable relationship between all methods.

In those cases in which the degree of myopia in the two eyes differs considerably in amount, it is my custom, as a rule, to give the glass which corrects the less myopic eye to both eyes. I find that this is uniformly more agreeable than correcting each eye separately. This can hardly be said to be full correction in a true sense, but it amounts to that, and is in the way of my rule, viz.: the weakest glasses which give the best vision with the greatest comfort to both eyes.

Of course, the far point should always be thrust as near as possible to infinity, i.e., to say to twenty feet. But in the majority of cases it is not well to give the stronger glass if a weaker glass will give the same visual result, because the sharper visual image furnished by the stronger glass causes the patient discomfort. I do not believe that the cause of this lies in the increased accommodation. I believe it is an inherent quality in some retina. It is obvious, then, that the weakest glass which gives the best vision compatible with comfort is the strongest glass which will be tolerated. I am accustomed to ask the patients if the glasses feel "soft." This word seems to convey the proper idea to them. There seems to be a uniform conviction that full correction ought not to be worn where fundus changes, particularly choroidal ones, are present. For a long time I held this to be an exception to my views of full correction, but one case which I shall relate has caused me to give as full a correction as possible in many of these cases.

A woman, aged between 35 and 40, had a high-graded myopia with extensive posterior staphyloma in each eye and marked changes at the macula in the left eye. She had been under the care of a surgeon in one large city, but the surgeon entertained old views about the correction of myopia. He cautioned her against any correction at all, but gave her a weak pair of lenses with which she could see very little better at a distance than without any, and told her to read without glasses. She could not enjoy the pleasures of reading, nor the theater, nor could she go about the streets by herself without great danger. This had persisted for at least ten years. The loss of sight, and particularly detachment of retina, was held up to her as a check on her ambition to be more comfortable, and so she sat and held her hands. In her right eye she had 20/30 vision with —11 D.S.,—1. S.D. with ax. 90°; in her left, 20/200 vision, with —11 D.

After the use of atropin for a week, I gave her the above correction for distance, and at the end of another week I gave her a reading glass; in the right eye, —7 D.S. C —1, 7 D.S. The cylinder correction, and in the left, —7 D.S. She tolerated both glasses well and has worn this correction for five years. At first I determined she should increase her reading gradually in this wise: the first day she was to read fifteen minutes, the second thirty minutes, the third three-quarters of an hour, and so on until she had attained two hours of steady reading. I was rigorous in this particular, and I customarily give these instructions to cases in which there is a high degree of myopia, and in which the full or the best possible correction has not been worn before. This lady, emboldened by the ease and comfort with which she sees far and near, has regularly taken each summer since a course at a summer university. Her whole method of life has been altered, and she is grateful. She was of uncertain age and so I gave her a reading glass. If she had been ten years younger I verily believe she would have accepted the same glass for distance and reading. Before the correction she was wont to have photopsies and musec volitantes. These symptoms practically disappeared under correction.

I am inclined to think that some lay too much stress on the matter of choroidal changes in the correction of myopia. I believe it is always well to proceed with such cases cautiously, and it is my custom to use a mydriatic for some time before prescribing, but I do not believe that the tension on the choroid necessarily caused in the act of accommodation has so serious an effect as is ordinarily believed. This case supports my views on this point fully, and I have had many similar ones in my practice.

As to the use of a mydriatic, I hold that it is well in all cases of choroidal lesion to employ atropin sulphate, and when the eyes have been kept in a condition of physiologic rest for an appropriate time to discontinue its use, and give the correction according to the principles I have set forth.

As to the use of homatropin, it is my custom to use this agent in simpler cases in which there is spasm of the accommodation or the asthenopic symptoms are particularly marked. I believe that the use of a mydriatic in all cases is not necessary. I also believe that a skilful ophthalmoscopist can, in the great majority of cases, adjust the glasses correctly without its use. Per contra, I believe the use of homatropin in every case will do no harm and will lead more nearly to a correct adjustment. In some way I conceive that the constant and uniform use of homatropin is a refuge for the unskilful.

It is always my custom to make first an approximately quantitative diagnosis with the skiascope, to cor-
DISCUSSION ON MYOPIA.

8. The far point should be thrust as far as possible toward infinity, but, at the same time, it should be compatible with the best vision and the greatest comfort.

39 West Thirty-sixth Street.

DISCUSSION
ON THE PAPERS OF DRS. WURDEMANN AND BLACK AND CLAIROBE.

Dr. Edward Jackson, Denver—No fixed rules can be laid down, in my opinion, as to what cases are suitable for operation and what cases are not, and a very definite opinion on the advisability of operation can not be given in any case until it has been repeatedly seen and studied and the test lenses tried. I have so often seen lenses of 18 and 20 diopters worn with comfort for years that my experience with removal of the clear crystalline lens has been very small. I think, too, that the indications can not be stated very definitely, as any rules will have so many exceptions that they will lose the value of rules. Fundus changes are not necessarily a contra-indication. If they are so extensive that perfect focusing of light on the retina will not give any improvement of vision, probably there would be no reason for an operation. If the eye is not in a good condition for operation, as having a recent choroiditis, or recent hemorrhages, an operation should not be done at that time. With reference to the vision, we can expect a certain improvement from the effect of bringing the nodal point forward from the retina by the operation; and that becomes a very important indication in cases where the acuteness of vision can be brought up by lenses to 1/6 or 1/8. If you can get vision of 1/6 or 1/8 with the lenses and the operation is successful and the case goes smoothly, there is a probability of bringing up the vision to a point where it will be very useful. Vision much lower than that, however, may be improved so as to be of great benefit. As to the effect of operation on refraction, it may be expected to increase for some months and sometimes for some years afterward. If myopia remains it will be still further reduced and if hyperopia, it will become greater. That corresponds to what occurs in cataract extraction. Diminution of refraction goes on after the changes of astigmatism have ceased. As to the methods of operating, one point should be emphasized; that is the care in making a moderate or small incision to commence with. While the effect of this on some eyes may be very slight and may even be some what injurious, if a great deal safer. I have had to take out for sympathetic ophthalmia an eye that had been lost by an operation for the removal of the lens. While I did not do the original operation, it was a free discussion and was followed in twenty-four hours by severe swelling. Of course, if one be prepared to deliver the lens at any time after discussion the serious damage may be obviated. Still after acute swelling the eye is not as in good condition for the removal of the lens as when the lens has been allowed to become opaque slowly. If the lens must be removed as soon as possible, it is better and safer to remove it without any discussion whatever, even though a subsequent operation has to be done.

Dr. A. B. Hale, Chicago—In my clinical work about 38 per cent. of the cases are myopic, as many of them are Russians and Poles. I have ten cases of operation that I have not yet reported in which the results have been very good. Where Dr. Black gives the percentage he forgets that many cases of postoperative prolapse do not go into the records at all. I saw six cases last summer of postoperative prolapse that were not reported and heard of six others. Axenfeld, in a personal letter, says that he is not satisfied with the reports for the first six months, but is inclined to wait for one and a half or two years, as he had one prolapse two years after operation. I think we must accept statistics with a little less cheerfulness than they are presented to us.

Dr. H. D. Bruns, New Orleans—In about 2,500 cases of refractive operations we have operated seven times for the removal of the lens in high myopia. I reported three of these in the American Journal of Ophthalmology, 1898 and 1899, under the heading of "Cases from the Clinic." It seems to me that the greatest value of the operation is prophylactic. There is little chance of keeping a very high myopia in a young person stationary and we
have the greatest opportunity to rescue these individuals from helpless middle age, with the oncoming of cataractous changes later; and we all know how unfortunate operations on such catacts are. All of my operations but one have been in patients under 18 years of age; that exception confirms what we have all been apprehensive about, the pathologic changes not being a contraindication. The discussion was done to relieve the dull, incessant pain of a highly myopic eye with posterior staphyloma in a woman of 35. I operated in 1897 and the patient some years afterward was entirely free from pain, the disease had made no further progress and she was well satisfied with the result. I agree fully with what has been said about the modernness of the discussion and I think it holds true of all discussions. It is well to make a small discussion and wait to see how the eye will tolerate it. I prefer safety with length of time to the loss of a well-seeing eye which I have counseled the patient to have operated on for his future good. That makes the loss of an eye a calamity indeed. The only case in which there was a bad reaction was one operated on by one of my assistants, which had to be extracted. The lens was too much broken up in the discussion. A month of iridocyclitis followed. The patient was a little child 12 years of age with good eyes, except that she had 14 diopters of myopia and she experienced such a bad that I have never since been tempted to try to gain time at the expense of absolute safety.

Dr. Melville Black, Denver—It seems to me that Nature makes a strong effort in high myopia toward prophylaxis that should be recognized. There is a tendency in all these cases to divergence due to inability of the interni to swing the eyes in. It would seem to me that it is well to recognize this effort on the part of Nature and not try too much to overcome it by giving the patient binocular single vision. I have operated recently on a case with 20 diopters. It will not be my policy to operate on the other eye, for I prefer to have in this case as much disassociation of the eyes as possible. It will be impossible in this case for the patient to use the eyes together. I have given nothing for distance over the eye operated on, but have corrected the other eye by a minus 14 diopter lens, which can be worn for near work; thus the patient uses the eye operated on for distance and not the eye operated on for near work. I think that will tend to reduce the probabilities of increase in the myopia.

Dr. J. P. Fulton, St. Paul—I am so pleased with the results of discussion that I do not see why extraction should ever be attempted. It is wonderful how rapidly the lens will be absorbed. Success consists in being extremely careful in the original discussion. After that you can tear up the anterior capsule freely. The few cases I have operated on have been extremely satisfactory.

Dr. H. Moultin, Ft. Smith, Ark.—I believe in the full correction of myopia, but in cases in children we must secure the cooperation of the parents. Many parents do not do enough close work to understand or appreciate the insistence on suitable light and places of study for the children. It is difficult to get them to follow out our directions properly.

Dr. Oscar Donn, Chicago—For the last few years I have been correcting my myopic cases in full and find that they are not only more comfortable, but, in following them up and having them come back for examination, six months, I find that nearly all remain stationary, while those cases I operated on which were not fully corrected made much greater changes. One point to be insisted on, I think, is the careful correction of the astigmatism. I had a case of high myopia not very long ago a man 39 years of age, that had been refracted by an oculist ten years before. In the course of a year he lost his reading glasses and had worn those intended for distance, 32 D. I found that he took a —22 D. in one eye and —24 D. in the other, and in the distance sufficiently well to read the names on the street cars. I advised removal of the lenses, but at his age I was careful about promising a good result. He preferred to get along with an occasional use of the distance glasses.

Dr. G. E. De Schweinitz, Philadelphia—In all important particulars I agree with Dr. Claiborne. I believe that young persons under 25, with good vision and a moderate degree of myopia (under 6 D.) should wear the full correction of their refractive defect constantly, if accommodation is ample and no signs of fatigue are present. The same rule is applicable to patients until they reach those years when accommodation must necessarily receive help, or when examination shows that the angle of the eye is too small for accommodation. To try to improve the fixation of the patient's life. I agree with Dr. Jackson that full correction is the object to be attained for young persons with normal visual acuity and binocular near vision, no matter how high their myopia, provided the lens selected shall not be an over-correction when brought close to the eye. I fully understand that there are many exceptions to these rules, and that each case must be studied and decided on its own merits, but other things being equal I consider it a positive misfortune when the young people first come under the correction of their myopia they are so frequently given the so-called under-correction, because once under-correction having been given, it is difficult to alter it to a full correction, and a full correction, within the limits already stated, is the best safeguard against the increase of myopia, when worn with proper regard to the hygiene of the eye and the body generally. My experience in the removal of the clear crystalline lens for the relief of high degrees of myopia has been a limited one, but entirely favorable. I have been able to operate on patients selected by discussion first, followed by extraction. The really brilliant results which I witnessed in Dr. Bruns' clinic to-day have well-nigh persuaded me, however, to pursue his method of repeated discussions.

Dr. Learstus Conner, Detroit—All school children are subject to about the same conditions, and yet only a few develop myopia. Why is it? My explanation is that some unknown factor of nutrition exists in the eyeball in these particular persons by which the disastrous results develop. We should, of course, endeavor to remove these so far as we can.

Dr. Allen Greenwood, Boston—I think these cases should always be refracted under the complete mydriasis of atropin.

Dr. John E. Weeks, New York—Although the accommodation theory may not, perhaps, be logical, certain cases come before us that are difficult to explain in any other way. I have in mind a family of five, the father and four children. The father had a myopia of 10 diopters with astigmatism of about 2.50 D. in each eye, with some floating opacities in the vitreous. The eldest son had a myopia of about 5 diopters with astigmatism of 1.50; the child next in age had a myopia of about 2 diopters with some astigmatism; the third, hyperopic astigmatism of 1.50 to 2 diopters, and the fourth, hypermetropia with astigmatism. In each case there was progressive posterior staphyloma. The error of refraction was corrected as completely as possible. This was about seven years ago. The father died about three years after the examination was made and his myopia had not increased. The children have been under observation ever since, and with the exception of about .50 diopter in the oldest boy the refraction has not changed. This is not an isolated instance in my practice. I have not infrequently found that the correction of the error of refraction arrested the process in cases in which staphyloma posterior or schelerochorioiditis posterior was progressive. Although convergence may be chiefly instrumental I do not believe it is the whole cause. As to the removal of the lens in high myopia. I have operated a number of times; I shall hereafter operate by small dissections at first. I shall do linear extraction only in those cases in which I am compelled to do it. It is, as Dr. Bruns has said, a great calamity to lose an eye after advising removal of the clear lens. Operation by dissection and subsequent linear extraction is safer than primary extraction.

Dr. N. M. Black, Milwaukee—I thoroughly agree with Dr. Bruns in doing small repeated discussions and not attempting linear extraction unless indicated; one exception, however, can be made, in the case where the lens is becoming cataractous; in that case linear extraction is justified. As to operating where there is disease of the fundus I think the patient should first undergo a certain amount of treatment.

Dr. J. H. Claiborne, Jr., New York—Dr. Thompson taught the full correction of myopia some twenty years ago. I was not aware of that until Dr. Bruns called my attention to it in
a note just now. I thought Forster was the first. As to Dr. Connor's question: I made mention of a case in these words a "relaxed condition of the tissues peculiar to some people." The negro has a characteristic expression for conditions of this kind, 'slack twisted people.' Such are persons of low vitality who are placed in unfavorable conditions. Some one has suggested that there should be full correction always under atropin. It is clear to me that if you take the refraction under atropin and then without you find a considerable difference. The eye will be more myopic when the atropin has worn off because there is a tonic action of the ciliary muscle that we can not get rid of. I can not accept that proposition as an absolute truism. I have observed a habit growing among ophthalmologists in speaking of "refracting patients," and I want to put it on record as opposed to it. A patient may be refractory, but can not be refracted. We should eliminate that expression from our nomenclature.

RESEARCH PROBLEMS OF PHARMACOLOGY. a
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The main object of pharmacology is to supply a basis for rational therapeutics. The entire medical profession has always been in accord as to the desirability of this end, but the methods of pharmacology did not at first secure universal recognition. This prejudice against laboratory experiments has now practically disappeared, partly through the advance of medical education and partly through mutual concessions. The modern physician realizes that rational therapeutics can not be based solely on bedside "experience," but must be based on the basis of imperfect and imperfectly observed and digested data. The phenomena in question are too complex to be understood by such primitive methods. They need to be studied by the most delicate and profound methods over which modern science disposes. This study constitutes a large part of the research problems of pharmacology.

PRACTICAL PROBLEMS.

These problems, which pharmacology must investigate in regard to every used drug, before rational therapeutics can rest on a sound foundation, are broadly as follows: The immediate and late, the direct and indirect, modifications produced by varying doses of the drug in every structure on which it may act, intentionally or accidentally; these actions as manifested in disease; the cause of these actions; the fate of the drug in the body; the chemical constitution of the drug; the effect of the constitution on the action; the possibility of modifying the constitution of active drugs and with this their action, with consequent improvements in the drug; and, finally, the effect of the simultaneous presence in the body of this drug with others.

Almost every pharmacologic research deals more or less directly with one or another of these questions, and considerable has been accomplished in this direction. The results are, however, altogether too scanty. To realize how far we still are from a satisfactory solution of these problems, you need only examine critically our present knowledge of even the most commonly used drugs, such as strychnin, and you will see that not a single of the above questions is answered as fully as our present experimental means permit. It is well to recall that we do not even know wherein the members of a pharmacologic group—such as the digitals or the bitters, the cathartics—differ from each other. As a further instance of our limited knowledge of very important points, it must be confessed that we know very little of the late changes produced by drugs and of the reactions which must in many cases follow their actions.

PROBLEMS REQUIRING CO-OPTION WITH OTHER MEDICAL BRANCHES.

To obtain satisfactory solutions of these problems, pharmacology must undertake, in the first place, a more detailed study of the therapeutic and poisonous actions of important remedies, such as aconite, alcohol, anti¬pyretics, antiseptics, arsenic, caffeine, cathartics, chol¬agogues, dietaries, digestive ferments, digitalis, diuretics, ergot, gelatin (as hemostatic), hydrastis, iodides, iron, mercury, quinin, strychnin, saline infusions, etc. These should be investigated not only by laboratory experiments, but also on carefully diagnosed and observed cases at the bedside. For this a correct diagnosis and understanding of the pathologic condition are prerequisite, and the slow progress of therapeutics is partly due to the deficiencies in this respect, deficiencies which the leaders in these branches are the first to acknowledge. However, it should be possible, even with the present conditions, to state the problems to be investigated that the answers should be clear and decisive, and that the results of different observers would be comparable.

It is in this connection, in directing and co-ordinating clinical inquiries, that the older, experienced practitioners could do invaluable service in advancing pharmaco¬logic research. Very great benefits are to be expected from the reorganizing hospitals for this purpose, for there are at present very few hospitals in which the experimentalist can co-operate with the clinician. As an instance, there are very few which have the laboratory facilities to make the most ordinary observations on metabolism; nor have they on their staff any men prac¬ticed in such work, or even nurses or orderlies who are trained in collecting the material properly. The limits of the thermometer, microscope, hemoglobinometer, hemocytometer and thermostat; and of test tube and burette work, have been pretty well exhausted. To make real advance, the hospitals must have added facilities, and must have a man or a staff who can devote themselves to the scientific work, without distraction by routine duties lying outside of the scientific scope.

This would also give opportunity for applying pharma¬cology to the investigation of the nature of disease. It must be remembered that both in pharmacology and in pathology we deal with altered cell metabolism. It is often merely a matter of convenience under which science we class a given phenomenon. Toxin-tetanus, diphtheritic paralysis, diabetic coma, and many other forms of disease are strictly intoxications. The meth¬ods used in their investigations must be essentially those which have proved so fruitful in the pharmacologic laboratories. All the diseases due to toxins, as also uremia, scurvy, rickets, gout, nephritis, indigestion, etc., need to be investigated in this spirit. This fact is not yet suffi¬ciently appreciated. Natural and acquired tolerance to poisons is another subject in which the pathologist, clinician and pharmacologist can co-operate; but in this field pharmacology is particularly behind. We know less about the mechanism of tolerance in the case of drugs, as morphin, nicotine, alcohol or atropin, than in the case of bacterial toxins—although even here our knowl¬edge is not exhaustive.

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