should be given sufficient antisyphilitic treatment to maintain a negative spinal fluid Wassermann reaction.

QUERIES

1. Does the predominance of the male occur because the lumbar spine is more liable to injury and because men are more liable to trauma, or because the large percentage of cases of tabes are in the male?

2. Is the lumbar puncture or the intraspinal method of therapy accountable for some of these cases?

3. The fact that the temporary paralysis has been markedly increased immediately after intravenous injections of arsenical preparations leads to the further query as to the pathologic condition accountable for the spinal arthropathies. Dr. Billings is of the opinion that intravenous injections of arsenical preparations are a cause of endarteritis.

4. Surgical intervention in a case of spinal arthropathy appears to us to be a debatable question. Might not the traumatism inflicted by the operative procedure act unfavorably on these already disorganized vertebrae?

ADVANTAGES OF THE USE OF MINUS
CYLINDERS IN ROUTINE
REFRACTIONS *

JOSEPH D. HEITGER, M.D.
LOUISVILLE, KY.

Though I may not be able to inform men more than they know, yet I may be able to give them occasion to consider.—
Sir W. Temple.

In the last decade, from conversations with various persons at our special meetings, I have been impressed by the general diversity of opinion regarding the use of minus cylinders in routine refractions. From what I have been able to deduce, this difference of view is largely due to a failure to employ the principles of physiologic optics involved in the geometrical figure of the conoid of Sturm, coupled with the faulty use of astigmatic charts or the use of charts which were at fault in proper construction or, when astigmatic charts were not used, failure to grasp one of the first fundamental rules of refraction: "As much plus or as little minus spherical power as the patient will accept, combined with the weakest minus cylinder, simplifies the work of refraction and insures accuracy without waste of time."

From this chaotic state of affairs there has been a tendency, in the words of Pope, "to damn with faint praise, assent with civil leer, and without sneering teach the rest to sneer."

So much has been assumed in most that has been written in the past that being led astray has been a natural consequence. Details on which accuracy depends have been conspicuous by their absence. As a flagrant example of such I would call attention to a short paper by Dr. Ernest Maddox¹ of England, entitled, "Some New Tests for Astigmatism." In the description of the charts for the "V" and arrow tests, no idea of the method of obtaining the best contrast between black and white is given; the length and width of the stripes are not mentioned, and in addition an

interpretation of one phenomenon is entirely at fault, if our principles of physiologic optics are to be credited.

In the consideration of any subject it is always illuminating to hark back to original sources, and I would invite attention to the writings of Young, Airy, Whewell, Helmholtz, Fick, Sturm, Knapp, Donders, Landolt, Green, Sr., Gullstrand, Duane, Hardy, Sheard, Lancaster, Jackson, Potter and John Green, Jr. I acknowledge my indebtedness to these sources for the fundamental principles contained in this paper, realizing that the harvest in these old storehouses of ophthalmologic knowledge is too vast to do any more than touch the high points in my efforts to bring up the subject for discussion.

Donders was perhaps the originator of the employment of cylindrical lenses in the treatment of astigmatism. His methods of examination were mostly subjective, and included the point of light test, the stenopeic slit, visual acuity test with Snellen letters, and astigmatic charts as developed and perfected by Dr. John Green, Sr., who was carrying on his investigations with Donders and Snellen in the early sixties. It is particularly appropriate and fitting that this subject, which interested him so greatly, should again be brought forward at a meeting in this city, which was his home for many years.

The point of light test with a spherocylindric lens combination and a movable screen will develop the well-known conoid of Sturm. If one takes a convex spherocylindric lens combination, such, for example, as a plus three diopter sphere with a plus three cylinder axis 90, a beam of light from a distant source, say 20 feet, will be thrown on a small screen held behind the lens as a luminous patch of light, changing shape with the shifting of the screen. If the screen, such as a piece of cardboard, is placed 16.66 cm. back of the lenses, a vertical band of light will be formed which is known as the anterior focal line. As the screen is moved farther back, this vertical line gradually changes into a prolate oval, then into a circle, called the focal circle, then into an oblate oval, and finally into a horizontal band of light. This horizontal band of light will appear most distinct when the screen is 33.3 cm. the focal distance of the sphere only behind the lenses. It will be noticed that the anterior focal line is shorter and more distinct than the posterior focal line; hence an image formed at the anterior focal line is less blurred and smaller than one formed at the posterior focal line. The distance between the anterior and posterior focal lines is called the interval of Sturm.

In the light of Gullstrand's researches, the conoid and interval of Sturm with the diffusion images formed by a spherocylindric combination as described give us only a rough idea of astigmatic refraction, yet a thorough knowledge of this rough idea is essential to a full understanding of the finer details of astigmatism. What is true for ordinary lenses is still more true of the astigmatic refraction of the eye, which is a complicated affair. Gullstrand has shown that the diffusion images formed by a spherocylindric combination are not the regular lines and ovals as I have pictured, but more like stellate figures. The clearness of vision is determined not so much by the shape and size of the diffusion image as by the way in which the light is concentrated in the diffusion image. If the major portion of the light is massed in the center of the latter, the less distinct hazy area about this will be little in evidence, and a distinct image will result. No eye is so constructed that it

* Read before the Section on Ophthalmology at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

1. Maddox, E. E.: *A. J. Ophth.* 4:571 (Aug.) 1921.

will refract a pencil of rays in accordance with the classical conoid of Sturm, yet roughly we must realize that only so far as the refraction of the eye approximates this geometric figure can we correct its astigmatism with ordinary cylindric or spherocylindric lenses.

As Lancaster has well stated, the astigmatism of the eye may be analyzed into two portions: one which is so geometrically regular that it can be corrected by our geometrically regular lenses, and a remainder which cannot be corrected by any lenses at our disposal. For this reason more than any other, the examiner must possess a practical working knowledge of the conoid of Sturm. The importance of this will be brought out again later under the discussion of the use of astigmatic charts. A thorough knowledge of the relations between visual perceptions of test objects, power meridians and directions of axes of correcting cylinders is essential for accurate and rapid work, and these are best acquired by a study of the conoid of Sturm.

In such a study, the pupillary diameter assumes considerable practical importance, as the focal lines vary decidedly with pupillary diameter; i. e., the larger the pupillary aperture, the greater will be the lengths of the focal lines and the size of the circle of least confusion. It has been calculated that with a degree of astigmatism so small as 0.1 diopter, the anterior focal line will vary from 0.001361 mm., with a 1 mm. pupil, to 0.010888 mm., with an 8 mm. pupil. With a pupillary diameter of 4 mm. and an astigmatism of 0.1 diopter, the length of the anterior focal line is 0.0054 mm.

This length is very nearly double the diameter of a macular cone.

It is thus evident that even from a tenth to an eighth of a diopter of astigmatism should diminish the visual acuity when the size of the pupil is about the average, or 4 mm. When the error rises to 1 diopter with an average pupil, the lengths of the two focal lines are 0.023 and 0.025 mm., and each of these covers approximately ten distinct retinal elements. A diopter of astigmatism will therefore have a very distinct influence on the visual acuity. When the size of the pupil is reduced from 6 to 2 mm., the lengths of the focal lines are reduced in the ratio of 3 to 1 for the two conditions. This explains why an astigmatic eye sees better under strong illumination. A pupillary contraction which accompanies accommodation will considerably reduce the errors due to astigmatic images by diminishing the lengths of the focal lines. This influence of illumination and accommodation on pupillary diameter and lengths of focal lines should be constantly in mind when investigating astigmatism.

The farthest point at which fine horizontal and fine vertical lines are seen distinctly varies in astigmatic eyes. The far point for horizontal lines is, in the majority of such eyes, less than for vertical lines. A

similar difference is encountered in determining the near point of distinct vision. The difference here becomes more marked because the two determinations are not made under similar conditions of convergence. The greater the convergence, the greater the accommodation associated with it.

Two lines crossing at right angles in the same plane, one horizontal and one vertical, are not seen with equal sharpness. If the horizontal one is more distinct, the vertical, to be equally distinct, must be set at a greater distance from the eye; for, as we accommodate for the vertical line, the horizontal in order to obtain equal sharpness must be brought nearer to the eye. A similar difference is constantly maintained with each degree of tension of accommodation.

This asymmetrical arrangement of the points of the refracting meridians around one axis is of such a nature that the focal distance is shorter in the vertical meridian than in the horizontal. In order to see a vertical line acutely, the rays which in a horizontal

plane diverge from each point of the line must be brought to a focus on the retina; it is not necessary that those diverging in a vertical plane should also previously converge into one point, as the diffusion images still existing in a vertical direction cover one another on the vertical line. On the other hand, to see a horizontal line distinctly, it is necessary only that the rays of light diverging in a vertical line should unite in one point on the retina. Now, horizontal lines are sharply seen at a shorter distance than the vertical ones; therefore rays situated in a vertical plane which are refracted in the vertical meridian of the

eye are more speedily brought to a focus than those of equal divergence situated in a horizontal plane, and the vertical meridian therefore has a shorter focal distance than the horizontal. When one examines the diffusion images of a point of light, provided the eye under examination is not accommodated for the source of light, the correctness of this view becomes apparent.

Vertical focal lines make a clearer image of many letters than horizontal or oblique ones; hence, if the anterior focal line were horizontal it would not favor so clear vision as the posterior focal line, which in such an instance would be vertical. This has been well brought out by Dr. John Green, Jr.² Letters with vertical components distinct are more easily recognized than those with horizontal components distinct. One has only to render oneself artificially astigmatic with the rule and then against the rule, using the same cylinder, to appreciate the difference in distinctness of the same line of letters. With the latter condition, artificial astigmatism against the rule, there is a much greater interference with the legibility of ordinary printed type.

Fig. 1.—Appearance of Lancaster and Verhoeff charts when a 0.75 cylinder is placed before the lens of the focused camera.

2. Green, John, Jr.: *Tr. Am. Acad. Ophth. & Oto-Laryng.*, 1918.

One should remember that in an astigmatic eye the perception of a line, accommodation being eliminated, is good if the direction of that line corresponds to the direction of the focal line which is at the retina or nearest to it. This explains why it is possible to determine subjectively the axis of astigmatism by means of radiating lines of a properly constructed clock dial astigmatic chart, and measure its amount by use of cross lines at right angles with minus cylinders.

It is important to remember under such conditions as outlined that the clearest and most indistinct lines of the chart correspond to the focal lines of the eye; that the focal lines of the eye are at right angles to the meridians of which they are the respective foci, i. e., the first focal line is at the focus of the meridian of greatest refraction and greatest curvature and parallel to the meridian of least refraction and least curvature; the second focal line at the focus of the meridian of least refraction and least curvature and parallel to the meridian of greatest refraction and greatest curvature; the clearest chart lines correspond in direction to the most ametropic power meridian of the eye; hence the power of the cylinders is needed in that direction; the most indistinct lines of the chart correspond to the emmetropic or nearest emmetropic meridian of the eye; hence the rule that the axis of the correcting minus cylinder should be placed in a direction corresponding to the least distinct or blurred lines or at right angles to the most distinct or clearest lines.

The principles of physiologic optics so far mentioned are not only of scientific value but of the greatest practical importance in the investigation of astigmatism, and also afford us a common ground for discussion. We are fortunate in possessing several tests for astigmatism, both objective and subjective, so we are not compelled to rely on any one test.

The objective tests I shall dismiss for the moment with the statement that they are not only of great value but indispensable, and confine myself to the subjective tests, laying special emphasis on the astigmatic chart. Like all other things, the astigmatic chart has gone through various stages of evolution. The classic form of Javal's clock dial was adopted by Green and modified. Later came Noyes' selection of Green charts, the most satisfactory of which were the wedge-shaped radii narrowing to the center, with the companion double wedge crossing at right angles. Various other types of clock dials were developed featuring single, double and triple radii.

These were followed by Verhoeff's charts, one having concentric circles of fine lines with wider radii at 15 degree intervals, the other of wide lines at right angles crossed by finer lines. The latter chart is pivoted so that the cross lines can be set at any angle.

Next in this evolutionary development comes the Lancaster chart. It is to the latter that I desire especially to invite attention. Chart 1 consists of a square piece of heavy so-called wedding stock cardboard, 65 by 65 cm., on which a circle with a radius of 30 cm. is drawn. At intervals of 10 degrees, strips of black velvet baby ribbon No. 1 or No. 1½ and 20 cm. long are glued to the cardboard, extending from the periphery to within 10 cm. of the center. The finished chart appears as a rimless wheel of thirty-six spokes with a clear white center or hub 20 cm. in diameter.

Chart 2 is made of the same wedding stock measuring 45 by 45 cm. A circle 36 cm. in diameter is drawn on this square of cardboard, and the periphery marked at 10 degree intervals. A disk 36 cm. in diameter is cut from another piece of cardboard, and two diameters of No. 1 or No. 1½ black velvet baby ribbon are glued to this disk at right angles. The disk is pivoted to the marked circle so that it may be rotated to any desired position.

These charts have several advantages. They are larger than those generally used, permitting the patient to select the radii which are larger with greater ease. The sharp contrast between black and white is superior to any other form of chart, only a glance, in comparison with other charts, being necessary to establish this superiority. The charts are not easily soiled, and may be easily cleaned with art gum. The charts constructed as outlined are thus standardized. The large chart (No. 1) is employed in determining the axis of astigmatism, and the cross line chart (No. 2) with the use of minus cylinders in measuring its amount. These

charts may be used with or without cycloplegia. Further to facilitate our work, the instrument makers are now equipping their latest models of phorometers with batteries of minus cylinders. It is a sad commentary that the manufacturers, aware of the advantages of minus cylinders, have seen fit literally to force their use upon us. Accommodation is probably the greatest stumbling block in refraction, because astigmatism can be and is neutralized or hidden by accommodation.

Before explaining the use of the Lancaster charts, I would recall some simple but convincing experiments made by Lancaster bearing on one phase of the manner in which the eye may neutralize or mask its astigmatism. He made photographs of astigmatic charts with a focused camera made astigmatic with a 0.75 cylinder. The images of the astigmatic charts as depicted in Figures 1 and 2 showed a marked difference in the lines. In Figures 1 and 2 the axis of the 0.75 cylinder was placed, respectively, in the vertical and horizontal positions. The focusing screw of the camera was turned to a position where the lines looked

Fig. 2.—Appearance of Lancaster and Verhoeff charts when a 0.75 cylinder is placed before the lens of the focused camera. Note that the 0.75 cylinder in this figure has been placed at a right angle to its position in Figure 1.

all alike, as in Figures 3 and 4. The camera thus neutralized the astigmatism by its focusing, which of course could not be unequal or partial, but was uniform in all meridians. The focusing, while making all the lines look alike, does not make them sharp and clear. His explanation of this is as follows: The part of the focal interval after focusing which falls on the retina or photographic plate is the interfocal circle, which does not blur one line any more than another, does not produce any astigmatic effect, and so the lines look all alike. The reason they look blurred is that the focus is a circle and not a point; the greater the astigmatism, the larger the diameter of the focal circle; when the astigmatism is very small, say 0.25 or 0.37, the diameter of the focal circle is so small that one hardly notices any blur. When one grasps the significance of this simple experiment, a large part of the problem of how the eye behaves toward its astigmatism has been mastered. The eye shifts the focal interval forward or backward by accommodating or relaxing so as, if possible, to get that part of the retina which will give the best image. In Figures 3 and 4 the blurring is equal to what would be produced by a sphere of about one half of the strength of the cylinder used. Whether the eye prefers a focal line or the focal circle remains a matter of dispute; but, in high astigmatism, a focal line is probably preferred, whereas, in low astigmatism, the preference is for the focal circle.

In refraction, we avoid the disturbing effect of accommodation by the use of cycloplegics and fogging. Fogging may be used with or without a cycloplegic in subjective testing with astigmatic charts. A stronger convex or weaker concave sphere than that selected for best vision is placed before the patient's eye, and the sphere employed is just strong enough to keep the whole of the focal interval in front of the retina, with the posterior focal line near to the retina but always in front of it.

Any accommodation on the part of the eye increases the blur and only makes matters worse.

How are we to determine that the fogging is such that the focal interval is in front of the retina? With proper fogging, a minus cylinder will make the lines parallel to its axis clearer, while a plus cylinder will make the lines parallel to its axis more blurred. If the posterior focal line slips back of the retina, a minus cylinder will make the lines at right angles to its axis clearer, and a plus cylinder will make lines parallel to its axis clearer.

These points are of great practical importance when we are nearing the completion of our tests and the fogging is reduced to a minimum to obtain the greatest visual acuity, if we are properly to interpret the answers of the patient and avoid confusion.

If the posterior focal line is permitted to slip back of the retina, conditions are prepared for the eye to begin to accommodate, and the focal circle may eliminate the astigmatic effect with an associated blurring. As the focal circle is closer to the anterior focal line than the posterior, the blurring is equal to a little less than half of the accommodation employed.

Failure to detect astigmatism with astigmatic charts is often due to insufficient fogging, which permits the focal circle, which does not blur the one line more than another, to fall upon the retina. By keeping in mind the principles just outlined, this pitfall may be easily avoided.

METHOD OF USING THE LANCASTER CHARTS

My refractions are done in a corridor, the illumination of which can be varied. I use a phoropter with batteries of minus cylinders and spheres, as such an instrument saves time in changing lenses. The astigmatic charts and test types are placed at one end of the corridor illuminated by "Daylite" lamps, which give a clear, white, shadow-free light. Spheres which give a fogging of 20/50 are rotated into position before one eye; the same is done for the other eye. The lights are turned off and the patient instructed to stare into space for a few minutes. The lights are then turned on. It will be found sometimes that vision has improved to 20/40. The blind is turned into position before the left eye, and with fogging at 20/40 the patient is directed to look at Chart 1 with the radiating lines and is asked whether the lines are all alike or some darker than others. They may appear all alike

Fig. 3.—Appearance of Figure 1 when the focus is shifted to bring the focal circle on the plate, thus neutralizing the effect of the cylinder by "accommodation." Note the slight fogging, which is about equal to what would be produced by a sphere of half the strength of the cylinder, i. e., 0.37 diopter.

either because they are all alike in the image on his retina or because he fails to notice any difference. A —0.50 or —1.00 cylinder is quickly rotated into position at vertical, horizontal and oblique axes, and the patient is asked whether he now sees any difference. This will assist in training him as to what he is expected to see. If he notices any difference, the cylinder is reduced. If with a 0.25 cylinder he promptly and accurately detects the difference whichever way the axis is held, and he notices no difference when the cylinder is removed, one may know that less than 0.25 astigmatism exists. When using such a weak cylinder, the fogging should be very slight—from 20/30 to 6/8. If no difference is detected with a 1.00 or 1.50 cylinder, the case is unsuited to this or other subjective tests, and is one for objective tests only.

When the amount of astigmatism is small, say 1 diopter or less, a number of lines, from four to six or more, is selected as darker and clearer. When the amount is higher, say, above 2 diopters, two or three lines are selected. Let us, for example, suppose that the patient selects the lines from 70 to 110 as darker

and clearer. The approximate axis would be at 90. As I have already stated, Chart 1 is employed to determine the axis of astigmatism, while Chart 2 is used in determining its amount.

Chart 2 is now set with the lines at 90 and 180. The axis indicator is next set at 180, and minus cylinders are rotated into position until both the vertical and horizontal lines are alike. A -0.25 cylinder from the trial case is held axis vertical, and the patient is asked whether the lines are still alike. If the astigmatism is corrected, he will answer that the vertical line is now blacker. The -0.25 cylinder is now held axis horizontal, which makes the horizontal line blacker. In many cases a -0.12 cylinder will give the same result; held vertically, the vertical line becomes blacker; held horizontally, the horizontal line becomes blacker. In the last instance this means that the astigmatism uncorrected is less than one-eighth diopter. I know of no other method, objective or subjective, which will stand such a delicate test. The patient's gaze is directed to the test letters, and the spheres are reduced until the best visual acuity is obtained. The same procedure is adopted for the other eye.

From the questions put to patients during the examination, we may at times receive surprising, confusing and anomalous answers. Many of these may be due to failure on the part of the patient to grasp what he is supposed to do or see. A little training, explanation and assurance will clear matters. In his writings on the subject, Lancaster has described and explained a number of these anomalous and confusing answers.

The same procedure as outlined with the Lancaster charts may be used with the Verhoeff charts. In order to obtain greater contrast with the Verhoeff charts I have found it of advantage to trace the lines on the charts with India ink.

The principles of the subjective method with astigmatic charts and minus cylinders hold true both with and without cycloplegia, thus making it the most flexible of our subjective tests.

For those who do not care to use the astigmatic charts but who prefer the objective method of cycloplegia and retinoscopy alone or combined with the subjective method of test types, the use of minus cylinders offers advantages. If after the vision is fully corrected under cycloplegia the accommodation is tested by the method advised by Duane, one is often surprised to find that complete cycloplegia does not exist.

DUANE TEST

Briefly, the test is carried out as follows: To the full distance correction a $+3.00$ sphere is added and the near and far points are obtained for close range, measurements being made from the anterior focus of the

eye and a Duane disk, with a short black line or diamond print used as a test object. The near and far points under theoretical conditions of complete cycloplegia should be at 33.3 cm. from the anterior focus of the eye. It will be found that the near and far points are usually separated by a distance of 10 cm., which means about 1 diopter of accommodation in action. I have yet to find these two points closer than 5 cm., even after long continued use of atropin. The strongest convex or weakest concave sphere, combined with the weakest minus cylinder, will reduce the action of this small remaining amount of accommodation to its minimum.

In retinoscopy, if a plus sphere is required the strongest meridian is first neutralized and minus cylinders in this meridian added until full neutralization occurs; if a minus sphere is required, the weakest meridian is first neutralized and minus cylinders in this meridian added until full neutralization occurs. When plus cylinders are used, more changes are necessary to accomplish the same results obtained by using minus cylinders.

In brief, when minus cylinders are used exclusively in refraction, changes of the cylinders are necessary only after the strongest plus or weakest minus sphere is obtained. When minus cylinders are used exclusively, changes in the cylinders only are required. On the other hand, when plus cylinders are employed, it becomes necessary to change spheres and cylinders in routine. It therefore becomes merely a matter of mathematical optics and transposition, and the use of minus cylinders is urged either with trial case lenses or with batteries

of lenses, as supplied on the latest models of the phoroptometers.

The problem for each of us is to select the methods which give us the most reliable results, and at the same time give our patients the greatest comfort and improvement in vision.

CONCLUSION

I would emphasize that the advantages accruing from the use of minus cylinders will aid materially in solving this problem, in that their use reduces the action of accommodation to its minimum, simplifies the work of refraction, and insures accuracy with a diminished expenditure of time and energy.

808 Francis Building.

ABSTRACT OF DISCUSSION

DR. JOHN GREEN, JR., St. Louis: It is by no means an easy task to measure exactly the refractive state of the eye. An atropinized eye free from regular astigmatism should yield identical results to successive examiners. As a matter of fact, the estimates will vary from 0.12 to 0.25 diopter. Several reasons may be offered in explanation of these discordant

Fig. 4.—Appearance of Figure 2 when the focus is shifted to bring the focal circle on the plate, thus neutralizing the effect of the cylinder by "accommodation." The same slight fogging is noted here as in Figure 3, and is about equal to what would be produced by a sphere of about half the strength of the 0.75 cylinder used.

results: 1. No cycloplegic will completely paralyze the ciliary muscle; hence, that part of the accommodation which is still active may prevent an exact measurement. 2. Examiners vary greatly in their ability to put themselves en rapport with patients; and, hence, their interpretations of patients' answers vary accordingly. 3. The retina quickly fatigues under repeated testing, and the patient may, on this account, unwittingly mislead. When axial ametropia is modified by corneal and lenticular astigmatism, the determination of the exact error becomes even more difficult. Dr. Heitger has wisely ignored all mechanical and mercurious aids to refraction and has brought to our attention a method based on sound principles of physiologic optics. We must agree with him that, despite modifications in the form of the geometric figures of an astigmatic pencil (as shown by Gullstrand), only so far as these figures approximate the well known lines, ovals and circles of the conoid of Sturm can we correct ocular astigmatism by means of a spherocylindric combination. Dr. Heitger has reminded us that we have ignored an elementary rule in the use of astigmatic charts; namely, that the entire focal interval must be anterior to the plane of the retina and must remain so throughout the test. The influence of the width of the pupil on the lengths of the focal lines should direct attention to the advisability of using a disk having a circular aperture equal to the average width of the pupil under ordinary interior illumination when the eye is tested under cycloplegia. During the postcycloplegic test, the patient should be seated in daylight, which should have approximately the same intensity as the illumination of the room in which he habitually works. Those of us who are constantly working with astigmatic charts place our main reliance on them in the determination of the axis and the strength of the cylinder. Invaluable aid may come from a careful skiascopic measurement. It is absolutely indispensable in young children, in dull witted adults, and in certain others, who, with peculiar perversity, fail utterly to grasp the meaning of the test. Astigmatic charts of any sort are of little avail in cases of cerebral astigmatism. I heartily endorse all Dr. Heitger said in praise of Lancaster's charts. It is my belief that the method introduced by Ferree and Rand of reducing the intensity of illumination to test the resolving power of the eye, will prove a useful refinement in the test with astigmatic charts. Let us assume that the test has resulted in the patient's selecting the 90 and 100 degree line as the best and he is undecided as to whether the 110 degree line should be included with the first two. If now the illumination is reduced to the point where no line is visible and then gradually increased until one line becomes faintly visible, that line which first emerges from the darkness will be the axis of the astigmatism. The assumption that no astigmatism exists because 6/6 or 6/5 vision may be obtained with spheres alone is untenable. In my opinion, more than 50 per cent. of such patients possess an astigmatism of from 0.12 to 0.5 D., which can almost invariably be demonstrated by means of Lancaster's charts. A low astigmatism with the rule can often be ignored without detriment to the patient's working ability and comfort; this is not true if the astigmatism be oblique or inverse. When the test is made without cycloplegia (as in presbyopic persons), failure to use astigmatic charts is especially reprehensible, as it is in these patients that low inverse astigmatism productive of great ocular discomfort so frequently occurs.

DR. JOSEPH D. HEITGER, Louisville, Ky.: Dr. Green's suggestions regarding the use of the variation of the degree of illumination to determine low errors of refraction recall the work done by Ferree and Rand. These investigators were stimulated in this work owing to the fact that when the war broke out certain types of eyes were necessary, particularly in the navy, as "lookouts." It was found that, while a great many persons had 20/20, 20/15, or even 20/10 vision, only about 20 per cent. of these could be trusted with the work of lookouts in the navy. The work of Ferree and Rand has shown the importance of illumination as a refinement in the test of visual acuity. It is all based, of course, on the resolving power of the retina rather than on the resolving power of the refractive media.

CANCER OF THE TONGUE

SOME PITFALLS IN DIAGNOSIS AND TREATMENT*

WILLIAM SEAMAN BAINBRIDGE, M.D.
NEW YORK

The object of this paper is to consider some of the truths emphasized in my experience with malignant and nonmalignant conditions of the tongue, especially the importance of early recognition and well directed treatment.

Fig. 1 (Case 1).—Advanced lingual cancer diagnosed as syphilis because the incipient lesions appeared near the center of the tongue, a site more characteristic of syphilis than of epithelioma.

No symptom or set of symptoms can be relied on always in making a diagnosis of cancer, and this is true of cancer of the tongue as well as malignancy in other parts of the body. As there is at present no infallible clinical test for cancer, except the dangerous one of allowing its course under observation to prove its character, a careful correlation of clinical and laboratory methods of diagnosis must be brought to bear on each case. Even the most experienced may make mistakes; but the aim must be toward the minimum of diagnostic errors.

The onset of cancer of the tongue is insidious and, except for a small ulcer or nodule, which would alarm only the most nervous patient, is often without other symptoms. Moreover, there is a variety of conditions so closely simulating early cancer of the tongue that nothing but the most painstaking clinical diagnosis, with accurate laboratory analysis, can definitely determine the real character of the disease.

From my examination of 700 of my records of tongue lesions, selected at random, the cases herein reported illustrate the following points:

* Read before the Section on Stomatology at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.