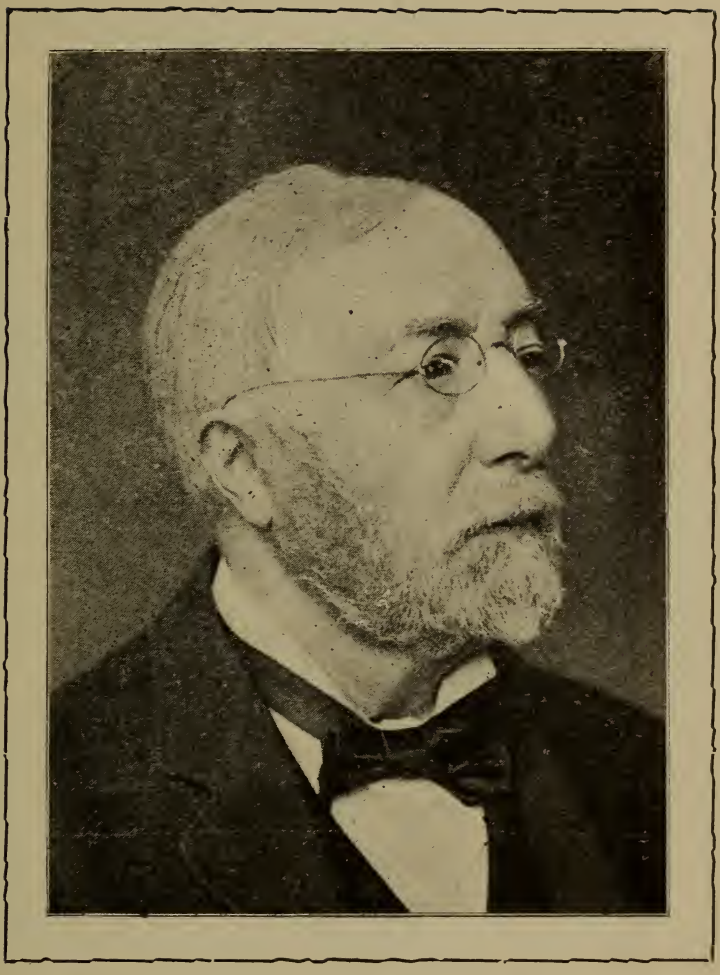
# The Home Optical Instructor.

## How to Become an Expert in Fitting Glasses.



*L. Conigiskij.*

# The Home Optical Instructor.

Owing to the Laws recently passed in various States, which prevent an impractical spectacle vender from selling spectacles without the knowledge of Optical Science, and to enable them to practice at home, I have compiled this Book of Instructions in a short system for the good of mankind, for ladies and gentlemen, young and middle aged people, to study Optometiry at home in their leisure time and to enable them to

Practice it in all the States of the Union.

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FIRST EDITION

# PREFACE.

In my experience with watchmakers and jewelers during the past 26 years probably a thousand have expressed to me a desire and need for such a course of study. For these reasons I believe that a thorough course in this branch of science will meet with a hearty reception from the entire trade. This is an Independent Course. It is not necessary that you be a graduate in Optics in order to take this course. It is intended for the watchmaker and jeweler in his daily handling of spectacles as well as for the optician or oculist. It is as good for the student as for the advanced optician.

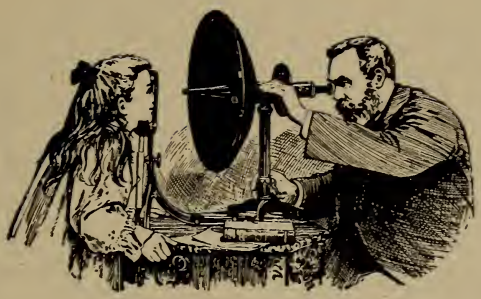
The jeweler and watchmaker who has no intention of taking a regular optical course will find the practical work covered in this Instructor. It is worth a great many times the cost in actual dollars and cents. Under the subject of this book I teach the student to test and neutralize simple and compound lenses; to know a first quality lense from a second or third quality; to locate quickly the axis of a cylinder; to find the center of a lense; to neutralize decentered lenses and prisms, and a valuable lecture on the accommodation and anatomy of the Human Eye, and this course consists of ninety-five questions and answers. Each lesson includes a lecture and quite a series of practical questions on the subjects covered in the lecture. With each lecture is a review and explanation and re-explaining the questions of the previous lesson and setting the student right upon such points as he does not fully understand. In that way every subject is covered twice and the student is not permitted to form wrong impressions. Each individual receives a personal instruction the same as if he were the only member of a class.

# INSTRUCTOR.

This Instructor is for practicing to become a practical optician and refractionist. The student will be entitled to a diploma in any college if he thoroughly masters all the valuable questions and answers.

Composed by Prof. Louis Conigisky, the eminent Prussian Optician and Scientist who graduated from Prussia and also holds Diplomas of Honor of the most eminent Opthalmic Colleges of this country.

# CONTENTS.



"Persons having normal vision will be able to read this print at a distance of 14 inches from the eyes with ease and comfort; also will be able to read it with each eye separately. If unable to do so your eyes are defective and should have immediate attention. When the eyes become tired from reading or sewing, or if the letters look blurred and run together, it is a sure indication that glasses are needed The lenses sold in the cheap goods are of unequal density and have imperfectly formed surfaces. Continued use of these poorer lenses will result in positive injury from the constant strain upon the muscles of accommodation to supply the defects in the glass."

# INTRODUCTION.

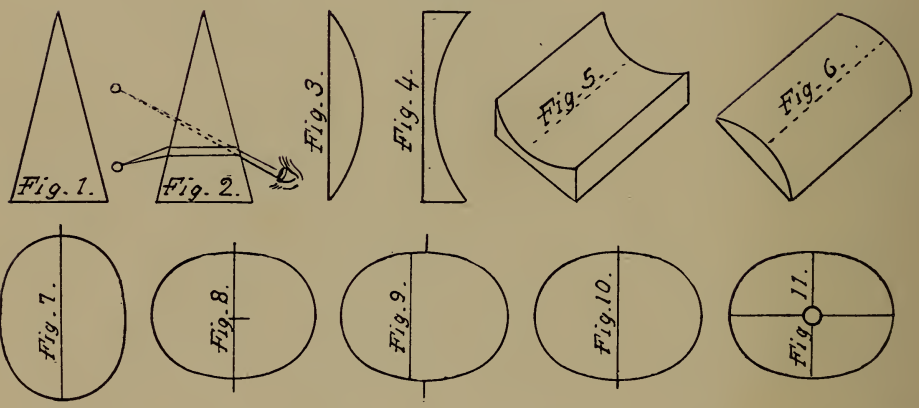
To the Students:

You will find that this course of instruction is a short, concise statement of the principles which underlie and compose the science of optics. There are several methods of testing eyes. I have adopted for this course the one which has proven the most accurate and altogether the most satisfactory to both the patient and the operator. If you will master this instruction and practice step by step you will become an expert optician. It will require study and practice. I have not used ten words to express a thought which could have as well been framed in two. I have stripped the subject of all surperfluities and have devoted no space in proving my assertion concerning refraction. Special attention has been given to the measurement of the eyeball curvature of the cornea and length and strength of the ocular muscles. Considerable space has been given to the disease of the eye and to the nervous disturbance of the whole system due to the eye strain.

The way to success is clearly pointed out. You relieve your fellow man by means of properly fitted glasses. Study each lecture carefully and answer the questions in writing before taking up the succeeding study. Review each day all that you have studied the day before. Make every thought in these pages your own practice, each test as you proceed, and you may be assured that you will become a benefactor of mankind.

# INSTRUCTION—1.

Fig. 2.




It is first necessary to study the kinds and power of lenses. There are only five so it will be easy to remember them. We will start with the simplest form of lens which is called a prism. A prism is a wedge of glass. (See figure 1.) The thin edge is called the apex and the thick edge the base. Rays of light passing through the prism are bent towards the base. (See figure 2.) This displaces the object to an eye back of the prism. Thus a person would see the object much higher with one eye if a prism of 8 degrees was placed base down in front of the eye producing double vision. We will next consider the convex spherical lense. This lense is a combination of prisms with base in center. (See figure 3.) Rays of light striking the surface of this lense are brought to a focus or point back of the lense, the covexity of the lense determining the length of the focus. The thicker it is

in the center the quicker the lines are brought to a focus. A concave spherical lense is a combination of prisms with the basis out and apex or thin part in the center. (See figure 4.) The lines of light passing through these lenses are bent towards the base, and consequently diverge and do not come to a focus. A cylinder concave lense is the same thickness on the axis of the glass. It bends the rays of light one way. (See figure 5.) The dotted lines show the axis of the cylinder. Light passing through the cylindrical lense is focused to or diverged from a line; in the spherical it is focused to a pin-head point, in the cylindrical convex the thick part is the axis. (See figure 6.)

These are the five lenses used in correcting all errors of refraction and muscular insufficiencies. Learn these thoroughly and you will understand what lense to prescribe for each defect. To illustrate: Suppose an eyeball is too short, you use a spherical convex lens to get a shorter focus. If the eye is too long you would use a spherical concave lens to diverge the lines of light. If only one meridian of the eye is at fault you use the cylindrical lense to bring forward or throw back the focus in that one meridian. The optical center of a lens is called the cone. (See figure 11.) To find the cone hold the lens about 6 inches from a straight edge card and move the lens until the edge of the card is continuous from top to bottom, (See figure 7 and 8.) Mark the the lens with ink over the line, then turn the lens half around and mark the line again. Where the line crosses is the cone or center.

## INSTRUCTION—2.

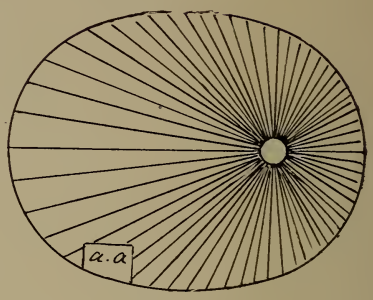
Before studying this instruction answer questions numbered. This will form a part of your final examination.

1. What is the simplest form of a lens?
2. What is the thin edge of a lens called?
3. What is the thick part called?
4. Rays of light passing through a prism are bent in what direction?
5. What is a spherical convex lens?
6. How are rays of light bent in passing through this lens?
7. What is a spherical concave lens?

8. How are rays of light bent in passing through this lens?

9. What is a cylindrical concave lens?

10. How does it *bend the rays* of light?



A. A.

The lens shown in cut A. A. is out of center. To neutralize a lens use a concave lens to neutralize a convex lens and vice versa.

A convex lens, if moved before the eye will cause objects to move in the oppsite direction. The rapidity of the motion will depend on the strength of the glass.

A concave lens will cause objects to move in the same direction as the hand moves. If you place a convex lens over a concave lens of the same strength there will be no motion and it is neutralized. In a cylindrical lense there is no motion of the axis, and to neutralize the lens the axis of both lenses must be parallel. When motion ceases the lens is neutralized. A prism is neutralized by placing another prism with base over the apex. When a card will show a continuous line the prism is neutralized. (Figs. 9 and 10, instruction No. 1.)

The spherical convex lens, also called a plus lens, corrects Hypermetropia and Presbyopia. It adds to-|-plus sign. The spherical concave lens is also called — lens and corrects Myopia. It reduces in size (—)minus sign.

Cylindrical lenses correct Astigmatism.

Prisms correct muscular irregularities, often called "cross-eyes" or "squint-eyes." The proper name is Strabismus.

These are the lenses and defects of eyesight with which we have to deal. Some eyes have but one defect, while others have two or even more. Compounding lenses so as to correct all the defects is the work that pays, both in cash or favor, with the people. It is simple after you master the use of the lenses. We bend the rays of light so they will focus upon the retina of the eye naturally. Refraction means to bend or break the rays of light. You should have a sample of the five lenses to examine and experiment with. We will now pass on to the eye.

The eye is like a photographer's camera. It takes the picture upside down. We see with the brain.

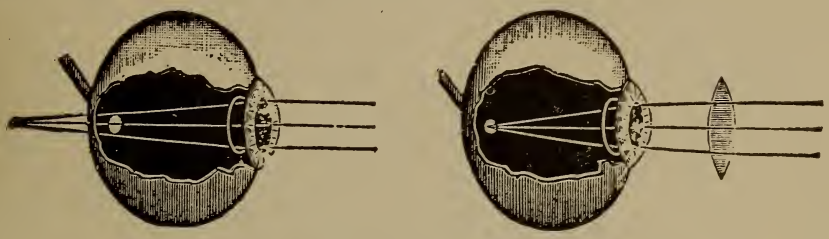


Fig. 4. No. 7.

Hypermetropia. Corrected.

This eye is too short. The focus is made by the ciliary muscle which thickens the lens in the eye.

Correct with spherical convex lenses.

Fig. 5. No. 5.

Myopia. Corrected.

This eye is too long. The focus is made in front of the retina. The lines then cross and the picture is blurred. Throw the focus back with a spherical concave lens. This trouble makes a person near-sighted.

Astigmatism is caused by an irregular cornea the clear part of the front of the eye. If the cornea is more convex one way than the other the lines are bent quicker at the convexity, and only one meridian can be focused properly.

## INSTRUCTION—3.

Before studying the instructions answer questions numbered. This will form a part of your final examination.

11. What is the cone of a lens and how found?

12. How do objects appear to move when viewed through a convex spherical lens which is in motion?

13. How do they appear to move when using a concave spherical lens?

14. How do you neutralize a lens?

15. What is Hypermetropia?

16. What lens corrects it, and why?

17. What is Myopia?

18. What lens corrects it, and why?

19. What is Astigmatism?

20. What lens corrects it, and why?

21. When is a lens neutralized?

The eye is composed of fluids and solids. Fluids are: The Aqueous Humor, the Crystalline Lens and the Vitreous Humor or jelly of the Eye.

Solids are: The Sclerotic, or white coat, and the cornea. The middle coat is the Choroid and Iris. The inner coat is the Retina, a layer of rods and cones which is spreading out of the optic nerve that connects the brain.

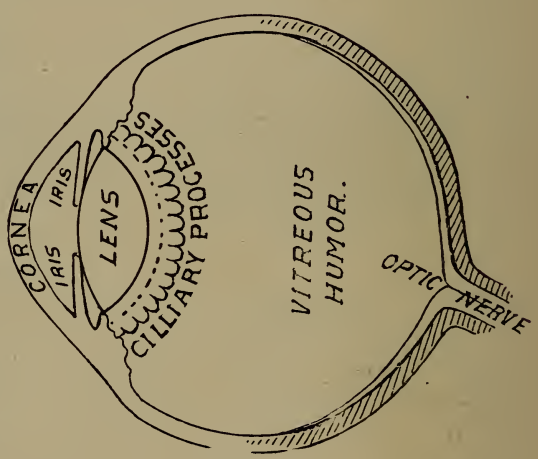



Fig. 6.
The Internal Arrangement of the Eye.

The Crystalline Lens is back of the Iris and is surrounded by a muscl ecalled the Ciliary muscle. The lens hardens with age and the muscle is over taxed at the age of 40 years, so one needs plus glasses for reading. This change is called the Presbyopic change. Sometimes the lens hardens and turns white. This is called Cataract. Usually it can be absorbed, but sometimes it has to be removed.. It is ripe when the person cannot count figures at three feet. At the commencement of cataract the lens often swells and produces "second sight." The person can read without glasses because of the thickening of the lens in the eye.

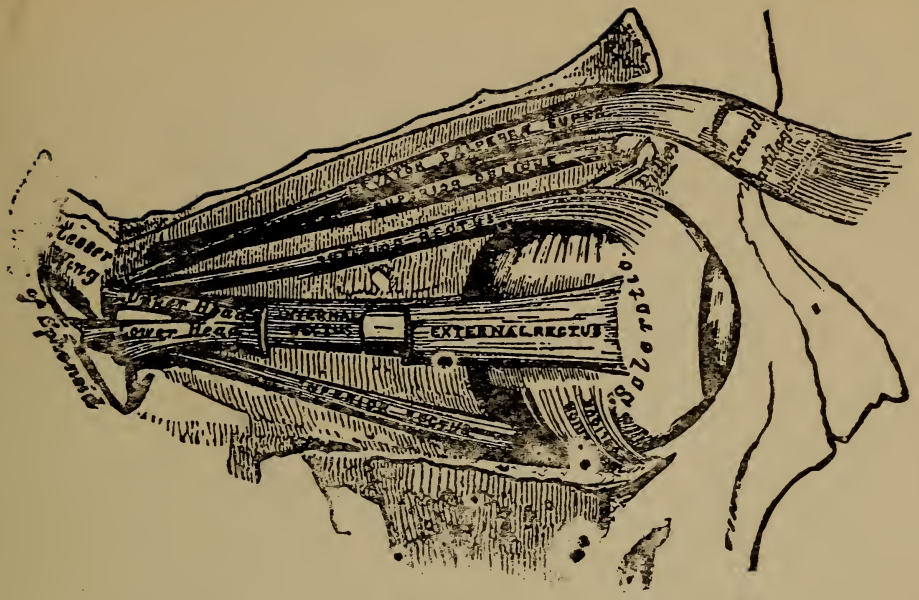



Figure 7. THE MUSCLES OF THE EYE.

The eye is held in position and moved by six muscles called the Recti Muscles. If one muscle is short and the eye is turned in the case is one of manifest Convergent Strabismus. Persons may have a good deal of muscle trouble and yet conceal it to the casual observer but a skillful optician readily discovers the error. The names of the seven muscles of the eye and their functions are as follows:

Superior Recti turn the eyes up.

Inferior Recti turn the eyes down.

Internal Recti turn the eyes in.

External Recti turn the eyes out.

The Superior Oblique is attached to the top of the eye-ball. It is called the "pulley muscle," as it runs through a pulley then back of the equator of the eye.

These muscles are all attached at the apex of the orbit. The Inferior oblique is fastened to the under part of the eye-ball and back of the equator and to the bottom of the orbit in front of the equator of the eye-ball. The oblique muscles rotate the eye-ball when the head is moved from shoulder to shoulder in order that the picture may fall in all respects on the same part of the retina of each eye. The ciliary muscle surrounds the lens and regulates the focus. The Iris is the curtain of the eye and regulates the quantity of light admitted. The Macula is the sensitive part of the retina, the point of acute vision being straight back of the pupil. The mucous membrane covering the eye-ball is called the Conjunctiva and is continuous with that of the lids.

# INSTRUCTION—4.

Before studying this instruction answer questions numbered. This will form a part of your final examination:

22. Of what is the eye composed?
23. Name the fluids?
24. Name the solids?
25. Name the muscles of the eye and their functions?
26. What is the cause of Presbyopia?
27. What lens corrects Presbyopia?
28. What is Strabismus?
29. What lens corrects Strabismus?
30. What is Conjunctiva?
31. What is the Macula and where situated?

We will now pass on to a few of the terms used in the optical business, which the student will be expected to commit to memory. People like to hear you talk about Hypermetropia, Strabismus and Astigmatism. They would much rather have you say their trouble is Convergent Strabismus than to say they are cross-eyed.

Hypemetropia, Short eye-ball.

Myopia, Long eye-ball.

Presbyopia, Old age sight.

Astigmatism, Irregular curvature of cornea or lens.

Corneal Astigmatism, Irregular Cornea.

Lenticular Astigmatism, Irregular Lens.

Hyperopic Astigmatism, where the eye is short in one meridian and normal in the other.

Myopic Astigmatism, where the eye is long in one meridian and normal in the other.

Mixed Astigmatism, The eye is long in one meridian and short in the other.

Emmetropia, Eye in perfect focus.

Strabismus, Cross eyes.

Esophoria, Eye turns in.

Exophoria, Eye turns out.

Hyporphoria, Eye turns up.

Cataphoria, Eye turns down.

Hyperexophoria, Up and out.

Hyperesophoria, Up and in.

There are many other terms that one can learn. These cover all the optician needs, and to make this course as easy as possible and to save confusion to the beginner, we will not introduce anything that is not absolutely necessary. This course will fit you to do 95 per cent of the work you need and it will not pay you to handle the other 5 per cent, as the conditions are diseases of the eye.

We are now ready to begin the examination of the eyes. We need two cards. One has nine rows of letters of different sizes and marked from the top down as follows:

First line distance 120 feet. That is a person with normal vision should see the line at 120 feet. Suppose your patient is 20 feet from the card and can only read that line. You will find his vision 20-120 or one sixth normal.

Second line distance 80 feet. If at 20 feet he can only read the two top lines you will find the vision 20-80 or one fourth normal.

If he reads the third line 20-60 or one third or so on.

The lines run down to ten feet, so one can test in a ten-foot room if necessary, but it is better to have the card 20 feet away if possible. At 20 feet the eye is at rest. As an object comes nearer we begin to use our accommodation.

D—120.

B F

D—80.

L C P

D—60.

E D B T

D—50.

P N O D

D—40.

L T C P E

D—30.

B O L T E N

D—20.

E B P O C L T N

D—15.

N O C T E P D L B F

D—10.

C P O E L F B N T D

## INSTRUCTION—5.

Before studying this lecture use the questions numbered. This will from a part of your final examination.

32. At what distance from the card should you have a patient sit, and why?

33. What kind of card should you use?

34. If the patient reads the 20 foot line sitting at 20 feet what record do you make?

35. What is Emmetropia?

36. What is Esophoria?

37. What is Exophoria?

38. What is Hyperphoria?

39. What is Cataphoria?

40. What is Hyperexophoria?

41. What is Hyperesophoria?

The other card resembles a clock dial, with heavy black lines running from each hour mark to near the center.

The lines, three in each group, should all look alike.

You need a complete trial case of lenses and tests, in order to fit a patient with glasses.

Test each eye separately when the patient looks at the card. This can be done by placing a card in front of first one eye and then the other. Never let the patient close his eyes or press it with his hands or it will blur the vision.

Provide yourself with a pocket blank book and make a record as follows: Vision, right eye, 20-120 (or whatever your test may show;) left eye, 20-60. Pin-hole right eye, 20-30, left eye, 20-20.

The use of the Pin-Hole Test. If one-fourth or one-fifth vision is manifest use the pin-hole disc on one eye at a time, placing the solid disc before the other eye. This test is a black rubber disc with a pin hole in the center, which shuts off all but one ray of light which passes to the retina with out refraction. If this improves the vision there is an error of refraction and you can improve the sight. If this test does not help, the case is almost hopeless.

After taking a record of each eye separately at 20 feet, place a plus 2.50 D. lens in each side of the trial frames, which you will have carefully centered before each eye. This will fog an emmetropic eye so much that your patient cannot read 20-120. If he reads 20-20 without glasses he has no Myopia or Astigmatism. If plus 2.50 fogs him completely he has no manifest Hypermetropia. If he is under 40 years of age he has no Presbyopia.

Fig. 8.

The clock dial is used in detecting Astigmatism. If the lines from XII to VI are clear, as a rule he needs a minus cylindrical lens, with axis at right angles or at 180 degrees. If the clear lines are from (III) to IX he needs a plus cylindrical len, axis at right angles 90 degrees. Do not over correct. Stop a little short of full corrections in high degrees. First correct any Myopia or Hypermetropia and then correct Astigmatism. Always try plus lenses first,then minus.

If the eyes are not alike in focus, or if the patient can not see the card at 20 feet with one eye cover the good eye with the solid disc and bring the test card closer until the top line can be seen. Use the pin-hole test. If this improves the sight an error of refraction is indicated. Work out the case by fogging. Put on a plus lens strong enough to blur the top line. Place lens in the back cell of trial frame and neutralize the plus with minus lenses, commencing with minus 50—75—100 and so on unti! you get the best vision. The difference between minus and plus indicates the amount of Hypermetropia. Example: If it takes plus 5. 00D. to fog the top line and you have on minus 3.00D. to give the best distant vision subtract 3. 00D. from 5. 00D, and you have plus 2, 00D. remaining. If the lines on the clock dial are uniform in color and size this is the correction.

Myopia, Astigmatism and Hypermetropia can all be worked out under this system of fogging. Suppose you have a patient who reads 20-20 without glasses, you place in the cell plus 2.50D. both eyes, and they still read 20-20, you know the patient has at least 2.50D. of Hypermetropia. Put plus 5.00 in the frames and if some of the cards can be still read you have more than 2.50D. Reduce with minus lenses until your patient can read 20-20. The difference between the minus and plus gives the exact amout of Hypermetropia,

# INSTRUCTION—6.

Before studying this instruction answer questions numbered. This will form a part of your final examination.

42. What is the object of fogging with strong plus lenses?

43. Why will a plus 2.50D. spherical lens fog one person and not another?

44. Of what use is the pin-hole test?

45. How can you detect Astigmatism?

46. When the III to IX is clearest, what lens is indicated as a rule?

47. When the XII to VI is clearest, what lens is indicated, as a rule?

Suppose you have a patient who reads 20-50 both eyes and it takes plus 1.50 to fog the top line, you are almost sure, provided the clock dial looks even, to have a case of Myopia. Reduce the fog and stop when the patient reads 20-20, or when the next stronger lens fails to improve the sight. The difference between the plus and the minus lenses will measure the Myopia.

Do not use over 1.50 or 2.00D. difference between the lenses in a pair of glasses. Fit the good eye and let the poor eye go uncorrected beyond 2.00D. Example: If it takes plus 1.00 on one eye and plus 4.00D on the other eye to get the same vision give only plus 3.00D. on the poor eye. Give the weakest minus lens that will make him see the 20 foot line at 20 feet. Some eyes can not be brought up to perfect conditions.

After the age of 40 the Presbyopic change commences and progresses to 65 or 70. This is caused by the hardening of the Crystalline lens and shrinking of the eye-ball. It will usually take plus 1.00D. lenses for reading at 45 years; plus 2. 00D. at 55 and plus 3. 00D. at 65.

Always test for distant vision first, then test at 14 inches. On the reading test card are letters ranging from the finest to large size, after correcting the distant vision show the reading card to the patient, and if he can only read to 20 it indicates that a 20 inch lens or plus 2.00D. len will give him perfect vision. After correcting any errors of refraction hold 8 degrees of prism in front of one eye, base down and have the patient look at a door knob or candle.

This lens produces double vision. If one is seen directly over the other it shows the external and internal muscles are properly balanced. Turn the base of the prism in and he will see two candles horizontally. If one is not higher the other the superior and inferior recti muscles balance.

A person should be able to overcome 5 or 6 degrees of prism base in and 15 degrees base out. No test of the eye is complete unless the strength of the muscles is ascertained. When you place the base of the prism in your test the strength of the external muscles; base out the internal.

To exercise the muscle, place the apex of the prism over it. To rest the muscle place the base of the prism over it.

Suppose you have a patient who can overcome on a 20 foot test 20 degrees of prism, base in, and only 5 degrees, base out. You know at once that the externals are to strong for the internals in close work. Prisms are indicated base in. A person should overcome from 1½ to 3 degrees, base up or down, as the superior and inferior recti muscles should be of equal strength.

If one eye turns in set the base of the prism out. If the eye turns out, set the base of the prism in. A prism which brings the objects together measures the defect. The correction may be divided and half placed on each eye. In Hypermetropia the eye often turns in, there being a associated movements between accommodation and convergence.

Accommodation is the act of thickening the lens of the eye for close work. If the eye ball is short, the accommodation has to be used for distance. When the eye is normal, the accommodation is used when the object looked at comes within 20 feet, and at the same time the eyes converge, or come together. If you look at the end of your nose you have the appearance of being cross-eyed.

Many cases of cross-eyes in children may be cured with strong plus lenses. Let the lens fog the 20 foot line if the patient will wear it.

Care should be taken in prescribing prisms. Some writers claim the use of prisms criminal, but we have had some excellent results where others, who were afraid, failed. Use care and judgment.

# INSTRUCTION 7.

Before studying this instruction use the questions numbered. This will form part of your final examination.

48. After fogging the vision with plus lenses, how do you proceed, and when should you stop?

49. How much difference can be made in glasses where the eyes are not alike in focus?

50. Do you prescribe the weakest or strongest lens with which a patient can see 20-20 in Hypermetropia?

51. In Myopia?

52. What is Presbyopia, and how corrected?

53. How can you prove that the external and internal muscles balance?

54. How much stronger should the internal muscles be than the external?

55. How many degrees of prism, base in, should a person overcome?

56. How many degrees of prism base out, should a person overcome?

57. Base up or down, how many degrees prism should a person overcome?

58. If the eye turns in, how do you place the base of the prism?

59. If the eye turn out, how do you place the base of the prism?

In Strabismus, if the eye turns out, give full correction; if it turns in, half correction.

In fitting frames care should be taken to see that the nose piece is not too high or too low, too wide or too narrow. The patient must look through the center of the lens. To measure the pupilliary distance, hold a rule with the end in front of the center of the pupil of one eye. Where the center of the other pupil comes on the rule is the measure. It will run from 2 inches in children to 2 and eight-sixteenths in adults, the average being 2 and six-sixteenths. Occasionally we have one 2 and three quarter inches. Nose glasses are not as satisfactory as spectacles. Rimless

spectacles are easily broken, and people should be warned about them. A few hours practice on yourself or friends, with the trial case, will fit you for active work. Place a plus 3. D. in frame and your eye is made Myopic. Correct this with minus sphere of same number. Place a minus 2. D. in frame and this makes the case Hypermetropic, and that is corrected with the plus lens. It is the same with the cylindrical lenses and prisms. If you will practice on yourself you will understand better the cases you meet.

When the patient tells you how the chart appears you will recognize the case as the same you produced in your eyes with a certain lens and you will know immediately what corrects that trouble.

The lenses are numbered by the Dioptric system, a meter (40 inches), being the unit of measure. A lens of 1.00 D. strength focus at 40 inches or one meter. 200 D., being double the strength, focuses at half the distance or 20 inches 0. 50 D. being half the strength focuses at 80 inches. Divide 40 by the Dioptric measure of the lens and you have the distance in inches at which the line focus. 4.00 D. equals 10 inches, 5.00 D. equals 8 inches.

Care must be taken in writing a prescription.

1st. Let your patient wear the correction as long as possible in your office to see if it is comfortable.

2nd, Be sure to use the −|− or — sign before your sphere, or cylinder, and state whether prism are to be base in or out.

3d. Exercise care in fitting frames to have them set as close to the eyes as possible without the lashes touching the glass.

4th. See that the temples are long enough and wide enough to be eomfortable.

Blanks are furnished by optical companies to be used in writing prescriptions.

On the two cell trial frames the outer cell revolves. It is marked in degrees. If you use a plus 1.00 D. spherical lens combined with a plus 50. cylindrical lens, placing the axis perpendicular, you will find the pointer making 90 degrees. In this case you would prescribe: Right eye, plus

1.00 D. spherical, combined with plus 50 D. cylindrical axis 90 degrees. Left eye—what your test indicates.

After fogging with plus 2.50 spheres and gradually reducing the fog with minus spheres, if you find that the lines from VI to XII on the clock dial are very much clearer than the others, place a minus .25 D. Cylinder with axis at 180. If this does not make all lines appear alike try, successively — .38, — .50, — .62, etc., until all lines appear equally clear.

## INSTRUCTION 8.

Before studying this instruction answer questions numbered. This will form a part of your final examination.

60. Why should a person look through the center of their lenses?

61. At what distance should you test for muscle trouble?

62. How will you proceed to test eyes?

63. Explain the Dioptric system?

64. Name a few important points in fitting frames.

You may have this correction in your trial frame: -|- plus 1.50 D. sph. ⌒ (combined with) — .62 cyl., axis 180. Suppose this gives 20-20, or perfect vision. Before ordering the glasses you should transpose this into all plus and let the patient try them. This is to assure yourself that you have not made a mistake. To transpose a -|-, — into all -|-.

Subtract the cylinder from the sphere. Bring down your cylinder, but change the sign and turn the axis 90 degrees.

Example: -|- 1.50 Sph. — .62 cyl. axis 180 equals -|- .88 Sph. -|- .62 Cyl. axis 90.

The records you should take in each case are:

Distant vision (each eye).

Fogging with -|- 2.50 (each eye).

Astigmatic (each eye).

Pinhole if necessary (each eye).

Abduction (base in) both eyes open.
Adduction (base out) both eyes open.
Sursumduction (base down or up) both eyes open.
Presbyopia (each eye).
Prescription needed.
Frame measure.
Kind wanted.
Name—age—address.
Symptoms described.
Occupation. Price charged.
Disease of eyes or lids.

The stenopaic disc is a black rubber disc with a narrow opening across one way.

This is very useful in locating the good meridian in cases of astigmatism and tells you the point to place the axis of cylinder used. Place it in revolving cell, having the other eye covered with solid disc. Move it slowly and stop when vision is best and the chart looks clear to your patient. Read your trial frame at the point of opening, and place the axis of your cylinder at this point.

The Maddox muscle rod is an aid in locating muscle trouble. It is used with both eyes open looking at a lighted candle. One eye sees the candle, the other a streak of light. If one is in front of the other, the muscles balance. If not, use a prism of eufficient strength to bring them in line.

Spasm of ciliary muscle is caused from over-taxing the eyes. It can usually be cured with strong plus lenses. It is sometimes necessary to treat the eyes with antropine. This treatment paralyzes the ciliary muscles, and it gradually relaxes. It dilates the pupil of the eye. It takes several days for this to wear off. This trouble usually occurs in Hypemetropia. The ciliary muscle being forced to focus, the distant vision is never at rest. This over work causes the spasm. When testing the eyes always ask if they see floating spots. Also whether they see flashes of light. These are often signs of disease of the retina.

All disease arises from impure blood or nerve exhaustion. It is useless to treat the symptoms. The true science of healing is to remove the cause. Nature is the great healer. Color blindness is a congenital with about 4 per cent. of men and 1 per cent. of women. It is a lack of perception of the difference detween the seven primitive prismatic colors, viz: red, orange, yellow, green, blue, indigo and violet. It is often acquired from tobacco habit or other poisoning.

## INSTRUCTION 9.

Before studying this instruction answer questions numbered. This will form a part of your final examination.

65. Transpose −|− 3.00 D. Sph. ⊂ — 1.25 Cyl. axis 180°

66. Transpose — 2.75 D. Sph. ⊂ −|− 2.00 Cyl. 90.°

67. Transpose −|− .50 D. Sph. ⊂ — .50 D: Cyl. axis 180.°

68. Why should you keep a complete record of every case?

69. Why is it necessary to keep a record of each eye separately?

70. Give meaning of terms Abduction, Adduction and Surs-umduction.

71. Is it important to test the muscles of the eye?

Iritis is another dangerous and painful disease. The pupil contracts, eyeball becomes highly inflamed, the iris has a muddy appearance. There is dread of light (photophobia). This disease should be treated ot once by a physician as there is danger that the iris will become attached to the lens.

## INSTRUCTION 10.

Before studying this instruction answer the questions numbered. This will form a part of your final examination.

72. What is spasm of ciliary muscles?

73. How is it cured?

74. Of what are floating spots the sign?

75. What is Pterygium?

76. Name the three stages of conjunctivitis?

77. What is color blindness?

78. Define Glaucoma?

79, Describe the symptoms of iritis.

In Hypermetropia the Ciliary muscle is forced to over work. This causes dizziness, pain in the eyes, blurring of sight while reading, nervous dyspepsia, cross eyes, and is very common.

In Myopia the patient squints, has headache and holds objects close to his eyes.

In Astigmatism the strain produces headache and nervous exhaustion. From correction people receive prompt relief after doctoring for years.

I cure all these diseases by conserving the nerve forces. I remove the cause, eye strain nature comes to the rescue and a cure results.

With the Opthalmoscope we look into the eye and examine the retina. (See figure 4, Page 29). Each student will derive great benefit from the use of this instrument in examination, as many diseases may be detected by scrutinizing of the retina.

## INSTRUCTION 11,

80. What is the cause of disease?

81. How can it be cured?

82. Through what nerve do we get a reflex action?

83. What reflex is produced by strain of the ciliary muscles?

84. What are the nervous symptoms in Myopia?

85. What nervous troubles are caused by astigmatism?

86. State the difference between an error of refraction and an error of accommodation?

87. What parts of the eye would be touched by a line passing through the optical center?

88. What regulates the amount of light which enters the eye?

89. Why is it often possible for a hypermetropic person to see perfectly at a distance?

90. Do you use the Opthalmoscope?

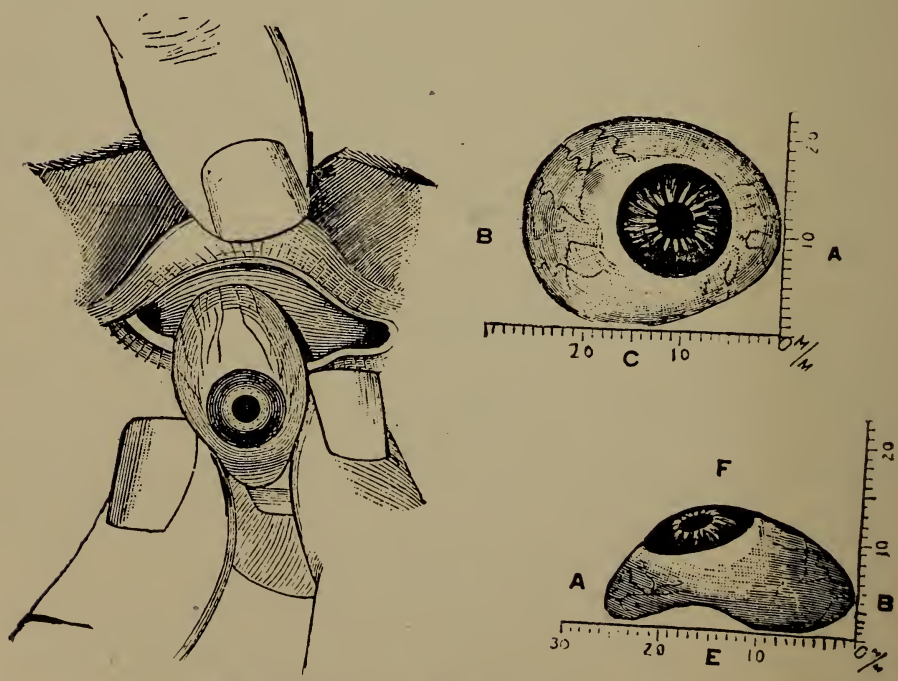
91. Have you taken optical instructions before?

62. About how many hours have you studied on this course?

93. Have you a trial case, and have you used it as directed?

94. Have you been helped in any way by this course?

95. Do you want to buy a trial case, or other optical instruments.




## *Artificial Human Eyes.*

### *And How to Insert Them*

## LECTURE ON THE ANATOMY OF THE HUMAN EYE.

Our present exact knowledge of accommodation, simple as it now seems to us, has only been arrived at after an immense amount of patience and laborious research, and within the last thirty years has finally received the character of an exact science. I must ask patience from some of the readers, as it is impossible to explain the matter before us without stating some facts about anatomy of the eye, and therefore I am compelled to make use of a few scientific phrases, but I hope this chapter will not be overlooked on that account, for it is the very one which conveys the information intended mainly to be given.

The eye is a globular body composed of three enveloping coats holding in place the contained liquids or humors, which are of a more or less resisting consistency. The eye rests in a hollow bony socket, (see fig. 6, page 12) through whose walls pass the optic nerve, vessels, etc., serving to maintain in the normal functions of the eye. The socket is lined with soft tissue, forming a yielding surface within which the eye moves and which also mitigates the severity of blows upon the visual organs.

The eye is moved by six muscles, (see fig. 7, page 13) originating at the back of the socket and passing forward to their attachment upon the front of the globe. The muscles move the eye in all directions, and a contraction or a paralysis of any of them produce the deformity called "cross-eye" which may usually be relieved by a suitable operation upon the affected muscles.

The outer coat of the eye is called the sclerotic, and is is hard, tough and unyielding, being really the skeleton of the eye, maintaining it's shape and holding the other portions in position. It is white and glistening in appearance and is indicated, when reference is made to the white of the eye. At the extreme front of the eye is seen a transparent bulging membrane, resembling the crystal of a watch, called the cornea. This is really a continuation of the sclerotic, only it is transparent, while the sclerotic is opaque. It performs the same function to an eye that a window does to a room, viz: it enables light to pass to the interior and allows one to look out and observe what is going on. If a window to a room was frosted or walled up, its interi-

or would be dark and one could not look out through it. So it is with the eye; the cornea is the window of the eye. If it becomes scarred or destroyed, light fails to pass inside and sight is destroyed. It will thus be seen how important it is to maintain the cornea in it's integrity, and to seek competent advice in case it is even slightly diseased, as a minute scar or opacity of its tissues especially if situated directly over the pupil, may practically destroy fine vision. The cornea is a continuation of the sclerotic of the outer membrane of the optic nerve, and the latter a continuation of the outer membrane of the brain; thus the eye is in reality a portion of the brain and should be regarded with the respect usually accorded to that important structure.

Passing inward the next coat of the eye is a dark, bloody membrane called the choroid. It plays an important part in furnishing nourishment to the eye, and it passes forward to the interior portions of the eye and forms a muscle called the ciliary muscles or muscles of accommodation which envelopes the periphery, of the crystalline lens, (Fig. 3). As the choraid passes still further forward it merges into what is known as the iris, which gives to the people's eyes their characteristics color of blue, brown, black, etc. The iris is a thin membrane or curtain situated just back of the cornea, with a hole punched in it's middle, called the pupil.

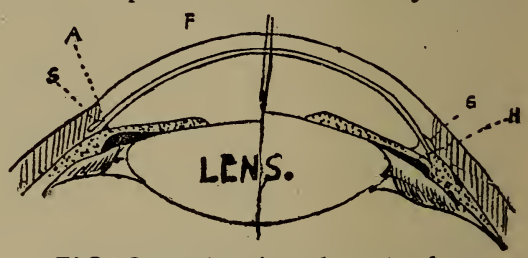



FIG. 3.—(Showing the act of accommodation. The left side is in a state of rest; the right side is in the act of accommodation as can be seen by the increased thickness or convexity of the lens.)

In the iris are found two muscles, which contract and dilate the pupil in order to control the amount of light entering the eye; thus if the eye is exposed to a bright light the pupil contracts; if the light is dim it dilates. Although the pupil is merely an opening, it nevertheless looks black because of the apparant lack of illumination, just as a door into a closed closet looks dark because the interior is not illuminated. If, however, daylight is allowed to pass through any portions of the closet wall, or if we stand upon the threshold with a lighted lamp the black area of the

doorway is lost, and the contents of the closet are revealed. If light rays can be thrown into the interior of the eye and if the head of the observer does not block the way to the transmission and reception of these rays the inside of the eye can be accurately observed. This is done with an instrument called the Opthalmoscope, which is practically and simply a perforated mirror held in front of the observer's eye by which light is reflected into the observed eye and an impression of it's contents transmitted back through the perforated mirror to the eye of the the observer. (See Fig. 4) In this way both eyes are directly within the light rays, and no obstruction exists to interfere with their mutual interchange. By means of the Opthalmoscope the optic nerve, retina, choroid, etc., may be clearly seen, and the wonderful picture of life in veritable action accurately observed.

Fig. 4.

As the optic nerve enters the eyeball at it's posterior extremity it expands into a thin membrane which lines the interior of the globe and forms the delicate perception tissue called the retina or third coat of the eye. It is a direct continuation of the optic nerve and brain and into it's sensitive substance are impressed the images of all we see, which are then transmitted via the optic nerve to the posterior portion of the brain, where they are interpreted at sight. The eye resembles a camera and like a camera, "takes pictures." The sclerotic corresponds to the box of the camera, the choroid to its black interior for the absorption of superfluous light, the retina to the receptive film, upon which the picture of an object is impressed, the pupil to the opening in front of the box, through which light passes, and the lens and humors to lenses and spaces inside the photographer's box. One point of difference however, is noticable, viz: the film of the camera can receive only one distinct impression, which it retains, but the film of the eye or the retina, can receive billions of impressions,

which appear and disappear with the rapidity of thought, as the gaze is directed at changing and ever changing objects.

As we have two eyes, so we see two impressions of every object upon which we gaze, but these two impressions are merged or focused together, so that we apparently see only one object, but by each eye looking at the object from a some-what different aspect, the impression obtained is much more general and comprehensive than if observed by only one eye. Sometimes the ocular muscles do not work harmoniously together in focusing the two eyes upon one object, under which circumstances the intuitive muscular and nervous struggle for the proper adjustment often produces tired eyes and headache. Unless one eye gives up the struggle, and a "crossed eye" and sometimes double vision results.

There are three liquids of humors inside the eye—namely, the aqueous and vitreous humors and the crystalline lens in its capsule or envelopes. The Aqueous humor is situated just back of the cornea. It is watery in consistency and is reproduced in a few hours after evacuation. The vitreous humor is situated in the back of the eye, is thicker in consistency and occupies about two-thirds of the ocular space and is not reproduced after evacuation. The crystalline lens is swung between these two humors by a circular ligament attached to the inside of the eye and sets just back of the pupil. It is harder than the other two humors and it is surrounded at its periphery, as has been said, by the ciliary muscle or the muscle of accommodation, as it is sometimes called.

These muscle produces a perpetual variation in the convexity of the lens to correspond with the size or distance of an object. If a small or close object is gazed upon the muscles of accommodation causes the lens to become more convex and clear vision is obtained. If a larger or distinct object is to be seen, the lens becomes less convex and vision is again adjusted. These changes are constantly occuring and the activity of this little muscle can be imagined, and it will be readily understood that when inordinately used under improper circumstances, it becomes fatigued and

characteristic eye and head pains result, which sometimes require rest, improved health or glasses to correct.

The healthy lens are clear and transparent, but sometimes it becomes milky or white, and then the eye is said to have a cataract, which can fortunately be cured by removing the opaque lens (fig. 5) and after replacing it by a strong convex glass lens in a spectacle frame, which acts as a substitute and re-establishes good vision.

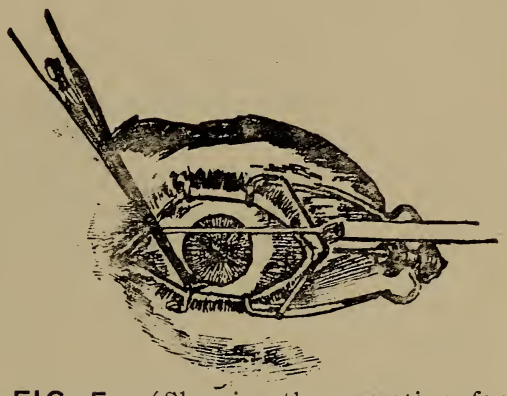


FIG. 5.—(Showing the operation for the removal of cataractous or opaque lens. The lids are held apart by an instrument.

The eyelids are outwardly covered with skin, and inwardly lined with a mucous membrane called the conjunctive, which becomes reflected into the eyeball over the white sclerotic as far as the corneal margin. It is thin and transparent and hardly visible in health, but when inflamed becomes red and swollen and more or less obscures the underlying sclerotic. The conjunctive is the seat of a majority of eye diseases and shows itself in the many varieties of "sore eyes" granulated lids, (fig. 6) etc. The body of the lid between the skin and conjunctive is composed principally of muscles which move it and a little piece of tough tissues which holds it in shape. The lids are fringed with lashes, which serve to enchance the personal appearance and to protect the eye from outside objects, such as sand, cinders, etc.

FIG. 6.—(Showing the appearance of "granulated lids." The upper lid is turned over, showing under surface.)

Somtimes the lashes become distorted in their position producing a condition known as "wild hairs" (Fig. 7) causing a constant a painful scraping on the sensitive cornea, which often causes blindness. It can usually be cured by an operation.

FIG. 7.—(Showing what is meant by the condition called "wild hairs"

The tears are manufactured in a gland over the eye and pass on to the ball. They are conducted towards the nose and pass into the little tear-ducts at the inside of the eye in the lids, whence they pass into the nose. (fig. 8) Sometimes the tear-ducts become more or less closed, producing what is known as "watery eyes" or constant presence of observable tears from their inability to pass down through the proper channels. This condition can usually be cured by an operation and treatment upon the tear-duct, which opens it up and maintains its draining qualities with out destroying its healthy physiological action

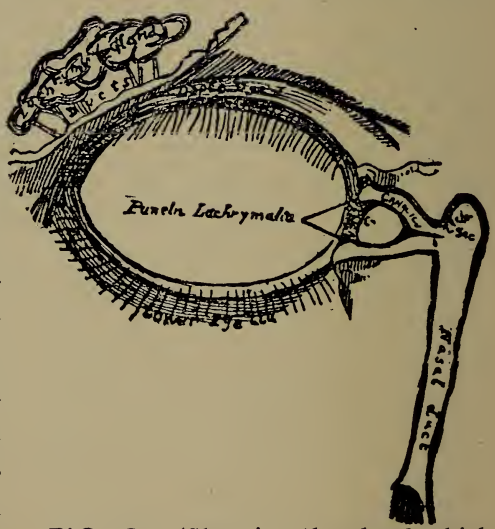



FIG. 8.—(Showing the gland which makes the tears and apparatus which conveys it over the eye into the nose.)

## Lecture on Physiologie and Histologie

There is a new question to consider, what has your sanity to do with your eyes? or, to put it the other way, what have your eyes to do with your sanity? The external impressions upon the brain of an individual who cannot see but a few inches from his nose, and in whose eyes the rays of light never focus correctly, must be very different from the impressions received by a normal eye, so differ-

ent as to be abnormal; and though the optician may, with glasses, correct to some extent the defect of the eyes, he can never, by mechanical means, cure the physiologic and histologic faults behind the eye, or restore to normal condition conceivable pathologic nerve paths, and nerve centers through which impression of the outer world must pass to the cerebrating centers of such a brain, much less is he capable of effacing from the brain the false impressions received before glasses were worn, or still imperfect and therein false and abnormal impression received since wearing them.

An impression from without in transit would at first encounter the distorting influence of defective eye, then is twisted from the normal along presumably corresponding defective nerve and ganglionic paths, and lastly is received and metamorphosed by presumable corresponding brain cells. The reflex of such cerebration is an expression of an idea and the idea represents the man.

Now you can no more get strictly correct ideas, normal ideas from a congenitally defective head, than you can get pure water from a sewer.

Every person congenitally blind or partially blind is mentally abnormal. This is a startling statement, as the orator of the old school would say, a statement to give us pause.

Defective vision is consequently a direct cause of insanity; prevalence of eye defects is a matter of vital interest to all who have eyes, whether they see with them or not.

A person's brain is his world, each one lives in his own world, and what that world is does not depend on the eye it depends on the brain. One sees with the brain, That a defect of the eye may disturb the brain and be a contributing cause of insanity, is to a certain degree true, because insanity results from physical causes; any strain may tend to produce insanity—eye strain as well as any other.

The question as to the relation existing between the eye strains and diseases of the brain cannot be answered without taking into consideration certain psychological facts. The brain is simply a store-house or rather a stomach for the reception of all kinds of impressions, whether

from the eye or other special senses, and when they are received they are digested and stored away as a basis for thought. If any avenue be closed or in any way limited, unless it be sufficiently made up by other of the special senses; certainly a weakness or perversion of mental power may result.

However, to say that near sightedness or other disease due to a lack of symetry of the eyeball is a proof of brain degeneration. or even is a contributing cause to insanity, further than the weakening or disuse of any other organ which disturbs the general health and nutrition and which depresses the general system is a cause, is not accepted.

We must remember certain fundamental facts of psychology. We do not see with our eyes, or hear with our ears, or smell with our nose, though we do all these things through them. The eye is simply a mechanical instrument to the back of which a nerve is attached that conveys the rays of light to the brain, or rather so irritates the nerve as to produce a corresponding impression upon the brain. If this same impression could be made without the medium of the eye, vision would result equally well. As a matter of fact, in certain pathological conditions of the brain, we do not have this phenomenon. Hallucinatians which are so frequent in the insane and which are not uncommon in the sane are to be thus explained, in our dreams at night visions are frequent, and we do not see though darkly and often without vivid memory.

The child who is born blind, and later, by a cataract operation with the aid of glasses is given normal vision, does not see as the educated eye sees. We see with our brain and must digest our impressions before we can judge as to what we do see. This is an education in itself and can only be acquired by practice. The distance between our two eyes is simply a base line, and by this we calculate objects. The person who has lost one eye, still has in one sense good vision,—in another not, as he is at fault in accurately calculating. He cannot pour his tea or hit the open mouth of his ink-well.

The child who cries for the noon probably thinks it no farther off than is the light of a candle. A person suddenly restored to sight is helpless until he learns to know and judge of what he does see. The man who loses his arm and complains that he can feel his hand and that his fingers ache actually does feel a pain, which by mental education he refers to his hand; yet it is but the irritated end of a nerve which once did supply the hand even amongst so-called normal individuals. Where all the special senses are perfect, yet there is a vast difference as to what one remembers. The artist will look at a face and at a tree or a landscape, go home, vividly recall it and be able to reproduce it. The effect produced by the Wagner operas on different individuals bears a direct relation to brain cultivation and aptitude. The ears of listeners are probably normal, but what to one is divine harmony and pleasure unspeakable, is to another unmeaning jangle of inharmonious sounds.

It is thus seen that with perfect organs the understanding or memory is everything, and for this reason the kingdom of each individual is his own brain and the limitation is only a brain limitation. Dr. F. W. SOUTHARD, who as a specialist in the diseases of the eye, enjoys a fame in the capitals of Europe as well as at home, regards the eye as of the higher importance in fixing and preserving mental balance.

The defective eye regarded simply as an organ, will not cause insanity or brain disturbance. It's the strain on the brain brought about by the effort to overcome that defect that does the damage. The phisiological disturbance comes not from the image, but from strain. Such strain is in many cases the cause of chorea, and of a nervous condition that emulates epilepsy, and when it is very severe and long continued and other condition are favorable, it is possible for it to cause insanity. When the effort to see —to overcome eye defects goes beyond the normal, it causes an excessive draft on the energy and drawing on the principal, as it were, which is likely to exhaust the capital faster than it can be supplied—bankruptcy break-down.

The importance of correcting errors of vision cannot be exaggerated. Through his eyes the child gains his first ideas of the external world, through them, aided by touch and muscular sense, he learns the direction, size and distance of objects in space. Very early in life his mind begins to take cognizance of visual impressions and upon his ability to correctly interpret them may depend his whole future life, either for success or failure. If, through any defect in his eyes, false or distorted pictures of objects are formed upon the retina, then will his notions of external world be erroneous, his judgment unreliable and but little dependence can be placed upon its statements concerning events coming under his personal observation. There should be no cause of surprise if the child provided as he is with a most marvelous organization, made to collect, transmit, assort and store up in the cells of the brain the products of the visual impression for future reference should misinterpret their meaning, if the pictures of objects looked upon the imperfect. That the mind may be able to correct wrong visual impression it must posess a true standard: such cannot in the nature of things exist; it comes, and must always come, through experience.

Before the fifth year a childs perceptive powers have begun to unfold. He is gradually learning the power of attention. Slowly and surely his mind is being filled with a desire to know, his former uncontrolled inquisitiveness is gradually giving place to acquisitivenes. He asks for the meaning of things. His mental horizon expands. He originates ideas, he is begining to think.

During the period of receptivety the eyes should be capable of seeing the most accurately. At this period of life should there be errors of refraction they are most easily and satisfactorily corrected.

The study of anatomy and physiology teach us not only that the child may suffer physically and mentally, but that his whole character may be greatly modified, or even changed, by the condition of the eyes.

Perhaps at no physical point has the development of man borne more heavily upon him than in the matter of

his eyesight, not with-standing the wonderous power and facility of that sense and the marvelous inventions in its aid. The eye is the nurse and foster mother of all the other senses and the patron of all the arts and sciences, and the modern man is looking minutely into a myriad of things and taxing his eyesight accordingly, and many are the hopes that have failed and bitter has been the disappointment when eyesight has given way under the stress and ceasless burden of the varied avocations and professions of modern life, at last we are begining to realize what an endless train of terrible evils attend upon the breaking down and destruction of the eye under this stress and burden, and not the least of these evils is the overstrain on the already overtaxed nervous system.

That extreme, near sightedness for example, would have any effect on the brain. I do not believe objects, to the near sighted man, appear the same within the range of his vision as they do to the man with normal eyes. The only difference is that its world is more limited; what he sees, he sees as well, only he does not see as far. If the brain is normal his impressions are normal. Of course, if his brain is abnormal, no matter how nearly perfect the eye as an organ is, the impression the brain receives through it are likely to be abnormal.

These impressions may be affected by the condition of the eye, however, as in cases where a man is suffering from alcoholism for instance, the curious things a man sees when suffering from alcoholism are partly due to the brain disturbance and partly due to the condition of his eyes. When he sees snakes, it is not entirely due to hallucination; it is partly due to the condition of his eye. When he sees as in Kipling's Lu Nuit Blanche: a blood-red mouse; it is due as much to the engorged blood vessel of the eyes as to a freak of imagination.