

1-1-1959

# Measurement of the lag of accommodation by a cross-cylinder method

Thomas Niven  
*Pacific University*

Kenneth White  
*Pacific University*

---

## Recommended Citation

Niven, Thomas and White, Kenneth, "Measurement of the lag of accommodation by a cross-cylinder method" (1959). *College of Optometry*. 213.  
<https://commons.pacificu.edu/opt/213>

This Thesis is brought to you for free and open access by the Theses, Dissertations and Capstone Projects at CommonKnowledge. It has been accepted for inclusion in College of Optometry by an authorized administrator of CommonKnowledge. For more information, please contact [CommonKnowledge@pacificu.edu](mailto:CommonKnowledge@pacificu.edu).

---

# Measurement of the lag of accommodation by a cross-cylinder method

**Abstract**

Measurement of the lag of accommodation by a cross-cylinder method

**Degree Type**

Thesis

**Rights**

Terms of use for work posted in CommonKnowledge.

---

### Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the “Rights” section on the previous page for the terms of use.

**If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:**

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see “Rights” on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to: [copyright@pacificu.edu](mailto:copyright@pacificu.edu)

MEASUREMENT OF THE LAG OF ACCOMMODATION

BY A CROSS-CYLINDER METHOD

by Thomas Niven  
Kenneth White

Pacific University

January, 1959

## ACKNOWLEDGEMENTS

We would like to express our sincere thanks to Dr. C. B. Pratt for his time and patience with us. For this thesis could not have been written without his greatly appreciated help.

## OBJECTIVE OF THE FOLLOWING MATERIAL

To measure the lag of accommodation while the subject is looking at a 20/20 line of letters at a 16" testing distance.

## EQUIPMENT

I. Four spherocylinders cut in half so as to produce eight split lenses. The lens powers of which are as follows:

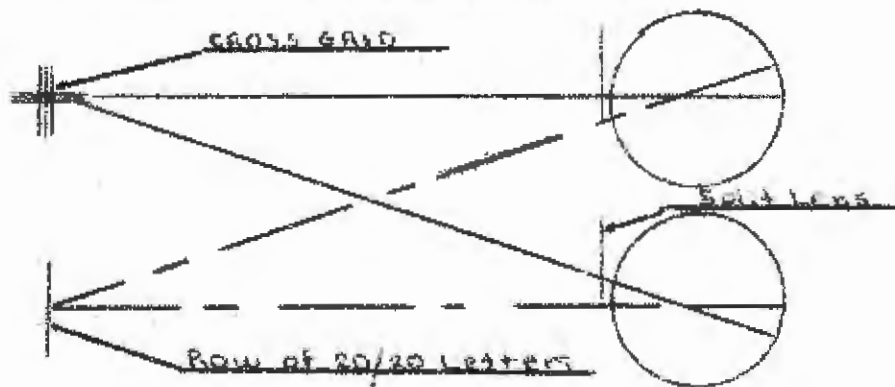
1.  $\neq 0.25 - 1.00$
2.  $- 0.25 - 1.00$
3.  $- 0.50 - 1.00$
4.  $- 0.75 - 1.00$

II. A near point card with a single row of 20/20 letters, also a dark cross grid is imposed on this same card with a separation between the centers of the two figures of 44 mm.

III. A Bausch and Lomb Green phoropter.

## PROCEDURE

The near point card was placed at 16" in front of the patients eyes, upon this card the effect of illumination was a constant 22 ft. candles for each subject. Number one split spherocylinder lens was placed in front of the phoreopter and is diagramed as follows:



Thus creating a crossed cylinder at the spectacle plane.

The subject was now told to adjust the phoreopter so a single line was seen between the row of letters and the cross grid on the near point card. The single line would appear when the two half-lenses were at the same position in front of each eye.

The subjects prescription was now incorporated in the phoropter, this included his habitual cylindrical component. The following instructions were then given each subject.

"While reading the row of letters over and over to make sure you are accommodating at that point be aware of the cross grid but do not look directly at the grid". Plus lenses were now introduced binocularly in 0.25 diopter steps until the patient reported the letters were completely blurred. After reducing the plus lens 0.25 diopters, the subject was now asked to report as to which of the crossed lines were blacker, the horizontal or the vertical. This question was asked each time the plus lens was reduced by a 0.25 diopter until the subject reported the opposite lines were blacker. If this point was indistinguishable, the subject was told he could glance at the cross grid and back to the letters as fast as he could. The 0.25 diopter in-phoropter reading after equalization was the amount recorded. Minus lenses were now added



to 1.50 diopters below the last recorded finding and the same instructions were given as quoted above. Plus lenses are now added in 0.25 diopter steps until reversal again occurs. The lens at which the grids reverse was recorded.

The above procedure was repeated with lenses number 2, 3, and 4 and recorded as stated above.



The above is a reproduction of the testing target used for this experiment and the following are the measurements and angular deviation effective at the eye from both the cross and the row of letters.

Center of the near point card to the center of the cross is 28 mm. and the center of the near point card to the center of the letters is 16 mm.

The angular deviation at the eye from the center of the cross subtends an angle of 4 de-

grees 1 minute. The angular deviation at the eye from the center of the row of 20/20 letters subtends an angle of 2 degrees 17½ minutes. The vertical and horizontal lines of the cross are 1 mm in width therefor subtend an angle of 8.5 minutes of arc, and the row of 20/20 letters subtend an angle of 4½ minutes of arc. These angles are calculated from a 16 inch distance.

#### STATISTICAL DATA

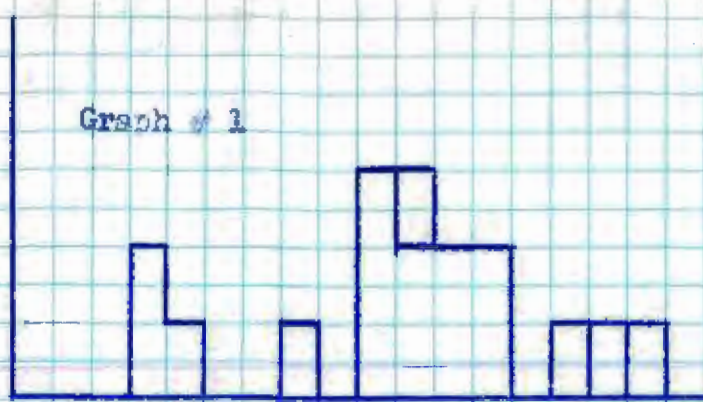
Sixteen subjects were used and the following is the statistical data acquired. Graphs number 1 through number 8 inclusive show the relationship of the findings through each cross-cylinder as compared to each other. The left hand column of graphs show the findings from the direction of greater plus and the right hand column shows the findings from the direction of lesser plus. The dioptric findings on the horizontal axis are the gross in-phoropter reading less the subjects habitual less a constant which changes the split lens power to a

4 0.50 - 1.00 cross cylinder. Lens number one constant is equal to  $-.25$  diopter; lens number two constant is equal to  $-.75$  diopter; lens number three constant is  $- 1.00$  diopter; and lens number 4 constant is equal to  $- 1.25$  diopters; as can be determined by the graphs, the correlation between them is similar.

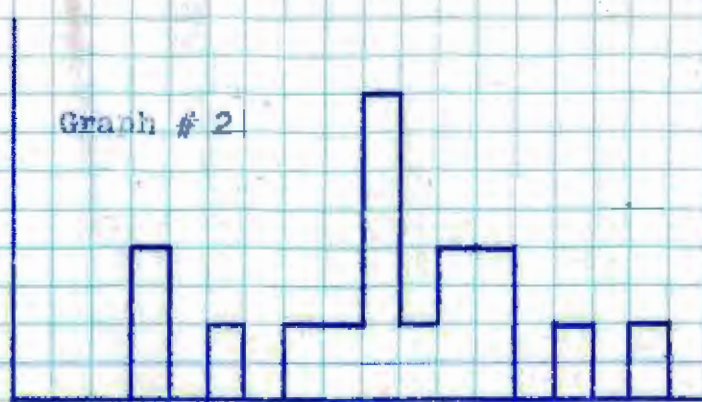
Graphs number 9 and number 10 show the combined distribution of the findings through all four lenses and graph number 11 shows the distribution of the minus and plus phase combined.

Table number I shows the calculation of the mean, mode, median, sigma, and sigma of the mean for each of the above mentioned graphs.

TIMES OCCURRED

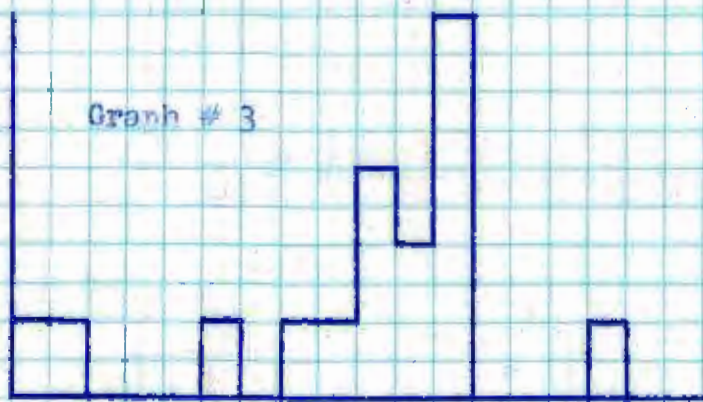


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = .250 )

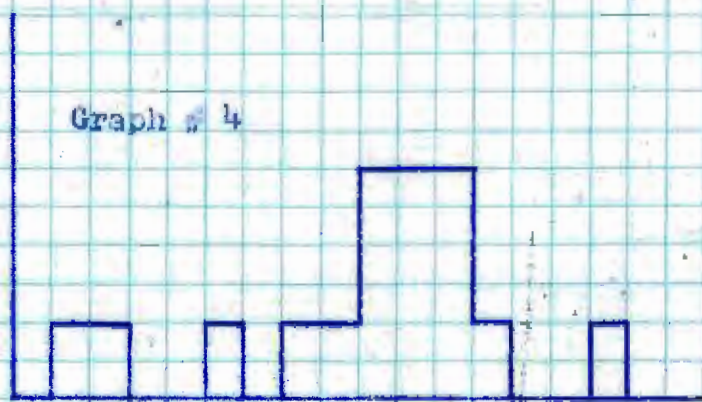


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = .250 )

TIMES OCCURRED

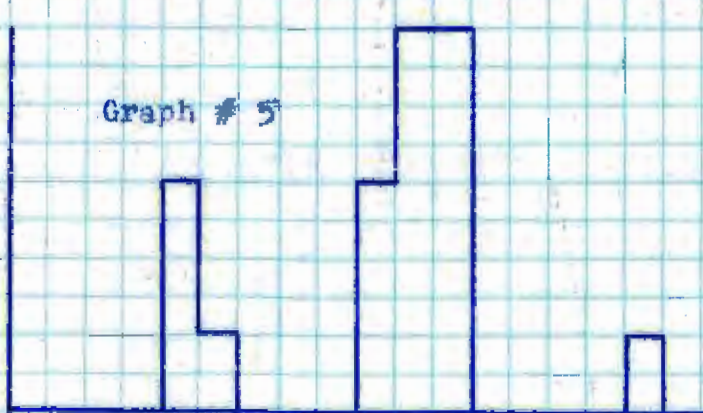


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = .750 )

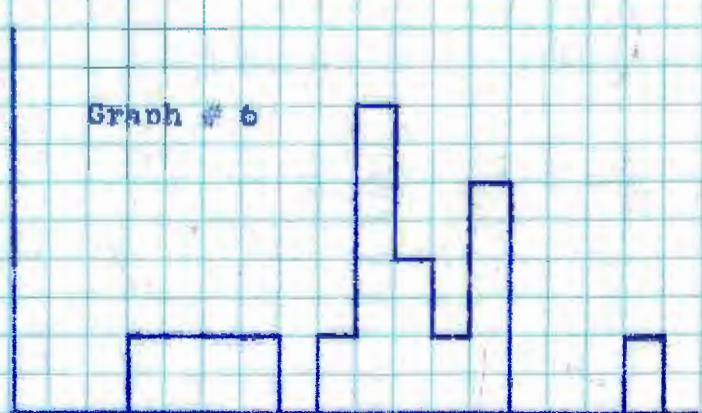


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = .750 )

TIMES OCCURRED

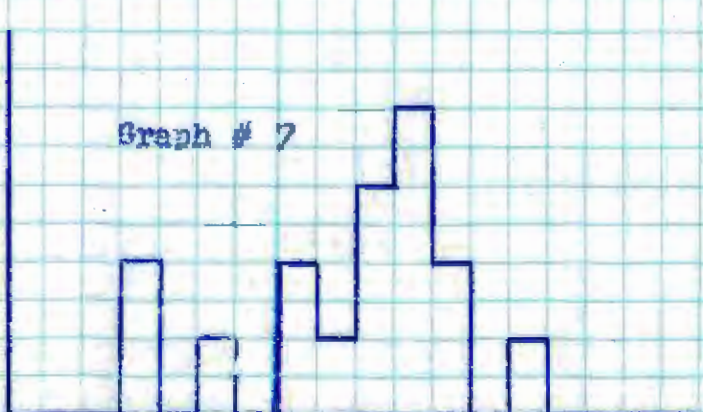


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = 1.000 )

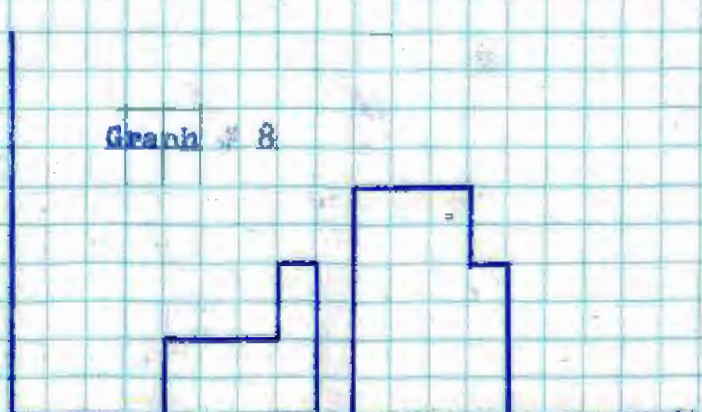


-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = 1.000 )

TIMES OCCURRED



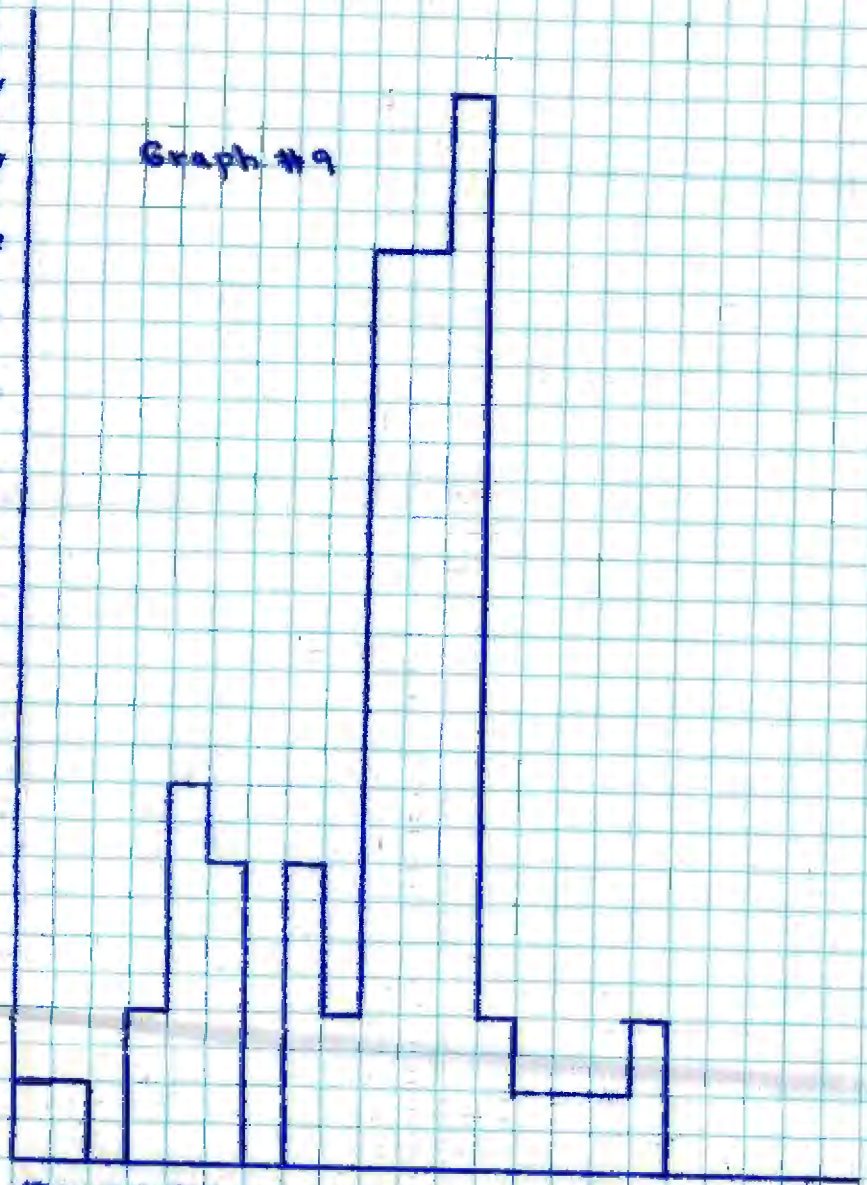
-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = 1.250 )



-1.25-1.00-.75-.50-.25 PL +.25+.50+.75+1.00+1.25+1.50+1.75+2.00+2.25+2.50+2.75+3.00  
N-k Diopters ( k = 1.250 )

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

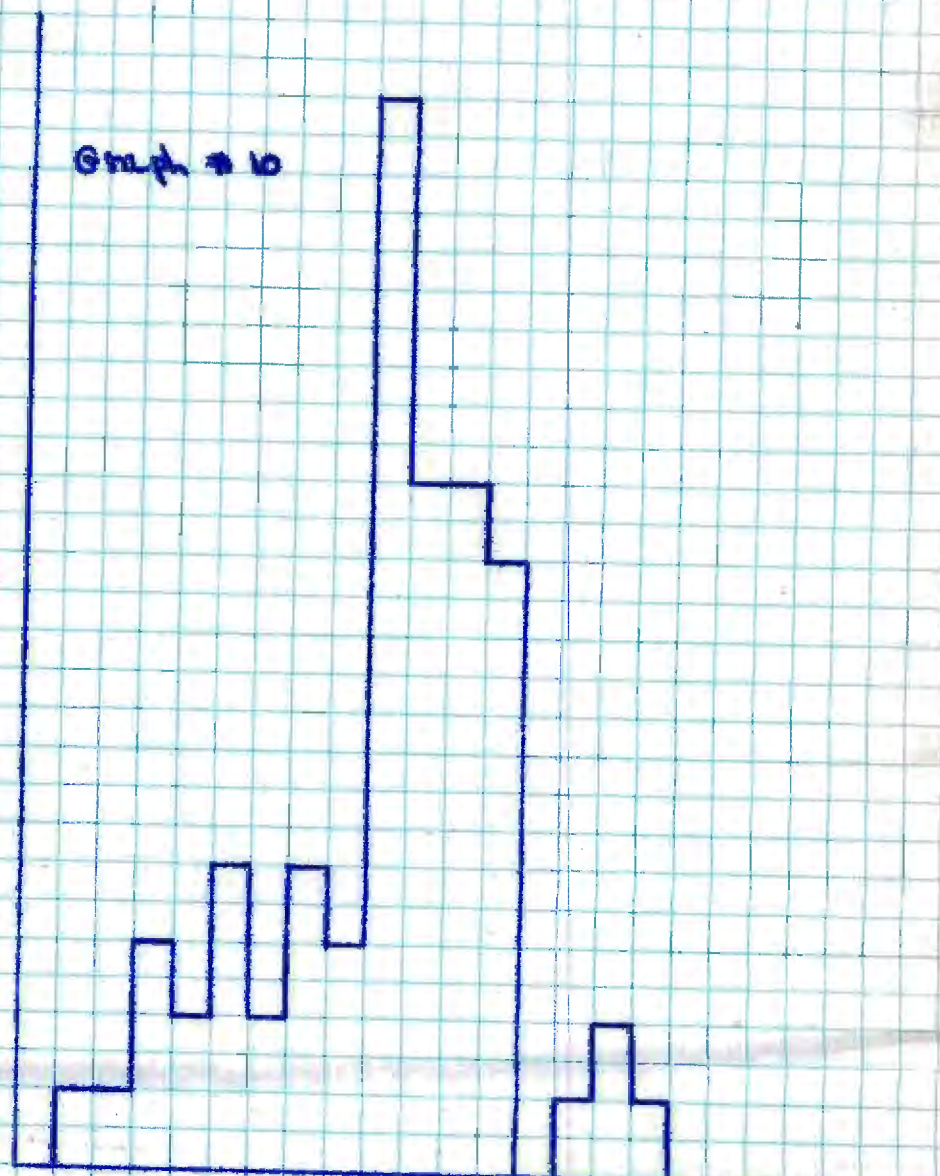
Graph #9



-10/00 -20 -25 PL 125 130 135 140/15 150/15 200/15 210/15 220/15 230/15

Diopeters

Graph #10



-10/00 -20 -25 PL 125 130 135 140/15 150/15 200/15 210/15 220/15 230/15

Diopeters

Graph # 11

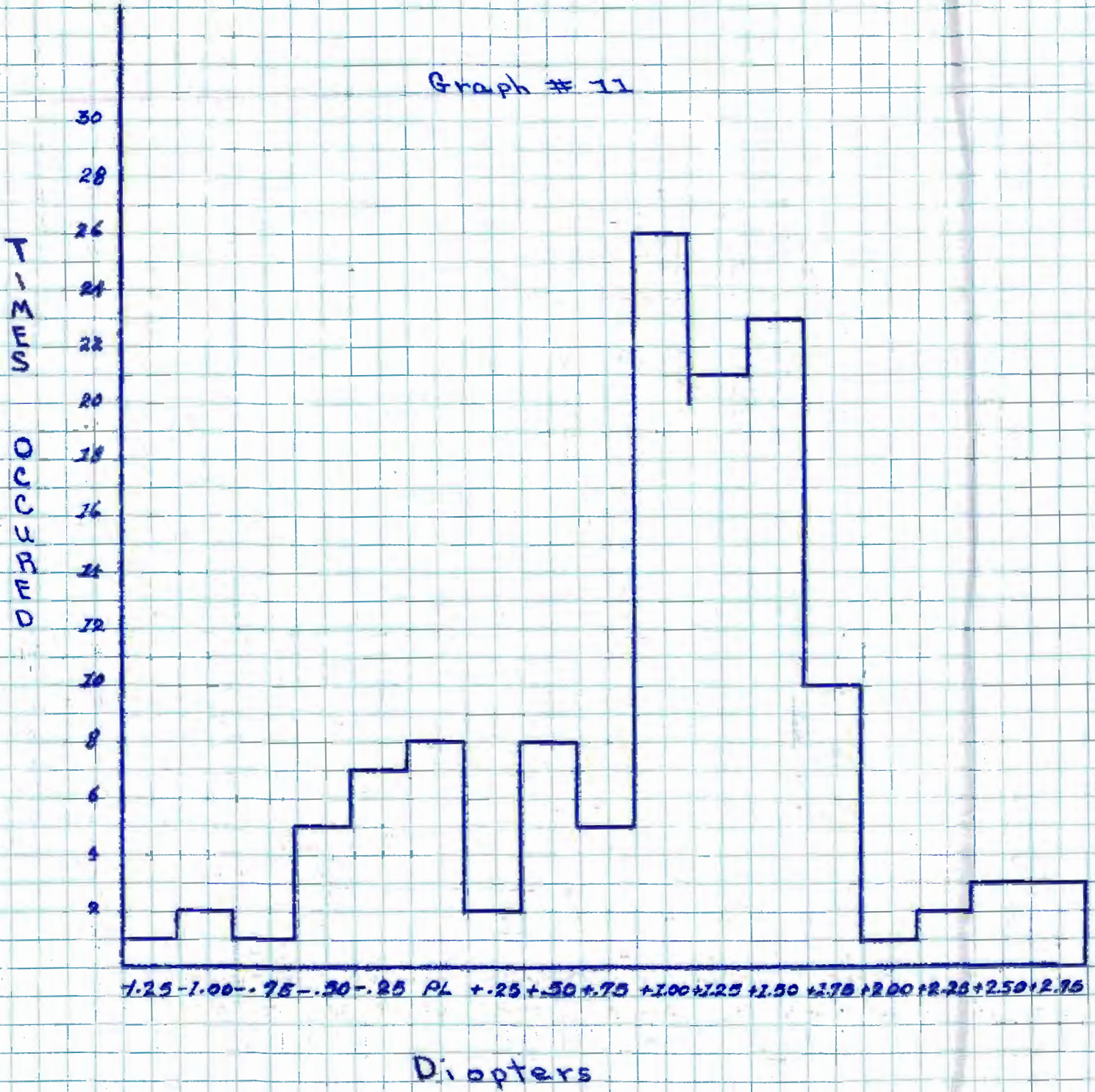


TABLE I

<u>GRAPE NUMBER</u>	<u>MEAN</u>	<u>MODE</u>	<u>MEDIAN</u>	<u>SIGMA</u>	<u>SIGMA OF DIFF.</u>
1.	1.14	1.47	1.25	.73	.18
2.	1.06	0.88	1.00	.77	.19
3.	0.91	1.54	1.12	.91	.23
4.	0.94	1.48	1.12	.86	.22
5.	1.01	1.73	1.25	.63	.16
6.	1.00	1.00	1.00	.75	.19
7.	0.89	1.22	1.00	.56	.14
8.	0.95	1.46	1.12	.52	.13
9.	1.00	1.25	1.25	.63	.077
10.	1.00	1.00	1.00	.57	.071



## REFERENCES

1. The Clinical Aspects of Accommodation and Convergence

by M. W. Morgan

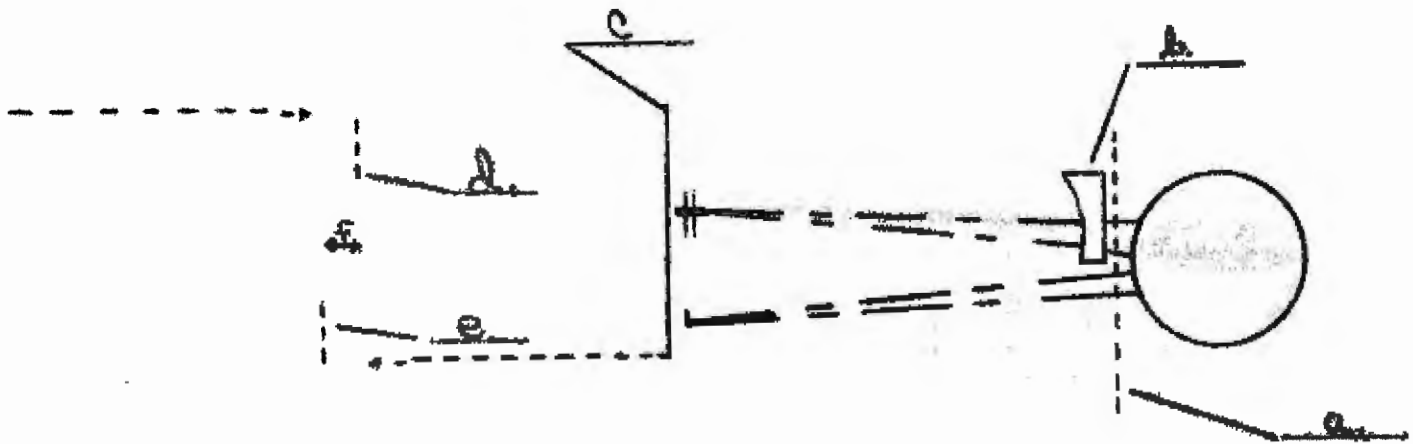
American Journal of Optometry 21, 303-313  
1944

In the haploscopic measurements, the lower limit of accommodation was found to be about 0.50 diopters to 1.25 diopters as averaged from 50 college students. This means that the so-called "lag of accommodation" as found by dynamic skiametry should be between the limits of 1.25 to 2.00 diopters or an average about 1.50 diopters.

Haploscopic measurements indicate, when you have 20/20 acuity that this occurs when the smallest diameter of the conoid falls about 0.50 to 0.75 diopters in front of the retina.

To sum up the above, static skiametry and subjective refraction give results about 0.75 diopters more plus than do results found with the haploscope.

## Diagrammatic Representation of Project Results



- a. Is the photoper
- b. Is the split time
- c. Is the 16" testing target
- d. Accommodative posturing limit measured from the side of lesser plus.
- e. Accommodative posturing limit measured from the side of lesser plus.
- f. Difference in magnitude between accommodative posturing limit measured from the side of greater plus and the side of lesser plus

## CONCLUSION

Given the same astigmatic or cross-cylinder interval, the combination of lens power makes no difference in the end point of the lag of accommodation.

Under the conditions as stated in the aforementioned procedure, we found the magnitude of inhibitory limit of the posture of accommodation during fixation at 16" to be  $\neq 1.10$  minus  $0.50$  ( for the cylindrical element of  $1.00$  diopter ) which equals  $.60$  diopters. Measuring from the side of lesser plus, this finding would be  $0.12D$  greater and the finding taken from the side of greater plus would be  $0.12D$  less.

Coming from the side of greater plus and then from the side of lesser plus, the difference in magnitude is  $0.125$  diopters.