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## A determination of the mean values of the #19 test for various age levels and a comparison to those of Donders and Duane

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# **A determination of the mean values of the #19 test for various age levels and a comparison to those of Donders and Duane**

## **Abstract**

The purpose of this study is to determine the mean value and variability of the amplitude of accommodation as designated by the number nineteen finding in the standard analytical routine and to compare these to those means of Donders and Duane .

## **Degree Type**

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## **Degree Name**

Master of Science in Vision Science

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D.T. Jans

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A DETERMINATION OF THE MEAN VALUES OF  
THE #19 TEST FOR VARIOUS AGE LEVELS  
AND A COMPARISON TO THOSE OF DONDERS  
AND DUANE

Clinical Year Thesis

By

Stephen J. Anderson

and

John F. Pyle

June, 1964

## ACKNOWLEDGMENTS

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We also wish to thank those who assisted us in gathering our sample from the clinical files.

S. J. A.

J. F. P.

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STATEMENT OF PURPOSE

The purpose of this study is to determine the mean value and variability of the amplitude of accommodation as designated by the number nineteen finding in the standard analytical routine and to compare these to those means of Donders and Duane.

## REVIEW OF LITERATURE

Donder's Method. Most methods used today in determining the amplitude of accommodation are related to the method used by Donders in 1864.<sup>1</sup> The test was run monocularly and a target consisting of small detail of such nature that blurring can readily be recognized is moved slowly toward the non-occluded eye along its line of sight. The patient is to report the first noticeable blur. The target should be moved inside this position to see if the blurring becomes worse. If it does, the point at which the blurring was first reported represents the near point of accommodation. This near point of accommodation should be checked by several repeated measurements. The target is moved from a remote, clear position toward the eye past the point of blurring. It can then be made to recede from this position at which it appears blurred, and the subject is to report when the target becomes clear. In general, the near point determined by clearing will be slightly beyond that determined by blurring. An average between these two points can be taken as the near point of accommodation.<sup>2</sup>

Lower-case letters make a good target for this determination since blurring of these letters is more easily detected by naive observers than is blurring of

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1. Monroe J. Hirsch and Ralph E. Wick, Vision of the Aging Patient, (Philadelphia, 1960), p. 90.

2. Ibid, P. 91.



upper case letters. The dioptric value of the distance of the near point of accommodation from the spectacle plane can be taken to represent the amplitude of accommodation.

The binocular amplitude of accommodation may be measured by moving the target toward the eyes along a midsagittal line ending at the bridge of the nose. The near point distance will always be less along the midsagittal line than it is along the line of sight. In general, the binocular amplitude will appear somewhat greater than the monocular.

Duane's Method. Duane recognized the disadvantage in Donders's method of measuring the amplitude of accommodation. This was that the small-case letters, or the 20/20 letters subtended a visual angle of 5' only at 16". The closer the letters were moved toward the eye, the greater the angle and hence the lesser the acuity stimulus. He, therefore, substituted a thin, single black thread on a white card for the 20/20 acuity letters and thus eliminated acuity from the finding altogether.<sup>3</sup>

Concave-at-Near. Sheard<sup>4</sup> (1917, 1957) thought that the method of Donders, sometimes referred to as the push-up method, would lead to estimates of the amplitude which would be too great. The angular size of the detail of the target increases as the target

3. Harold M. Haynes, Theory of Optometry IV Lecture Notes, November 1, 1963.

4. Monroe J. Hirsch and Ralph E. Wick, Vision of the Aging Patient, (Philadelphia, 1960), Pp. 91-2.

approaches the eye and the pupil decreases; these changes tend to make blurring difficult to recognize. Duane's method offered a disadvantage also, in that blurring of a thin, black thread was difficult to discern for an untrained observer. As a substitute, he recommended the use of a method he termed the "concave-at-near procedure." Jaeger No.2 print is placed 33 cm. from the spectacle plane. If the subject cannot read the print readily, convex lenses are added until he can. The test is then made monocularly by reducing the convex lens power or by adding concave lenses until the maximum minus lens power has been added through which the print is barely readable. The apparent amplitude is then equal to the dioptric value of the fixation distance (3.00 D.) plus the added lens. If the net lens power results in a convex add, this amount is deducted from 3.00 D. , if the add is concave, it is added. This method results in apparent amplitudes which are slightly less than those determined by Donders' method. The same method may be used binocularly.

Analytical Routine Method. Sheard's method was altered somewhat for the standard analytical routine used today. The target was changed to .62 M type (16" type) while the testing distance remained at 13". The stimulus factor of the 16" type (2.50 D.) was retained.<sup>5</sup>

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5. D. T. Jans, Theory of Optometry II Lecture Notes, January 30, 1963.

## PROCEDURE

We took a random sample of the cases in the Pacific University Optometric Clinic files and determined the mean value and variability of the amplitude of accommodation as designated by the number nineteen finding in the standard analytical routine. These mean values were in five year age groups, beginning at the age of 27½ to 72½.

All cases which showed that pathology was present or in which visual training had been part of the therapy were eliminated from our sample.

ORGANIZATION OF THE DATA

Our sample consists of nine hundred cases from the Pacific University files between the age groups 27½ to 72½ years of age, in five year intervals. No attempt was made to separate male from female subjects or to break down the refractive errors into myopes, hyperopes, or emmetropes.

Table No. I shows the Mode, Mean, Standard Deviation, and Probable Error of the #19 test in the analytical routine for the ages 27½ through 72½ by age groups of five years.

Table No. II shows a comparison of Normal Amplitudes of Accommodation for the three different methods of testing; #19, Donders, and Duane.

Graph No. I shows our calculated means plus or minus one probable error as compared to the means of both Donders and Duane.

Statistical methods and formula used.

Mean  $\bar{X} = \frac{\sum X}{n}$  1

Where,  $\bar{X}$  = The arithmetic mean

$\sum X$  = The sum of the values of the variable

n = The number of subjects in each age group.  
We had a constant n for each age group of 100 subjects.

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6. Allen L. Edwards, Statistical Analysis, New York, Rinehard & Company, Inc., 1958, p.40.

Mode, This we define as the observation that occurs most frequently in our given set of observations.

Standard Deviation,  $s = \sqrt{\frac{x^2}{n-1}}$       2

Where, s = The standard deviation

$x^2$  = The sum of the squared deviations

n = The number of subjects in each age group

Probable error,  $Pe = 2/3 s$

Where, Pe = probable error

s = standard deviation

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7. Allen L. Edwards, Statistical Analysis, New York, Rinehard & Company, Inc., 1958, p 53.

TABLE I

Mode, Mean, Standard Deviation and Probable Error of  
the #19 test for the ages 27½ through 72½ by age groups.

AGE GROUP	MODE	MEAN	STANDARD DEVIATION	PROBABLE ERROR
27½ - 32½	5.00	6.40	1.131	.757
32½ - 37½	5.50	5.56	1.288	.863
37½ - 42½	5.00	4.58	1.241	.831
42½ - 47½	3.25	3.08	.823	.551
47½ - 52½	2.00	2.39	.814	.545
52½ - 57½	1.50	1.86	.685	.458
57½ - 62½	1.25	1.57	.756	.506
62½ - 67½	1.50	1.43	.719	.481
67½ - 72½	.87	1.22	.825	.552

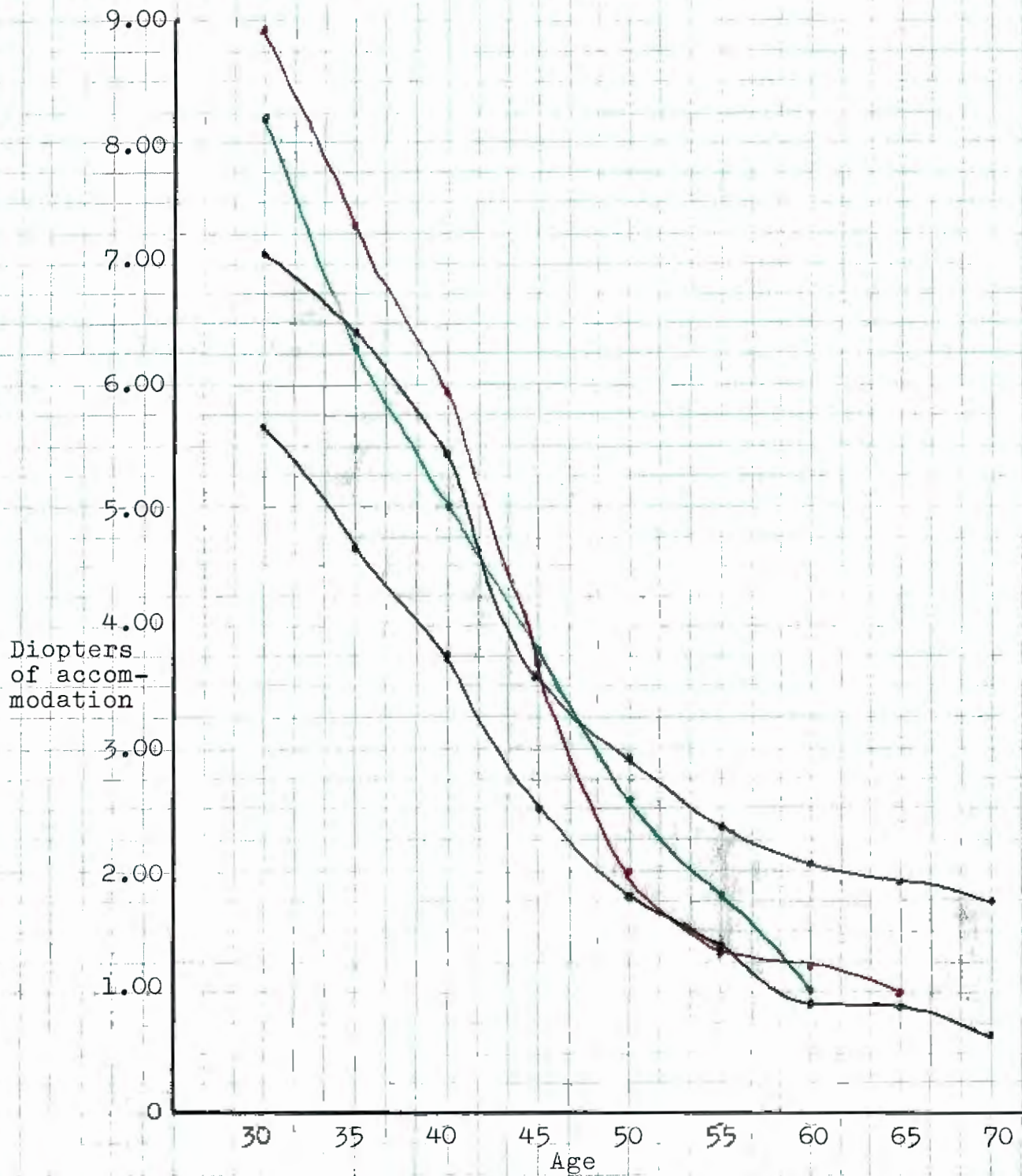
TABLE II

Comparison of Normal Binocular Amplitudes of Accommodation for Three Different Methods of Testing:  
 #19, Donders and Duane, by five year age intervals.<sup>8</sup>

Age	#19	Donders	Duane
30 yrs.....	6.40 D.	8.20 D.	8.90 D.
35.....	5.56	6.30	7.30
40.....	4.58	5.00	5.90
45.....	3.08	3.80	3.70
50.....	2.39	2.60	2.00
55.....	1.86	1.80	1.30
60.....	1.57	1.00	1.20
65.....	1.43	-	1.00
70.....	1.22	-	-

8. Monroe J. Hirsch and Ralph E. Wick, Vision of the Aging Patient, (Philadelphia, 1960), P. 87.

GRAPH I



The mean #19  $\pm$  P.E. for each age group as compared to Donders and Duane's means for similar age groups. Donders' means are shown in green, Duane's in red and the upper and lower limits of #19 in black. A mid-line through the shaded area would represent the #19 means.



## SUMMARY AND CONCLUSIONS

In summary, the #19 means for the five year age intervals listed previously agree closely with the means of Donders and Duane with the exception of the 30, 35 and 40 year old groups of Duane and the 30 year old group of Donders. We have postulated two reasons for this discrepancy. First, there is a tendency for clinicians at Pacific University, from whose files the data was taken, to end the amplitude of accommodation test on persons below the age of presbyopic onset at 5.00 D. This can be shown by our modes of these three age groups. Secondly, this difference could be due to the different testing procedures used in all three of these tests.

In all six of the other age groups, our means closely resembled the means of either Donders or Duane.

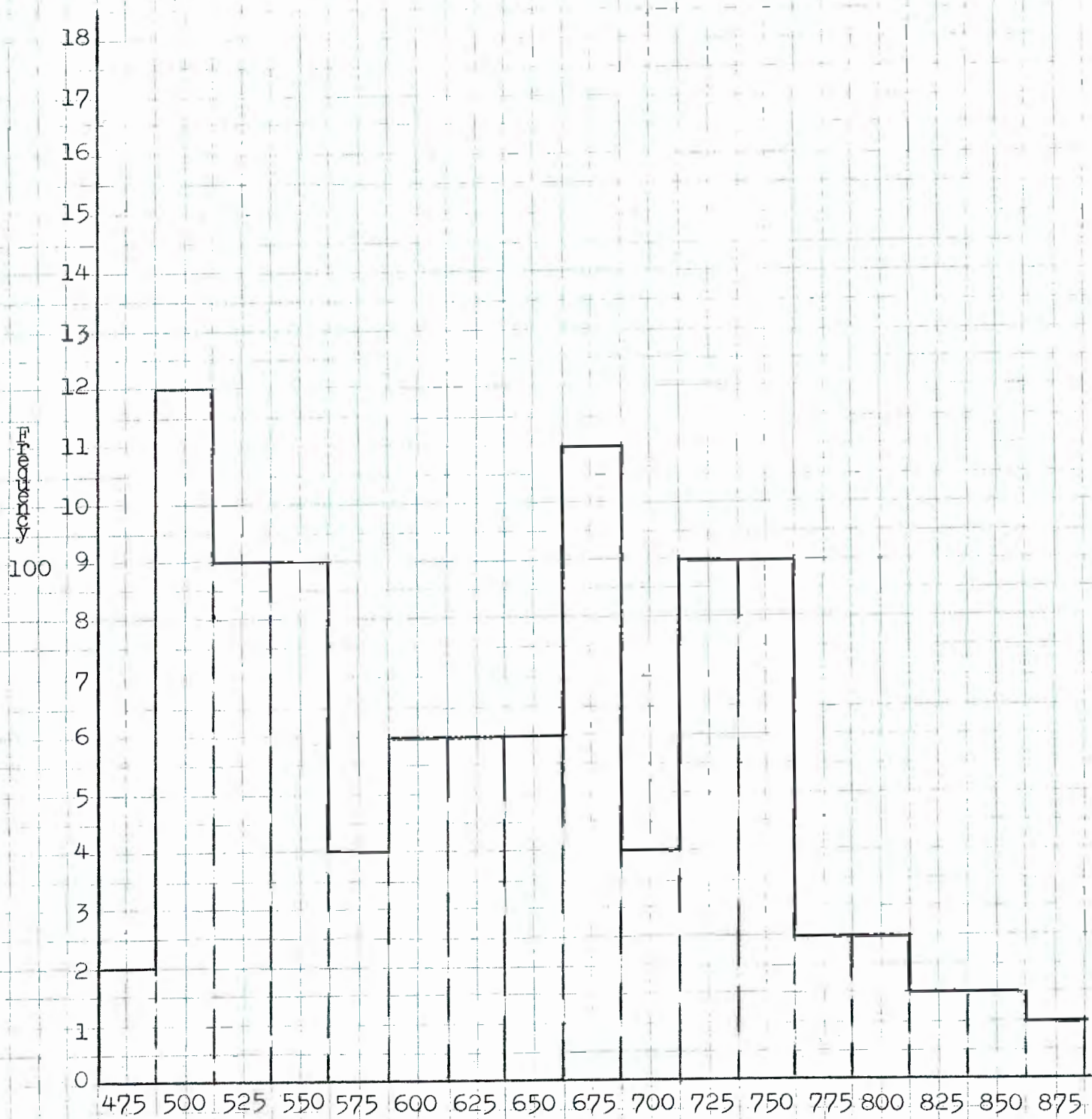
We conclude, therefore, that the average #19 test, of the standard analytical routine, for various age levels recedes at much the same rate as that previously described by Donders in the over 45 year age groups and by Duane in the over 35 year age groups and that this test is a comparable measurement of the amplitude of accommodation.

BIBLIOGRAPHY

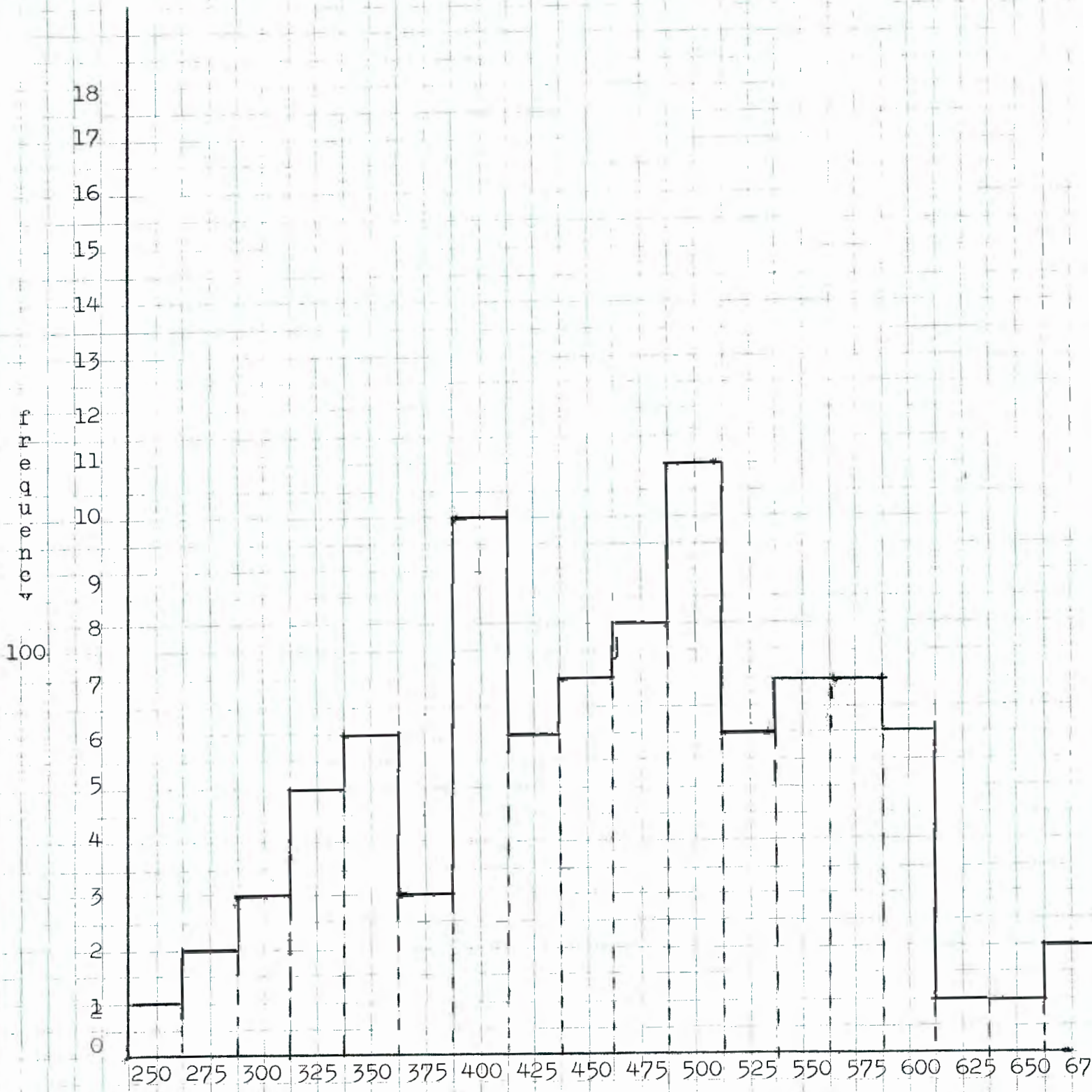
1. Edwards, Allen L., Statistical Analysis, New York, Rinehard & Co., Inc., 1958.
2. Hirsch, Monroe J., and Wick, Ralph E., Vision of the Aging Patient, Chilton Co., Philadelphia, 1960.

## APPENDIX I

## Frequency Distribution Graphs



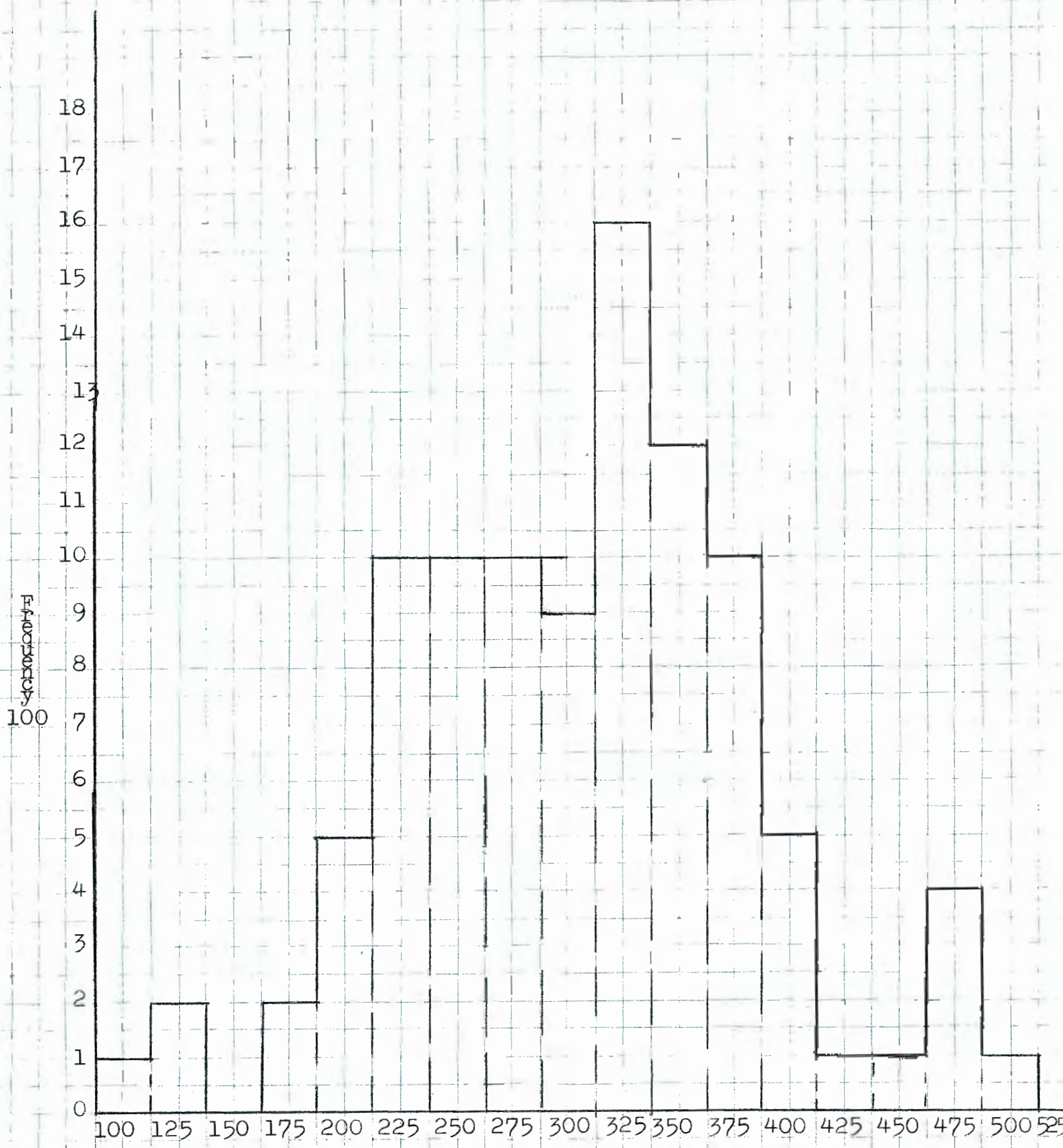
Diopters of Accommodation  
for the ages 27½ - 32½



Diopters of Accommodation  
for the ages 37½ - 42½

\*Note, these findings not graphed

.50	1
1.50	2
2.00	1
7.25	1
8.00	1
<u>6</u>	total

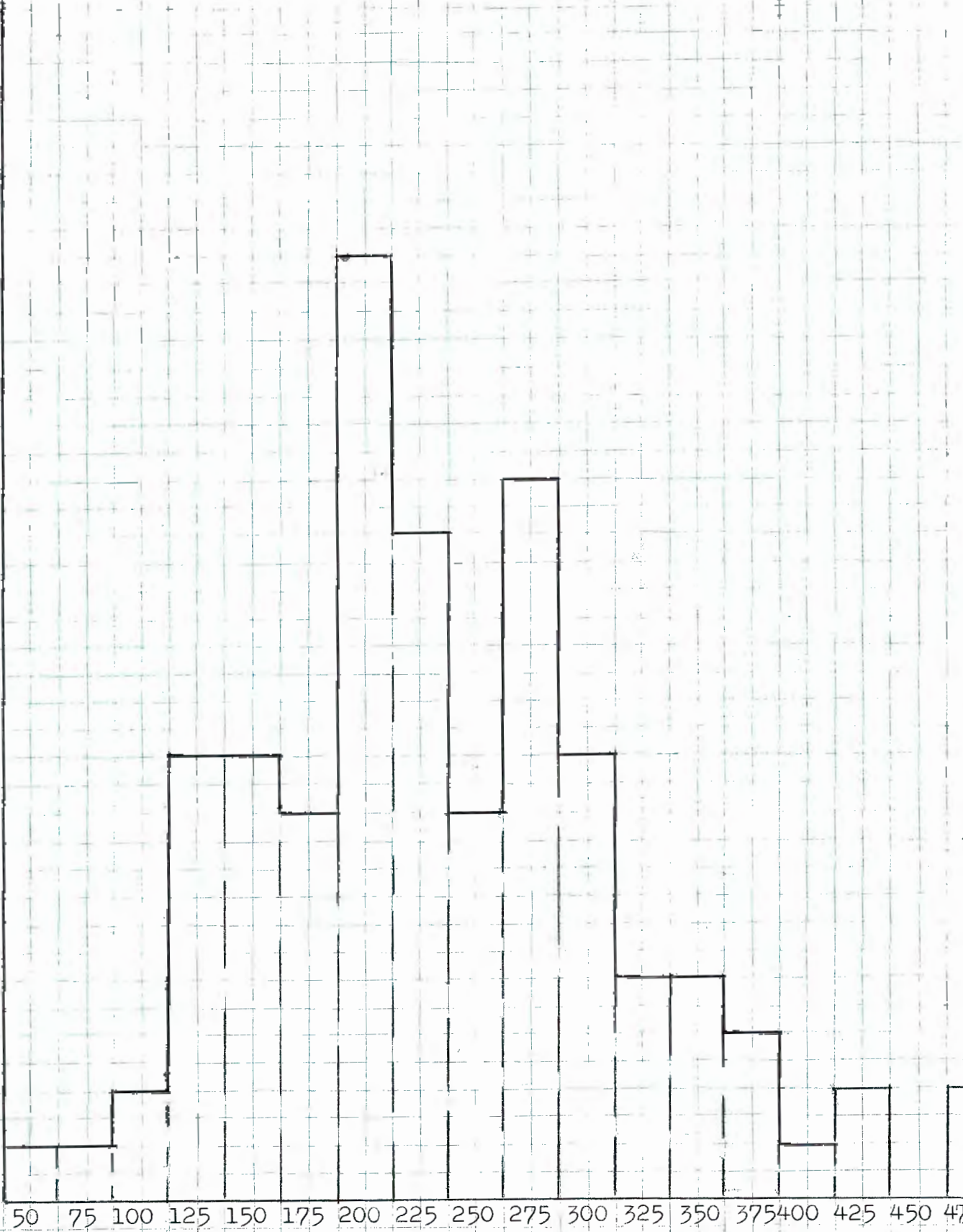


Diopeters of Accommodation  
for the Ages 42½ - 47½

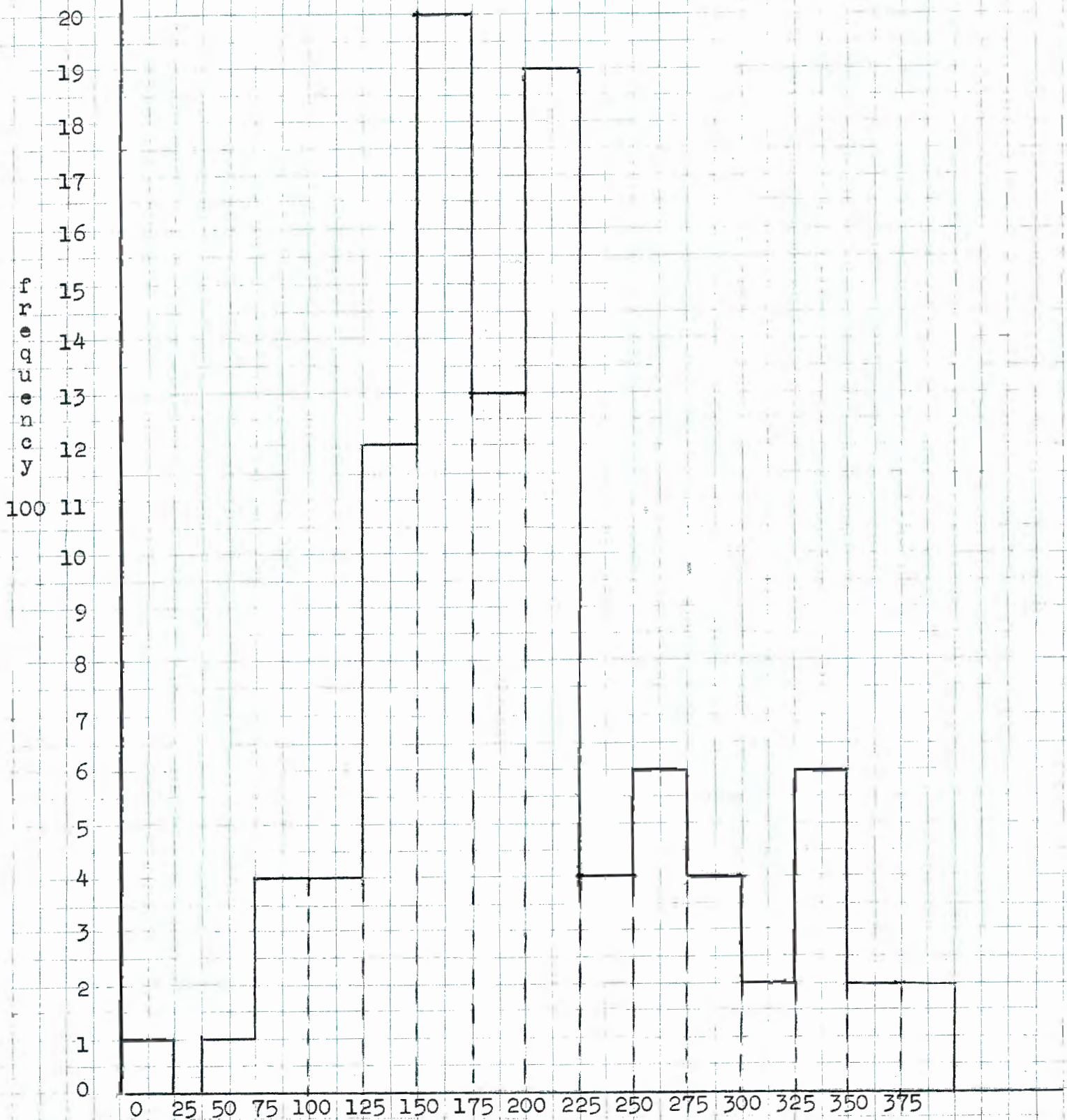
\* Note, This finding not graphed  
550  $\frac{1}{1}$  total

18  
17  
16  
15  
14  
13  
12  
11  
10  
9  
8  
7  
6  
5  
4  
3  
2  
1  
0

Frequency  
100

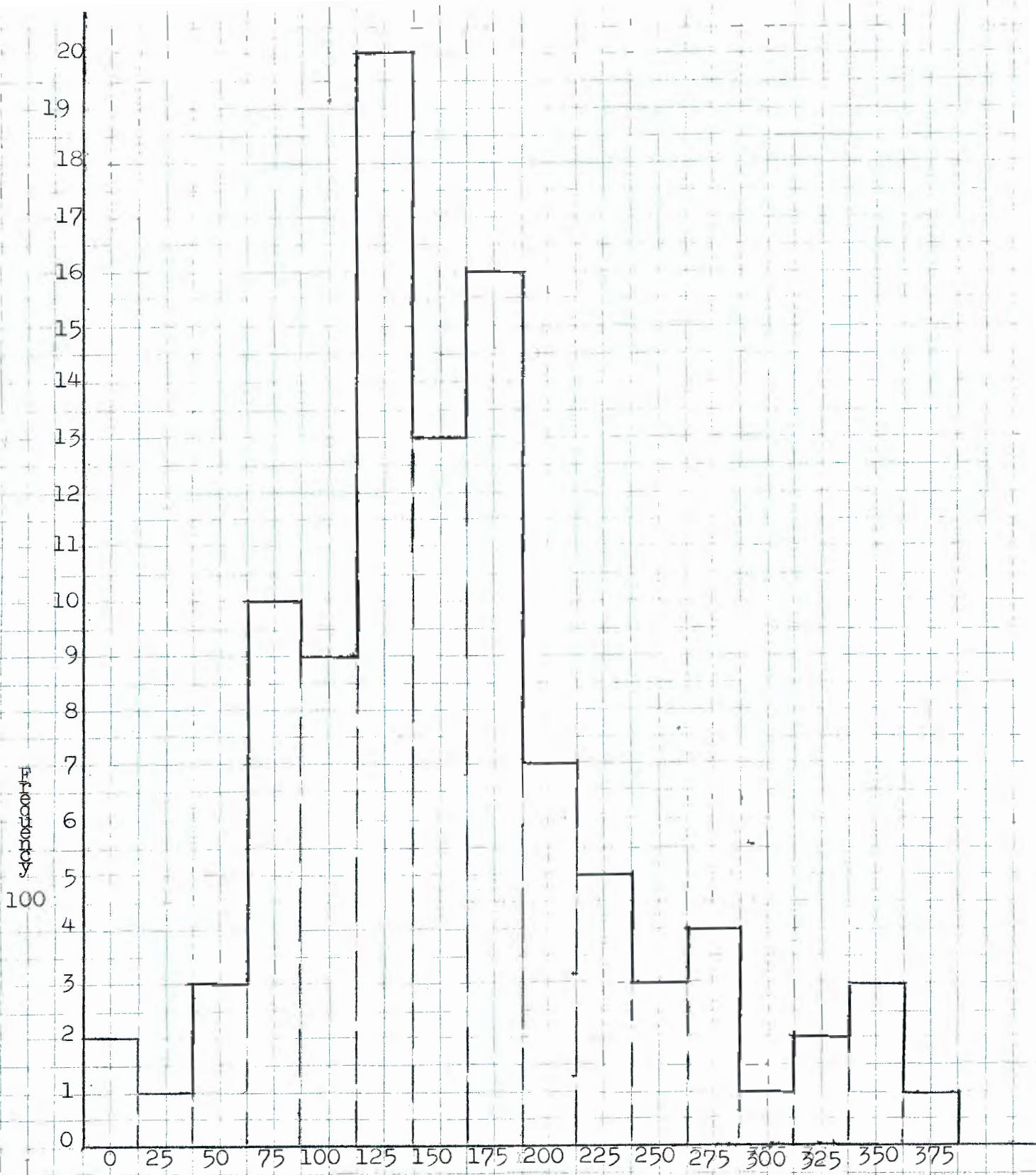


Diopeters of Accommodation  
for the Ages 47½ - 52½

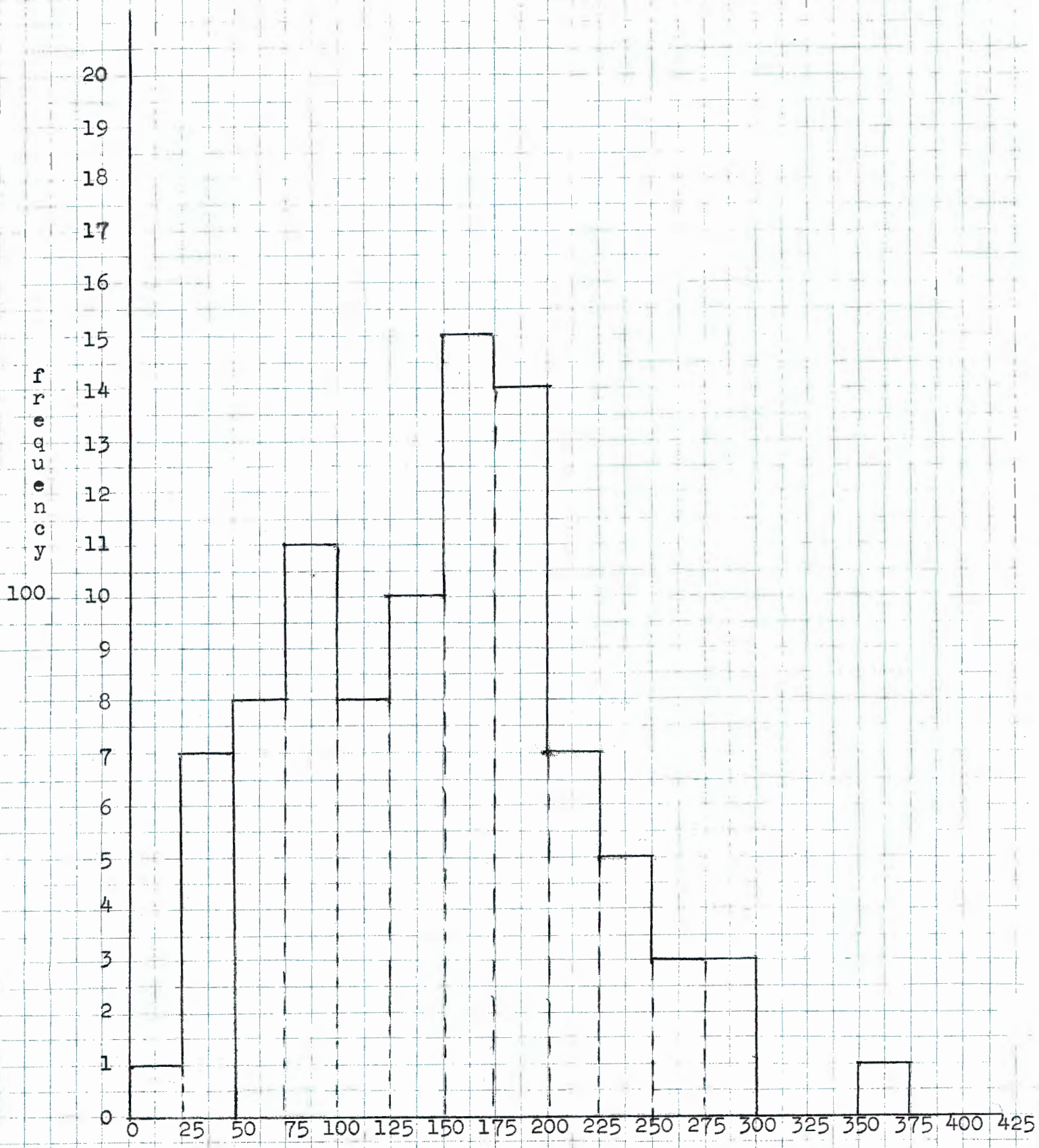


Diopters of Accommodation  
for the Ages 52 1/2 - 57 1/2

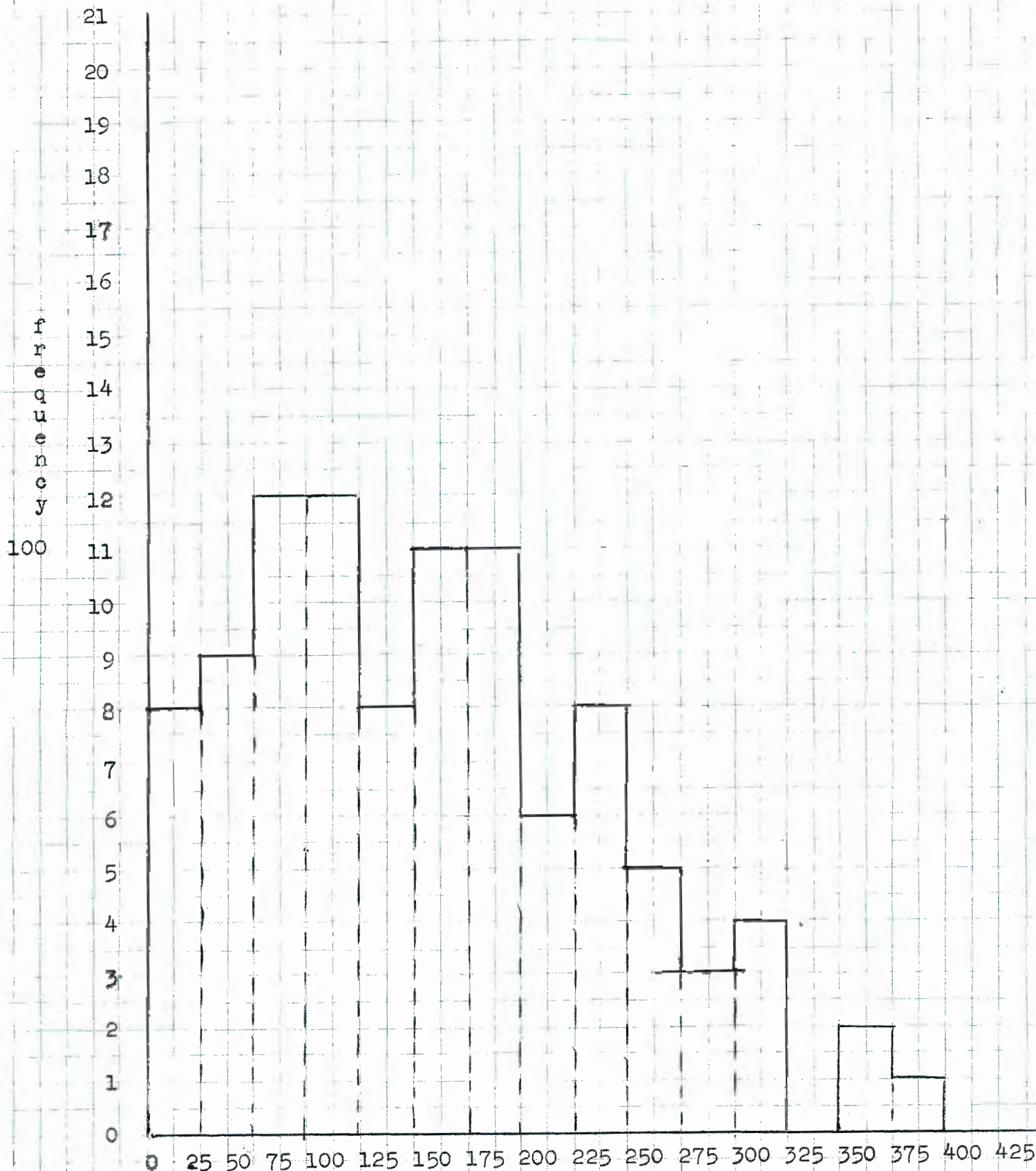




Diopeters of Accommodation  
for the ages 57½ - 62½



Diopeters of Accommodation  
for the Ages 62½ - 67½



Diopeters of Accommodation  
for the Ages 67½ - 72½