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Comparison between the method of determining the power and axis of the cylinder by the Jackson cross cylinder technique and a Lebensohn's type astigmatic chart

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Abstract

The purpose of this study is to make a comparison between the Jackson Cross Cylinder (J.C.C.) technique of determining the axis and power of the far cylinder with a Lebensohn's type of astigmatic chart. The authors of this paper would like to know if the Lebensohn's type astigmatic chart can be substituted for the Jackson Cross Cylinder test.

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COMPARISON BETWEEN THE METHOD OF DETERMINING THE POWER AND AXIS OF THE CYLINDER BY THE JACKSON CROSS CYLINDER TECHNIQUE AND A LEBENSOHN'S TYPE ASTIGMATIC CHART

By

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L.H.N.
D.C.S.

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PURPOSE

The purpose of this study is to make a comparison between the Jackson Cross Cylinder (J.C.C.) technique of determining the axis and power of the far cylinder with a Lebensohn's type astigmatic chart. The authors of this paper would like to know if the Lebensohn's type astigmatic chart can be substituted for the Jackson Cross Cylinder test.

REVIEW OF THE LITERATURE

The "Lebensohn's chart is such an arrowhead chart with the obliquity of the arrowhead lines at 30°, and the arrowhead adjacent to the line of the cross. If all lines of the cross and arrow are equally black, no astigmatism exists. If one line is blacker, the line with the arrowhead is placed at that meridian and the wings of the arrowhead compared. When these match, the correct meridian has been found."[1] "Once the principal meridians have been determined and the axis of the correcting minus cylinder located, the correction consists simply of increasing the power of the minus cylinder until the contrasted (cross) lines appear equally black."[2] This Lebensohn's chart is seen in figure one.

Figure 1

"The Jackson Cross-Cylinder technique is basically the same as that of the rotating cylinder insofar as the optical effects are concerned. Although recommended for the determination of astigmatism, it is also chiefly used as a check test for the astigmatic axis and power."[3]

PROCEDURE

The authors of this paper alternated turns in testing twenty five subjects. This was done to eliminate one examiner's idiosyncracies from influencing the findings.

The instruments used in the testing were the American Optical R_x Master lens bank and wall projector. The two testing procedures were done entirely at the far point.

The testing procedure used with the Jackson Cross Cylinder technique was as follows: (1) Pupillary distance (2) 20/30 blur (3) clock dial (4)red-green and then the Jackson Cross Cylinder technique.

The testing procedure used with the Lebensohn's type astigmatic chart was as follows: (1) red-green (2) the dial was set at 90° and the subject was asked which lines of the arrow if any were blacker than the other (3) if neither of the lines on the arrow were blacker than the other then the chart was rotated right and then left to determine if the axis of astigmatism could have been at 90°. If neither of the arrow lines were seen blacker than the other then it was determined that astigmatism did not exist.

(4) if the subject noted that one of the lines on the arrow was darker, the arrow was then rotated in a direction opposite the darker line until both lines on the arrow were equally black (5) the axis of the correcting cylinder was then placed 90° away from this meridian (6) the subject was then asked to note which lines of the cross were blackest (7) the response was always the line with the arrowhead, and then the cylinder was placed in front of the eye and increased until the subject noted equal blackness (8) if equality could not be seen, then the largest amount of cylinder power was recorded that did not produce reversal

The recording of the cylinder powers was never between the powers in the lens bank. That is for example, if the correct cylinder power was more than $.25^{D}$ and less than $.50^{D}$ the magnitude recorded was $.25^{D}$.

ORGANIZATION OF THE DATA

Twenty-five subjects ranging in ages from nine to forty-two were tested. The distribution is as follows:

AGE	NUMBER OF SUBJECTS
0 - 10 years	1
11 - 20 years	6
21 - 30 years	17
31 - 40 years	0
41 - 50 years	1

Three of the subjects tested were females and twenty-two were males.

Table I, page 6, is a tabulation of the raw data.

Table II, page 7, is a scatter diagram of the power of the right eye as done by the J.C.C. and the Lebensohn's chart.

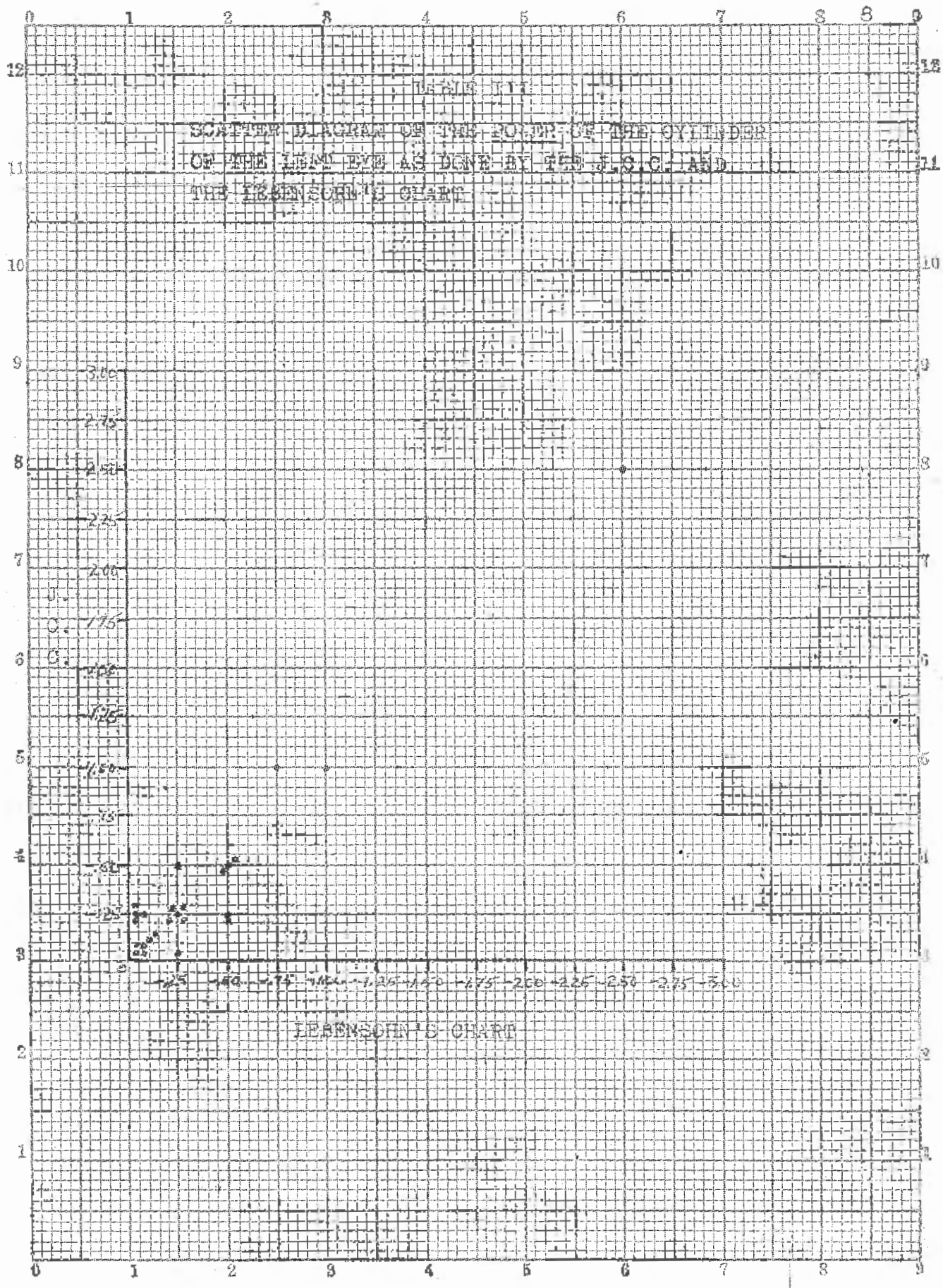
Table III, page 8, is a scatter diagram of the power of the left eye as done by the J.C.C. and the Lebensohn's chart.

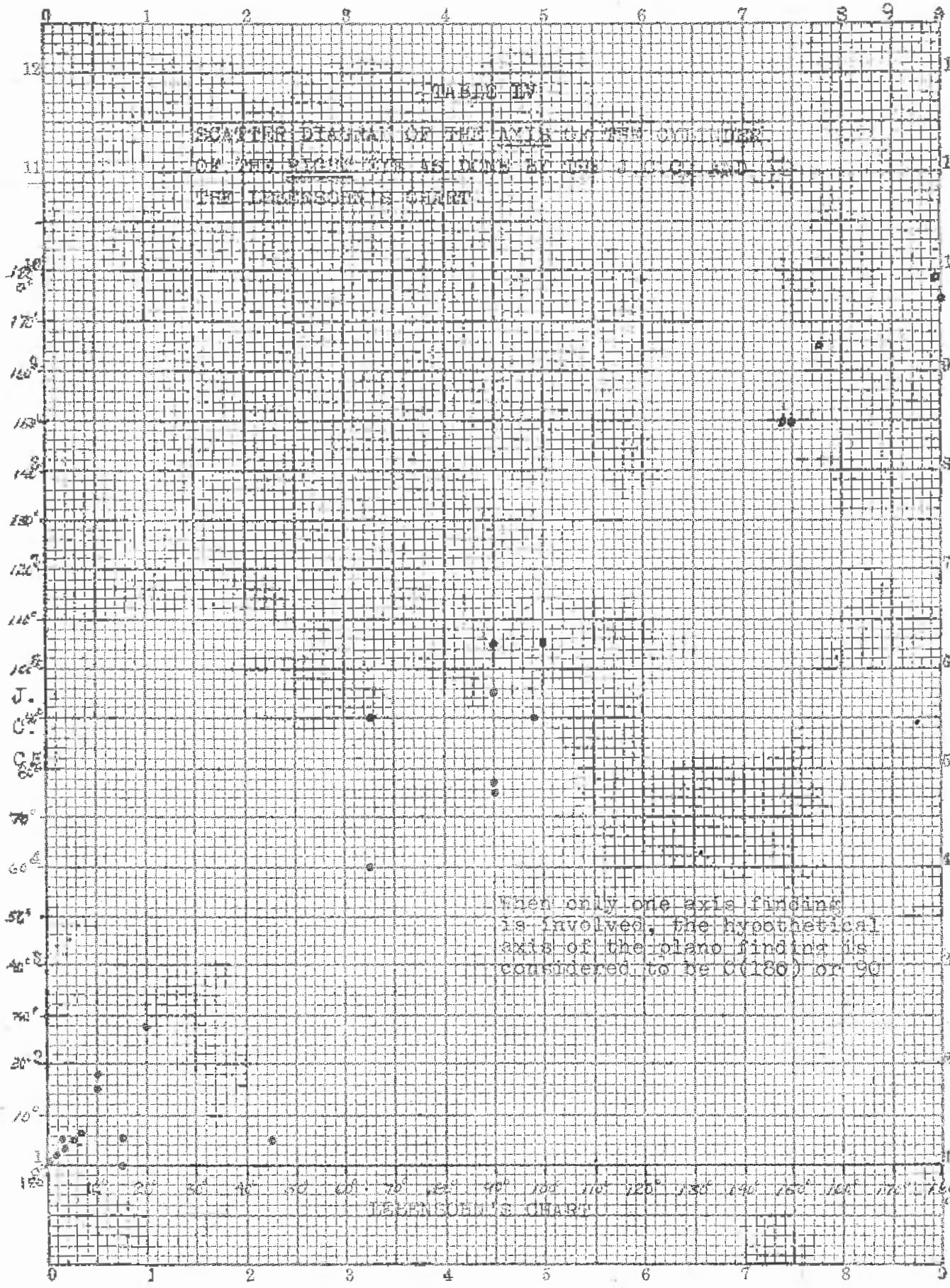
Table IV, page 9 is a scatter diagram of the axis of the right eye as done by the J.C.C. and the Lebensohn's chart.

Table V, page 10, is a scatter diagram of the axis of the left eye as done by the J.C.C. and the Lebensohn's chart.

TABLE I

CASE NO.	AGE:	SEX:	O.D. J.C.C.	O.S. J.C.C.	O.D. Lebensohn's chart	O.S. Lebensohn's chart
1.	23	M	- .25x175	- .25x180	- .25x180	- .25x175
2.	23	M	plano	- .25x180	plano	- .25x165
3.	9	F	- .25x165	plano	-.25x155	- .25x30
4.	23	F	plano	- .25x180	plano	plano
5.	20	F	- .75x5	-1.00x180	- .50x15	- .75x165
6.	18	M	plano	- .25x40	plano	plano
7.	18	M	plano	- .25x30	plano	- .25x55
8.	19	M	- .25x75	- .25x85	plano	plano
9.	24	M	- .75x180	- .50x180	-1.00x15	- .50x160
10.	42	M	- .25x180	plano	plano	plano
11.	19	M	- .25x75	- .25x180	- .25x90	plano
12.	18	M	- .50x150	- .25x15	- .25x150	- .50x45
13.	25	M	- .75x105	-1.00x85	-1.00x100	-1.00x90
14.	23	M	plano	plano	plano	plano
15.	24	M	- .50x90	plano	- .25x98	plano
16.	27	M	- .75x15	- .25x170	-1.00x10	- .50x180
17.	22	M	- .50x95	- .25x80	- .50x90	- .25x90
18.	22	M	- .50x60	- .50x105	- .50x65	- .50x120
19.	23	M	plano	plano	- .25x65	plano
20.	22	M	- .25x105	plano	plano	plano
21.	22	M	-2.75x5	-2.50x180	-2.50x3	-2.50x175
22.	23	M	- .25x5	plano	- .25x45	plano
23.	25	M	- .25x28	- .25x170	- .50x20	- .25x165
24.	23	M	- .50x150	- .50x15	- .50x160	- .25x10
25.	24	M	- .50x18	- .50x110	- .25x10	- .50x95


SCATTER DIAGRAM OF THE POWER OF THE CYLINDER
OF THE LEAD EYE AS DONE BY THE I.S.C. AND
THE LEBENSOHN'S CHART
LEBENSOHN'S CHART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SCATTER DIAGRAM OF THE AXIS OF THE CYLINDER
OF THE EYES AS DONE BY THE J.C.C. AND
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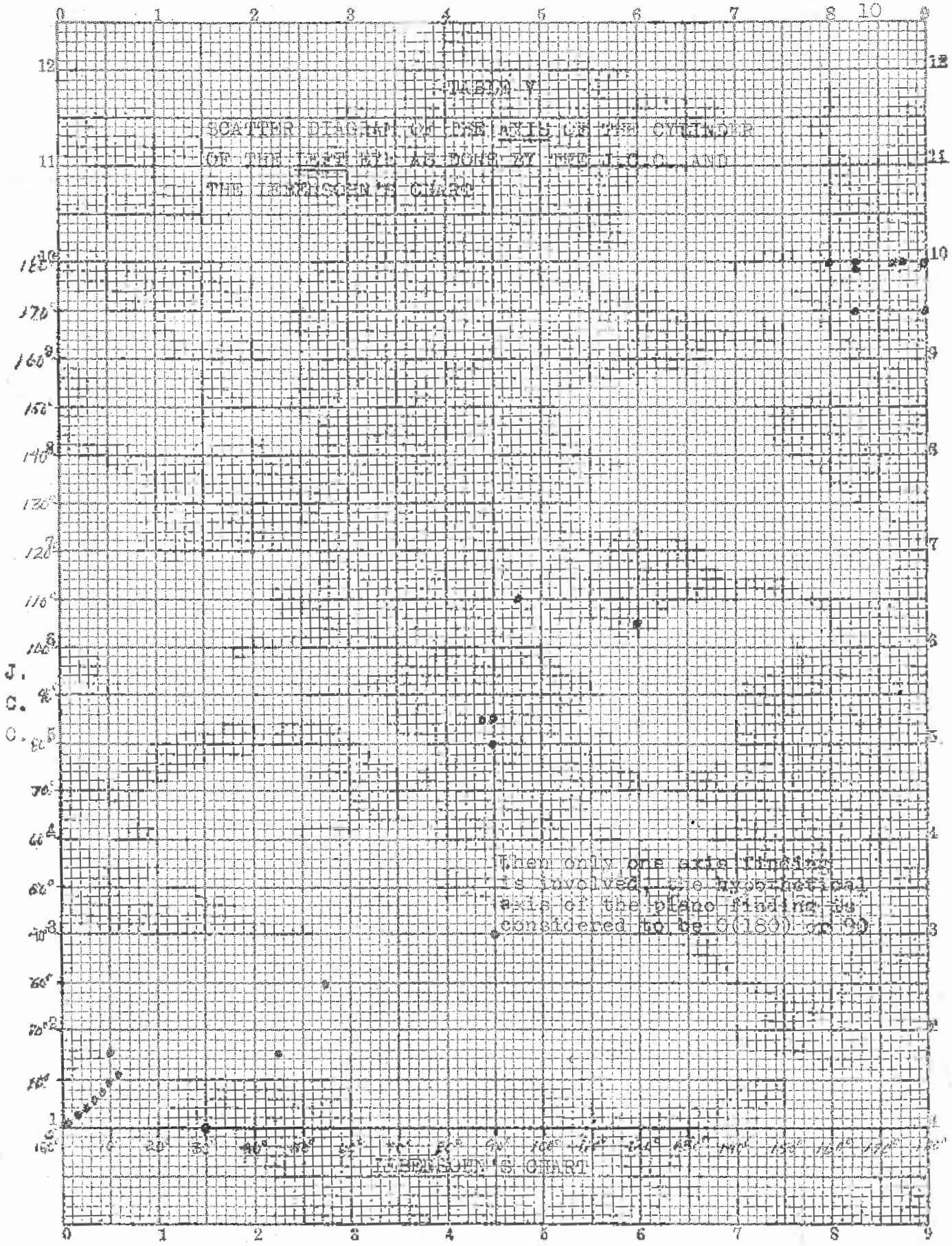
When only one axis finding is involved, the hypothetical axis of the plano finding is considered to be 0(180) or 90
LEDERSCHEIDER'S CHART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THE IMPRISON'S CHART
J.
C.
C.
When only one axis tendency is involved, the hypothetical axis of the plano finding is considered to be 0(180) or 90
IMPRISON'S CHART

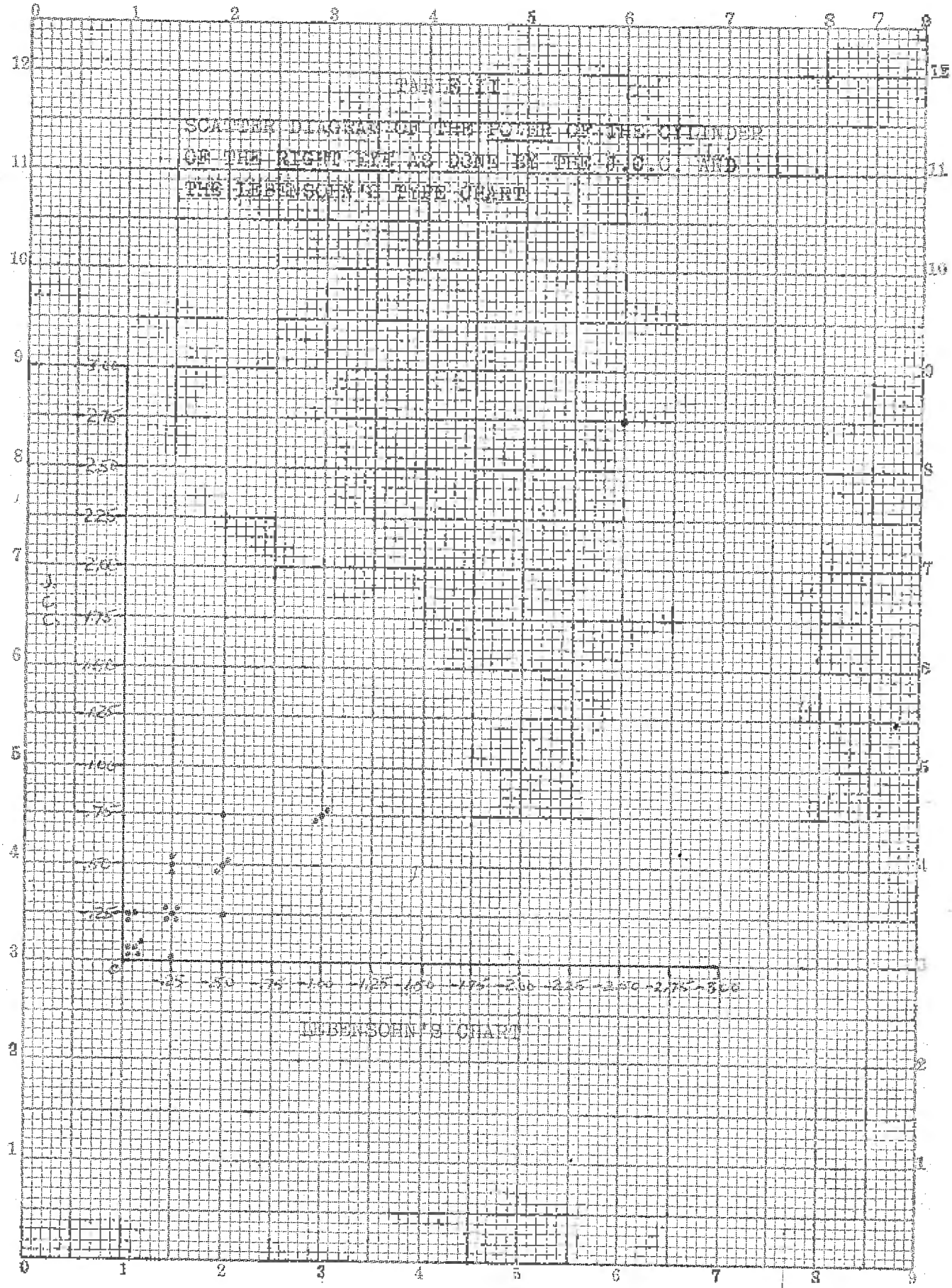
TABLE II
SCATTER DIAGRAM OF THE POWER OF THE CYLINDER
ON THE RIGHT EYE AS DONE BY THE B.C.C. AND
THE LEBENSOHN'S FLUE CHART
LEBENSOHN'S CHART

Results of the statistical analysis are:

Means:

Power of the cylinder (in diopters)

	J.C.C.	Lebensohn's type chart
O.D.	.43	.40
O.S.	.37	.34

Axis of the cylinder (in degrees)

	J.C.C.	Lebensohn's type chart
O.D.	88.6	81.5
O.S.	123.4	114.2

Standard Deviations:

Power of the cylinder (in diopters)

	J.C.C.	Lebensohn's type chart
O.D.	.55	.53
O.S.	.52	.52

Axis of the Cylinder (in degrees)

	J.C.C.	Lebensohn's type chart
O.D.	.62	.59
O.S.	.64	.60

Correlation Coefficients

1. power of O.D. = .96
2. power of O.S. = .95
3. axis of O.D. = .92
4. axis of O.S. = .91

STATISTICAL ANALYSIS

The three formulas used in the statistical analysis are:

Mean:

$$M=\frac{EX}{N} \quad 4$$

Where M= the arithmetic mean
E= "the sum of"
X= a score from the data
N= the total number of scores

Standard Deviation

$$S=\frac{Ex^2}{N-1} \quad 5$$

Where S= the standard deviation
E= "the sum of"
x^2= a deviation from the mean squared
N= the total number of scores

Correlation Coefficient

$$r=\frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} \quad 6$$

Where r= the correlation coefficient
E="the sum of"
x= a deviation from the mean M_x
y= a deviation from a different mean M_y
Ex^2= the sum of the squared deviations in X from M_x
Ey^2= the sum of the squared deviations in Y from M_y

SUMMARY AND CONCLUSION

The statistical analysis proved conclusively mathematically that the two techniques could be interchanged with each other. The correlation coefficient was above .9 for each eye for both power and axis. A higher correlation in the power of the two techniques exists, while the correlation in axis is lower.

The authors of this paper believe that the relatively high correlations may be somewhat misleading because of the relative variability of any clinical test.

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