1959

An index of the convergence tests used to evaluate the convergence system

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Abstract

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Harold M. Haynes

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Optometry

AN INDEX OF THE CONVERGENCE TESTS USED TO EVALUATE THE CONVERGENCE SYSTEM

by

John R. Dumka
and
Walter G. McCrum

1959

The co-authors of this report wish it to be known that a good deal of pleasure and satisfaction was derived from this research. The determination of a Convergence index and its statistical significance was totally like an adventure; and the two authors felt themselves as explorers in an unknown land. Our joy was matched only by our gratitude to our advisor and instructor, Dr. Harold M. Haynes, who pointed out this unknown land and gave us encouragement and advise in mapping some of its terrain.

TABLE OF CONTENTS

Section I

Statement of the Problem

The problem of this paper was to collect clinical data and to investigate a means of developing an objective scoring system of the convergence findings taken in the Pacific University clinical routine. The problem and the proposed scoring system was suggested by Dr. Harold M. Haynes. This work represents the research undertaken with the direction and guidance of Dr. Haynes. It is part of a larger project to be assigned, also in parts, and completed in the future; and was not designed to arrive at general conclusions.

Section II

Experimental Procedures.

The data was collected from Pacific University clinical files from 125 case records limited according to the criteria set up in a following page. The assembling of this data was a joint undertaking of this group and a second group. This "raw" data is not included here but may be found in a separate folder in the appendix. However, the total information is summarized and graphed in Section III.

The purpose of the research was to evaluate the convergence system as tested in the Pacific University clinical routine. An arbitrary scoring system was set up in which each test score of 13 tests (for convergence) was assigned a "point value" according to its variation from its mean (see Sec. III for point values and means). This was done for each of 125 cases; each case was totaled for the sum point value ("raw score"). Each case was also assigned a convergence "index value" (see Sect. III). These raw scores and convergence indices were subjected to statistical analysis for means and standard deviations (see Sect. III).

An auxillary group of data was assembled to determine the mean and standard deviation for three additional convergence "indicators". These are the following relationships:
a. PD. X $2\frac{1}{2} \subset$ 13B-8 b. $16B_p$- 13B c. $17B_p$ 13B
(see Sect. III for summaries, graphs, of frequency distributions and statistical computations).

For each of 125 cases, a point value was tallied for each of its 13 test scores. A value of 3 points was assigned if the test score was within its mean $\pm$ 1 PE ; 2 points for a score within $\pm$ 1 PE above that; 1 point for a score within 1 PE in addition beyond that. A zero value was assigned for a score beyond these limits; "X" value was assigned for an indeterminate score; 4 points value was arbitrarily assigned in those convergence tests that indicated superiority of function of convergence. (e.g. NPC "to the nose" or within 1 inch). These point values for the means and variations are shown on page in table I.

Section III

Results

a. Discussion of work-ups.

b. Identification of graphs.

c. Point values, and limitations sheets.

d. Detailed summaries, graphs, and rough calculations.

A.

The convergence index (ci) was evaluated as follows: The total or "raw score" was divided by the number of tests in the battery for the convergence system. (13 in this case). Wherever an "X" value was encountered this 13 was reduced one unit per each "X".

e.g. $\frac{\text{raw score}}{\text{total tests}}$ e.g. case #51 $\frac{34}{13}$ is 2.62

The limitations for selection of cases was meant to exclude particular visual cases that might have interferred with any or all aspects of testing the convergence area. The age limitations and refractive limitations were artitrary, and meant to be part of a definitive research. These limitations are listed in a later page, beneath the point values table, Table #1.

Since a random sampling of a population is necessary for any statistical study, any arbitrary selection by alphabet will meet this requirement. Selection of cases by this group was begun at the last of the names beginning with "Z" and working forward" to the front of the alphabet in the Clinic files.

B.

The graphs are frequency distribution curves of the raw scores and the Ci. The data represented by these curves are to be found in the "summaries" associated with each graph. The statistical computations for each curve are included for convenience and for critical evaluation.

Identification of graphs and summaries:

Graph #1 Frequency distribution of "raw score"
Graph #2 Frequency distribution of "convergence indices"
Graph #3 Frequency distribution of PD. X $2\frac{1}{2}$ 13B-8
(ie. total absolute convergence from far point phoria to near point phoria)
Graph #4 Frequency distribution of $16B_{y}$- 13B
(ie. convergence variation of BO recovery posture to phoric posture at the near point.)
Graph #5 Frequency distribution of $17B_{y}$- 13B
(ie. convergence variation of BI recovery posture to phoric posture at the near point.)
Graph #6 Frequency distribution of point values
(composite graph including each point columb.)

Note: Graphs #3, #4, #5, are auxillary data for the determination of mean and sigma for 3 additional convergence relationships and can be incorporated into the original "raw" score data, and used to compute a different convergence index.

C. Limitations for selection of clinical cases:

1. Sphere not more than + or - 2.00 Diopters
2. Anisometropia not over .75 Diopters (.87 D. or more)
3. Cylinder not over .75 Diopters (.87 D. or more)
4. Visual Acuity must be 20/20 or better with Rx.
5. No Visual Training cases unless there has been not training for one year prior to taking the findings (can use original findings before Visual Training if within other limitations.)
6. No strabismics past or present.
7. No Amblyopes.
8. No Pathology cases or any cases with a pathology history.
9. Age limit: 15 to 35 years.
10. Discard cases where fll finding is over 14 prism diopters. (15 prism diopters or more.)

Test	Mean	PE	Range / Value 4 pt.	± 1 PE 3 pts.	± 2 PE 2 pts.	±3 PE 1 pt.	± 4 PE 0 pt.
#8	.75	1.75		2.5 xo to 1 eso	2.75 xo to 4.25 xo 1.25 eso to 2.75 eso	4.5 xo to 6 xo 3.0 eso to 4.5 eso	6.25 xo and more 4.75 eso and more
#13B	5.5	3.5		9xo &2 xo	9.25 xo to 12.5 xo 2.25 xo to 1.5 eso	12.75 to 16 xo 1.75 eso to 5 eso	16.25 xo and more. 5.25 eso and more.
#10-B	19.6	4.5	24.1 & more	24 to 15.1	15 to 10.6	10.5 to 6.1	6.0 and less.
#10-R	7.0	3.0	10 & more	9.9 to 4	3.9 to 1	.9 to -2	-2.1 and less.
#11-B	7.8	2.5	10.3 to 14	10.2 to5.3	5.2 to 2.8	2.7 to .3	.2 or less.
#11-R	3.3	1.75	5 & more.	4.9 to 1.6	1.5 to .1	.9 to-1.85	-1.9 and less.
#16-B	20.3	4.75	25 & more	24.9 to 15.5	15.4 to 10.8	10.7 to 6	5.9 or less.
#16-R	9.0	4.0	13 & more	12.9 to 5	4.9 to 1	.9 to -3	-2.9 and less.
#17-B	22.3	2.75	25 & more	24.9 to 19.5	19.4 to 16.8	16.7 to 14	13.9 and less.
#17-R	13.1	3.0	16.1 & more.	16.0 to 10.1	10.0 to 7.1	7.0 to 4.1	4.0 and less.
NPC-B	2.5	1.0	1.5 & less	3.5 to 1.6	3.6 to 4.5	4.6 to 5.5	5.6 and more.
NPC-R	4.5	1.75	2.75 and less.	2.8 to 6.25	6.3 to 8	8.25 to 9.75	10.0 and more.
Fixations (Near ⇄ Far)				"Good"	"Fair"	"Poor"	

Table of point values

Section III (Part D)

Summary of Frequency data

FREQUENCY OF ITEM (Raw Score)		SCORE	FREQUENCY INDEX
20	0	1.6	2
21	2	1.7	1
22	1	1.8	1
23	2	1.9	2
24	0	2.0	0
25	1	2.1	2
26	1	2.2	7
27	3	2.3	3
28	3	2.4	11
29	4	2.5	22
30	3	2.6	11
31	10	2.7	0
32	11	2.8	12
33	14	2.9	22
34	12	3.0	8
35	9	3.1	8
36	11	3.2	3
37	11	3.3	0
38	8	3.4	1
39	8	3.5	1
40	7		
41	0		
42	2		
43	0		
44	1		
45	1		
46	9		

$\frac{9}{125}$ * Please see Graph I

$\frac{1}{125}$ - Please see Graph II

~~ROUGH~~ ROUGH CALCULATIONS

Mean and Standard Deviation of Raw Score (See Graph I)

Score	fo	mid point	f	x'	fx'	$f(x')^2$
21	2					
22	1					
23	2	23	6	0	0	0
4	0					
5	1					
6	1					
7	3					
8	3	28	14	1	14	14
9	4					
30	3					
1	10					
2	11					
3	14	33	56	2	112	224
4	12					
5	9					
6	11					
7	11					
8	8	38	45	3	135	405
9	8					
40	7					
1	0					
2	2					
3	0	43	4	4	16	64
			125		277	707

MEAN

$\bar{X} = 23 + \frac{277 \cdot 5}{125}$

$= 34.1$

≈ 34

SIGMA

$\Sigma x' = 25\left[707 - \frac{277^2}{125}\right]$

$= 25 \times 14$

$\sigma = \sqrt{\frac{25 \times 14}{12}}$

$= 4.35$

$\approx 4\frac{1}{2}$

MEAN CALCULATIONS

of

MEAN and STANDARD DEVIATION for CONVERGENCE INDEX (See Graph E)

Score	f	mid point	x'	f_1	f_1x'	$f_1(x')^2$
16	2					
17	1	17.5	0	6	0	0
18	1					
19	2					
20	0					
21	2	21.5	1	12	12	12
22	7					
23	3					
24	11					
25	22	25.5	2	52	104	208
26	11					
27	8					
28	12					
29	22	29.5	3	50	150	450
30	8					
31	8					
32	3					
33	0	33.5	4	5	20	80
34	1					
35	1					
				125	286	750

MEAN

$\bar{X} = 17.5 + \frac{28?.4}{125}$

$= 27$ ≈ 27

SIGMA

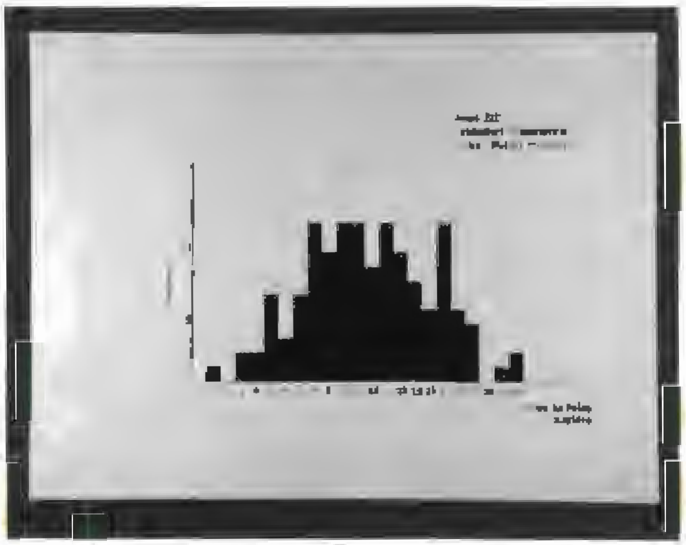
$\Sigma_x = 16\left[755 - \frac{2?7^2}{125}\right]$

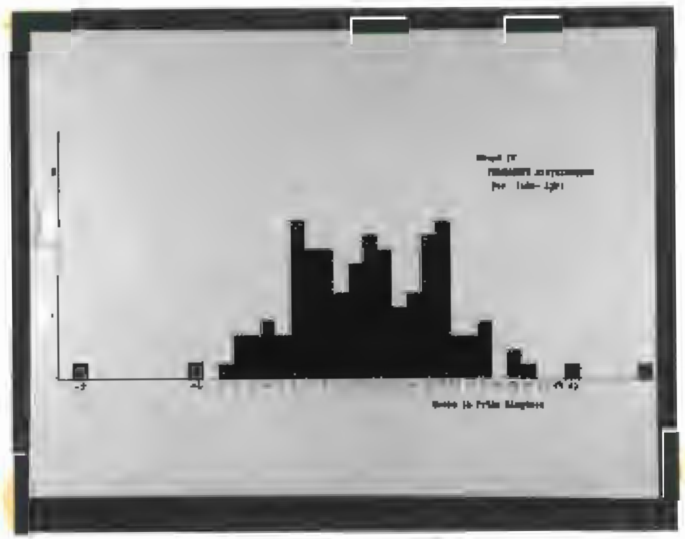
$= 16(97)$

$\sigma = N\sqrt{\frac{16 \cdot 97}{124}}$

$= 3.54$

≈ 35 ≈ 35





SUMMARY OF DATA FOR FREQUENCY DISTRIBUTION IN PRISM DIOPTERS

(Graph III)

A. (B - 13B) ⊃ PD (2.5)

0 - .99	= 0
1.00 - 1.99	= 1
2.00 - 2.99	= 0
33.00 - 3.99	= 2
4.00 - 4.99	= 2
5.00 - 5.99	= 6
6.00 - 6.99	= 3
7.00 - 7.99	= 6
8.00 - 8.99	= 11
9.00 - 9.99	= 9
10.00 - 10.99	= 11
11.00 - 11.99	= 11
12.00 - 17.99	= 8
13.00 - 13.99	= 11
14.00 - 14.99	= 9
15.00 - 15.99	= 7
16.00 - 16.99	= 5
17.00 - 17.99	= 11
18.00 - 18.99	= 5
19.00 - 19.99	= 4
20.00 - 20.99	= 0
21.00 - 21.99	= 1
22.00 - 22.99	= 2
	125

(Graph IV)

B. (16B - 13B)

-.9	= 1
-.1	= 1
0	= 0
1	= 1
2	= 3
2.5	= 1
3	= 2
4	= 4
5	= 3
6	= 11
7	= 10
8	= 9
9	= 6
10	= 8
10.5	= 1
11	= 9
12	= 9
13	= 5
14	= 6
15	= 10
16	= 11
17	= 2
18	= 3
19	= 4
20	= 0
21	= 2
22	= 1
23	= 0
24	= 0
25	= 1
30	= 1
	125

(Graph V)

C. 17B - 13B

-.4	= 1
-.3	= 1
-.2	= 3
-.1	= 1
0	= 2
1	= 1
2	= 5
3	= 7
4	= 11
5	= 10
6	= 7
6.5	= 1
7	= 8
8	= 13
9	= 8
10	= 9
11	= 8
12	= 8
13	= 5
14	= 5
15	= 4
16	= 4
17	= 1
18	= 0
19	= 1
20	= 1
	125

DATA FOR FREQUENCY DISTRIBUTION

(Composite Graph #6)

4 Points

Score	Freq.
0	45
1	29
2	29
3	10
4	5
5	5
6	0
7	0
8	1
9	1

3 Points

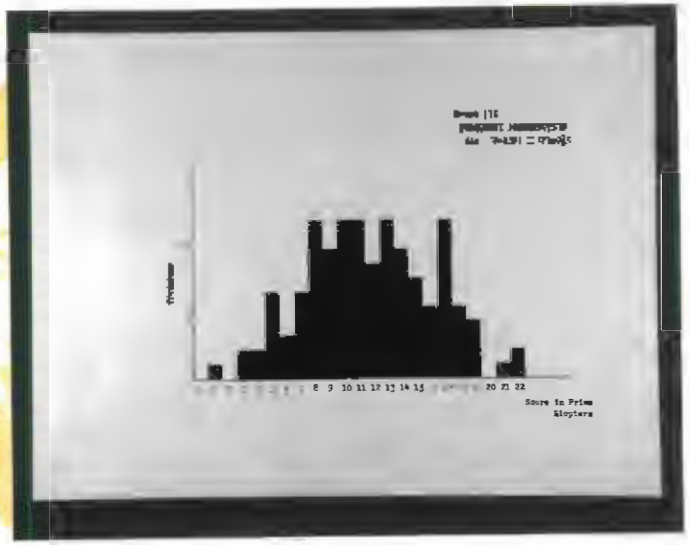
Score	Freq.
0	0
1	0
2	1
3	4
4	6
5	15
6	13
7	21
8	21
9	8
10	17
11	10
12	2
13	1

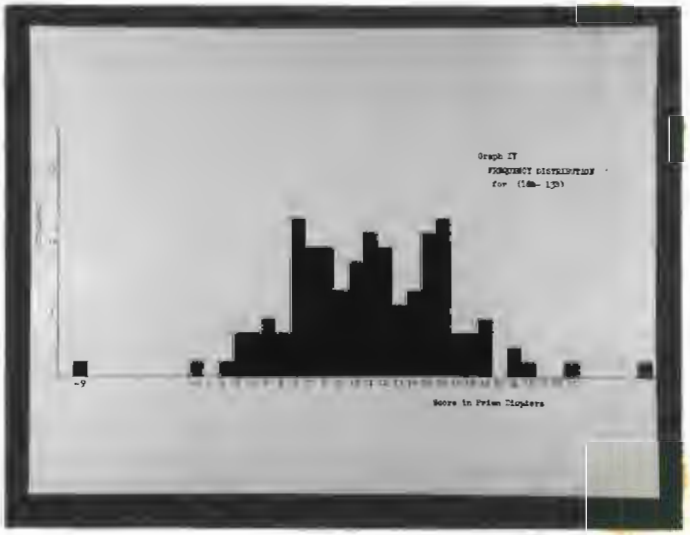
2 Points

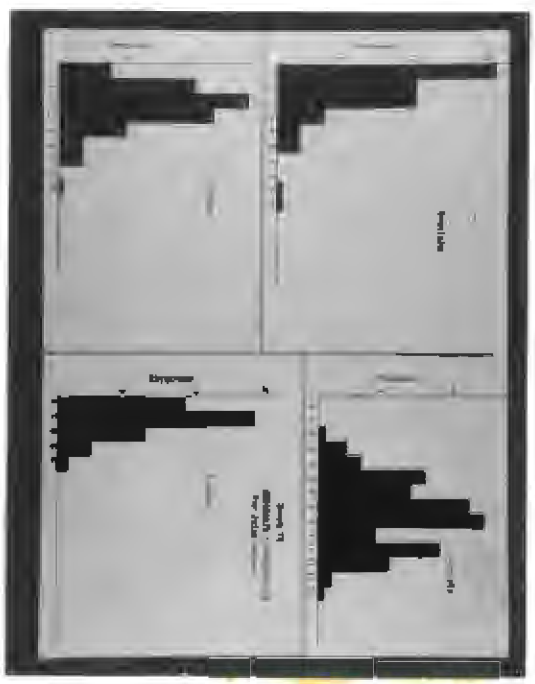
Score	Freq.
0	11
1	28
2	39
3	32
4	14
5	5
6	5
7	0
8	1

1 Point

Score	Freq.
0	35
1	54
2	24
3	9
4	3


8 9 10 11 12 13 14 15 20 21 22
Score in Prism Kloyters


Graph IV
-9
Score in Prism Kloyters



ROUGH CALCULATIONS REGARDING (13B-8)PD x $2\frac{1}{2}$

(See Graph III)

Score	f	xf	fx'	$f(x')^2$
1.0 - 5.75	11	0	0	0
6.0 - 10.75	40	1	40	40
11.0 - 15.75	46	2	92	184
16.0 - 20.75	25	3	75	225
21.0 - 25.75	3	4	12	48
			219	497

MEAN

$$\bar{X} = 3.37 + \frac{219 \times 5}{125}$$

$$= 12.13$$

$$= 12.4$$

SIGMA

$$\Sigma x^2 = 25\left[497 - \frac{219^2}{125}\right]$$

$$= 2825$$

$$\sigma = \sqrt{\frac{2825}{124}}$$

$$= 4.77$$

$$= 5^4$$

ROUGH CALCULATIONS REGARDING (168_p - 130)

(See Graph II)

Score	f	x'	fx'	$f(x')^2$
-9 to -3	1	0	0	0
-2 to 4	12	1	12	12
5 to 11	56	2	112	224
12 to 18	47	3	141	423
19 to 25	8	4	32	128
26 to 32	1	5	5	25
			302	812

MEAN

$$\bar{X} = -6 + \frac{302}{125} \times 7$$

$$= 10.9$$

$$\simeq 11$$

SIGMA

$$\Sigma x^2 = 49\left[812 - \frac{302^2}{125}\right]$$

$$= 49[24]$$

$$\sigma = \sqrt{\frac{49[24]}{124}}$$

$$= 5.75$$

$$\simeq 6$$

ROUGH CALCULATIONS REGARDING $(27\frac{1}{2} - 13B)$ (See Graph I)

Score	f	x'	fx'	fx'^2
~~-5~~ to 0	0	0	0	0
1 to 5	34	1	34	34
6 to 10	46	2	92	184
11 to 15	30	3	90	270
16 to 20	7	4	28	112
			244	600

MEAN

$$\bar{X} = -2 + \frac{244 \times 5}{125}$$

$$= 7.75$$

$$\approx 8^{\blacktriangle}$$

SIGMA

$$\Sigma x^2 = 25\left[600 - \frac{244^2}{125}\right]$$

$$= 25\,[124]$$

$$\sigma = \sqrt{\frac{25(124)}{124}}$$

$$= 5^{\blacktriangle}$$

Detailed Summaries by Cases

FREQUENCY POINTS

Case #	4	3	2	1	0	X
1	2	8	2	1	0	0
2	0	8	4	1	0	0
3	0	10	2	1	0	0
4	1	7	1	2	0	0
5	0	12	0	1	0	0
6	1	8	2	2	0	0
7	0	11	2	0	0	0
8	2	10	0	0	0	1
9	0	7	2	3	1	0
10	1	11	0	0	0	1
11	1	8	3	1	0	0
12	3	4	5	0	0	1
13	2	5	2	1	3	0
14	1	5	4	0	2	1
15	0	4	5	1	2	1
16	2	6	2	0	2	1
17	1	7	3	1	1	0
18	0	11	2	0	0	0
19	0	11	2	0	0	0
20	2	4	5	1	1	0
21	2	7	3	1	0	0
22	1	6	2	1	3	0
23	1	7	2	2	1	0
24	1	11	0	1	0	0
25	3	5	3	2	0	0

SUMMATION POINTS

Case #	4	3	2	1		TOTAL (Average)	INDEX
1	8	24	4	1	=	37	2.85
2	0	24	8	4	=	36	2.77
3	0	30	4	1	=	35	2.69
4	4	21	2	2	=	29	2.23
5	0	36	0	1	=	37	2.85
6	4	24	4	2	=	34	2.61
7	0	33	4	0	=	37	2.85
8	8	30	0	0	=	38	3.17
9	0	21	4	3	=	28	2.15
10	4	33	0	0	=	37	3.08
11	4	24	6	1	=	35	2.69
12	12	12	10	0	=	34	2.83
13	8	15	4	1	=	28	2.15
14	4	15	8	0	=	27	2.25
15	0	12	10	1	=	23	1.92
16	8	18	4	0	=	30	2.50
17	4	21	6	1	=	32	2.46
18	0	33	4	0	=	37	2.85
19	0	33	4	0	=	37	2.85
20	8	15	8	1	=	32	2.46
21	8	21	6	1	=	36	2.77
22	4	18	4	1	=	27	2.08
23	4	21	4	2	=	31	2.38
24	4	33	0	1	=	38	2.92
25	12	15	6	2	=	35	2.69

FREQUENCY POINTS

Case #	4	3	2	1	0	X
26	0	6	2	3	2	0
27	0	11	1	1	0	0
28	2	6	4	0	1	0
29	2	8	1	2	0	0
30	5	5	2	0	1	0
31	3	8	1	0	1	0
32	2	9	1	1	0	0
33	0	8	3	2	0	0
34	2	8	0	1	2	0
35	0	8	4	1	0	0
36	8	3	2	0	0	0
37	0	13	0	0	0	0
38	1	8	1	3	0	0
39	9	2	0	2	0	0
40	4	3	2	2	2	0
41	2	4	6	1	0	0
42	2	6	3	1	0	1
43	2	7	2	2	0	0
44	2	8	1	1	0	1
45	0	5	4	3	0	1
46	1	8	2	0	0	2
47	0	10	1	0	2	0
48	3	10	0	0	0	0
49	1	7	1	3	0	1
50	2	10	0	1	0	0

SUMMATION POINTS

Case #	4	3	2	1		TOTAL	INDEX
26	0	18	4	3	=	25	1.92
27	0	33	2	1	=	36	2.77
28	8	18	8	0	=	34	2.62
29	8	24	2	2	=	36	2.77
30	20	15	4	0	=	39	3.00
31	12	24	2	0	=	38	2.92
32	8	27	2	1	=	38	2.92
33	0	24	6	2	=	32	2.46
34	8	24	0	1	=	33	2.54
35	0	24	8	1	=	33	2.54
36	32	9	4	0	=	45	3.46
37	0	39	0	0	=	39	3.00
38	4	24	2	3	=	33	2.54
39	36	6	0	2	=	44	3.38
40	16	9	4	2	=	31	2.38
41	8	12	12	1	=	33	2.54
42	8	18	6	1	=	33	2.75
43	8	21	4	2	=	35	2.69
44	8	24	2	1	=	35	2.92
45	0	15	8	3	=	26	2.16
46	4	24	4	0	=	32	2.91
47	0	30	2	0	=	32	2.46
48	12	30	0	0	=	42	3.23
49	4	21	2	3	=	30	2.50
50	8	30	0	1	=	39	3.00

FREQUENCY POINTS

Case #	4	3	2	1	0	X
51	1	7	4	1	0	0
52	5	5	1	2	0	0
53	2	5	5	1	0	0
54	1	6	4	1	1	0
55	4	7	1	1	0	0
56	0	8	3	1	1	0
57	0	10	1	2	0	0
58	0	9	3	1	0	0
59	2	7	3	1	0	0
60	1	8	3	1	0	0
61	3	9	0	1	0	0
62	0	8	4	1	0	0
63	2	7	3	1	0	0
64	2	6	3	2	0	0
65	2	4	4	2	1	0
66	1	11	1	0	0	0
67	0	5	8	0	0	0
68	2	4	4	3	0	0
69	1	7	1	2	2	0
70	2	8	2	1	0	0
71	2	5	3	2	1	0
72	1	8	3	1	0	0
73	0	3	4	4	2	0
74	0	9	3	1	0	0
75	0	10	1	1	1	0

SUMMATION POINTS

Case #	4	3	2	1		TOTAL	INDEX
51	4	21	8	1	=	34	2.62
52	20	15	2	2	=	39	3.00
53	8	15	10	1	=	34	2.62
54	4	18	8	1	=	31	2.38
55	16	21	2	1	=	40	3.08
56	0	24	6	1	=	31	2.38
57	0	30	2	2	=	34	2.62
58	0	27	6	1	=	34	2.62
59	8	21	6	1	=	36	2.77
60	4	24	6	1	=	35	2.69
61	12	27	0	1	=	40	3.08
62	0	24	8	11	=	33	2.54
63	8	21	6	1	=	36	2.77
64	8	18	6	2	=	34	2.62
65	8	12	8	2	=	30	2.31
66	4	33	2	0	=	39	3.00
67	0	15	16	0	=	31	2.38
68	8	12	8	3	=	31	2.38
69	4	21	2	2	=	29	2.23
70	8	24	4	1	=	37	2.85
71	8	15	6	2	=	31	2.38
72	4	24	6	1	=	35	2.69
73	0	9	8	4	=	21	1.61
74	0	27	6	1	=	34	2.62
75	0	30	2	1	=	33	2.54

FREQUENCY POINTS

Case #	4	3	2	1	0	X
76	4	2	3	1	2	0
77	1	10	2	0	0	0
78	3	7	2	1	0	0
79	0	10	1	1	1	0
80	2	9	2	0	0	0
81	0	10	3	0	0	0
82	3	7	3	0	0	0
83	3	8	2	0	0	0
84	3	6	3	1	0	0
85	0	7	6	0	0	0
86	0	10	3	0	0	0
87	2	7	3	1	0	0
88	0	8	4	1	0	0
89	2	9	1	1	0	0
90	1	7	3	2	0	0
91	5	6	2	0	0	0
92	0	8	3	2	0	0
93	0	10	3	0	0	0
94	1	10	2	0	0	0
95	1	9	1	2	0	0
96	1	10	1	1	0	0
97	5	5	2	1	0	0
98	0	10	1	2	0	0
99	0	5	1	4	3	0
100	0	10	3	0	0	0

SUMMATION POINTS

Case #	4	3	2	1		TOTAL	INDEX
76	16	6	6	1	=	29	2.23
77	4	30	4	0	=	38	2.92
78	12	21	4	1	=	38	2.92
79	0	30	2	1	=	33	2.54
80	8	27	4	0	=	39	3.00
81	0	30	6	0	=	36	2.77
82	12	21	6	0	=	39	3.00
83	12	24	4	0	=	40	3.08
84	12	18	6	1	=	37	2.85
85	0	21	12	0	=	33	2.54
86	0	30	6	0	=	36	2.77
87	8	21	6	1	=	36	2.77
88	0	24	8	1	=	33	2.54
89	8	27	2	1	=	38	2.92
90	4	21	6	2	=	33	2.54
91	20	18	4	0	=	42	3.23
92	0	24	6	2	=2	32	2.46
93	0	30	6	0	=	36	2.77
94	4	30	4	0	=	38	2.92
95	4	27	2	2	=	35	2.69
96	4	30	2	1	=	37	2.85
97	20	15	4	1	=	40	3.08
98	0	30	2	2	=	34	2.62
99	0	15	2	4	=	21	1.61
100	0	30	6	0	=	36	2.77

FREQUENCY POINTS

Case #	4	3	2	1	0	X
101	0	10	2	1	0	0
102	1	5	6	1	0	0
103	1	11	0	1	0	0
104	1	6	3	3	0	0
105	0	9	3	1	0	0
106	1	7	2	2	1	0
107	2	6	1	4	0	0
108	0	6	5	2	0	0
109	0	3	5	3	2	0
110	5	4	3	1	0	0
111	0	8	3	2	0	0
112	2	8	1	0	2	0
113	0	5	3	2	3	0
114	4	7	1	1	0	0
115	3	6	3	1	0	0
116	0	11	2	0	0	0
117	0	6	6	1	0	0
118	4	7	1	1	0	0
119	0	8	4	1	0	0
120	0	5	6	2	0	0
121	2	10	1	0	0	0
122	0	11	2	0	0	0
123	0	12	1	0	0	0
124	1	6	3	3	0	0
125	1	7	1	0	4	0

SUMMATION POINTS

Case #	4	3	2	1		TOTAL	INDEX
101	0	30	4	1	=	35	2.69
102	4	15	12	1	=	32	2.46
103	4	33	0	1	=	38	2.92
104	4	18	6	3	=	31	2.38
105	0	27	6	1	=	34	2.62
106	4	21	4	2	=	31	2.38
107	8	18	2	4	=	32	2.46
108	0	18	10	2	=	30	2.31
109	0	9	10	3	=	22	1.69
110	20	12	6	1	=	39	3.00
111	0	24	6	2	=	32	2.46
112	8	24	2	0	=	34	2.62
113	0	15	6	2	=	23	1.77
114	16	21	2	1	=	40	3.08
115	12	18	6	1	=	37	2.85
116	0	33	4	0	=	37	2.85
117	0	18	12	1	=	31	2.38
118	16	21	2	1	=	40	3.08
119	0	24	8	1	=	33	2.54
120	0	15	12	2	=	29	2.23
121	8	30	2	0	=	40	3.08
122	0	33	4	0	=	37	2.85
123	0	36	2	0	=	38	2.92
124	4	18	6	3	=	31	2.38
125	4	21	2	0	=	27	2.07

Section IV

Summary

Section V

Appendix

Note: The 125 tally sheets are with the original thesis in the possession of Dr. Harold M. Haynes.