1938

An investigation of periods of arrested development in learning curves

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An Investigation of Periods of Arrested Development in Learning Curves

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B.A. Montana State University (1937)

Presented in partial fulfillment of the requirements for the degree of Master of Arts.

Montana State University

1938

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List of Tables and Figures

Table of Contents

AN INVESTIGATION OF PERIODS OF ARRESTED DEVELOPMENT IN LEARNING CURVES

Review of Literature

Many investigators in the field of learning have discovered plateaus and "breathing places"[1] in curves of learning. Basing conclusions on introspective and objective data, attempts have been made to explain the existence of these peculiar and salient periods during which there is no measurable improvement.

Historically oldest of the major works are the studies of Bryan and Harter on telegraphic language in 1895-96. For the purpose of the present paper several facts from these studies may be pointed out. All of their results show a long flat curve extending from about the tenth to the twenty-fifth week on the receiving curve. There are in addition minor plateaus or "breathing places," each one followed by relatively rapid improvement. The sending curve, however, differs from the redeiving curve in the fact that there is no plateau in the earlier part of its course, and then, after the early rapid rise, a gradual leveling-off to the point of maximum efficiency.

Bryan and Harter attempt to explain the curve on the basis of the order of the learning habits. "A plateau in the curve means that the lower order habits are approaching their maximum development, but are not yet sufficiently automatic to leave the attention free to attack the higher-order habits. The length of the plateau is a measure of the difficulty of making the lower-order habits sufficiently automatic."[2]

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1. Following Book this term will be used to distinguish short periods of arrest from the longer plateaus.
2. Bryan and Harter, "Studies on the Telegraphic Language. The Acquisition of a Hierarchy of Habits." Psych. Rev. Vol. VI, p. 357.

They do not mean, however, that there is complete separation of one order of habits from another for "the experience of operators agree in showing that from an early period letter, word, and higher habits make gains simultaneously, but not equally."[3] Swift contradicts this statement with the assertion that "There is no evidence furnished by this investigation of a special time for the formation of 'higher habits,' or association groups."[4] Book makes a similarly contradictory statement. "The lower order-habits were perfected in and through the formation of the higher, as a further development of the higher was dependent upon the final perfection of the lower."[5] This lack of agreement leaves a rather confusing situation.

The early ascent in the telegraphic curves of Bryan and Harter is partially explained on the basis that as the actual learning of the letters is relatively simple the learner can each week give more and more attention to the acquisition of syllables and words. As there is a large number of words to be learned little time can be given to each word, and the receiving rate is correspondingly slow. Thus we have a plateau. The authors assert that plateaus are not necessary in all forms of learning, but are integral parts of receiving curves of the telegraphic language. When the subject masters the vocabulary he is ready for a new forward spurt. A plateau then is largely a phase of a subjective or psycho-physical process in which lower unit habits are being coordinated into higher unit habits. To some extent at least, the plateau is inherent in the learning process.

An investigation made by Leuba tends to substantiate this conclusion that the plateau is inherent in the learning process. He states "Even though

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3. Bryan and Harter, op. cit., p. 356.
4. Swift, "Studies in the Psychology and Physiology of Skill." Am. Jl. of Psych. Voll XIV, p. 201
5. Book, "The Psychology of Skill." University of Montana Publications in Psychology. Bul. No. 53, p. 88.

the several psycho-physiological processes involved in learning to write German script, under the conditions of this experiment, should appear in a definite order of succession, they do not reach complete maturity before the next one becomes possible. On the contrary, several of them grow together, and, before they have been fully perfected the next ones are already in operation."[6] Although he fully appreciates the interdependence of the various phases of a learning process it is clear from his work that any plateau is an inherent factor in a learning curve.

To test another assertion made by Bryan and Harter to the effect that the plateau was connected with the degree of complexity of the task, Batson attempted to break down a learning problem into its elements and then investigate each element separately. He hoped to throw new light on the problem. He isolated the factors involved in ball tossing and constructed curves for the development of each factor separately. A difficulty apparent at once and one recognized by Batson is the virtual impossibility of separating any one factor clearly from another. He believed, however, that the problem could be broken into its simple sensori-motor reactions. His first investigation involved the factors affecting the learning process simultaneously. In the second set, the work was reduced to its simplest form and only a relatively sensori-motor reaction was required. In the third part he studied the effect of several factors acting in succession.

In regard to the plateau Batson felt justified in drawing the following conclusions. "There is no evidence to show that they ever occur in learning processes where there is only a single association involved. They may or may not occur in a complex learning process. If the factors involved are of such

6. Leuba, "An Experiment in Learning to Make Hand Movements." Psychological Rev. V. XII, p. 353.

a nature that they must be improved together or if the subject is able to attend to them as a whole, there will be no plateau. If, however, the nature of the work is such that the factors must be attended to in succession or if the subject gives his attention to the separate factors, as such, there will be plateau."[7] A few years later Book concluded similarly that in simple forms of learning where only one or two simple associations are to be formed, no plateau will appear. He went further to say that even in cases of complex work it is possible so to direct and control effort that they will not appear.

His work showed, too, that the causes of "breathing places" were irregular lapses in spontaneous attention and effort. "A number of influences acting to decrease the learning enthusiasm will soon produce a marked lapse of attention and effort, the effects of which regularly accumulate until broken up by fresh incentives to effort. These lapses are almost entirely responsible for the 'breathing places'."[8]

Bateson's results showed no plateaus when the subject was directed to concentrate his attention on one or the other phase of the game. He further complicated the task, and plateaus occurred with those subjects who gave their attention to the separate factors of the task, but not with those subjects who tried to make progress in all the parts simultaneously. This of course did not eliminate the possibility that plateaus were inherent rather than due to a concentration of attention on one part of the task, but it showed to some extent that the more complicated the task, the more chance there was for a plateau.

We have considerable evidence that plateaus may not necessarily be inherent in the learning process. Even those investigators who have reached this

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7. Bateson, "Acquisition of Skill," Psych. Mon. V. 21, p. [illegible].
8. Book, op. cit., p. 139.

conclusion have found consistent plateaus only in particular kinds of learning and then exceptions would often occur. It seems possible, then, that we may look to the emotional factors as a clue to the cause of periods of arrested development.

The nearest parallel to Bryan and Harter's curves are those in reading shorthand notes. Swift's curves show no initial rapid rise followed by a plateau. The form of the curve is constantly upward from beginning to end. From this investigation Swift concluded that the plateaus must be explained on some other basis than the fact that there is a hierarchy of habits being formed during these periods. Whatever arrests occurred could be accounted for on the ground of emotional factors.

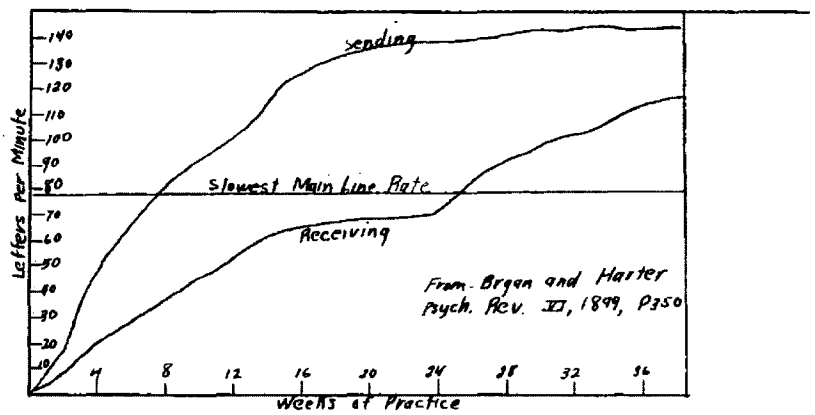
Swift's explanation of the plateau differs from that of Bryan and Harter. He found in all of his investigations that objective factors played a leading role in the determination of plateaus. Physical efficiency, for example, was very important but a high degree of euphoria did not guarantee an advance in score. In fact, at no time could the subject tell in advance how well he would do. All advances required effort, but too much effort may cause a loss. Swift goes on to say that "this lack of energy, due to waning interest, probably has more to do with delaying the learner's progress and making 'plateaus' than anything else. One cannot escape a dead level in uninteresting work and after the enthusiasm that novelty stirs has spent itself this interest is dulled and effort slackens. This is a potent cause of the long dreary period of no progress in learning to speak a modern language or to play upon a musical instrument."[9] He also states that "when there is continued arrests of progress its sufficient cause in the writer's opinion, is to be found in the emotional

9. Swift, op. cit., p. 213.

factors of learning."[10] Swift disagrees with the hierarchical explanation. As one association is being formed the other is developing. "There is clearly no separation of periods in which lower and higher order habits are formed."[11]

In a later investigation with Schuyler, Swift tempers this original stand to some extent but continues to emphasize the emotional factors as causes of the plateau. In this investigation of typewriting he found no long plateau but many short breathing places. He cites two causes for these. "Considered from the standpoint of automatization, they are resting places. The learner has overshot his permanent power and must wait until automatization is perfected. They are also due to a slump in enthusiasm."[12] It is of interest to note also that a repetition of the experiment on telegraphy revealed a similar curve without a plateau.

The importance of objective factors in learning was not entirely overlooked by Bryan and Harter. We find this statement: "The learner enjoys the practice of sending, but feels practice in receiving to be painful and fatiguing drudgery."[13] As will be recalled there is no plateau in the sending curve and a very distinct one in the receiving curve.



10. Swift, op. cit., p. 227.
11. Ibid.
12. Swift and Schuyler, "The Learning Process," Psych. Bul. Vol. 4, p. 308.
13. Bryan and Harter, op. cit., p. 31.

The suspicion must necessarily follow, then, that the drudgery in receiving practice is an important factor in plateau formation since there is no plateau in sending curves, the practice of which is somewhat pleasant. Bryan and Harter failed to discuss this point.

Another early investigator, Johnson (1898) writes that "if the subject could be induced to sustain the same attention day by day, there would be no plateaus."[14] He also indicated that he did not believe that plateaus were a necessary part of the development. Additional evidence is found in the fact that plateaus can be governed by the proper control of objective factors. Only two of the curves developed by Book show definite plateaus although all cases revealed "breathing places" which did not come at corresponding periods of advancement. Both of the plateaus, however, did come at the same periods of advancement. The cause of the "breathing places" was the irregular lapses in spontaneous attention and effort. "A number of influences acting to decrease the learning enthusiasm will soon produce a marked lapse in attention and effort the effects of which regularly accumulate until broken up by fresh incentives to effort. These lapses are almost entirely responsible for the 'breathing places'."[15] According to Wheeler, however, lack of attention, lowered interest and the like are symptoms of poor distribution of stimulation and incentives and are not causative factors.

M. Drury Smith[16] sums up all the possible causes of periods of arrested development with the phrase "Difficulties of coordination." The extent of the plateau is determined by undue attention to any one component or by oscillation of attention or by conscious effort to coordinate. The subject is just as apt

14. Johnson, Journal of Genetic Psychology, 1927, V. 34, p. 118.
15. Book, op. cit., p. 139.
16. M. Drury Smith, "Periods of Arrested Progress in the Acquisition of Skill." British Jl. of Psych., V. 21, p. 1.

to experience a plateau by giving undue attention to any one phase as by giving an insufficient amount of attention. To coordinate properly the various elements is the key to the elimination of learning curve plateaus. We have further substantiating facts for this stand from Batson who attempted to isolate the higher-level habits. His findings showed that unless the individual could properly integrate the elemental processes (each of which proceeded at an acceleration superior to that obtainable in learning a complex whole) he would experience plateaus of varying lengths.

Cleveland in a lengthy investigation in the psychology of chess found that the emotional accompaniment is an important factor in the chess player's development as in other sorts of acquisition.[17]

We can state by way of summary that there seem to be two possible sources of causes of periods of arrested learning. First, it may be due to a factor inherent in the learning process as Bryan and Harter and others claim. Second, it may be due to subjective and objective factors, such as lack of attention, misdirected attention, fatigue, etc. There is considerable evidence to support either view. Some workers also claim that the plateau is a result of a combination of the two factors.

17. Cleveland, "The Psychology of Chess." Amer. Jl. of Psych. Vol. 18, pp. 270-308.

The Present Investigation

A. Statement of Problem

The present investigation attempts to answer the following questions:

1. To find the effect of a long continuous practice period on plateaus in learning to toss balls. This was a repetition of the work of Batson and Swift except that longer periods of practice were used. Where these men allowed only ten trials per day, the subjects of this investigation were allowed periods ranging from 30 minutes to three hours or a range of 10 to 300 practice trials. Subject H's first practice trial was for 3 continuous hours followed by shorter periods of 1 hour each. Subject L's first practice was for two hours followed by one-hour periods. Subject J.H's periods were all of one hour. Subject M repeated the experiment with 10 practice trials per day.

2. To study the effect of different types of material in non-motor learning.

3. To find from the quantitative data if there is any regularity of the appearance of plateaus or "breathing places."

B. Procedure

The investigation may be conveniently divided into two parts; (1) motor learning, (2) ideational learning. These will be discussed in their order.

(I). Motor Learning

In the present study motor learning will be understood to mean learning to toss and catch two balls using only one hand. The purpose of this experiment was to determine whether and to what extent different lengths of practice periods and the distribution of short rest periods may be correlated

with plateaus.

Four undergraduate psychology students and one graduate student acted as subjects for this problem. The task was to toss and catch two white balls using only one hand. Each ball weighed 55 grams with a diameter of 64 mm. A high-ceilinged auditorium stage was used for practice which allowed ample room for moving about. The subject faced a gray wall with a bank of stage lights above and behind him. The conditions were thus nearly ideal.

The subject tossed for 10 minutes and then rested five minutes. Each of the subjects' initial practice periods varied from one to three hours, and the number of trials was divided into groups of ten each for the purpose of scoring. The succeeding practice periods averaged about one hour in length. Notes were made regarding the progress with especial attention to any sudden changes of method of tossing. The same procedure held for all subjects. Any introspective comments by the subjects were also recorded.

For purpose of comparison subject M learned to toss three balls with two hands. This was incidental to the main body of the experiment. Subject A has played much basketball and some baseball in addition to being a good track man. He has also played some tennis but had never before attempted to juggle two balls. He remarked previous to the beginning of the experiment that he had always wanted to learn to juggle and felt that this was a good time to acquire the skill. He worked steadily and consistently throughout the experiment.

Subject J was also a star high school basketball and football player. He has occasionally tossed two balls in play but has never learned to juggle. He manifested great interest throughout the experiment.

Subject H had no interest in athletics of any sort and had seldom participated to any extent in athletic contests. He was ambidexterous and preferred the left hand for the experiment.

Subjects R and M had considerable interest in athletics but purely from a recreational standpoint. Neither had ever attempted to juggle balls although both played tennis, baseball and basketball. The trials of subject M were interrupted at trial 24 by a broken finger but were resumed six weeks later with little loss.

(Note: Two minor changes from the Swift set-up were made. The balls used by Swift varied as much as 5 grams and were much heavier (125 g.). The small difference in weight may not change the results but any difference in the weight of the objects complicates the problem as was found by Batson.)

Table Ia

SCORES FOR SUBJECTS IN TOSSING BALLS

Two Balls

(First column is the raw score. Second column is smoothed score.)

Trial No.	Subject's Scores									
	H.		J.		A.		M.		R.	
1.	2.1	1.9	1.9	2.0	1.7	1.4	1.2	1.2	2.4	1.8
2.	1.7	2.7	2.2	2.1	2.5	2.3	1.2	1.2	2.9	2.6
3.	1.7	1.5	2.3	2.1	2.8	2.7	1.3	1.3	3.3	3.3
4.	1.1	1.4	1.8	2.0	3.2	2.9	1.4	1.6	3.6	3.8
5.	1.5	1.5	1.8	2.1	2.9	2.8	2.0	1.9	4.4	4.1
6.	2.0	1.8	2.6	2.3	2.5	3.2	2.3	2.8	4.2	4.4
7.	2.0	2.2	2.6	2.6	3.2	2.9	3.0	2.8	4.6	4.5
8.	2.5	2.9	2.5	2.4	3.0	4.9	3.0	3.2	5.7	5.3
9.	1.3	1.6	2.2	2.1	3.5	3.5	3.5	2.8	5.2	5.4
10.	1.0	1.3	1.6	1.9	4.0	3.6	1.8	3.3	5.4	5.4
11.	1.6	1.9	1.9	1.7	3.2	3.4	4.5	3.5	5.5	5.7
12.	3.1	2.5	1.6	2.1	3.1	3.7	4.3	4.7	6.1	6.1
13.	2.9	3.3	2.7	2.4	4.9	4.2	5.4	5.1	6.7	6.9
14.	3.9	3.2	2.9	8.7	4.7	4.5	5.7	6.1	8.0	7.5
15.	2.7	3.2	3.1	3.5	4.0	4.6	7.2	6.7	7.7	7.6
16.	3.1	2.8	4.4	4.8	5.1	5.2	7.2	7.6	7.0	7.5
17.	2.6	2.5	6.8	6.0	6.4	6.6	8.4	8.0	7.0	7.8
18.	1.9	2.5	6.8	6.6	8.4	9.2	8.5	7.7	8.7	8.0
19.	2.9	2.3	6.3	7.2	11.7	12.6	6.3	8.8	7.6	8.4
20.	2.2	2.5	8.4	7.9	17.7	12.3	11.6	10.0	8.9	8.3
21.	2.3	2.3	8.9	8.7	7.4	15.8	11.8	14.2	8.6	9.4
22.	2.3	2.4	8.9	10.1	22.4	21.8	14.2	14.2	10.8	19.1
23.	2.6	2.5	12.4	11.9	35.7	26.8	16.7	16.8	8.8	9.4
24.	2.7	2.8	14.3	13.8	28.3	32.6	19.5	17.3	8.7	8.6
25.	3.1	3.2	14.6	14.5	39.9	40.1	15.8	16.6	8.4	9.2
26.	3.7	3.5	14.5	19.4	57.9	55.4	14.5	16.3	10.4	9.9
27.	3.6	3.6	29.0	27.1	68.3	69.4	18.6	17.9	11.1	14.1
28.	3.4	3.7	38.0	38.0	81.0	49.8	20.7	21.4	11.2	11.2
29.	4.2	3.7	48.0	52.0			24.9	23.1	11.4	11.1
30.	3.5	4.1	69.0	68.3			23.6	25.4	10.6	11.1
31.	4.5	3.8	87.0	73.8			27.6	28.2	11.3	11.8
32.	3.5	4.4					33.5	29.1	13.4	11.9
33.	5.2	4.6					26.2	27.9	13.9	13.4
34.	5.0	5.1					24.0	27.2	15.9	18.4
35.	5.0	5.1					31.4	29.7	25.4	22.1
36.	5.2	4.6					33.8	40.3	25.0	25.8
37.	3.5	4.2					45.6	48.3	27.2	27.9
38.	3.8	3.6					65.7	58.2	31.4	29.7
39.	3.5	4.0					63.2	74.6	30.5	29.2
40.	4.7	4.2					94.8	88.2	25.8	28.3
41.	4.4	4.3					106.5	100.6	28.5	25.9

Table Ib

SCORES FOR SUBJECTS IN TOSSING BALLS

Two Balls

(First column is the raw score. Second column is smoothed score.)

Trial No.	Subject's Scores			
	H.		R.	
42.	3.8	4.2	23.4	24.2
43.	4.5	4.1	20.8	26.9
44.	3.9	4.2	26.7	25.3
45.	4.1	3.8	28.5	26.2
46.	3.5	3.7	23.4	24.2
47.	3.6	3.7	20.8	23.6
48.	4.0	3.8	26.7	26.7
49.	3.9	4.1	32.7	32.1
50.	4.5	4.4	37.0	35.9
51.	5.1	4.4	38.1	25.2
52.	7.6	6.7	42.7	43.1
53.	7.4	7.0	48.5	47.3
54.	6.0	6.0	50.9	52.7
55.	4.6	5.3	58.6	56.8
56.	5.2	5.5	61.0	70.2
57.	6.7	5.1	81.0	47.3
58.	3.4	4.5		
59.	3.3	3.2		
60.	2.8	4.7		
61.	7.9	7.2		
62.	12.0	10.1		
63.	10.5	10.6		
64.	9.3	11.7		
65.	15.3	12.4		
66.	12.7	15.5		
67.	18.4	17.0		
68.	19.9	20.3		
69.	22.7	19.2		
70.	15.0	20.3		
71.	23.2	29.2		

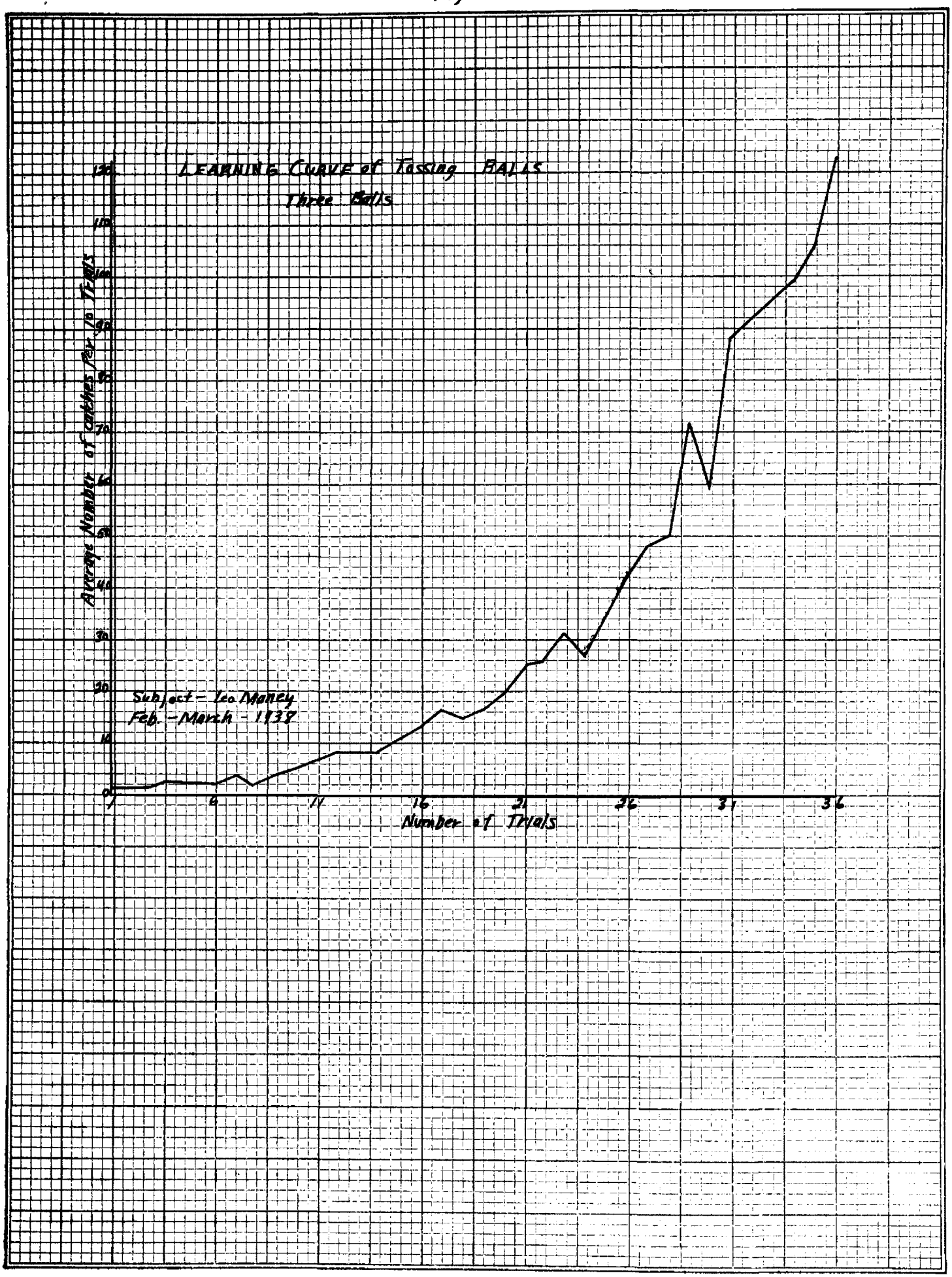
Table II.

SCORES IN TOSSING BALLS

Three Balls

(First column is the raw score. Second column is the smoothed score.)

Trial Number	Subject's Score.	
1.	1	1
2.	1.1	1.3
3.	1.5	1.6
4.	2.2	2.2
5.	2.9	2.5
6.	2.4	2.5
7.	2.3	2.9
8.	4.0	2.9
9.	2.3	3.5
10.	4.2	4.1
11.	5.8	5.4
12.	6.3	6.7
13.	8.1	7.5
14.	8.2	8.4
15.	8.9	9.3
16.	10.8	11.0
17.	13.3	13.5
18.	16.3	14.9
19.	15.3	16.1
20.	16.9	17.4
21.	20.2	20.9
22.	25.8	24.2
23.	26.5	28.5
24.	33.2	28.7
25.	26.3	27.9
26.	34.2	37.7
27.	42.6	45.1
28.	48.6	47.1
29.	50.2	56.9
30.	72.1	60.2
31.	58.3	72.9
32.	88.4	79.6
33.	92.0	84.6
34.	73.4	84.8
35.	89.0	86.1
36.	95.9	99.1
37.	112.4	69.4
38.		



a. Results and Discussion - Motor Learning

On Table I will be found the compiled results of the subjects in this experiment. The smoothed figures have also been included.

The curves shown on Figs. 1a and 1b have two characteristics common in all five curves; the long plateau at the beginning and the sharp rise toward the end. Individual differences show up markedly. The length of the plateau ranged all the way from 210 practice trials in curve I to 610 in curve V. The other plateaus were found somewhere within this range. The important fact, however, is that every curve shown has a distinct plateau through the early practice periods.

If we analyze the scores on Tables 1a, 1b and II we discover another interesting fact. That is, that there are distinct "breathing places" within the longer plateau. In H's scores, for example, there are short periods of no advancement. The first period extends from trials 1 through 12, the second period from 13 through 29, the third from 30 through 51, the fourth from 52 through 61. The results seem to indicate that these resting places are periods of coordinating new movements for another advance forward since in no case does the subject fall back for any extended time to a score lower than the average of the last resting place. In individual cases the subject did drop back to a lower score but he quickly increased his score above the last resting-place average. For example, the average scores of subject H for the twelve trials of the first minor resting-place was 1.9; for the second the score was 2.9; for the third it was 4.2 and for the last the score went up to 5.5. Thus, although each period shows no gain within itself, the average score is beyond that of the last resting place. This holds true in the other curves as well.

From the introspections of the subjects we find another factor which gave special trouble in all subjects. This was in the method of tossing the balls; that is, whether it is most effective to toss the balls in a circular fashion in a plane parallel to the body (right to left) or in a plane perpendicular to the body (front to back). When the subject finally mastered one or the other his scores went up rapidly. Two of the subjects adopted the front-to-back method while the other three used the right-to-left method.

The difficulties paramount to the final mastery of the most satisfactory tossing method were shown also in the objective records. A count was kept of all the collisions, and it was found that as the scores increased the number of collisions decreased. Towards the end of the experiment the subjects rarely lost a high score due to collisions.

Subject H's initial practice was for three consecutive hours followed by four one-hour practice periods. The plateau extended over a total of 610 practices which was much beyond that of any other subject. The long three-hour beginning practice period seemed to have no different effect from the usual ten-trial practice period. The curve is typical in that the plateau extended over a long period and was followed by a sudden rapid rise. The subject was unable to continue beyond an average of 20 catches. However, his consistently high scores towards the end were evidence that he had risen from the plateau.

Subject J had a two-hour initial period followed by three one-hour sessions. His is a more normal curve in so far as the number of practice periods is concerned. The curve in all respects is typical.

Subjects H and R had five one-hour practice periods and the curves again are typical, although R took nearly twice as many practice trials as did H.

Subject M practised only 10 to 15 minutes each day which has been the usual practice time in other investigations. The conditions otherwise were the same. The typical curve is found in this case also. When the two-ball performance was mastered M began work immediately on three balls using both hands. The curve this time shows a much more rapid rise from the very short plateau. The lack of a longer plateau is probably due to transfer from previous practice. From the subject's introspections it appears that the only difficulty involved was proper coordination of the left hand in passing the balls to the right hand for the throw-up. The coordination was quickly made and progress was rapid from that point.

An analysis of these curves reveals the typical curve in all cases for tossing balls. Our problem was to discover the effect on the curve of different lengths of practice. These curves tend to show that the length of practice has little effect on the plateau of the curve. We note, however, that curves H and J improved much more rapidly than M or R who took the usual practice period of 10 trials per day. This should be a valid comparison since previous training in athletics determines to a large extent the length of the curve and since the three subjects are more or less athletically inclined.[18] In subject E.H. we note a much different situation. He not only took nearly double the number of practice trials of H,J, and M but even then failed to make very rapid improvement at the end. It must also be noted that he had no interest in athletics. If we can eliminate this curve on the grounds that the extreme length of the curve was due to lack of transfer from previous muscular skills and use only curves H,J, and M for comparison,

18. (Note: This is not an apriori assumption for Swift's results show this. In analyzing his subject-sketches and comparing their athletic skills with their learning curve, in every case the shortest learning periods are allied to the athletically inclined.)

we find that apparently the length of practice periods does have some effect on the length of time required for mastery of the skill if other factors are relatively equal.

For our purposes, however, we note that 11 the curves including that of EH have a long plateau. This plateau covers about 70% of the total practice time and this is relatively constant in all the curves.

These results tend to show that, all other things being equal, the shorter the daily practice period the longer the plateau. As far as the writer can discover no one has previously investigated this phase of the problem. If monotony and loss of interest are factors in the plateau, then the control of these factors by completing the practice as quickly as possible should tend to reduce the length of the plateau. Such does not seem to be the case, since the plateaus are of the usual duration although at no time was there any apparent lack of interest on the part of the subjects.

(II.) Ideational Learning

Most of the investigations so far made have involved motor learning or motor skills of one kind or another. For example, telegraphy, tossing balls, typewriting, walking a tight rope, adapting eye reflex to stimuli, throwing shot into a tumbler are of the motor type. Ideational learning has been somewhat neglected, especially as far as quantitative results are concerned. Two such studies, however, have been made, namely, Swift's study of learning the Russian language (1 case) and his study of shorthand (1 case).

This part of the present investigation includes two series of experiments: (1) consisting of ten lists of 15 words each (see Fig. 2); (2) fifteen lists of three different lengths, namely, 10, 13, and 18 words respectively (see Fig. 4). The object of the two series of experiments was to see whether different degrees of difficulty of similar learning material had any influence on the occurrence of plateaus, i.e., whether the plateau is inherent in the learning process.

(1) Series I.

Seventeen subjects took part in this project. The subjects worked alone or in pairs although there was no competition in the latter situation since neither subject knew his scores. The subject was given a list of words and at the signal "go" was allowed to study the list for 15 seconds after which time he would immediately turn to the next list and so on through the entire ten lists. He was then given a blank sheet of paper ruled into 10 columns (see Fig. 3) on which he was to record the words from memory in the same order in which they appeared in the lists. In addition he was instructed to put each column in proper order; that is, list I in column I, list II in

column II, etc. Five minutes were allowed for recording.

In scoring, each column in the right order was given 4 points. For example, if the words of list I appeared in column I, four points were allowed. If this same group appeared in column three or four or any other column and no other group preceded it, the score would still be four points. If, however, the subject recorded the words of list II in column I and the words of list I in any other column, the list I would be considered out of order and would receive no points. In this case list II would receive four points since no other column precedes it.

The words were scored similarly. One point was awarded if the word were in the correct column regardless of order. No score, if the word were in a wrong column. An additional point was given for correct order. This was the more difficult part of the scoring. By referring to list III we can demonstrate the point (Fig. 8). If the subject recorded all 15 words as they appear in the list his score would be 30 or two points for each word. If he should put 'pioneer' after 'Indian', the latter would receive two points while 'pioneer' would receive only one point. Again if the order were 'Indian', 'pioneer', 'scout', 'musket', the word 'Indian' would get two points, 'pioneer' one point, 'scout' two points, 'musket' two points. The score for the paper is the total of all points. The highest possible score was 450.

An introspective report was made by each subject following the trial. The curve of both the raw score and the smoothed curve appear in Fig. 5 .

(2) Series II.

In series II ten subjects participated in the experiment. The conditions were the same for this as in series I with the exception that the number

of columns to be memorized was increased to 15 and the columns were of three different lengths, 18, 13, 10 words, respectively. The lists were arranged in random order as shown on Fig. 4. The length of the exposure of each list was governed by the number of words in the list. Lists of 18 words had 18 seconds, those of 13 words had 13 seconds, those of 10 words had 10 seconds. The recording procedure was the same as in I but 10 minutes were allowed. The scoring was identical with I.

Fig. 2

List of words used in Series I
of section I of non-motor learning.

I.	II.	III.	IV.	V.
1. theater	1. Lindberg	1. pioneer	1. food	1. village
2. director	2. aviation	2. wagon	2. sugar	2. policeman
3. cast	3. "We"	3. Indian	3. salt	3. arc-light
4. rehearsal	4. St. Louis	4. scout	4. bread	4. marshall
5. stage	5. airplane	5. hardship	5. butter	5. mayor
6. property	6. Atlantic	6. powder	6. corn	6. politics
7. actor	7. Paris	7. musket	7. starch	7. fireman
8. makeup	8. fame	8. coonskin	8. candy	8. taxes
9. curtain	9. Morrow	9. palisade	9. meat	9. streets
10. scene	10. child	10. governor	10. milk	10. treasurer
11. lights	11. kidnap	11. Boone	11. gravy	11. mail-man
12. screen	12. ladder	12. pinto	12. carrots	12. money
13. usher	13. Hauptman	13. oxen	13. potatoes	13. jail
14. program	14. guildy	14. Oregon	14. flour	14. court-house
15. audience	15. Jersey	15. banjo	15. peas	15. curfew

VI.	VII.	VIII.	IX.	X.
1. fraternity	1. army	1. west	1. universe	1. church
2. sorority	2. gun	2. coyote	2. mars	2. God
3. Greek	3. parade	3. cowboy	3. eclipse	3. hymn
4. rushee	4. band	4. corral	4. moon	4. collection
5. pledge	5. flag	5. rodeo	5. saturn	5. bazaar
6. hell-week	6. drill	6. lasso	6. milky-way	6. preacher
7. iniation	7. officer	7. steer	7. sun	7. Easter
8. ritual	8. khaki	8. pony	8. jupiter	8. pew
9. active	9. shell	9. spurs	9. sun-spot	9. choir
10. brother	10. battalion	10. roundup	10. stratosphere	10. Bible
11. house	11. bombard	11. wagon	11. poles	11. pulpit
12. party	12. target	12. bandana	12. equator	12. Sunday
13. fireside	13. command	13. calf	13. infinity	13. sermon
14. Siberia	14. armistice	14. brand	14. planet	14. rector
15. alumni	15. Pershing	15. ranch	15. astronomer	15. communion

Fig. 3

Form of Blank for Recording Series I - Non-motor learning
(Note: Five more columns added for recording Series II)

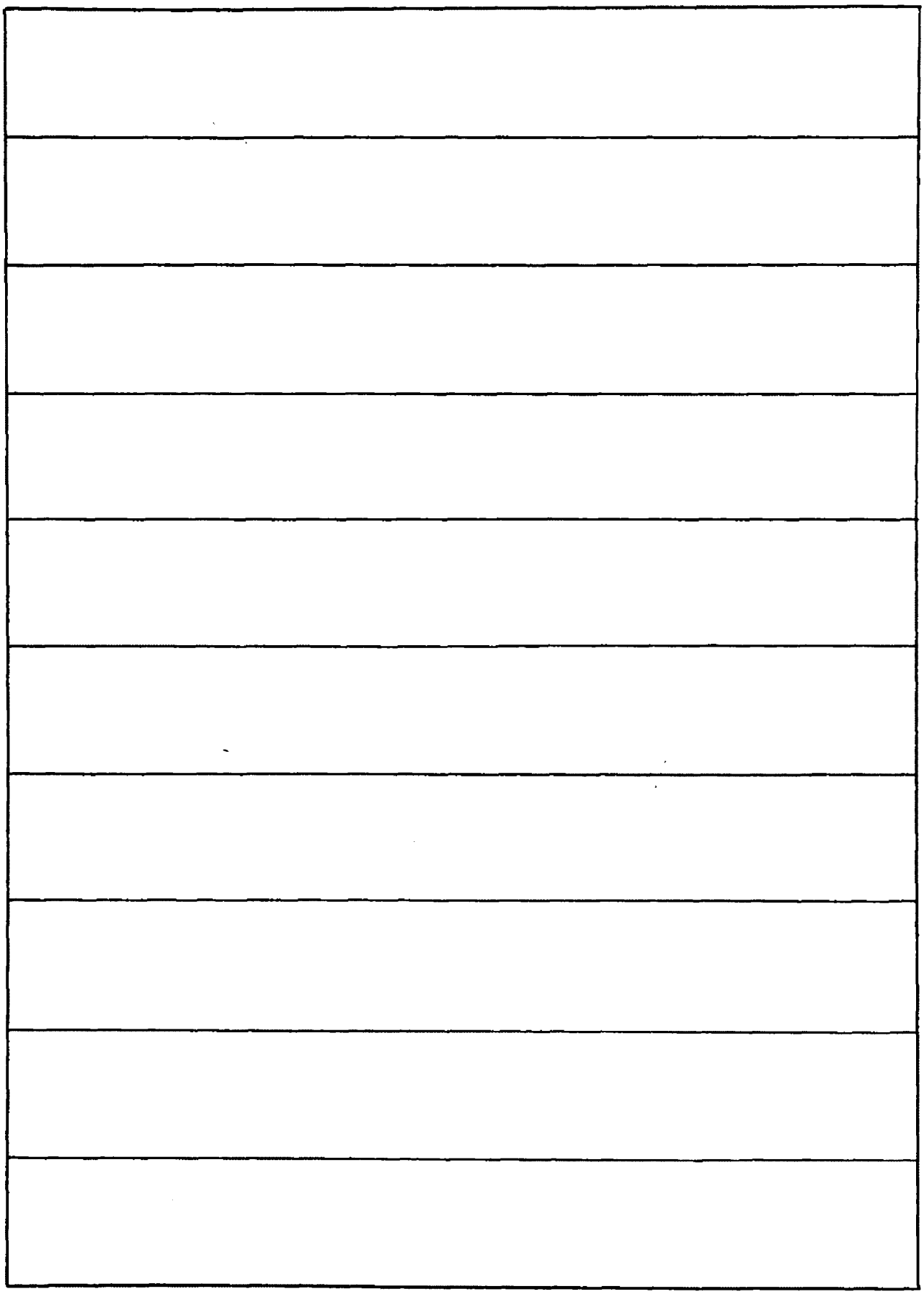


Fig. 4a

Lists of Words Used in Non-motor Learning Experiment - Series II

I.	II.	III.	IV.
1. pioneer	1. franc	1. doctor	1. snow
2. Indian	2. yen	2. ambulance	2. hail
3. scout	3. wampum	3. nurse	3. dew
4. musket	4. note	4. medicine	4. frost
5. palisade	5. check	5. druggist	5. sleet
6. pinto	6. schilling	6. operation	6. ice
7. Oregon	7. pound	7. surgeon	7. moisture
8. banjo	8. bullion	8. dentist	8. rain
9. oxen	9. draft	9. hospital	9. fog
10. coyote	10. lira	10. clinic	10. cloud
11. cowboy		11. interne	11. lightning
12. corral		12. specialist	12. thunder
13. rodeo		13. x-ray	13. crystals
14. lasso			
15. steer			
16. roundup			
17. brand			
18. ranch			

V.	VI.	VII.	VIII.
1. sugar	1. aviation	1. camera	1. fraternity
2. salt	2. Lindberg	2. shutter	2. sorority
3. bread	3. "We"	3. lens	3. greek
4. butter	4. St. Louis	4. film	4. rushweek
5. corn	5. monoplane	5. negative	5. rushee
6. starch	6. ocean	6. photographs	6. study table
7. candy	7. Paris	7. print	7. interfraternity
8. meat	8. fame	8. developer	8. pledge
9. milk	9. Morrow	9. bellows	9. hell-week
10. fruit	10. child	10. focus	10. initiation
	11. kidnap	11. tripod	11. ritual
	12. ransom	12. exposure	12. active
	13. Jafsie	13. portrait	13. brother
	14. ladder		14. house
	15. Hauptman		15. party
	16. guilty		16. fireside
	17. Jersey		17. Siberia
	18. England		18. alumni

Fig. 4b

Lists of Words Used in Non-Motor Learning Experiment - Series II

IX.	X.	XI.	XII.
1. zinc	1. lever	1. theatre	1. jewels
2. brass	2. pulley	2. director	2. diamond
3. bronze	3. wheel	3. cast	3. ruby
4. copper	4. axle	4. rehearsal	4. sapphire
5. lead	5. plane	5. stage	5. emerald
6. iron	6. wedge	6. property	6. topaz
7. mercury	7. screw	7. actor	7. garnet
8. quartz	8. gear	8. make-up	8. jade
9. aluminum	9. incline	9. curtain	9. pearl
10. radium	10. cylinder	10. scene	10. jet
		11. lights	11. opal
		12. usher	12. turquoise
		13. program	13. agate
			14. onyx
			15. sunstone
			16. moonstone
			17. goldplate
			18. silver

XIII.	XIV.	XV.
1. music	1. church	1. psychology
2. staff	2. God	2. stimulus
3. bar	3. hymn	3. response
4. note	4. collection	4. attention
5. rhythm	5. bazaar	5. perception
6. flat	6. preacher	6. learning
7. sharp	7. pew	7. thinking
8. pitch	8. choir	8. emotion
9. vibration	9. Bible	9. motivation
10. time	10. pulpit	10. recall
	11. sermon	11. recognition
	12. Sunday	12. memory
	13. communion	13. imagination
	14. bishop	
	15. lent	
	16. Easter	
	17. gospel	
	18. sect	

(a) Results and Discussion

Logically-Related Words

Series I

In the first series in which all columns were of the same length and difficulty, we find only two curves with definite periods of arrested development. Curves 8 (MCF) and 13 (LH) give us two rather distinct periods towards the end of the problem. The introspections of these subjects at the time, however, give us the reason for the lack of further improvement. In 8 the subject reported that he did not feel well but as this was the last trial of the experiment he decided to finish it out that day. In curve 13, the subject had just completed an examination and was much disturbed by the fact that he had not done well. These introspections seem to be a sufficient answer to the existence of the plateau.

In several other cases, introspections revealed disturbing situations but the subjects were able to overcome the distractions and make some improvement.

Series II

The results in Series II are similar to the results in Series I. No plateaus were found in any case and the smooth S-type curve was typical.

As will be recalled, the columns were of varying lengths to show the effect of length on the curve. Separate curves were made of columns of different lengths. Columns I, VI, VIII, XII, XIV, (all of 18 words) were compared with II, V, IX, X, XIII, (all of 10 words), and III, IV, VII, XI, XV, (all of 13 words). The individual curves show no plateaus and in general follow the trend of the subject's total-score curve.

Table IIIa

IDEATIONAL LEARNING

Scores for logically related words

(Raw score in first column. Smoothed score in second.*)

Curve I. (E.F.)	Curve II. (F.C.)	Curve III. (B.B.)	Curve IV. (M.O.)
82 - 111	51 - 85	125 - 159	38 - 69
140 - 139	122 - 114	194 - 181	100 - 95
195 - 177-	170 - 153	225 - 209	156 - 145
195 - 207	167 - 179	210 - 222	180 - 175
231 - 211	202 - 179	231 - 239	188 - 198
207 - 225	167 - 194	277 - 258	225 - 225
238 - 228	212 - 201	266 - 279	263 - 247
258 - 258	225 - 218	295 - 289	254 - 262
279 - 283	218 - 230	306 - 300	269 - 266
313 - 301	248 - 233	299 - 306	274 - 282
311 - 318	244 - 248	312 - 310	304 - 300
330 - 326	251 - 256	319 - 314	322 - 315
337 - 336	272 - 267	310 - 319	318 - 325
340 - 339	278 - 276	329 - 325	334 - 333
340 - 340	278 - 278	335 - 332	348 - 347
			350 - 350

Curve V. (W.B.)	Curve VI. (E.T.)	Curve VII. (H.T.)	Curve VIII. (M.C.F.)	Curve IX. (V.D.)
73 - 94	40 - 70	116 - 137	117 - 154	102 - 135
115 - 117	100 - 98	158 - 162	191 - 177	169 - 172
162 - 134	155 - 145	213 - 194	224 - 210	244 - 215
124 - 156	180 - 173	211 - 223	215 - 236	233 - 258
182 - 173	185 - 197	244 - 231	269 - 258	298 - 284
213 - 196	226 - 225	246 - 241	291 - 280	321 - 310
193 - 217	263 - 248	234 - 250	280 - 292	311 - 322
245 - 236	254 - 262	272 - 260	304 - 305	333 - 327
268 - 246	268 - 264	274 - 276	330 - 308	337 - 336
224 - 255	270 - 279	282 - 281	289 - 314	338 - 337
272 - 266	300 - 294	288 - 282	322 - 314	
301 - 287	321 - 313	277 - 282	330 - 321	
289 - 304	318 - 323		311 - 325	
323 - 315	330 - 331		335 - 329	
327 - 325	345 - 341		340 - 337	
	348 - 346			

*The smoothed score is secured by taking the average of three consecutive scores. For the first and last scores the average of only two is used.

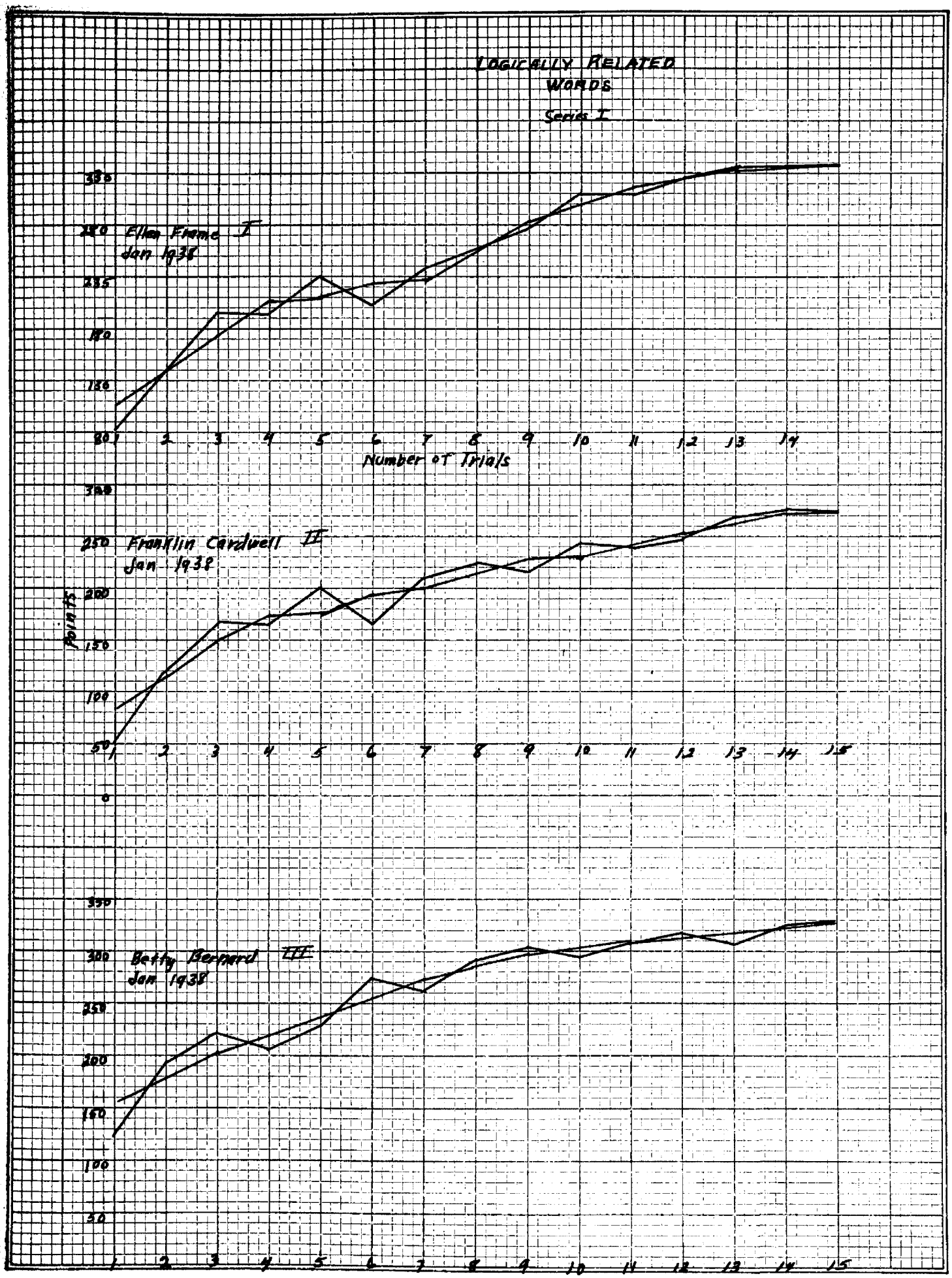
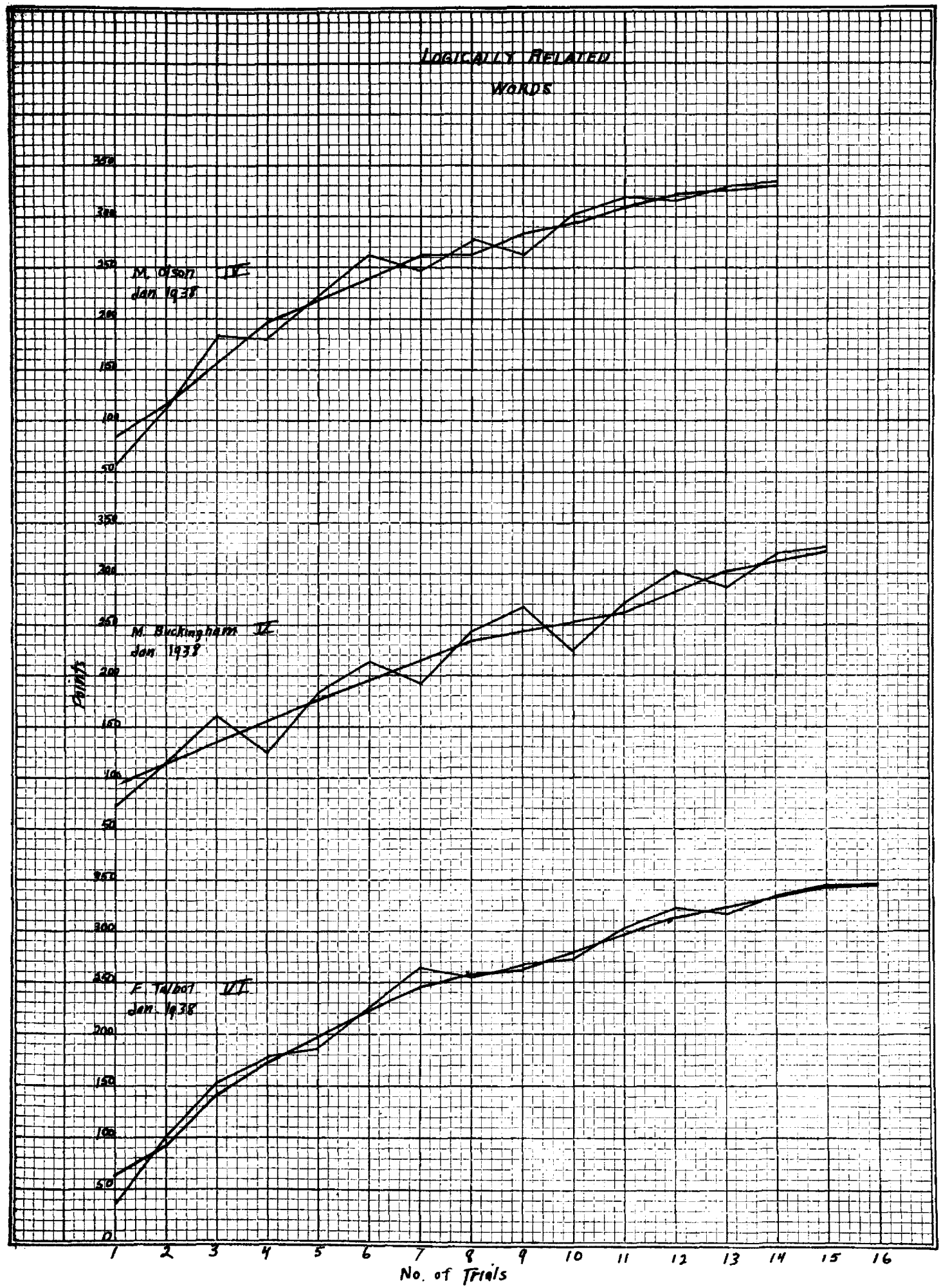


Fig 5b



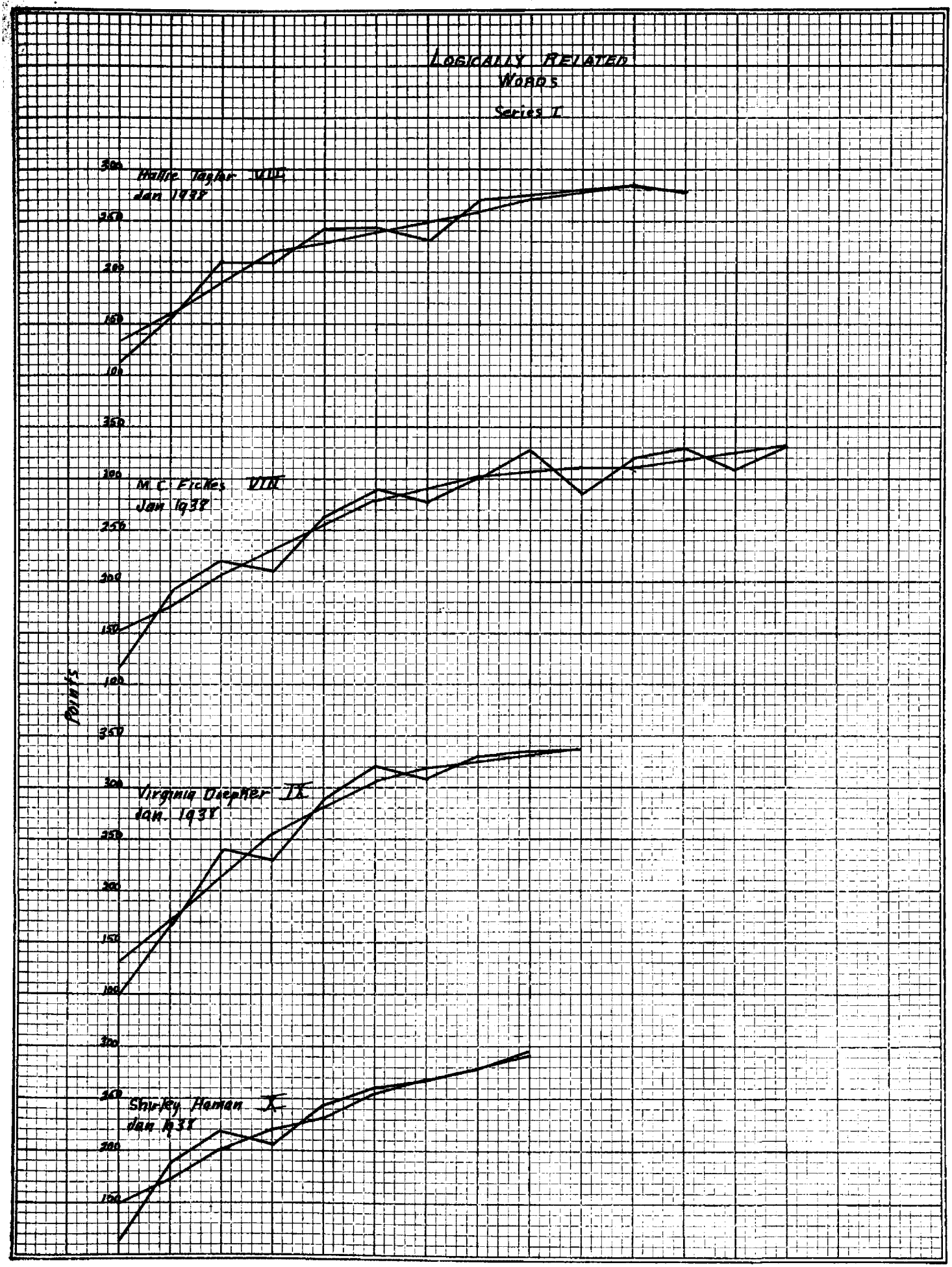


Table IIIb.

Ideational Learning

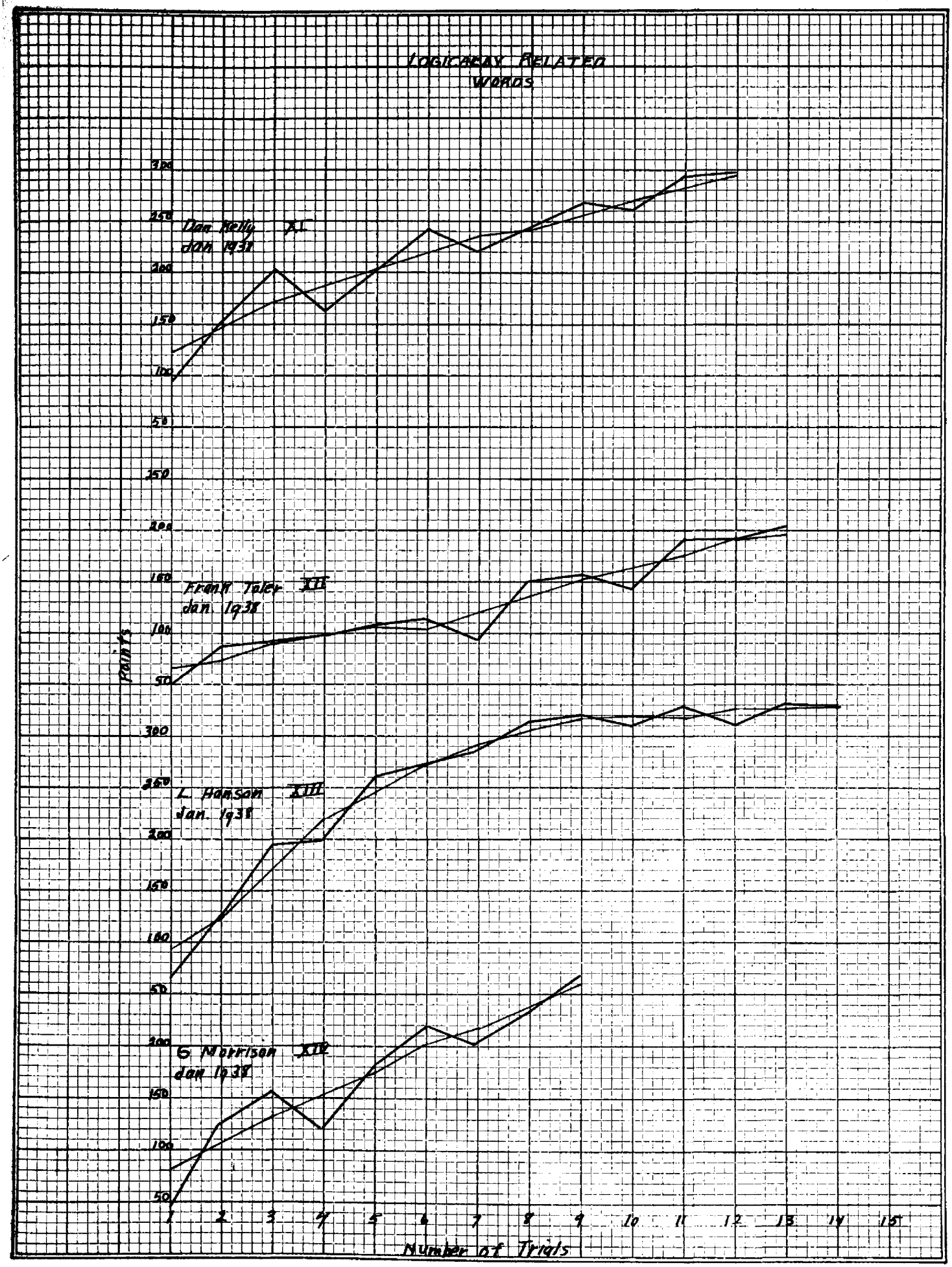
Scores for Logically Related Words.

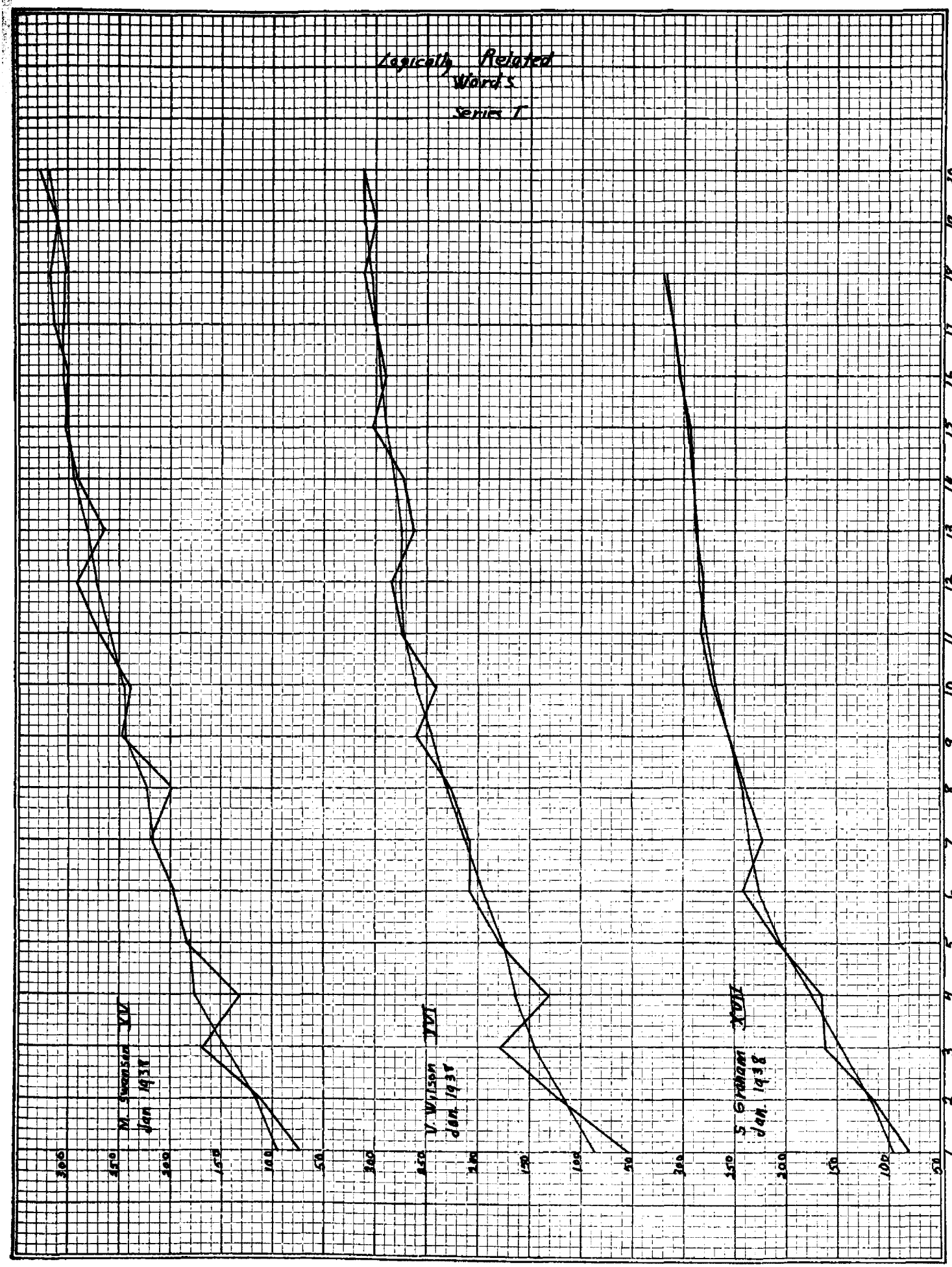
(Cont'd.)

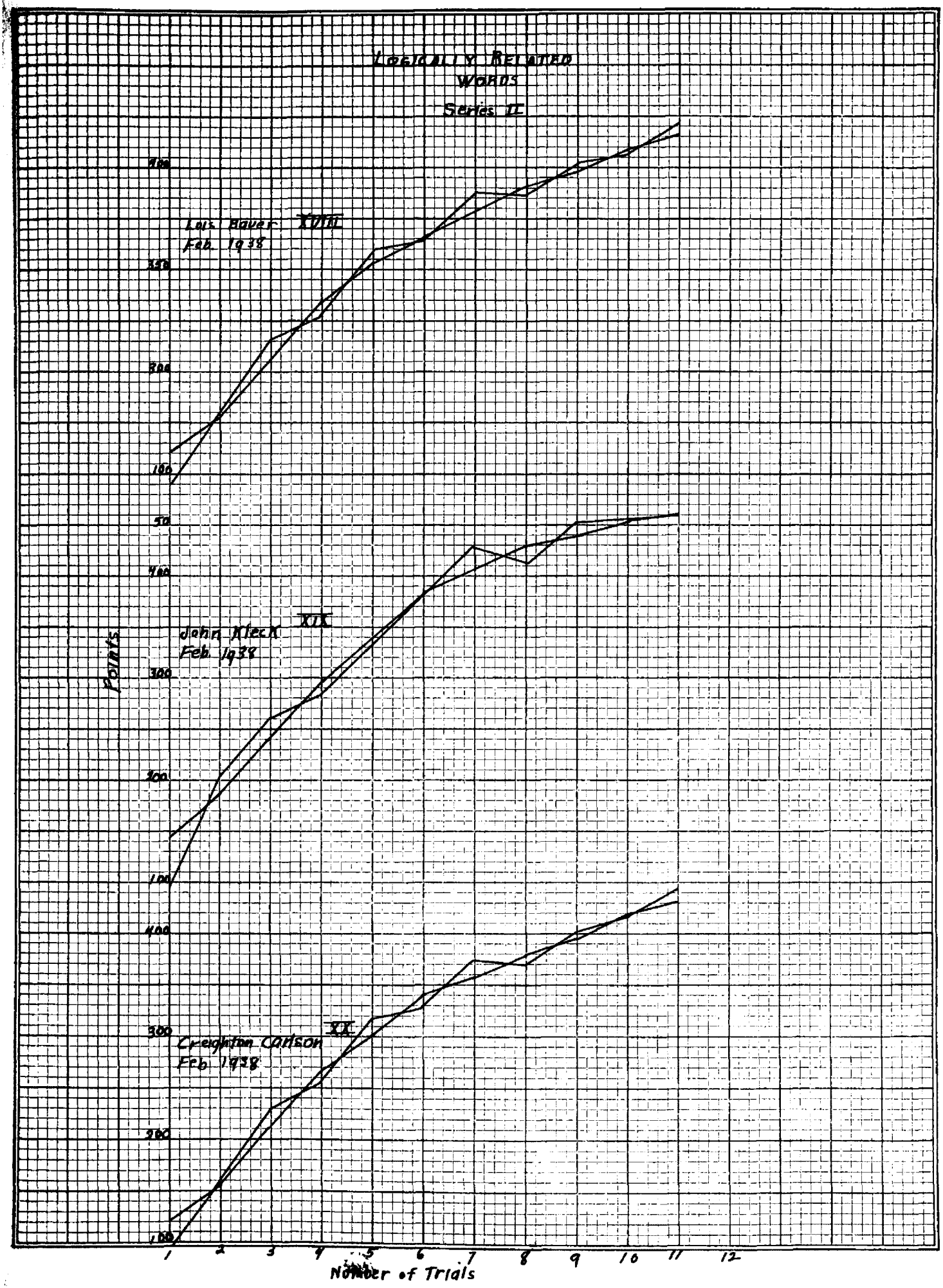
Curve X. (S.H.)	Curve XI. (D.K.)	Curve XII. (F.T.)	Curve XIII. (L.H.)
114 - 151	95 - 124	48 - 67	63 - 92
188 - 174	154 - 149	86 - 75	122 - 120
220 - 205	200 - 172	90 - 92	195 - 172
206 - 224	163 - 188	99 - 99	199 - 219
247 - 238	201 - 202	110 - 108	262 - 246
261 - 259	243 - 223	116 - 104	276 - 275
270 - 271	224 - 237	96 - 121	287 - 293
282 - 283	245 - 246	151 - 135	317 - 308
297 - 289	270 - 259	159 - 151	321 - 317
	263 - 276	144 - 165	312 - 321
	294 - 285	192 - 176	331 - 319
	299 - 296	191 - 195	313 - 327
		203 - 197	336 - 329
			337 - 336

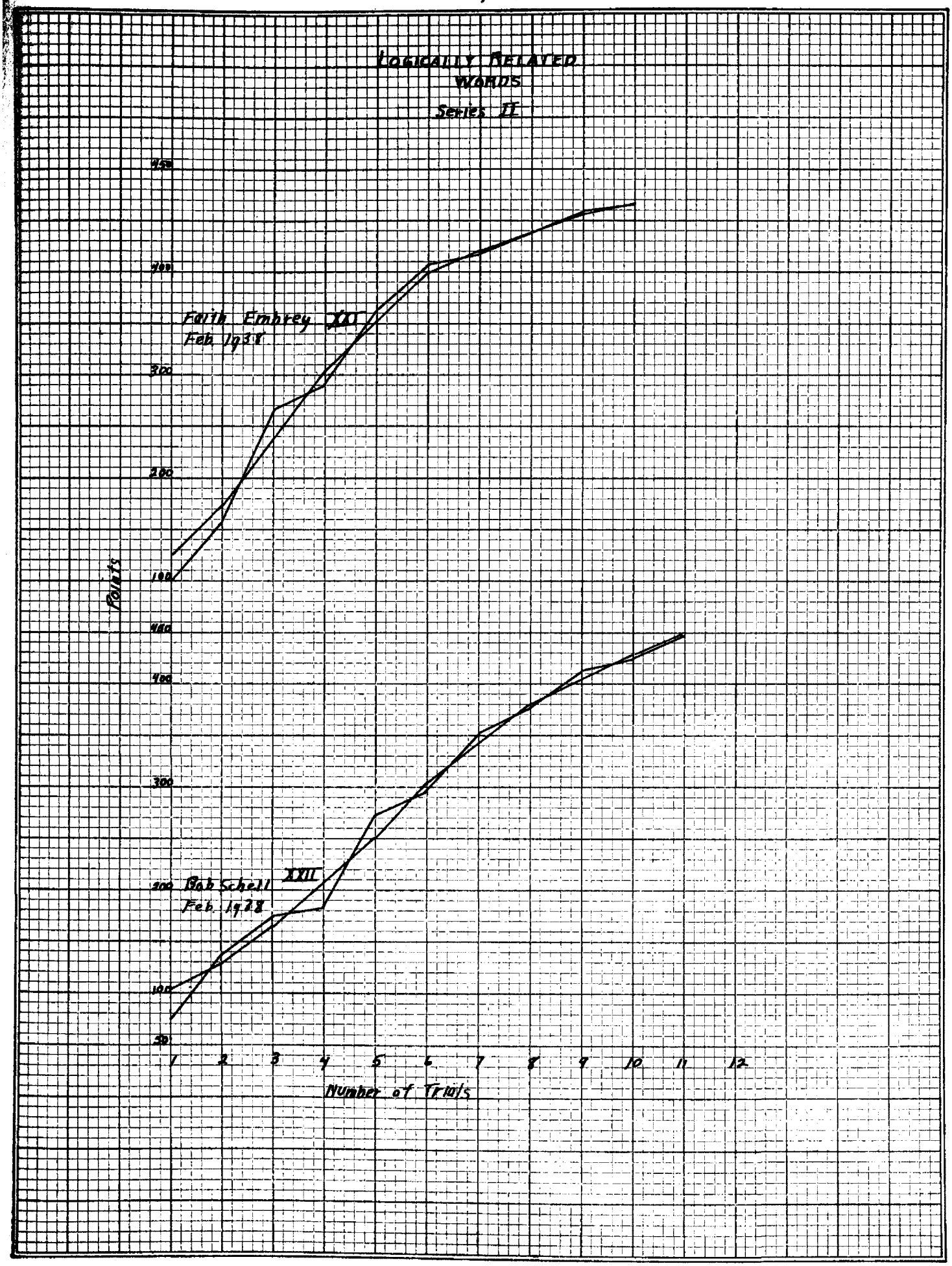
Curve XIV. (G.M.)	Curve XV. (M.S.)	Curve XVI. (V.W.)	Curve XVII. (S.G.)
39 - 81	76 - 94	51 - 86	76 - 94
125 - 106	113 - 122	122 - 118	113 - 117
157 - 133	176 - 142	181 - 146	161 - 147
120 - 152	137 - 167	135 - 166	166 - 178
180 - 173	188 - 174	183 - 175	208 - 208
220 - 201	198 - 203	207 - 198	242 - 241
203 - 219	222 - 208	205 - 213	256 - 257
233 - 237	203 - 225	226 - 233	273 - 271
274 - 253	250 - 232	267 - 245	256 - 257
	243 - 255	243 - 263	273 - 271
	271 - 269	279 - 269	284 - 279
	295 - 278	287 - 277	281 - 285
	268 - 286	265 - 275	289 - 288
	295 - 290	274 - 281	293 - 292
	308 - 302	304 - 290	295 - 299
	302 - 309	294 - 301	308 - 305
	319 - 314	305 - 305	312 - 314
	321 - 318	317 - 309	322 - 317
	315 - 323	305 - 313	
	333 - 327	317 - 317	
	333 - 333	328 - 322	

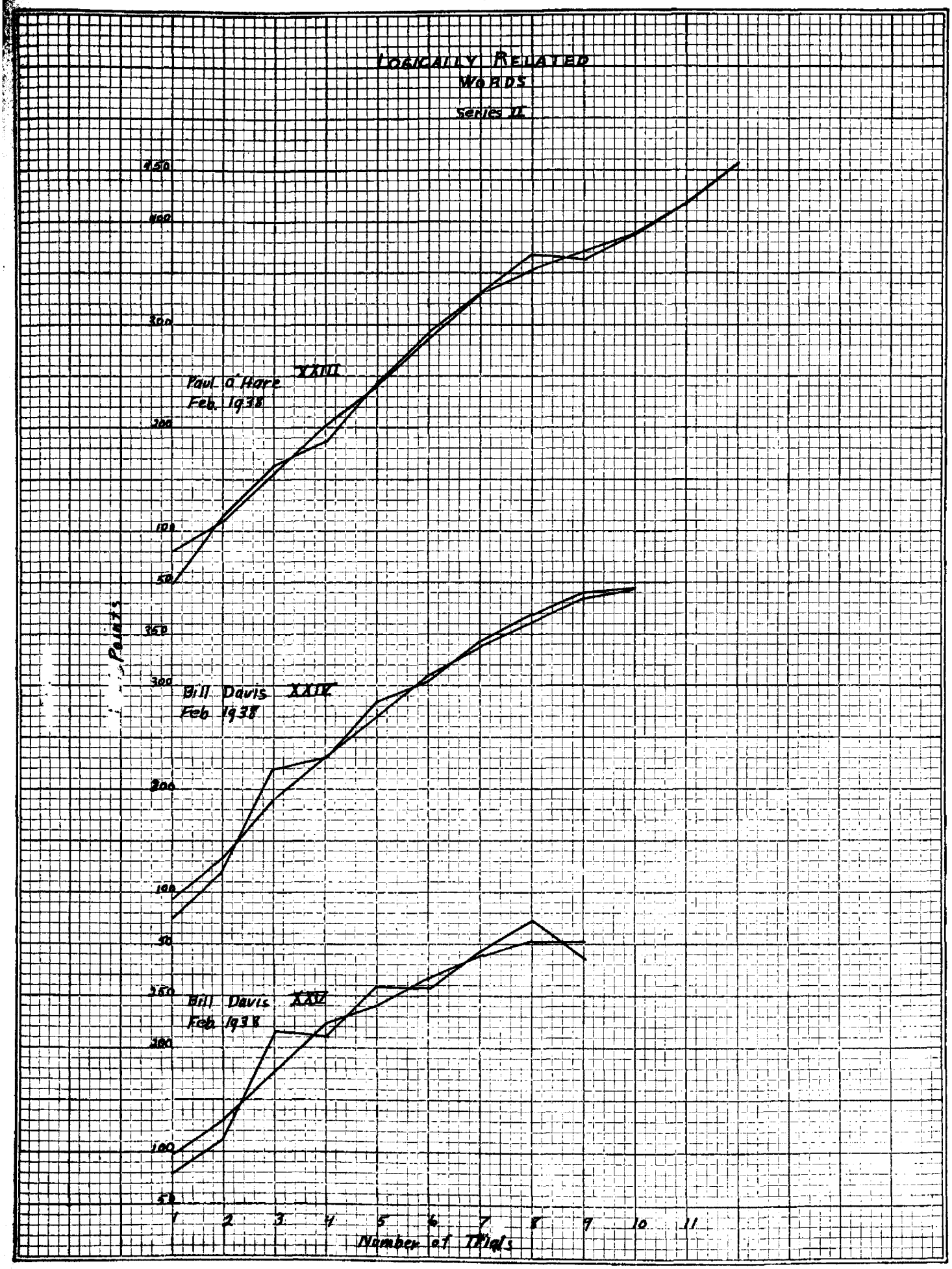
Fig 5d











(III). Line-Number Association

This phase of the problem involved the learning of a series of lines in correct order. Four lines each of a different length were used. The lengths were 8, 26, 37, 51 mm. respectively. Line number one was 8 mm. in length, number two 26 mm., number three 37 mm., and number four 51 mm. Each card contained one of the twenty-four possible combinations of the four lines. For example, the order of the lines on card one was 1,2,4,3. On card two the order was 2,3,1,4. Thus, each card was different from the others.

The subject was seated across the table from the experimenter. A muffled metronome was set at 60. The experimenter presented card number one to the subject for four beats of the metronome; after which it was placed at the back of the deck, exposing card two for four seconds. At the expiration of the four seconds the entire pack was placed behind a screen during the next four seconds while the subject recorded the order of the first card shown. The problem was to keep the order of the first set of lines in mind while learning the second set and then to keep the second set in mind while recording the first set, and so on through the 22 cards.

Fifteen subjects completed the experiment working in 8 thirty-minute periods spread over several weeks.

The total possible points was 88. For every line in correct order the subject received one point. For example, in card I the correct order is 1,2,4,3. If the subject's record showed this order, he received four points. If the subject's order were 1,2,3,4 he would receive only two points since 4 and 3 are in the incorrect order.

The trial score was the total number of points scored.

Line-Number Association

A. Results and Discussion

This experiment, in essentials, is a test of attention. We find all types of "breathing places" in all parts of the curve. Some subjects showed high scores from the first while others produced high scores only with some practice. The subject's introspections must be resorted to for an understanding of these very divergent curves.

The subjects could at will produce a high score by simply giving greater attention to the problem. Whenever there was the slightest lapse of attention the score dropped. All subjects were aware of this. Subject 10 (GT) demonstrated it to a marked extent. On his most successful scores he became set and gave his attention entirely to the problem. Just as soon, however, as any sort of distraction disturbed his progress that trial might just as well have been concluded. He made no more successful recalls. He reported, too, that it was absolutely essential to forget completely the previous cards in order to hold the new ones. If his thoughts shifted to them for just a moment he was lost on the next series. Every subject reported similar difficulties and the curve tends to bear them out.

Table VIa.

Line-Number Association

(Raw score in first column. Smoothed score in second.)

Curve No. I. (H.J.)	Curve No. II. (B.M.)	Curve No. III. (J.P.)	Curve No. IV. (H.P.)
74 - 71	31 - 41	54 - 60	48 - 50
68 - 72	51 - 44	67 - 62	52 - 45
75 - 62	51 - 54	65 - 67	38 - 51
44 - 59	60 - 54	70 - 66	64 - 58
59 - 54	60 - 57	62 - 57	72 - 66
59 - 63	60 - 58	39 - 51	62 - 61
71 - 67	53 - 58	53 - 51	50 - 55
72 - 64	61 - 59	62 - 57	52 - 58
50 - 62	63 - 64	55 - 59	72 - 69
64 - 62	67 - 66	59 - 60	82 - 80
71 - 69	68 - 65	66 - 63	86 - 83
72 - 72	60 - 63	63 - 65	80 - 77
72 - 73	61 - 58	66 - 69	64 - 72
74 - 74	54 - 61	78 - 73	72 - 66
76 - 75	68 - 64	74 - 73	62 - 67
76 - 72	71 - 72	60 - 77	
64 - 74	78 - 71	78 - 77	
82 - 77	64 - 71	73 - 76	
84 - 83	70 - 69	76 - 72	
84 - 84	63 - 67	68 - 75	
	68 - 66	80 - 74	
	67 - 70		
	76 - 71		
	69 - 74		
	76 - 69		
	64 - 70		

Fig 6a

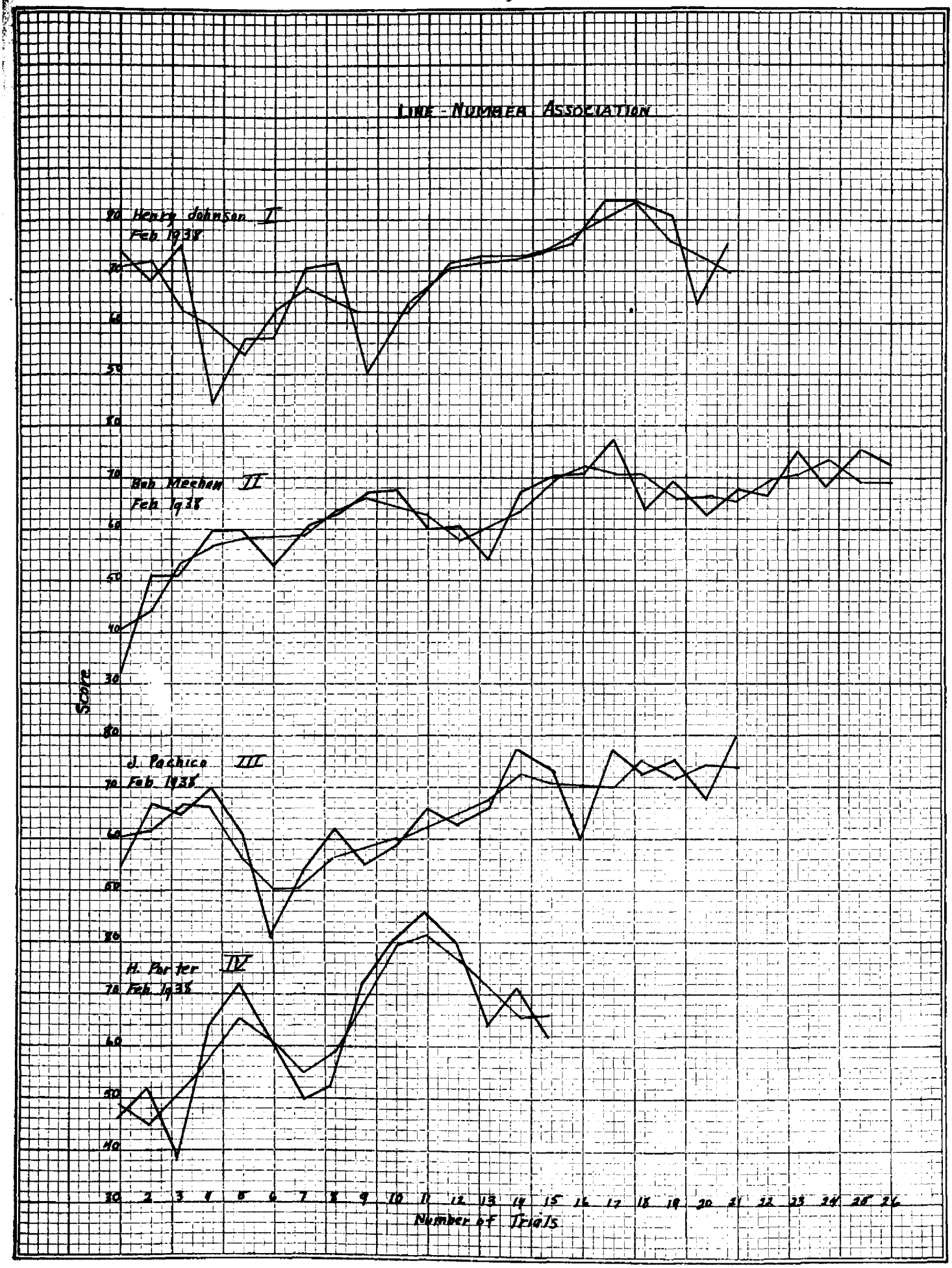


Table VIb.

Line-Number Association

Curve No. V. (S.H.)	Curve No. VI. (O.R.)	Curve No. VII. (G.T.)	Curve No. VIII. (F.M.)
67 - 77	44 - 48	48 - 52	37 - 38
88 - 74	53 - 53	56 - 53	40 - 34
66 - 76	61 - 60	56 - 59	25 - 34
73 - 76	67 - 53	66 - 68	43 - 36
88 - 66	31 - 42	81 - 78	21 - 32
37 - 65	29 - 29	88 - 82	33 - 26
71 - 59	28 - 41	76 - 83	25 - 25
70 - 71	65 - 49	86 - 80	26 - 21
73 - 74	55 - 64	77 - 82	21 - 28
79 - 78	72 - 62	82 - 82	46 - 39
82 - 74	58 - 64	88 - 85	22 - 36
62 - 70	62 - 62	86 - 86	41 - 33
66 - 71	67 - 60	85 - 85	36 - 43
84 - 75	50 - 56	84 - 81	33 - 44
76 - 80	50 - 53	73 - 78	64 - 49
	60 - 63	77 - 67	50 - 56
	78 - 69	52 - 70	54 - 49
	70 - 74	82 - 71	43 - 43
		79 - 81	31 - 39
		82 - 82	45 - 47
		84 - 77	64 - 59
		65 - 75	68 - 60
			49 - 58
			57 - 56
			62 - 60
			62 - 62

Curve No. IX. (N.L.)	Curve No. X. (P.W.)
29 - 38	21 - 42
48 - 35	63 - 47
29 - 39	66 - 72
39 - 38	86 - 70
45 - 42	59 - 66
43 - 47	52 - 50
53 - 49	38 - 48
51 - 50	54 - 44
45 - 49	39 - 48
51 - 46	50 - 48
42 - 44	55 - 52
38 - 47	52 - 54
62 - 51	54 - 51
53 - 55	46 - 52
49 - 46	55 - 51
37 - 49	53 - 53
61 - 50	50 - 56
62 - 61	64 - 54
	49 - 50
	38 - 44

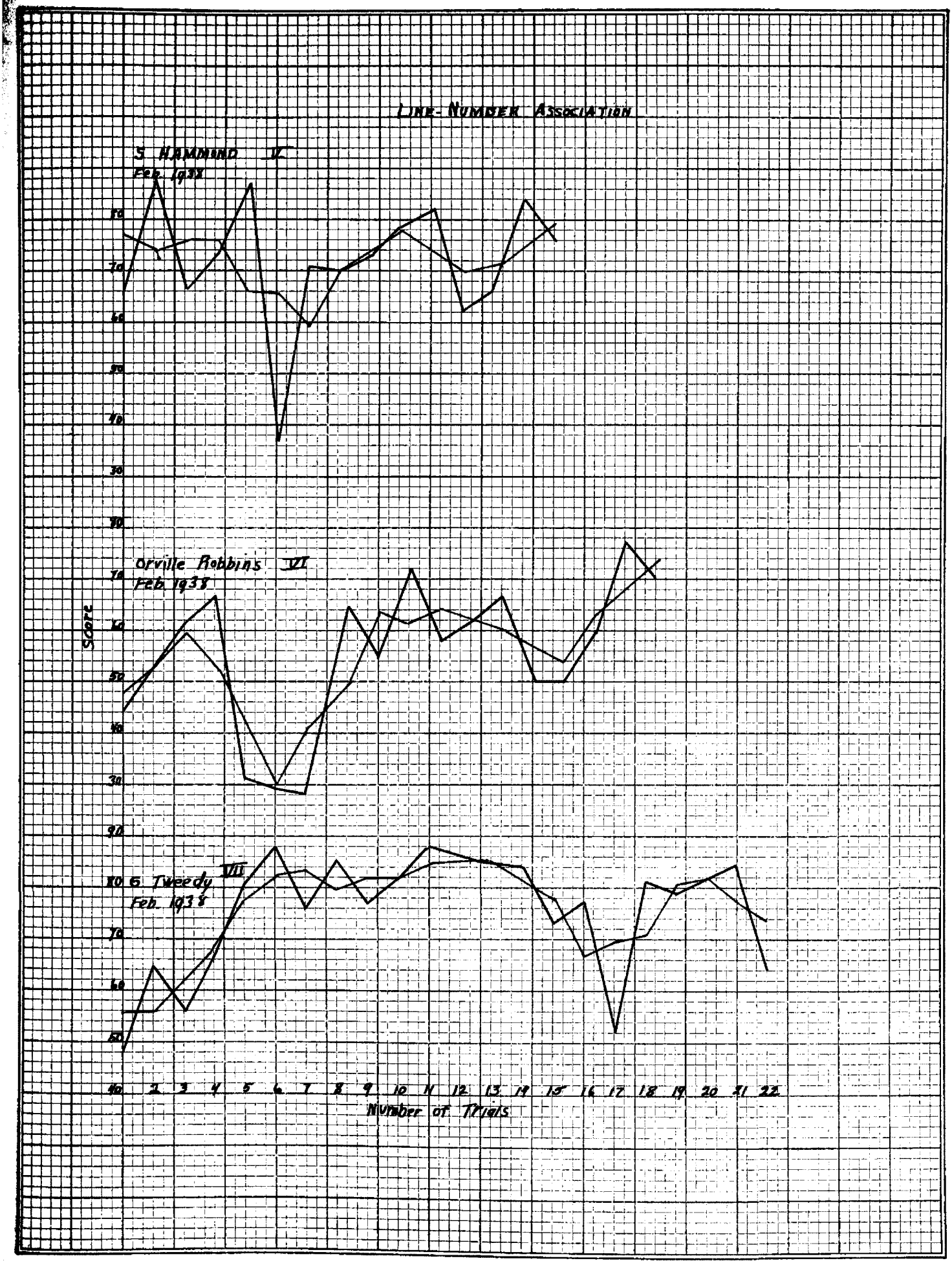
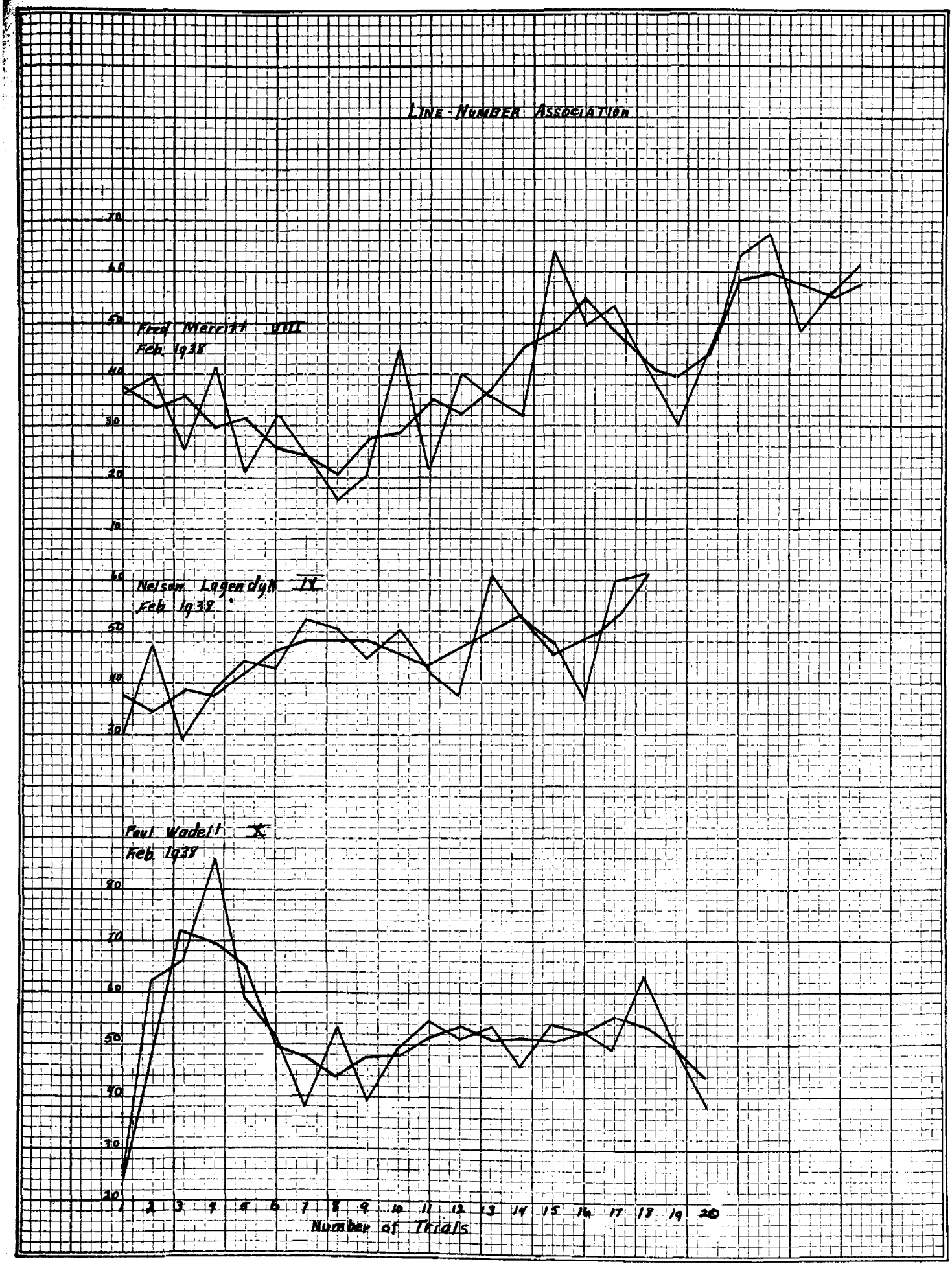


Fig 6C.



(IV). Memorizing Poetry

The purpose of this part of the experiment was to determine the type of curve for poetry and to find the effects of different types of poetry on the form of the curve.

Throughout these experiments the whole method rather than the part method of memorizing was used. The length of time required to read the selection was determined and each subject was then allowed only the time necessary for one reading. It was found, however, that in some cases the subjects would stop and repeat a line invalidating to some extent the score that he made. To control this factor the later subjects read the selection aloud. At the conclusion of the reading the subject recalled all of the lines that he could. When he had reached the limit of his recall, he re-read the selection.

In scoring, credit was given for a complete phrase or line. If the line were changed in any way the subject was given credit only if it were at least three-fourths correct. The subject worked alone and the record was kept by the experimenter. About 10 repetitions were made at each session.

Nine subjects learned the poem "Birches," containing 60 lines, written by Robert Frost. Introspections were written by each subject during or after the learning.

In a second part of this experiment the subject was asked to learn 60 lines of Canto I of Dante's "Divine Comedy." The purpose of this experiment was to compare the effect of learning poetry of different degrees of difficulty on the character of the learning curve. In other words, to see whether plateaus were more likely to occur in the second or more difficult poem than in the first or simpler type.

Memorizing Poetry

A. Results and Discussion

We find again only a few isolated occurrences of "breathing places," all of which are accounted for by emotional disturbances. In 1 (HJ) there occurs a plateau from the 15th to the 20th trials. Just a short time before the trial he had been hypnotized in another experiment and was to be again the subject for a demonstration that evening. He remarked that he didn't believe these experiences would have any effect on his scores, but he also recorded in his introspections that he was greatly excited about the evenings performance.

In 6 (BW) the subject misunderstood directions and thought that he was to repeat only the new lines that he learned. This necessarily kept his score quite constant. When re-directed to produce all lines learned each time, his score went up rapidly.

In 9 (MD) and 10 (GS) we have two subjects who were about to take an examination the following hour. From all appearances this was sufficient reason for the leveling off at this point.

The drop in the 23rd trial of 12 (WP) must go unexplained. Nothing in the introspective report could throw light on the cause. Further questioning of the subject revealed only that he was doing his best but couldn't seem to get going. It seemed to the observer that the subject was not giving his usual good attention, but this observation may not be indicative of his concentration and cannot be accepted as an explanation.

A comparison of the curves for learning "Birches" and "Canto I" shows no significant difference. We see individual differences as to the rate of improvement in both cases but the curves themselves are of the usual S-type

without plateaus. The curves for learning 130 lines are distinguishable from the other only in the length of time required for the learning. No plateaus appear.

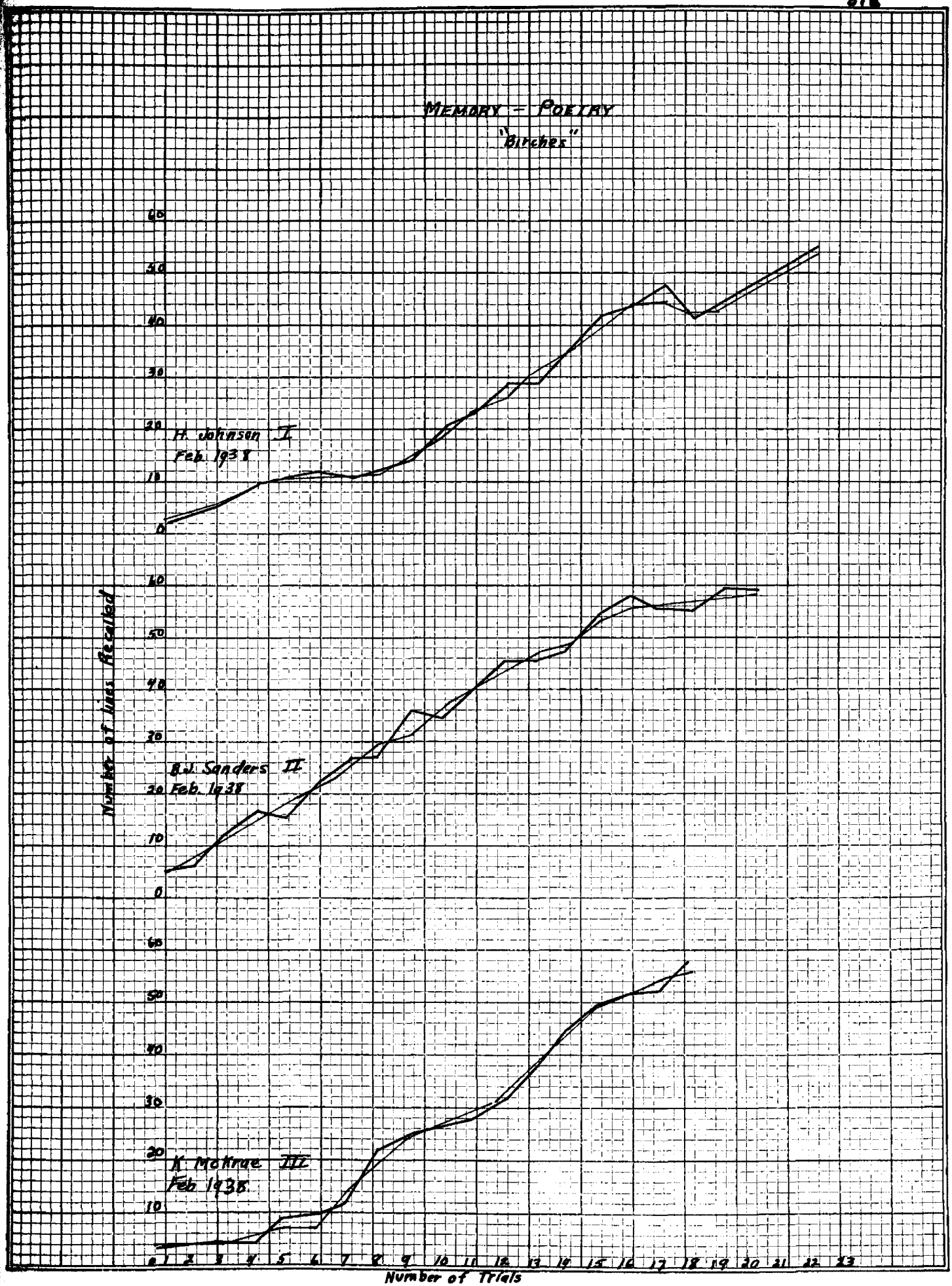
Table VIIa.

Memory - Poetry

"Birches"

(Raw score in first column. Smoothed score in second.)

Curve No. I. (H.J.)	Curve No. II. (B.J.S.)	Curve No. III. (K.Mc.)	Curve No. IV. (F.E.)
3 - 3	3½ - 3	2 - 3	3½ - 5
3½ - 4	2½ - 3	4 - 4	7½ - 8
4½ - 4	3 - 4	6 - 7	12½ - 12
4 - 6	6 - 5	10 - 9	14½ - 16
9 - 7	6 - 6	10½ - 11	20½ - 19
9½ - 7	6½ - 7	12 - 11	23 - 23
11½ - 14	9 - 9	11 - 11	25½ - 24
22½ - 19	10½ - 10	12½ - 12	25 - 26
25½ - 25	12½ - 12	14½ - 16	29 - 29
26½ - 27	14½ - 16	20½ - 19	32 - 32
28 - 29	21½ - 20	23 - 24	36½ - 36
31½ - 32	26½ - 27	29½ - 27	34 - 38
37½ - 39	33 - 31	29½ - 32	40 - 40
47 - 45	33½ - 34	36 - 36	41½ - 44
50 - 49	35 - 34	42 - 40	49½ - 46
52 - 52	34 - 36	44 - 45	48 - 50
53 - 55	39 - 37	48 - 45	55 - 54
59 - 56	34½ - 36	42 - 43	59 - 57
	36 - 36	40 - 44	
Curve No. V. (O.C.)	40½ - 42	49 - 47	Curve No. VI. (V.W.)
	48½ - 47	52 - 52	
3 - 4	55½ - 52	56 - 54	4½ - 4
6 - 5	54 - 53		5 - 6
6½ - 6	52 - 55		9½ - 8
6½ - 8	58 - 55		8 - 9
13 - 11			8½ - 9
14½ - 14			9 - 9
15½ - 13			8 - 11
10½ - 12			15½ - 13
10 - 13			15½ - 21
19 - 18			32 - 28
24 - 24			36 - 35
28½ - 27			50 - 46
30 - 32			52 - 50
39 - 39			49 - 52
47 - 45			55½ - 54
50½ - 51			58 - 58
55 - 54			60 - 59
57 - 57			59½ - 59
58 - 58			
60 - 59			
60 - 60			



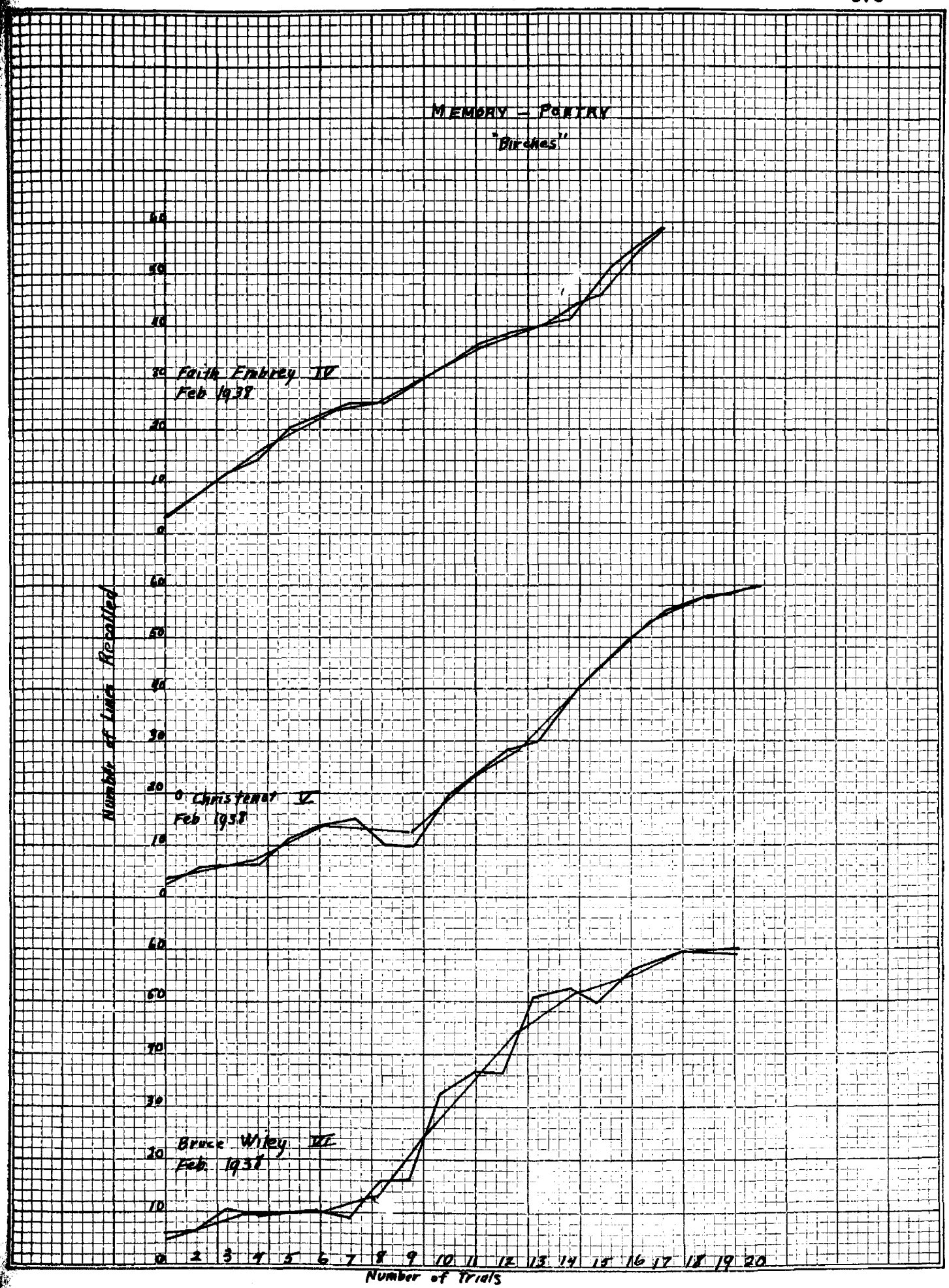


Table VIIb.

Memory - Poetry

"Birches"

Curve No. VII. (M.S.)	Curve No. VIII. (H.T.)	Curve No. IX. (M.D.)
3 - 2	½ - 0	5½ - 6
2 - 3	0 - 0	8 - 10
3 - 4	½ - 0	16 - 14
6 - 5	1½ - 1	19 - 16
6 - 6	3 - 3	13 - 16
6 - 7	4 - 3	15 - 17
9½ - 8	3½ - 4	23½ - 20
10 - 10	5 - 5	24½ - 24
12 - 12	6½ - 6	27 - 26
15 - 16	8 - 8	27 - 26
21 - 21	11 - 9	25½ - 29
27 - 27	9½ - 10	36 - 35
33 - 31	9 - 10	43 - 41
33 - 34	11 - 12	45 - 41
35 - 34	17 - 16	44 - 45
34 - 36	20 - 19	45 - 44
39 - 36	21½ - 22	45 - 44
35 - 37	25 - 25	49 - 46
36 - 37	28½ - 27	53½ - 48
40 - 41	29 - 29	
48 - 47	31 - 30	
52 - 51	31½ - 32	
54 - 53	32½ - 35	
52 - 55	41 - 39	
58 - 55	46 - 44	
	45 - 45	
	45 - 46	
	47 - 48	
	51½ - 51	
	55½ - 55	
	60 - 57	

Fig 7c

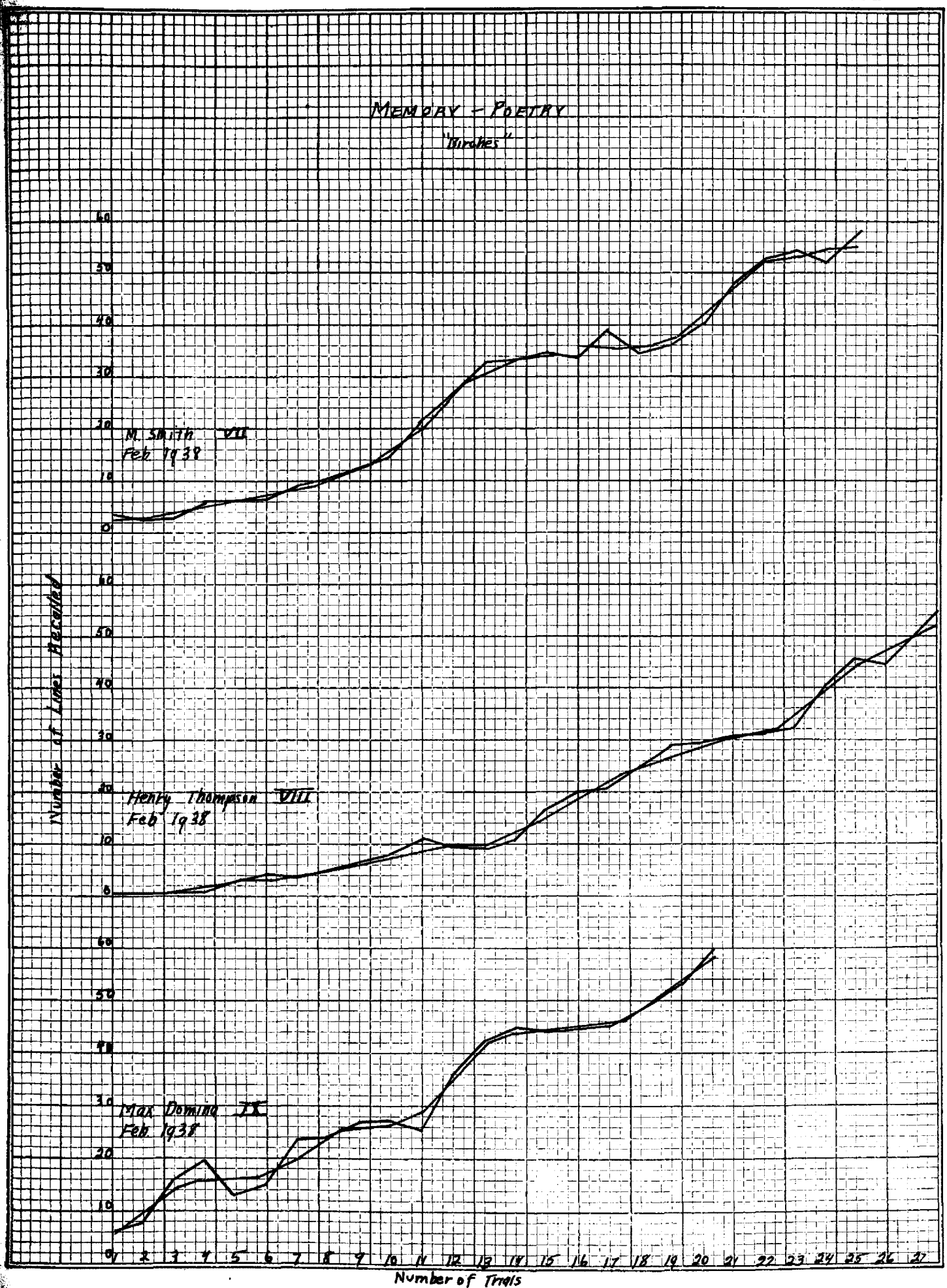


Table VIII.

Memory - Poetry

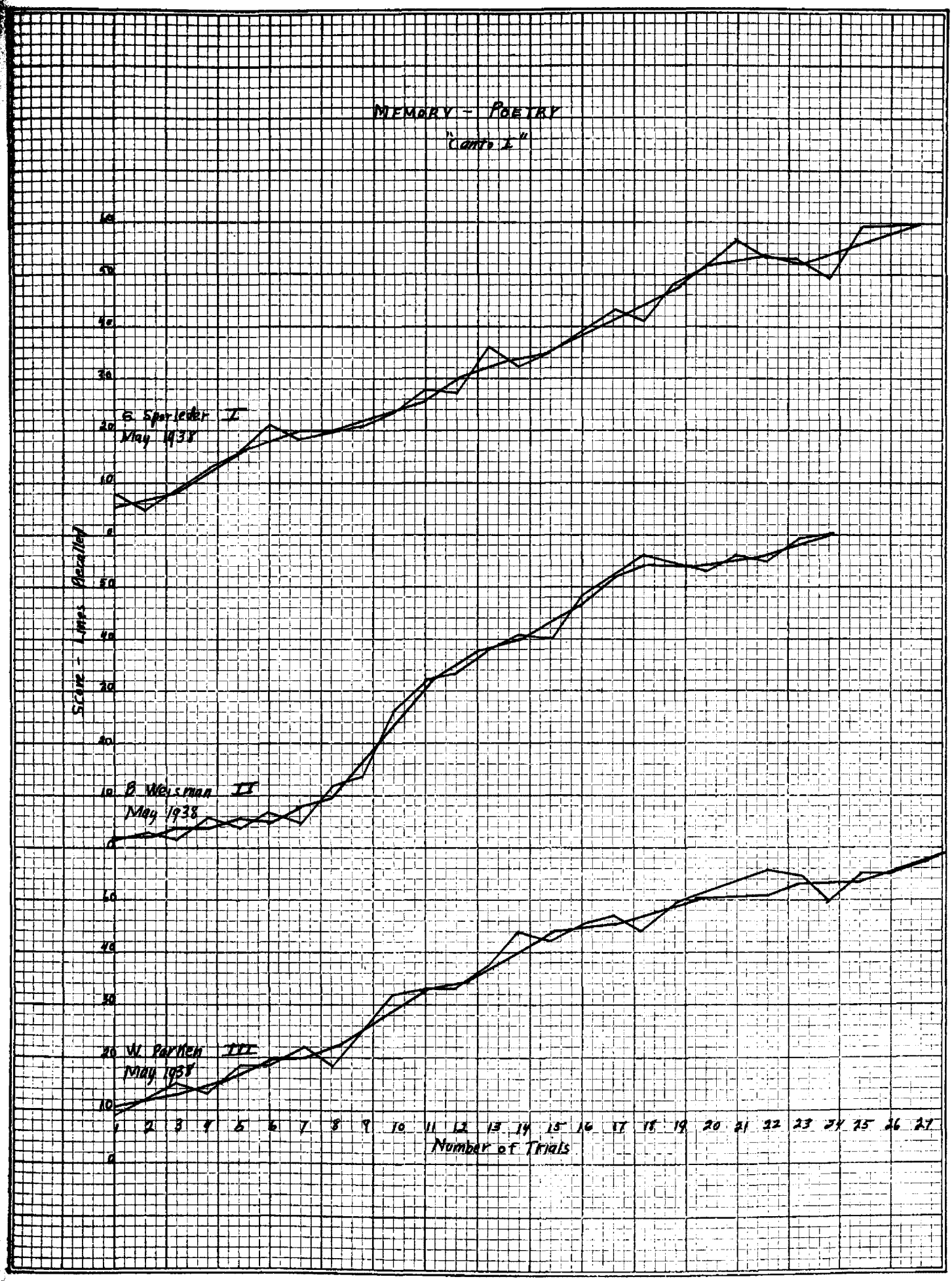
"Canto I"

60 line

(Raw score in first column. Smoothed score in second.)

Scores.

I. (G.S.)	II. (R.W.)	III. (W.P.)	IV. (E.B.)	V. (N.M.)	VI. (J.W.)
8-6	2-2	9-11	1-3	8-8	0-2
5-7	3-2	12-12	6½-6	8-9	5-3
9-9	2-4	15-13	12-10	12-12	3-6
13-13	6-4	13-15	16-14	16-14	9-7
16-17	4-6	18-17	14-16	15-16	10-12
21-18	7-5	19-20	18-19	17-17	13-14
18-20	5-8	22-20	24-23	19-19	18-15
20-20	12-10	18-22	27-26	20-23	15-16
21-22	14-17	25-25	28-28	29-28	16-18
24-24	26-24	32-30	30-31	36-34	22-20
28-26	32-31	33-33	36-36	38-39	23-22
27-30	34-35	33-34	42-39	44-43	25-23
36-32	38-38	37-38	38-42	48-47	22-25
32-34	41-40	44-41	45-42	50-50	28-26
35-35	40-43	42-44	44-46	52-52	27-29
39-39	48-47	45-45	48-45	51-53	33-31
43-41	52-52	47-45	42-45	55-54	35-36
41-44	56-54	44-47	46-46	57-56	38-39
48-47	54-54	49-48	50-50	55-56	42-40
51-52	53-54	51-51	54-54	56-57	40-42
56-53	56-55	53-51	59-58	60-58	43-43
53-54	55-56	55-51	60-60		46-45
53-52	59-58	54-53			46-46
49-54	60-60	49-53			49-48
59-56		55-53			52-50
59-59		55-52			52-52
60-59		57-57			
60-60		59-59			
		60-60			



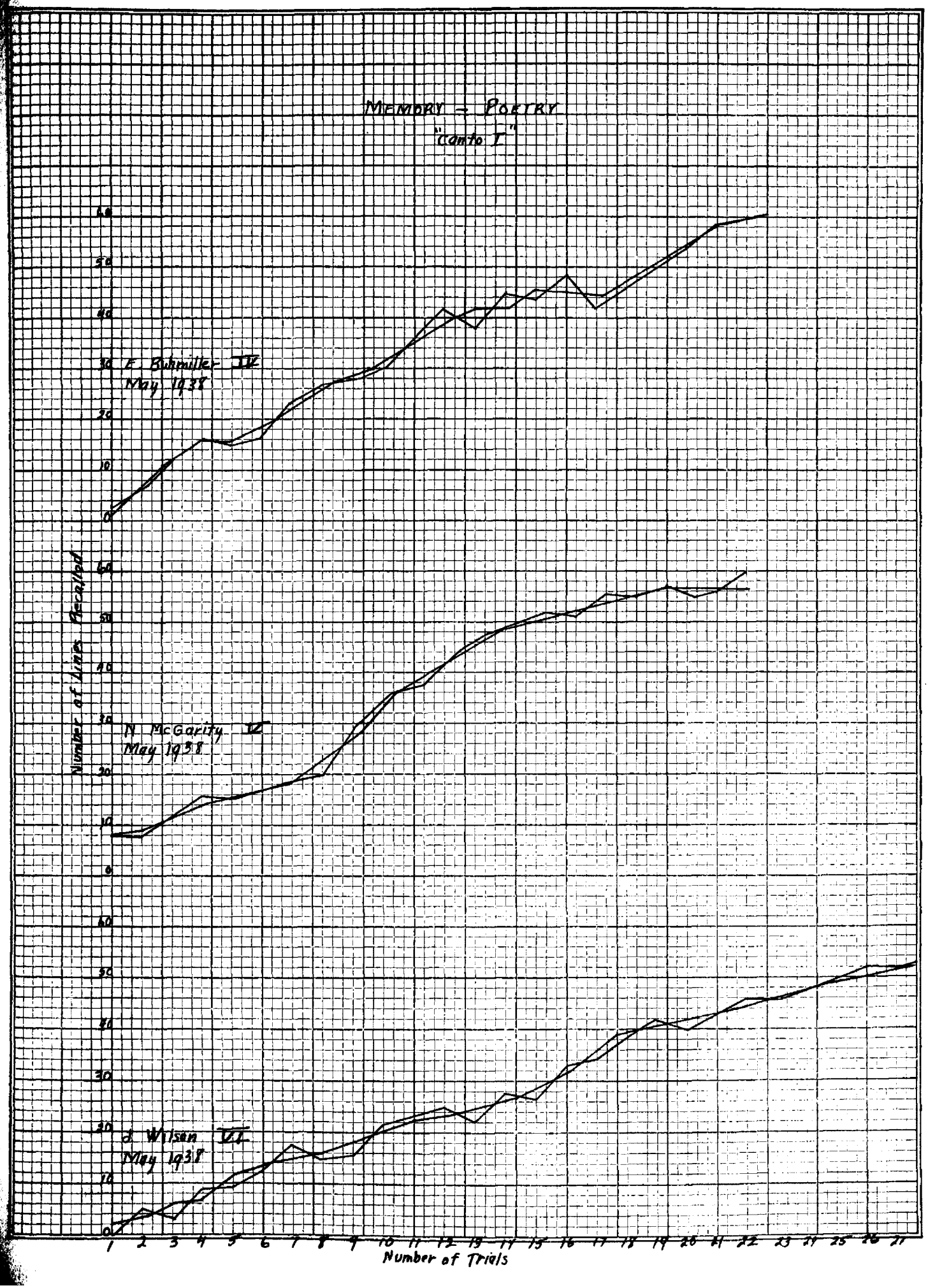


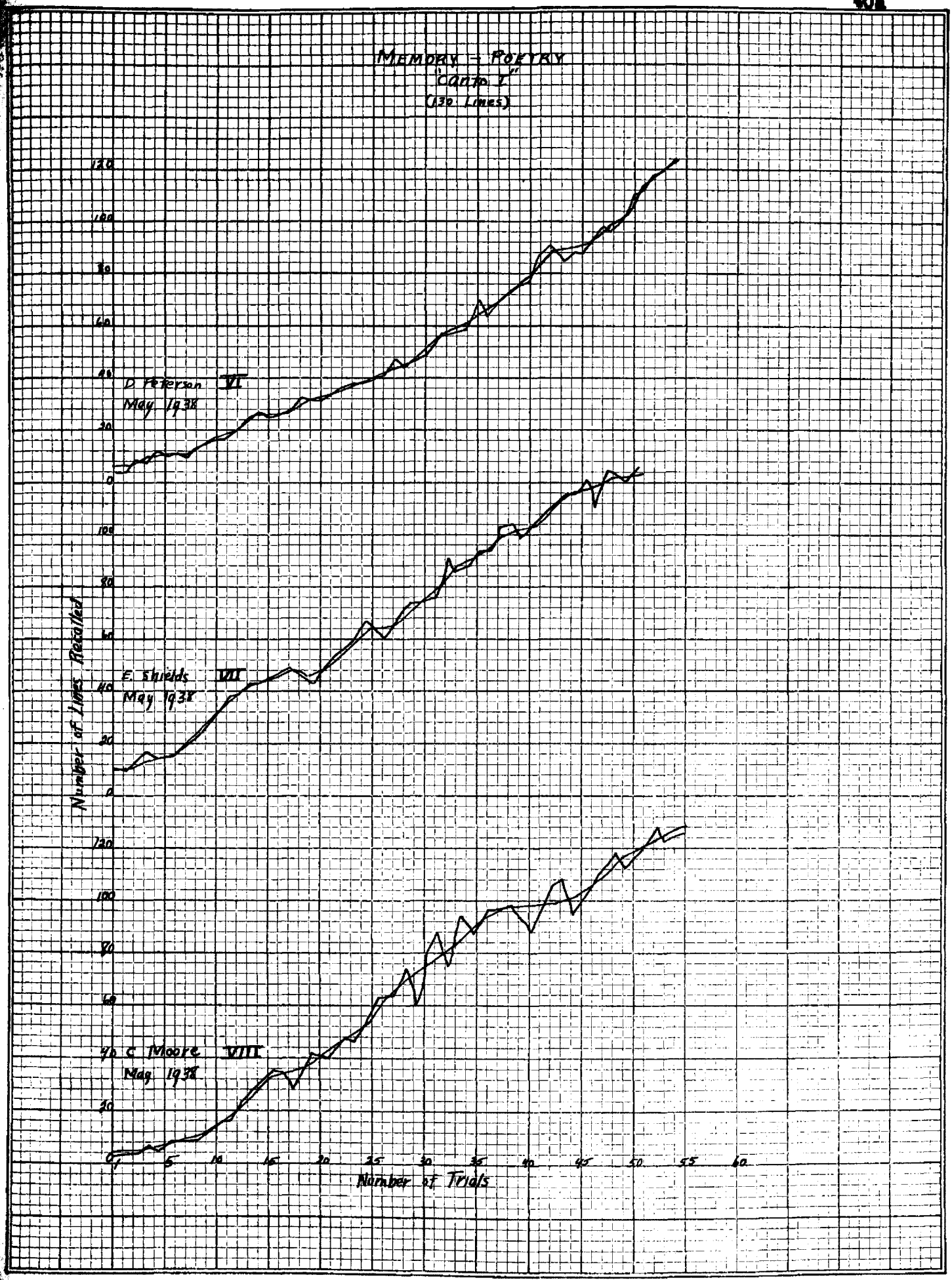
Table IX.

Memory - Poetry
"Canto I" - 130 Lines

(Raw score in first column. Smoothed score in second.)

VI. (D.P.)		VII. (E.S.)		VIII. (C.M.)	
6-5	89-87	11-10	115-114	3-3	105-105
5-7	88-90	10-12	122-115	4-4	111-111
9-7	94-93	14-14	109-118	4-5	118-114
8-10	98-96	18-16	123-118	6-5	113-115
12-10	96-98	15-16	123-122	8-7	116-116
10-11	101-102	17-17	120-121	9-9	120-121
11-10	110-108	20-20		9-13	128-123
10-12	112-113	23-27		11-12	122-125
14-13	118-117	28-28		15-14	124-124
16-16	120-121	33-33		16-18	125-125
17-17	126-125	38-37		23-22	
18-19		39-40		27-27	
21-21		44-42		31-31	
25-24		43-45		34-33	
27-26		47-46		34-32	
25-26		48-48		29-33	
26-26		50-48		35-33	
28-26		46-46		42-39	
33-31		43-46		40-42	
32-31		49-48		43-44	
31-33		52-52		48-46	
35-34		56-56		46-49	
37-37		59-60		52-54	
38-38		67-63		63-60	
40-40		62-63		64-67	
41-43		60-63		64-67	
48-45		68-67		74-66	
45-47		73-71		61-72	
49-49		74-75		82-77	
53-53		77-76		88-82	
56-55		78-82		75-85	
56-59		91-85		93-84	
64-59		86-98		84-89	
58-64		88-89		90-90	
70-64		94-93		97-94	
63-67		98-98		98-95	
69-69		103-98		92-92	
74-73		104-102		87-92	
76-76		98-102		97-97	
80-81		103-103		106-104	
88-87		109-105		108-103	
93-98		118-112		94-100	
84-89		116-114		99-99	

Fig 8C



(V). Codes.

The original plan of this experiment was to use the ordinary Morse code, but after several trials it was found to be too easy and not enough trials were secured to test the possibility of plateaus. Consequently a new code was devised which was sufficiently difficult to require at least four hours of practice to learn.

Code I contained 26 symbols most of which were taken from the semaphore code. A circle ½" in diameter was drawn, from which extended the two arms in various combinations as shown in Figure 9. In the circle was drawn another symbol. The 26 symbols were then placed on a drum 22" in diameter and this was mounted on a stand so that it would revolve when driven by a kymograph. A large screen was placed in front so that only one symbol at a time would be exposed to the subject. The kymograph revolved at the rate of one revolution in two minutes, allowing a four-second exposure of each symbol.

The problem then was to learn the 26 combination symbols. The subject was instructed to study the symbols carefully as they passed in view and at the end of one revolution he was given a sheet containing the 26 "semaphore" signals and a blank space for recording the matched symbol. Three recording sheets were made up, each having a different order of symbols. Sheet I was given after exposure I, sheet II after exposure II, sheet III after exposure III, sheet I after exposure IV, and so on in that order. The different order sheets were used to complicate the problem so that more trials might be secured. The recording time was three minutes.

Ten subjects took part in this experiment. Introspections were secured during each period of advancement.

Immediately following each trial the experimenter corrected and scored

each sheet. Whenever he found that three scores were nearly identical or that the scores were dropping he stopped the experiment long enough to secure any introspective data that might give a clue as to the cause of the arrested learning. In nearly every case interesting facts were secured from the subject as to the possible cause, although at no time was he aware of his score.

Fig. 9

Code I .

(Note: These symbols were placed in the order given on the circumference of a 22" diameter cardboard. The original circles were somewhat larger)

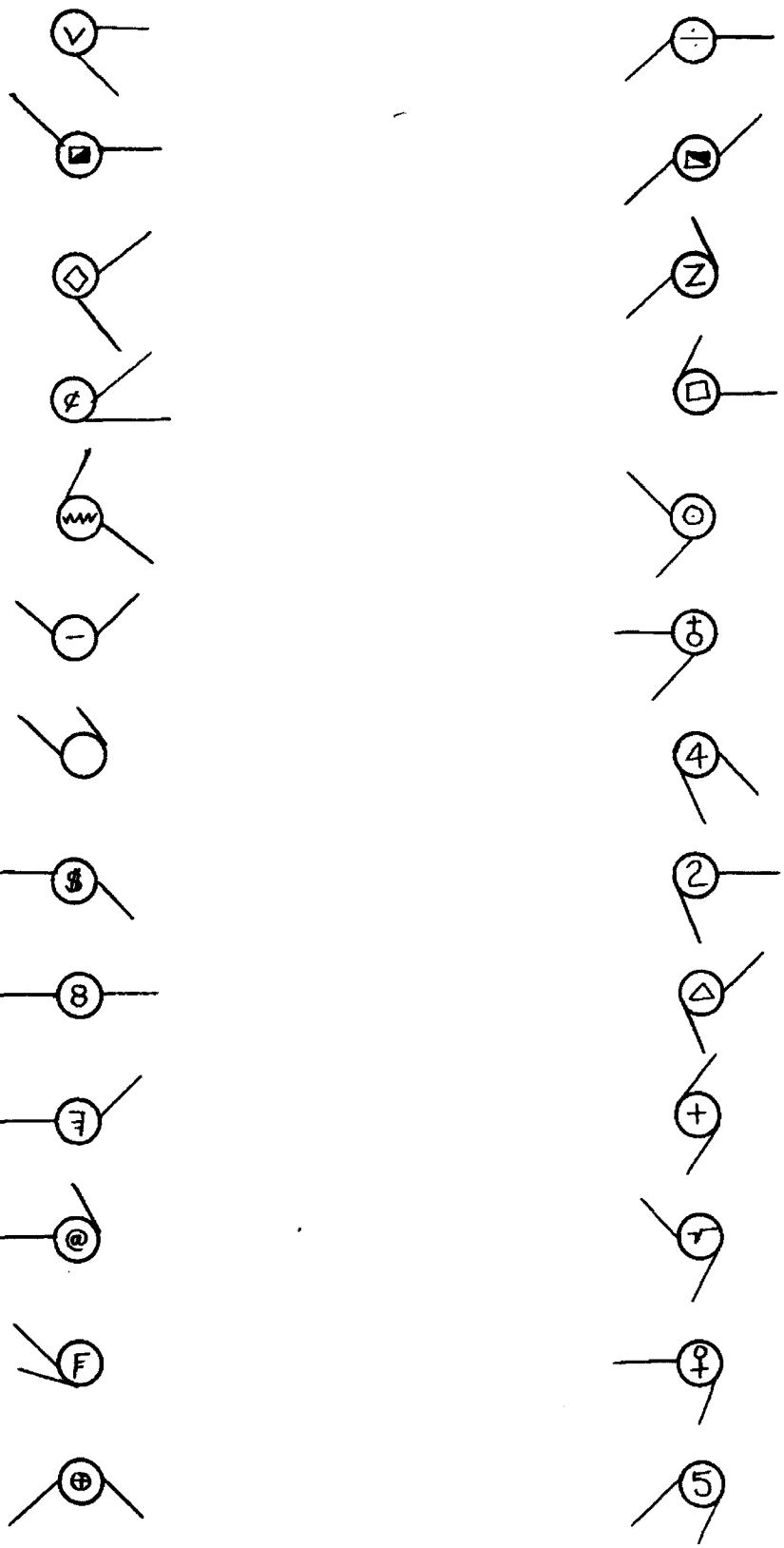
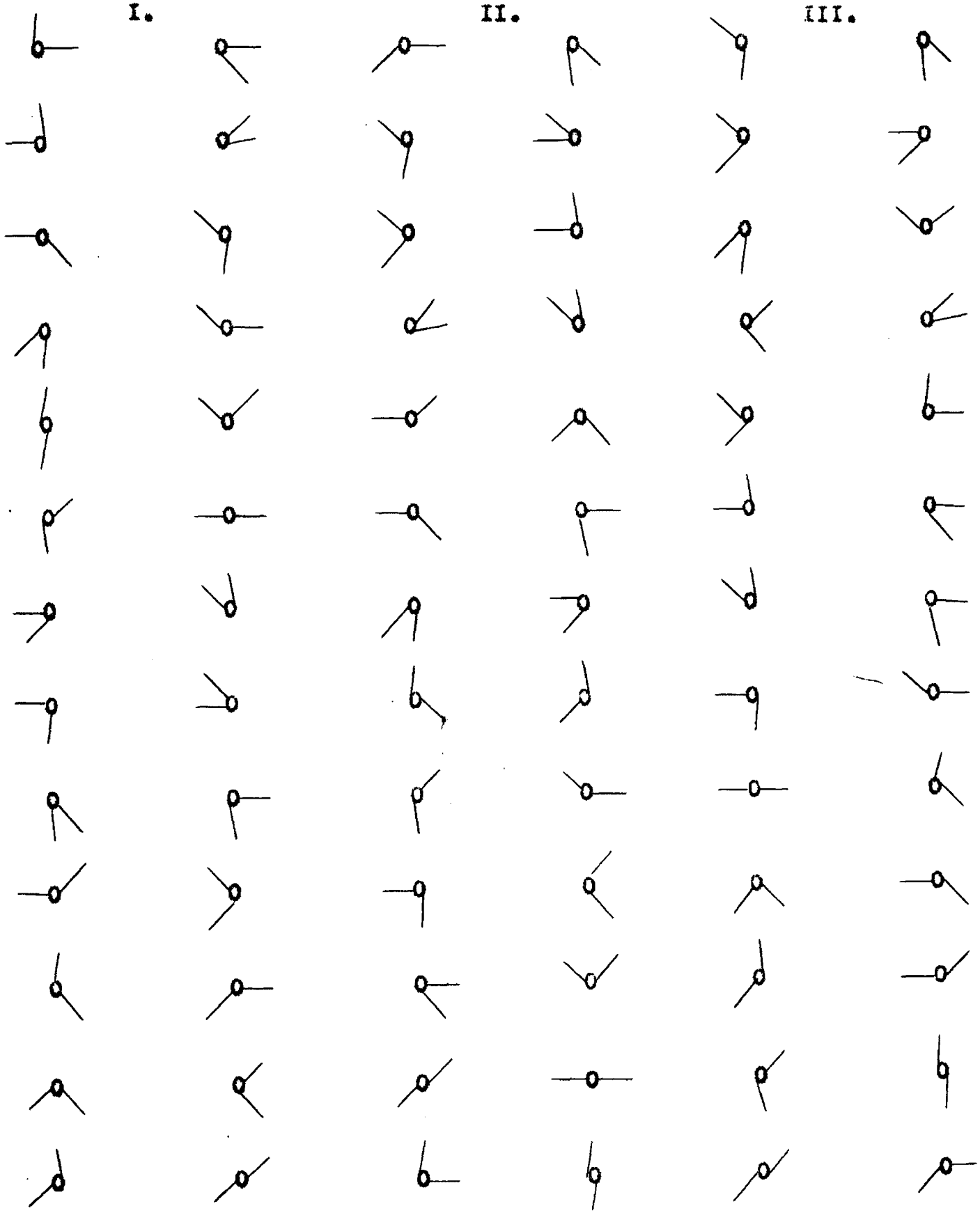


Fig. 10

Recording Sheet for Code I.

(Note: This sheet contains the three lists used. Number I was used for the first trial, number II for the second, etc.)



Code II

This code was a development of code I with several of the weak points of the first eliminated. It contained 40 symbols which was a sufficient number to hold the subject to the job for four to five hours. The difficulty of the task was increased by changing the recorded symbols to combinations of dots and dashes, no two of which were the same. Also a single sheet was used for recording which reduced the time wasted by the subject in re-orientating himself with each new order with code I.

The symbols were placed on a long tape of glazed paper ordinarily used for making smoked recordings on the kymograph. The tape was carried over the kymograph drum at one end of the table to the auxiliary drum at the other. The symbols were sufficiently large to be easily seen and were spaced at two inch intervals. A screen with a square exposure slot allowed an exposure of four seconds for each symbol. The subject was seated in front of the screen and after one complete revolution of the code, he was given the recording sheet. Three minutes were allowed for recording. Twenty-three subjects completed the work.

Fig. 11

Code II.

(Note: These symbols were drawn on Kymograph paper with two inches between each figure. The originals were larger and the "semaphore" symbols were clearly separated from the "dot-dash" symbols)

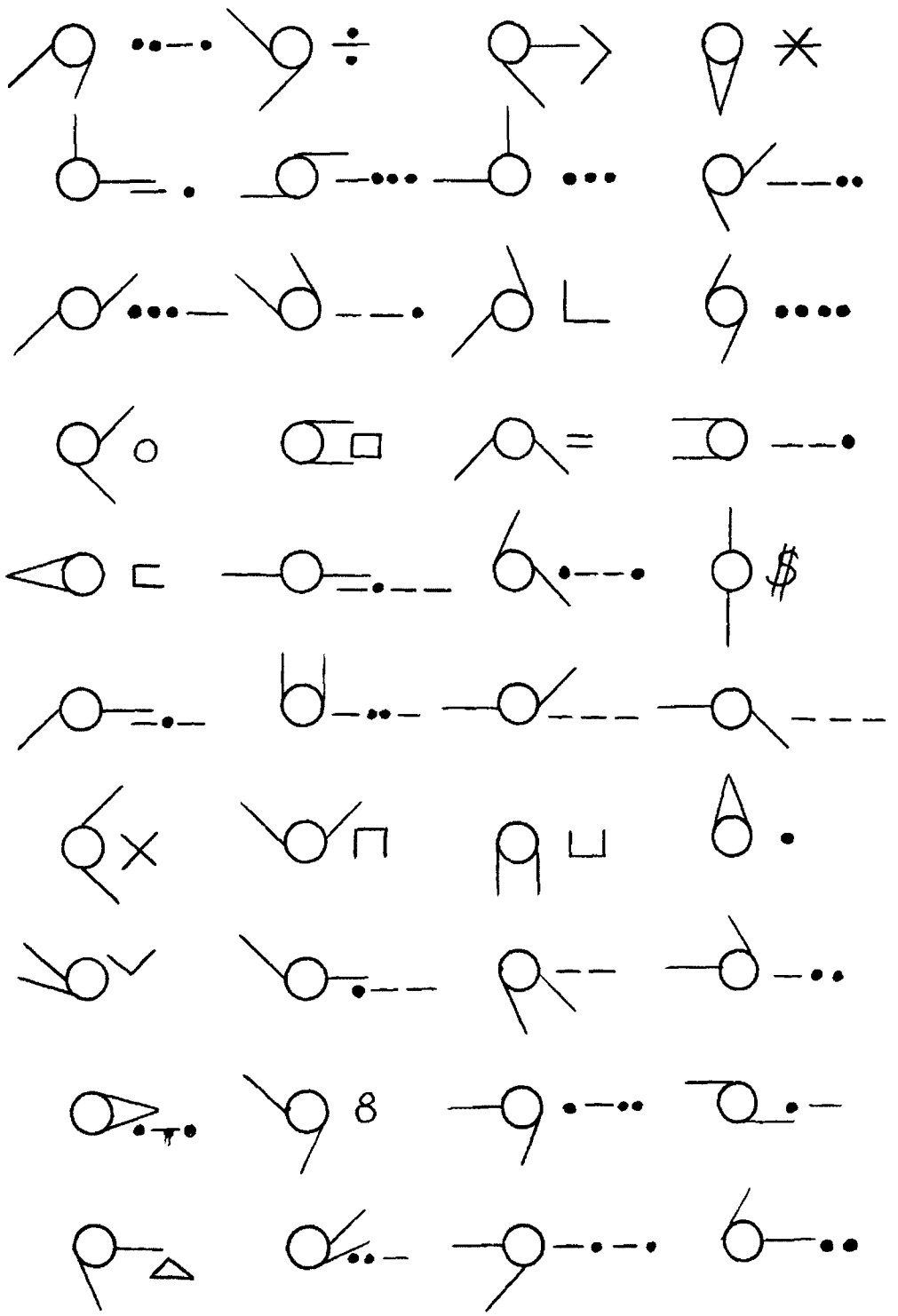
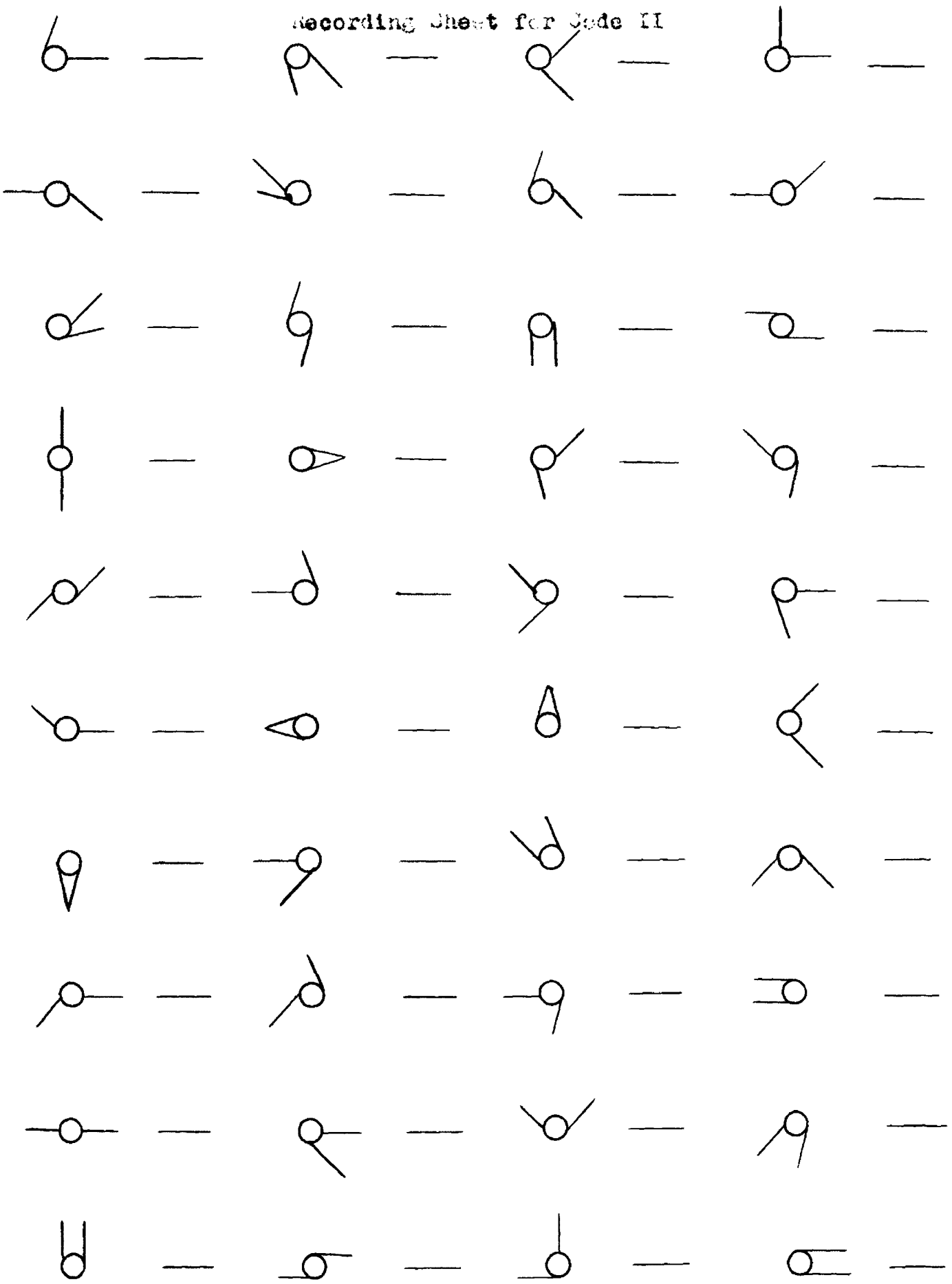


Fig. 12

Recording Sheet for Code II



Code I

Results and Discussion

Because of a somewhat greater complexity these curves contain more periods of arrested development than do the curves previously discussed. We see at least five such periods in the eight curves shown. Here again four of these periods can be adequately explained on the basis of introspection and the remaining one at least partially so. The plateaus of 2 (EW), 4 (MP), 5 (JK), 6 (LK) are partially due to the fact that an examination was to follow the trials. Subjects 5 and 6 were quite certain the cause could be traced to the examination. Subjects 2 and 4 admitted staying up late the night before to study but neither felt that had much to do with the plateau. No other possible clue could be given. In 7 the subject knew he had reached a plateau but could give no reason for it. He remarked that he was paying as much attention as usual but that he couldn't seem to "get them". The only factor found that might possibly have affected his progress was the fact that he was to accompany the glee club on a state-wide tour and the possible anticipation of this might have affected his score somewhat. He was not aware of this at any time, however.

Code II

Results and Discussion

This code was of more significance since it involved more subjects and was a real tax of the student's learning power in the time allotted. Following the completion of this experiment all of the curves were drawn to the same scale on large sheets of cross-section paper. It was felt by the experimenter that these would provide a better means of comparison of actual trends since they were all in view at once.

We find our typical curve which differed only in the number of trials required to learn the code. There are occasional periods of no-improvement, but only four of these can be classed as plateaus. In 8 (NS) the subject's rapid progress was halted by an attack of pneumonia. On recovery he took up the task again with a considerable drop from his previous high score. His improvement was steady from this point on. In this case we should really have called it two separate curves because the subject actually had to begin over again.

A week's lay-off accounts for the drop in 12 (BR). Here again we see rapid improvement when the task was taken up a second time.

Subject (PS) in Curve 16 was certain that his drop was due to a masquer's rehearsal which had kept him up most of the night previously. He was noticeably tired and was unable to give his best attention. This period may have lasted longer but after four trials the subject was dismissed and asked to report back two days later. His improvement from then on was very rapid.

Curve 13 (JM) lacks any adequate explanation. The subject began to drop after having almost reached the top. The subject had been working at top pitch previously and apparently was doing the same at the advent of the

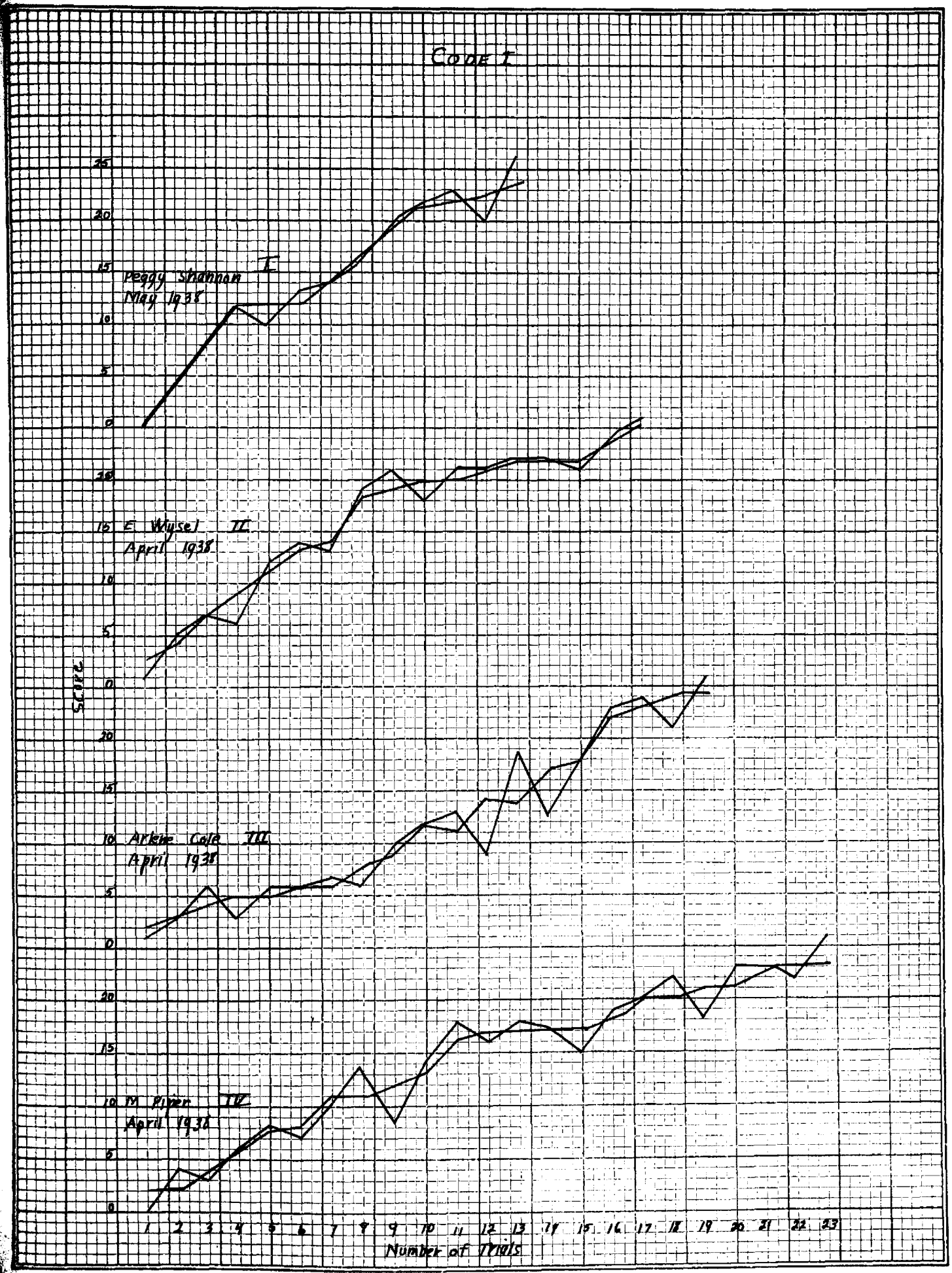
plateau. He said that the symbols had suddenly become confused and that he couldn't get them straightened out. This was the only plateau in the entire experiment that was left unexplained by the emotional situation and which might be due to some inherent factor in learning. Similar confusions were noted by Bryan and Harter which resulted in plateaus as did this one.

Table X.

Code I.

(Both raw and smooth scores are shown.)

I (PS)	II (EW)	III (AC)	IV (MP)
0 - 0	1 - 3	0 - 1	0 - 2
1 - 1	5 - 4	3 - 3	4 - 2
4 - 4	7 - 6	6 - 4	3 - 4
8 - 8	18 - 11	3 - 7	6 - 6
12 - 10	14 - 13	6 - 5	8 - 7
10 - 12	13 - 15	6 - 6	7 - 8
13 - 12	19 - 18	7 - 6	10 - 10
14 - 14	21 - 19	6 - 8	14 - 11
16 - 17	18 - 20	10 - 9	8 - 12
20 - 19	21 - 20	12 - 12	14 - 13
22 - 22	21 - 21	13 - 11	18 - 16
23 - 22	22 - 22	9 - 14	16 - 17
20 - 23	22 - 22	19 - 14	18 - 17
26 - 23	21 - 22	13 - 17	17 - 17
	24 - 24	18 - 18	15 - 17
	26 - 25	23 - 22	19 - 18
	24 - 25	24 - 23	20 - 20
		21 - 24	22 - 20
		26 - 24	18 - 21
		25 - 25	23 - 21
			23 - 23
V (JK)	VI -(LK)	VII (MM)	22 - 24
			26 - 24
2 - 2	0 - 1	2 - 2	
3 - 4	2 - 1	3 - 4	VIII (JQ)
6 - 5	2 - 3	6 - 5	
6 - 6	4 - 4	5 - 6	5 - 6
7 - 6	6 - 5	6 - 6	8 - 8
5 - 7	6 - 6	7 - 7	10 - 10
9 - 7	6 - 8	9 - 8	13 - 13
8 - 8	11 - 10	9 - 9	15 - 14
8 - 8	11 - 11	8 - 9	13 - 16
11 - 9	11 - 12	9 - 10	21 - 18
7 - 10	14 - 14	14 - 12	21 - 22
12 - 10	17 - 16	13 - 12	24 - 23
14 - 14	18 - 18	9 - 12	25 - 25
15 - 15	20 - 19	12 - 10	25 - 25
15 - 16	20 - 20	10 - 10	25 - 25
17 - 16	20 - 21	9 - 10	25 - 25
15 - 17	23 - 22	11 - 10	
19 - 18	24 - 23	11 - 11	
21 - 20	23 - 23	14 - 14	
	21 - 22	18 - 16	
	22 - 23	18 - 20	
	26 - 24	23 - 22	
	24 - 25	24 - 24	
		26 - 26	



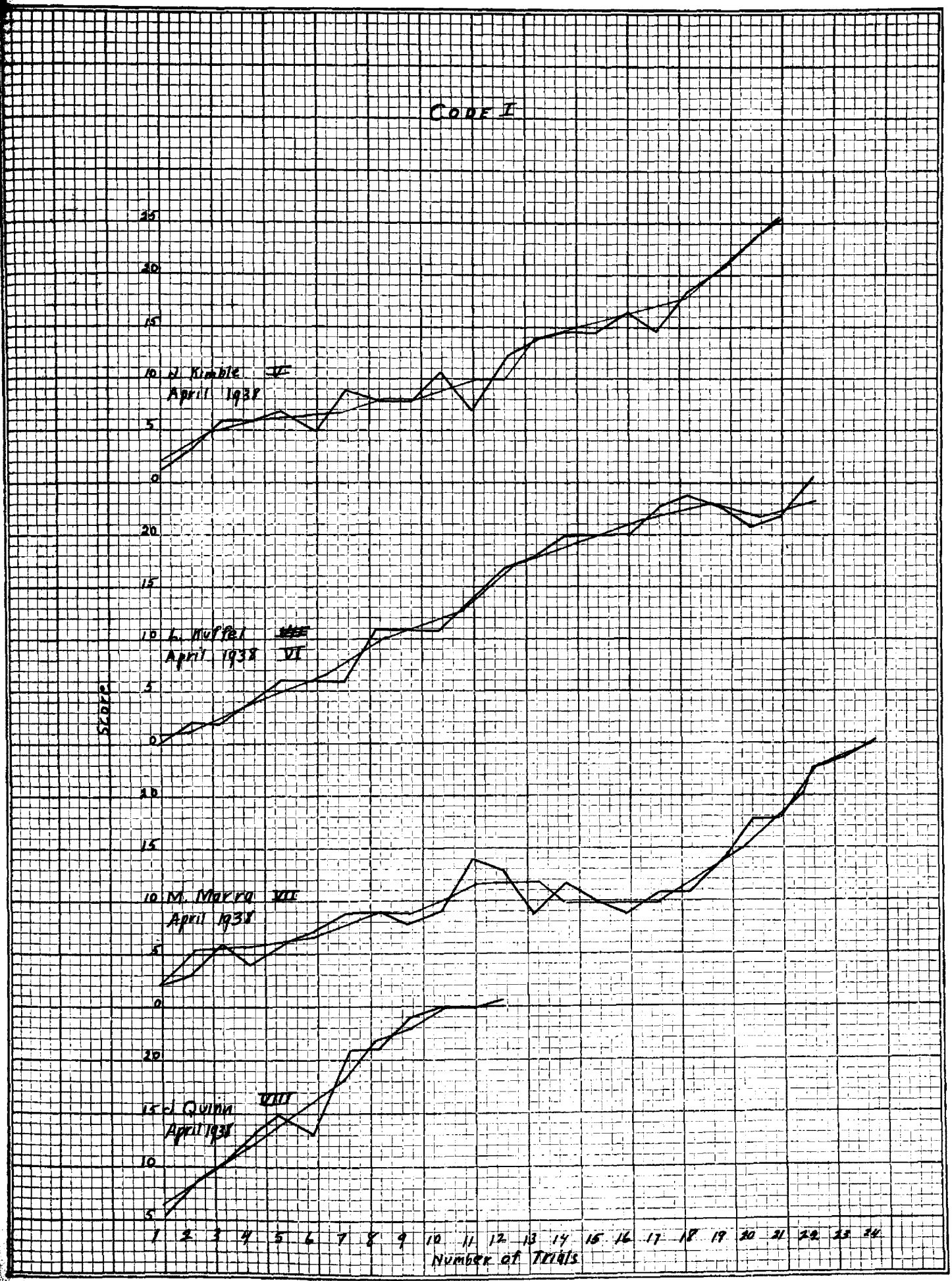


Table XIa.

Code II.

I. (RF)	II. (WM)	III. (MH)	IV. (MM)	V. (GR)	VI. (RB)	VII. (KN)
0 - 1	2 - 3	4 - 4	0 - 2	0 - 2	3 - 5	0 - 2
1 - 2	4 - 3	4 - 4	4 - 3	5 - 4	7 - 6	4 - 3
4 - 4	3 - 5	4 - 5	4 - 6	8 - 8	9 - 9	6 - 6
6 - 6	7 - 7	8 - 7	10 - 8	12 - 10	11 - 10	9 - 8
7 - 8	11 - 10	8 - 8	11 - 10	11 - 12	10 - 11	10 - 10
11 - 10	13 - 12	8 - 9	9 - 11	14 - 14	13 - 12	10 - 12
12 - 12	13 - 12	11 - 10	12 - 11	17 - 15	14 - 14	15 - 12
13 - 13	9 - 12	12 - 12	12 - 13	15 - 17	14 - 14	11 - 13
13 - 13	13 - 13	13 - 14	15 - 15	19 - 17	13 - 15	13 - 13
15 - 16	17 - 15	16 - 15	19 - 18	16 - 20	18 - 17	16 - 16
19 - 19	15 - 16	15 - 16	19 - 19	25 - 23	20 - 20	20 - 19
22 - 21	16 - 15	17 - 17	18 - 21	28 - 28	22 - 23	21 - 21
21 - 22	14 - 16	19 - 17	23 - 23	31 - 29	28 - 27	23 - 21
24 - 24	17 - 18	16 - 17	25 - 24	28 - 30	31 - 29	20 - 22
27 - 24	23 - 20	16 - 18	23 - 25	30 - 31	28 - 30	23 - 23
20 - 24	21 - 22	23 - 21	26 - 25	34 - 32	31 - 31	25 - 25
25 - 24	22 - 23	25 - 24	25 - 26	32 - 33	33 - 33	25 - 25
26 - 26	25 - 24	23 - 24	28 - 28	32 - 34	34 - 34	26 - 25
28 - 27	24 - 25	25 - 24	30 - 30	37 - 36	34 - 35	25 - 27
28 - 29	26 - 25	23 - 24	30 - 31	40 - 40	36 - 36	29 - 29
30 - 30	25 - 25	24 - 26	33 - 32		38 - 37	29 - 30
32 - 31	26 - 26	30 - 28	35 - 35		38 - 38	32 - 32
31 - 32	26 - 27	29 - 30	36 - 37		37 - 37	35 - 35
33 - 33	29 - 29	31 - 31	40 - 38		36 - 37	37 - 37
36 - 36	31 - 31	33 - 32	39 - 39		39 - 38	38 - 38
40 - 40	34 - 34	31 - 33	40 - 40		40 - 40	40 - 40
	37 - 37	34 - 34				
	39 - 38	38 - 37				
	40 - 40	40 - 40				

Table XIb.

Code II.

VIII. (NB)	IX. (ML)	X. (BJ)	XI. (DP)	XII. (BR)	XIII. (BB)	XIV. (GW)
0 - 2	2 - 2	3 - 3	3 - 4	1 - 1	4 - 3	0 - 1
4 - 5	3 - 4	4 - 4	6 - 6	2 - 1	3 - 4	2 - 1
6 - 6	6 - 4	4 - 5	9 - 11	1 - 3	6 - 6	2 - 2
7 - 6	4 - 6	8 - 7	17 - 12	5 - 5	8 - 7	3 - 5
6 - 7	8 - 7	9 - 9	16 - 19	8 - 8	8 - 9	9 - 7
8 - 9	10 - 8	11 - 10	24 - 22	10 - 10	12 - 11	10 - 10
13 - 11	5 - 7	11 - 11	27 - 25	12 - 12	12 - 13	11 - 10
13 - 13	7 - 6	12 - 12	25 - 25	15 - 12	14 - 13	9 - 11
14 - 15	7 - 9	14 - 14	24 - 26	9 - 12	14 - 14	13 - 12
18 - 15	13 - 10	17 - 17	30 - 29	12 - 11	15 - 16	13 - 14
13 - 17	11 -12	19 - 19	33 - 32	13 - 14	20 - 18	15 - 14
20 - 19	13 - 12	20 - 19	33 - 34	17 - 17	19 - 20	15 - 15
24 - 22	12 - 14	19 - 20	36 - 36	22 - 20	21 - 21	17 - 16
22 - 19	18 - 17	21 - 20	39 - 38	22 - 22	24 - 23	19 - 18
10 - 16	22 - 19	20 - 20	38 - 39	22 - 23	25 - 26	17 - 18
16 - 13	18 - 22	20 - 21	40 - 40	24 - 23	29 - 28	17 - 17
14 - 15	25 - 22	22 - 23		22 - 24	29 - 30	16 - 17
16 - 16	24 - 26	25 - 25		26 - 25	33 - 32	18 - 18
19 - 19	28 - 26	25 - 25		26 - 26	35 - 35	19 - 20
23 - 22	26 - 27	26 - 26		27 - 28	38 - 37	23 - 22
23 - 24	28 - 28	28 - 27		30 - 28	39 - 39	24 - 24
26 - 26	30 - 29	28 - 28		28 - 30	40 - 40	26 - 25
28 -28	30 - 32	27 - 28		31 - 30		26 - 27
29 - 30	35 - 32	29 - 28		31 - 32		28 - 29
32 - 31	32 - 35	28 - 29		33 - 34		33 - 32
33 - 34	37 - 36	31 - 32		37 - 37		34 - 34
36 - 35	38 - 38	36 - 33		40 - 40		36 - 36
37 - 37	40 - 40	33 - 35				38 - 38
39 - 39		35 - 35				39 - 39
40 - 40		36 - 37				40 - 40
		40 - 40				

Table XIC.

Code II.

XV. (WK)	XVI. (PS)	XVII. (MM)	XVIII. (EK)	XIX. (TW)	XX. (WT)
3 - 5	1 - 2	3 - 3	1 - 2	1 - 1	1 - 2
7 - 5	4 - 4	4 - 4	3 - 4	2 - 3	3 - 3
6 - 6	6 - 6	5 - 6	5 - 8	5 - 5	4 - 4
5 - 5	8 - 8	8 - 8	9 - 8	8 - 7	5 - 5
4 - 5	10 - 10	10 - 9	10 - 10	7 - 9	6 - 7
6 - 6	11 - 12	9 - 11	10 - 10	12 - 10	8 - 7
7 - 7	15 - 15	14 - 11	10 - 9	10 - 11	8 - 10
8 - 8	19 - 18	11 - 13	8 - 9	12 - 11	13- 9
9 - 9	20 - 21	15 - 15	9 - 10	10 - 11	7 - 9
9 - 10	24 - 21	18 - 17	12 - 12	10 - 10	8 - 9
11 - 12	20 - 21	18 - 18	14 - 13	11 - 11	13 - 12
16 - 13	20 - 21	19 - 19	14 - 15	13 - 12	14 - 14
12 - 16	22 - 21	19 - 19	17 - 15	13 - 13	14 - 14
21 - 18	21 - 25	18 - 19	16 - 19	12 - 13	13 - 15
21 - 20	27 - 25	20 - 19	24 - 19	14 - 13	17 - 15
27 - 19	27 - 26	19 - 20	17 - 21	13 - 15	14 - 16
20 - 19	23 - 24	19 - 20	23 - 20	19 - 17	16 - 16
21 - 21	23 - 24	22 - 22	20 - 24	19 - 19	17 - 17
23 - 23	25 - 25	25 - 26	28 - 25	21 - 21	19 - 16
25 - 25	27 - 28	30 - 28	27 - 27	24 - 21	12 - 16
26 - 26	32 - 31	30 - 31	27 - 27	19 - 22	16 - 15
28 - 27	35 - 34	34 - 38	28 - 28	22 - 21	18 - 19
27 - 27	34 - 35	21 - 25	28 - 30	23 - 22	23 - 22
27 - 28	37 - 36	21 - 22	34 - 31	20 - 21	24 - 25
31 - 29	38 - 38	24 - 24	32 - 33	21 - 21	27 - 27
30 - 32	40 - 40	27 - 25	32 - 33	23 - 23	29 - 29
35 - 33		25 - 25	34 - 33	24 - 24	31 - 28
35 - 36		24 - 26	32 - 34	25 - 26	24 - 28
38 - 37		28 - 27	36 - 35	29 - 28	28 - 28
38 - 39		30 - 29	37 - 37	29 - 30	33 - 31
40 - 40		30 - 30	38 - 38	33 - 31	33 - 34
		32 - 32	40 - 40	32 - 33	36 - 36
		34 - 34		35 - 35	38 - 38
		35 - 36		37 - 37	38 - 39
		38 - 37		38 - 38	40 - 40
		39 - 39		40 - 40	
		40 - 40			

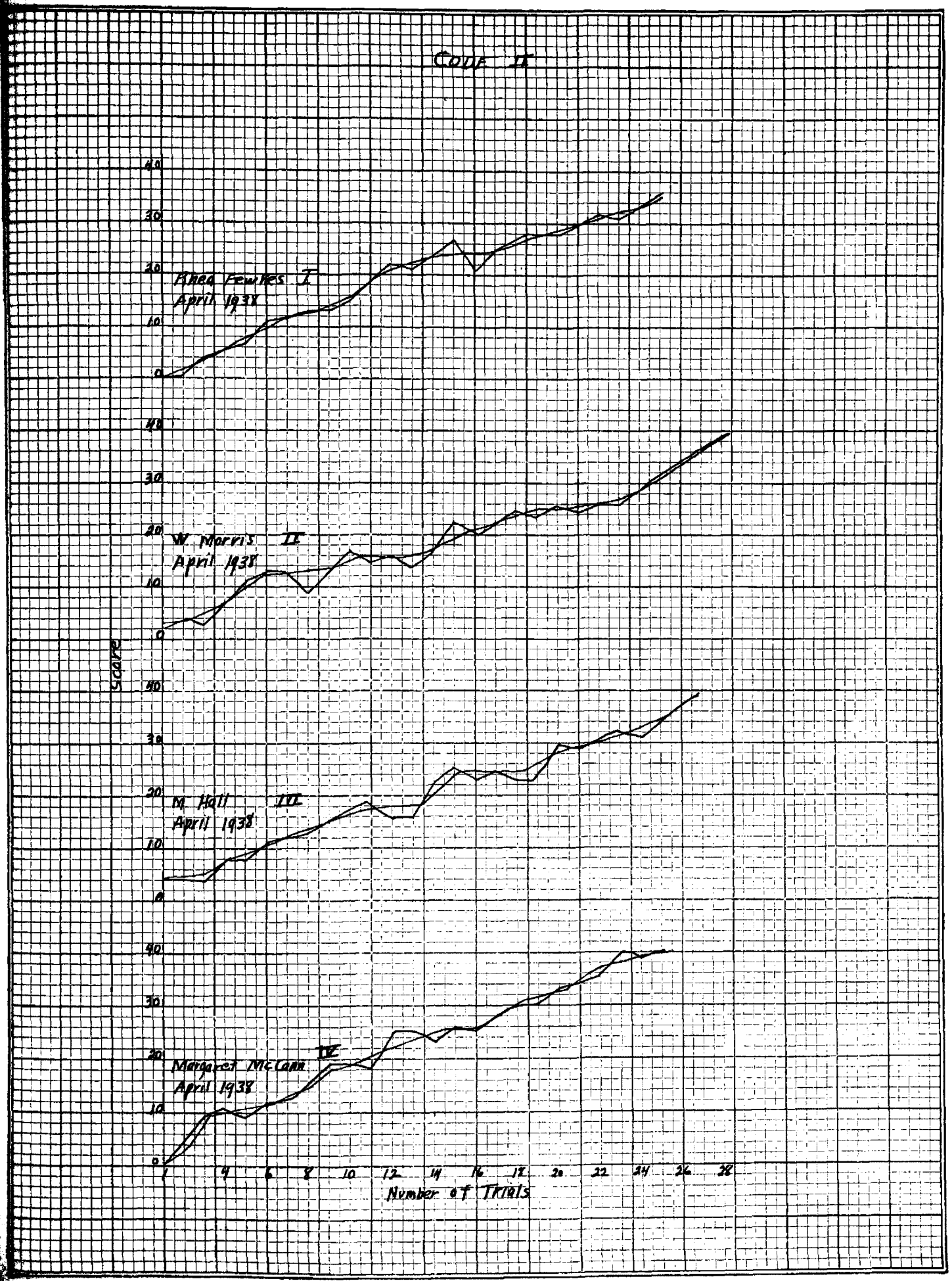


Fig 14b

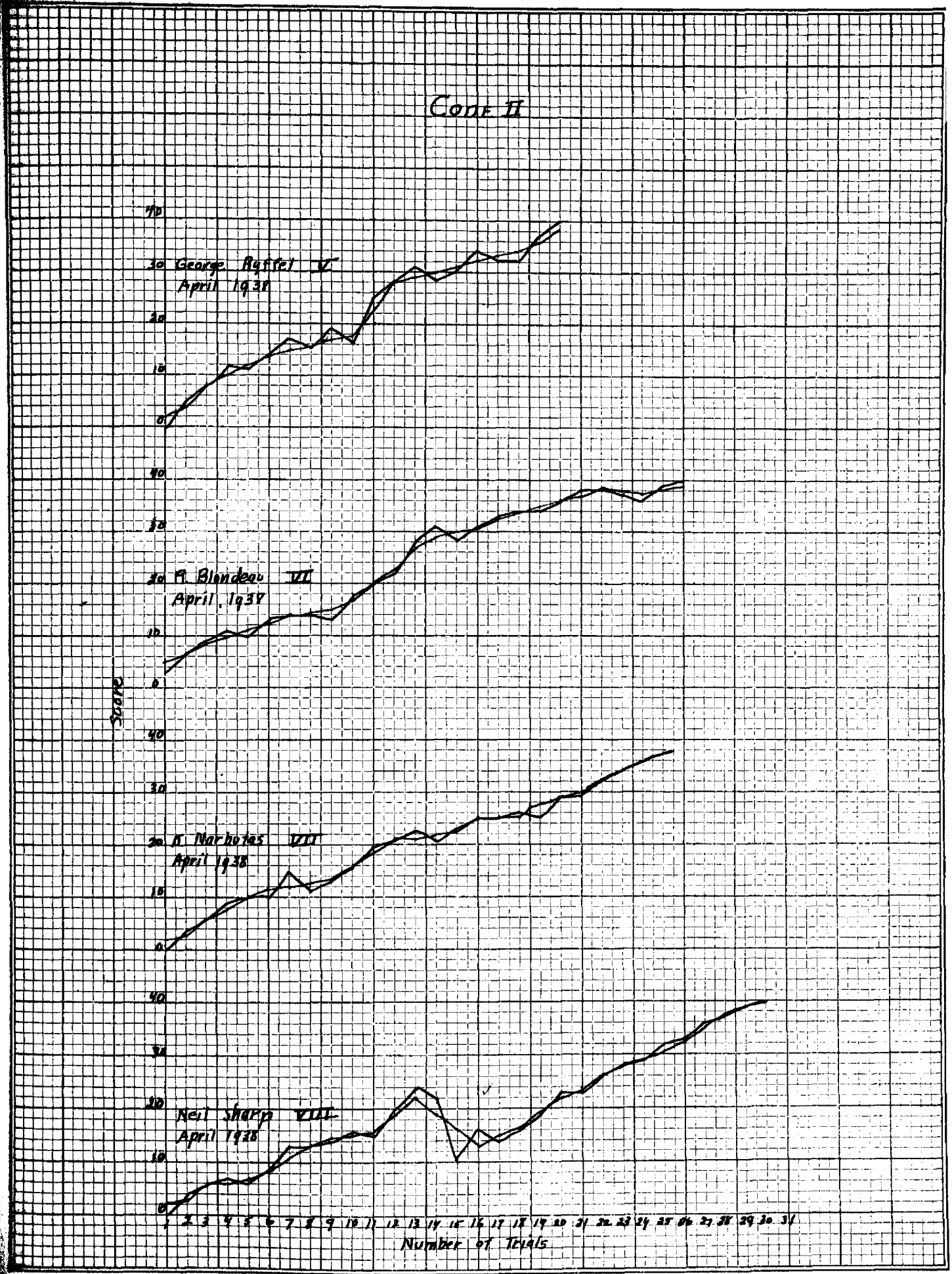
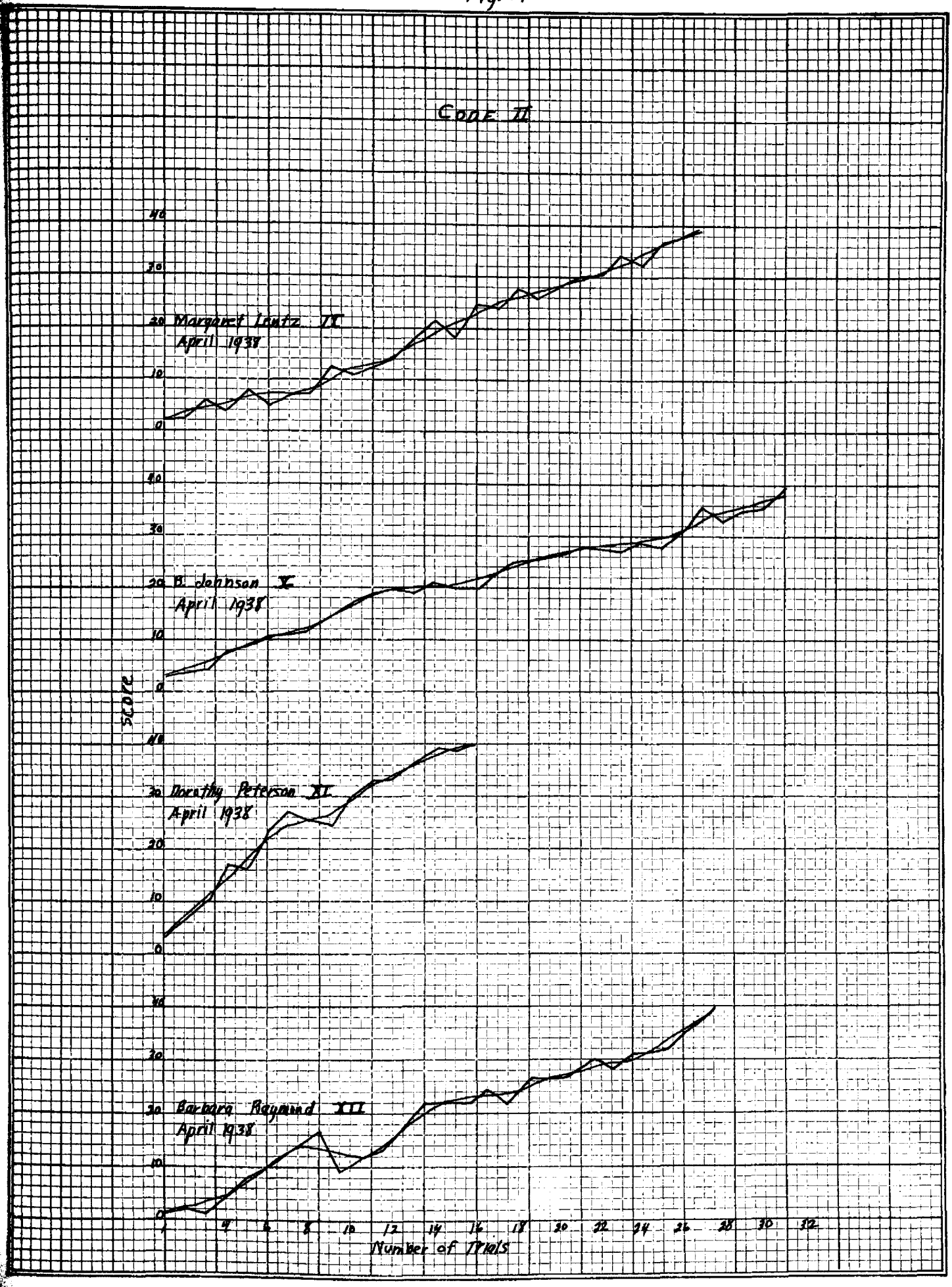
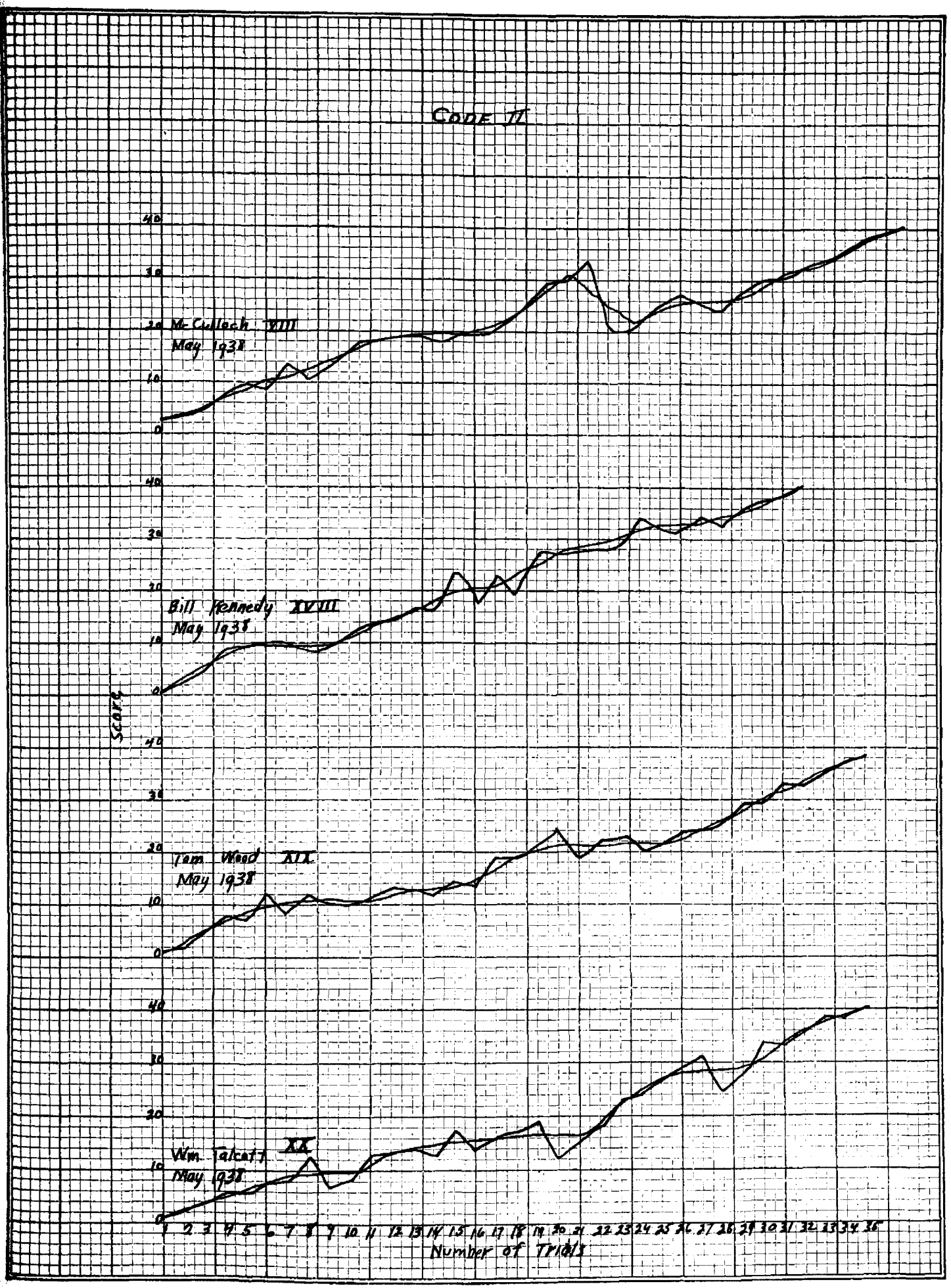
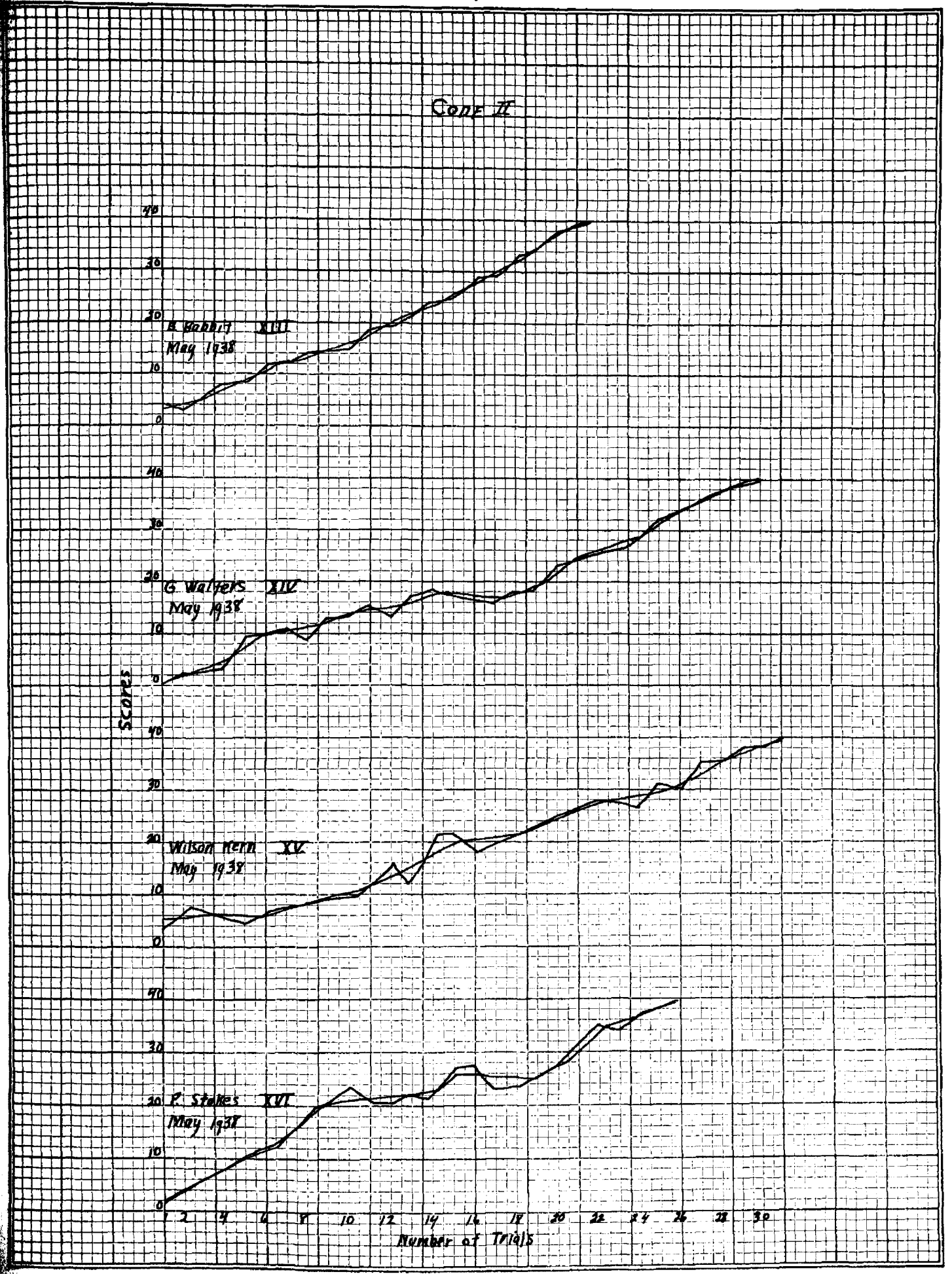


Fig. 14c







(VI) Word-Number Association

This experiment made a little more difficult the usual learning problem in as much as the subject was required to discover what he had to learn. Thirty words were associated with a given set of numbers. Each word had some number from 1 to 10 inclusive. The following instructions were read to the subject:

> "I shall read to you a series of words to each of which has been assigned a number from 1 to 10. You are to respond to each of these words immediately by calling out the first number from 1 to 10 inclusive which occurs to you. If you call out the right number I shall say 'right', and if you call any other number I shall say 'wrong'".

The experimenter kept a record of the right and wrong answers. The problem for the subject was to guess the correct number through chance and then to remember that number for future trials. The series was repeated until the subject knew all the associations. Ten subjects completed the work.

Fig. 15

Word-Number Association

(Words and numbers used as well as the scoring form.)

Word	No.	Trials						
University	5							
Campus	2							
Study	9							
Fraternity	6							
Sorority	10							
Greek	3							
Rushee	1							
Pledge	4							
Hell-Week	8							
Iniation	7							
Ritual	2							
Active	6							
Brother	3							
House	4							
Party	7							
Fireside	8							
Siberia	1							
Alumni	10							
Pan-Hell	9							
Inter-fraternity	5							
Formal	2							
Sister	10							
President	4							
Tradition	8							
Meeting	3							
National	9							
Stag	5							
Cook	7							
Fee	1							
Social	6							

TABLE XII.

Word-Number Association

I. (HC)	II. (NM)	III. (OB)	IV. (PG)	V. (JW)	VI. (BC)	VII. (LB)
5-5	4-4	2-2	2-2	3-3	2-2	2-2
5-5	5-4	2-3	6-4	5-4	4-4	3-4
7-6	3-4	5-4	6-5	5-7	7-7	5-5
12-10	5-4	6-6	5-5	6-5	9-11	5-6
12-12	3-5	7-7	5-5	5-5	10-9	7-7
12-12	6-5	9-8	5-6	6-5	10-10	8-7
12-13	6-6	7-8	7-7	7-8	10-10	7-8
14-14	7-7	9-8	10-9	8-9	11-13	9-9
16-16	7-7	7-9	11-11	8-6	13-11	10-9
16-17	6-6	13-11	11-12	7-9	13-13	7-10
17-19	6-6	14-13	13-13	8-5	13-13	11-11
23-21	6-7	13-13	15-14	9-11	13-13	12-12
23-23	8-8	12-12	14-14	11-10	14-12	13-14
24-25	9-9	12-12	15-15	11-11	14-16	16-15
28-28	10-9	13-12	16-16	11-11	16-16	16-16
30-30	8-9	12-14	16-16	13-13	16-16	17-15
	8-9	16-15	17-19	13-13	16-14	13-15
	10-9	16-16	22-18	13-12	16-16	14-14
	10-11	18-17	15-18	13-15	17-18	15-15
	12-12	17-17	16-17	14-12	19-18	17-16
	13-13	17-17	19-19	14-14	20-22	16-17
	14-14	17-17	21-23	14-14	22-21	18-18
	15-14	18-19	27-26	14-13	23-23	18-18
	12-13	21-21	30-30	15-14	25-25	19-19
	14-13	23-22		16-18	25-25	19-19
	14-15	21-22		16-16	25-25	20-21
	17-16	22-22		16-15	26-26	22-21
	18-19	22-22		17-17	28-28	24-24
	20-20	23-22		18-18	28-23	25-25
		22-22		19-19	28-29	26-26
		23-23		19-19	29-28	27-26
		24-24		18-16	29-29	26-26
		24-24		19-19	30-30	26-26
		24-26		18-20	30-30	27-26
		30-28		20-21		27-26
		30-30		22-21		27-26
				25-24		25-27
				29-28		29-29
				30-30		30-30

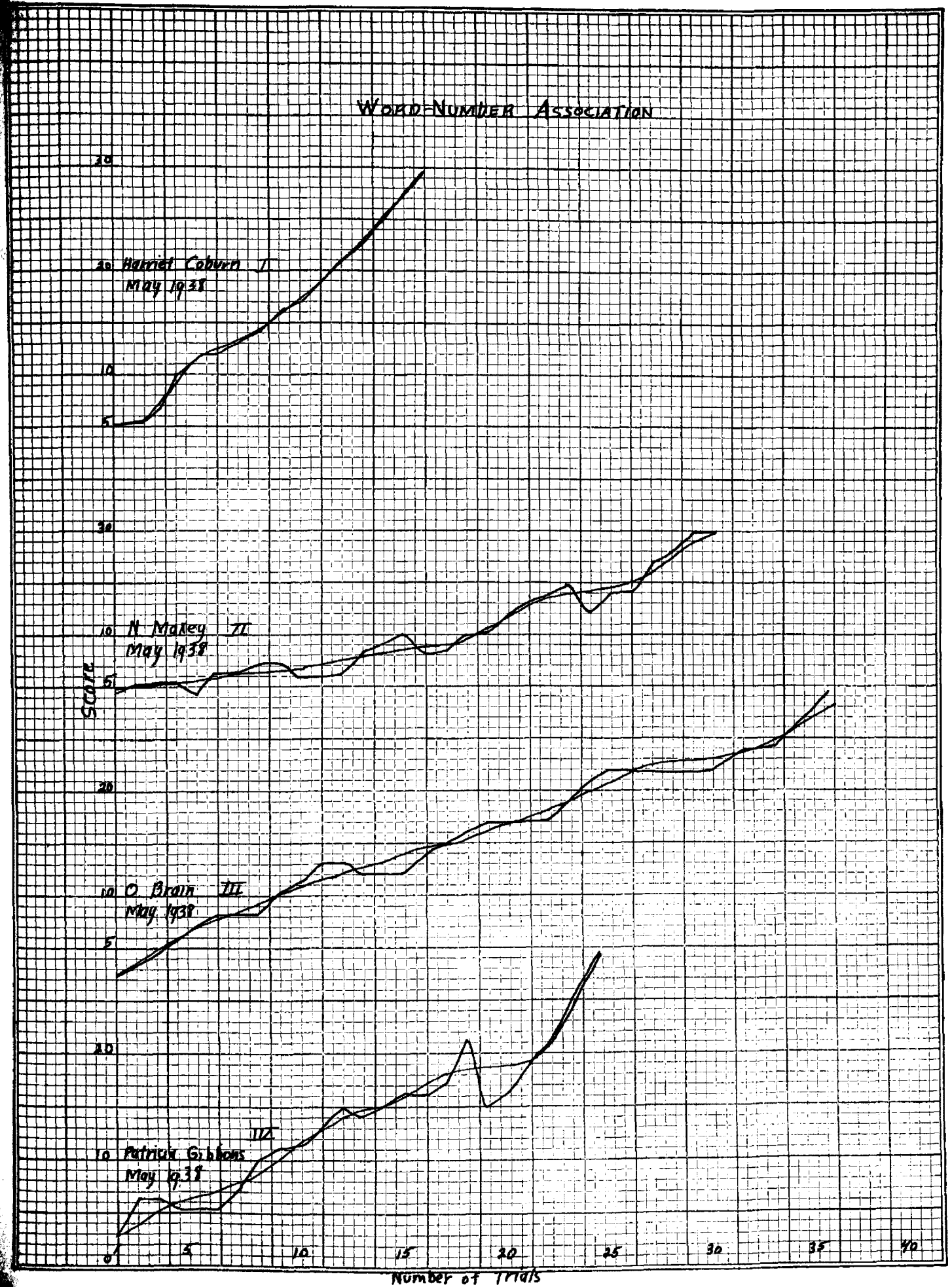
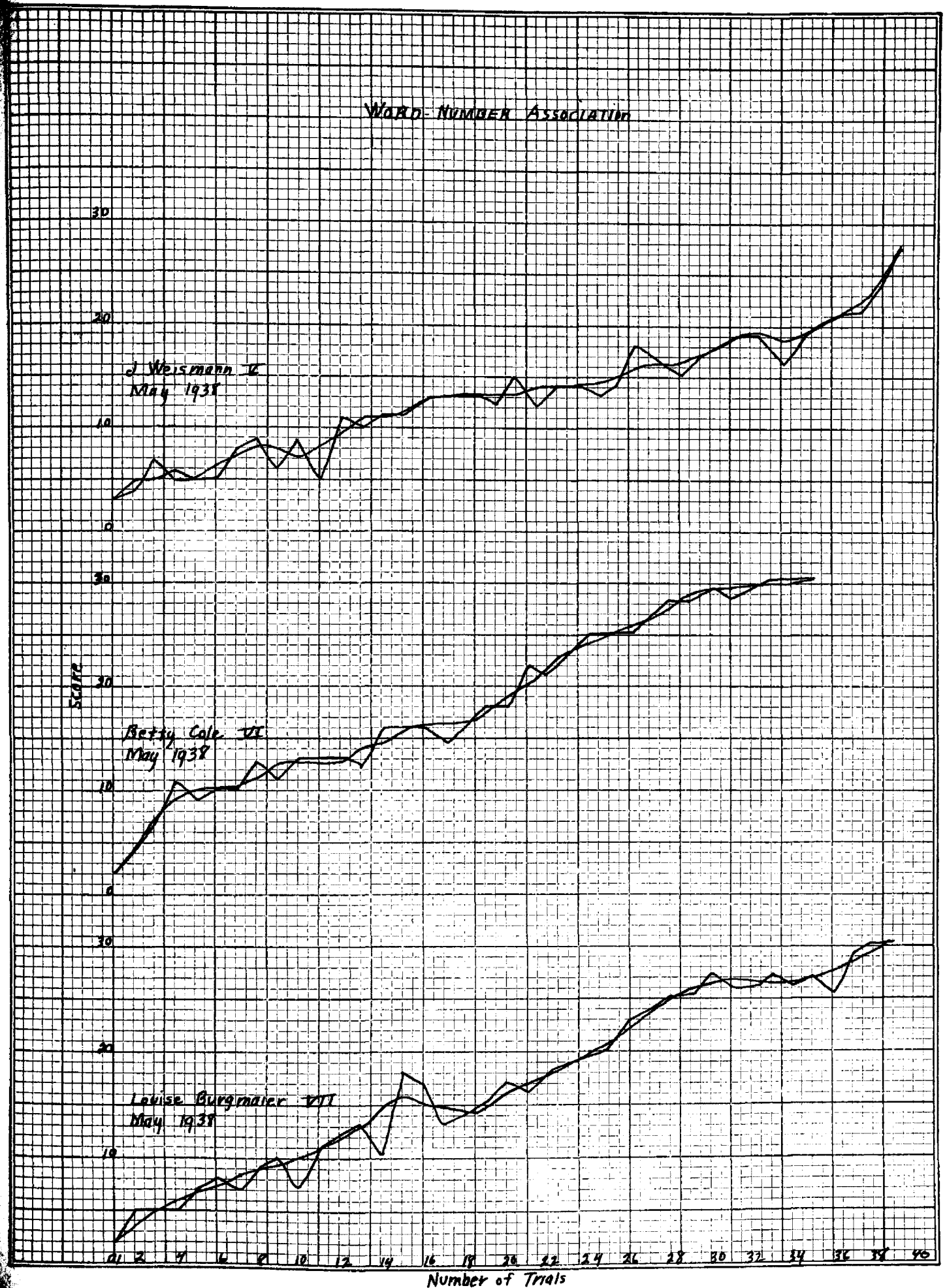


Fig. 16 b



Results and conclusions.

Codes

The general form of this curve is the same as that for the other ideational learning problems of the experiment. The trend is steadily upward until the problem is completed. However, several short periods of arrested development must be noted. In Curve JW a plateau extends from the 16th to the 27th trials. The introspective report is this case revealed that the subject was in an excited emotional state because of her participation in a dramatic club production which was to take place that evening. In BC and LB three short plateaus are found but in each case the subject reported "not feeling well". In two of these cases the trials were cut short because of the illness.

In curve HC the subject intended from the beginning to set a record in learning the associations. Because of this attitude she gave undivided attention to the problem and learned it more quickly than any other subject. This case is important since it demonstrates to some extent the fact that the greater the attention the less tendency towards plateaus.

Conclusions

The present investigation tends to show that:

1. In motor learning, especially in learning to toss balls, the length of the practice period seems to have little, or no, effect on the form of the learning curve.

2. There is some evidence to show that the length of the practice period does have some effect on the length of time required for the mastery of the skill. That is, the shorter the daily practice periods, the longer the plateaus.

3. In simple ideational learning there is apparently no necessity for plateaus if internal disturbances do not occur. The reports of the subjects during periods of arrested development in every case revealed disturbances which were considered sufficient cause for the existence of the plateau. Among the factors reported which affected the learning progress were illness, anticipation of an examination, excitement over play rehearsals and glee club trips, etc.

4. Plateaus do not consistently occur at particular places in learning curves of simple ideational problems. They may occur anywhere in the curve or nowhere.

5. The influence of distribution of attention on the results was demonstrated in the line-number association experiment. The attention of the subject influenced the general form of the curve of learning. Subjects could at will make high scores by giving careful attention to the problem. Furthermore, when attention became lax or overstrained there was an immediate drop in score.

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