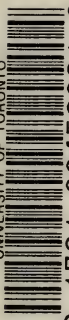


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Psychological Monographs

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EDITED BY

JAMES ROWLAND ANGELL, UNIVERSITY OF CHICAGO
HOWARD C. WARREN, PRINCETON UNIVERSITY (*Review*)
JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY (*J. of Exp. Psych.*)
SHEPHERD I. FRANZ, GOVT. HOSP. FOR INSANE (*Bulletin*) and
MADISON BENTLEY, UNIVERSITY OF ILLINOIS (*Index*)

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THE Psychological Monographs

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Mental Measurements of the Blind

A Provisional Point Scale and
Data for a Year Scale

By

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MENTAL MEASUREMENTS OF THE BLIND
A PROVISIONAL POINT SCALE AND DATA FOR A
YEAR SCALE¹

I

PLAN OF THE SURVEY AND THE SELECTION OF TESTS

This report embodies the results of a psychological survey of the Ohio State School for the Blind, conducted for the most part in the month of May, 1915. The initiative for this survey came from Mr. R. B. Irwin, Supervisor of the Education of the Blind, Cleveland, Ohio. In his work Mr. Irwin had come to feel the imperative need of mental tests for the Blind, by which the definitely feeble-minded could be eliminated from the public schools, and given the special education demanded by their defective mentalities. Mr. Horace Maurer, Superintendent of the Ohio State School for the Blind, and the Ohio Board of Administration, were very cordial in their reception of the suggestion that such a survey be made. The superintendent of the school had realized the fact that there were many feeble-minded children in the school, and as the law explicitly states that the school is for "blind persons, residents of the State, such as the trustees and superintendent are satisfied from reliable information and examination, are of suitable age and mental capacity to receive instruction by the methods pursued in the school," it was important, both to have the information as to who were feeble-minded in the school, and to have means put into hand, in the shape of tests, by which candidates for admission in the future might be effectively tested in respect to intelligence. It is evident that cursory examinations, such as physicians are now conducting, are not effective in eliminating the feeble-minded from amongst the candidates for admission. The actual examinations were made by Miss Alida C. Bowler and the writer. Much of the correla-

¹ Contributed from the Bureau of Juvenile Research, Columbus, Ohio.

tion of the data, and calculating of averages, was done by Miss Bowler. Dr. Rudolf Pintner made some valuable suggestions in regard to presentation of data.

The tests used were gathered from various sources. Mr. Irwin had gained many suggestions from Dr. Goddard and his fellow-workers at Vineland, N. J. Many of Mr. Irwin's own suggestions are incorporated. Tests suggested by Terman and Pintner are also used.

Work with the Yerkes-Bridges Point Scale in the examination of juvenile delinquents in Ohio had already convinced the writer of the economy of the Point Scale over any other modification of the Binet-Simon Scale, and also of its greater efficiency, both in its aim to measure more definitely psychological processes, and in affording a more ready means of comparison of one person's mentality with that of another. Our results from fifty-two totally blind persons, considered to be of normal intelligence, have already afforded a means of comparison of data from one subject with those from others, which means more for the mental assessment of each one of these fifty-two persons, and of several others of inferior mental endowment, than do results, more laboriously obtained by the Binet Scale. The Point Scale for the Blind, even with this preliminary try-out, reveals its value as a means of throwing suspicion upon the intelligence of several inferior blind children; and of reaching the decision that some others are feeble-minded. On account of the efficiency already shown, and in order to invite the accumulation of further data, these results are put forth as a provisional Point Scale for the measurement of the intelligence of the Blind. We wish it distinctly borne in mind that the scale is only provisional, inasmuch as it has been tried on such a small number of persons. One of the chief recommendations of the Point Scale as such, is that the norms are continually perfected as data are accumulated. They are never perfect. Data from one thousand blind children will be much more reliable than data from fifty. The data from these fifty-two subjects are presented in such form, that they may be added to at any time.

The Yerkes-Bridges Point Scale² was accordingly adapted to

the blind by substituting tests suitable for the blind, for a number which could not be administered to them. The following tests were eliminated from the Yerkes-Bridges Point Scale. The numbers given in each case are those found in the revised Point Scale as given on pages 136-7 of "A Point Scale for Measuring Mental Ability."

1. Chooses, twice, prettier in each of three pairs of pictures.
2. Sees picture lacks; (a) arms; (b) nose; (c) mouth; (d) eyes.
3. (a) Compares, twice, lines 5 and 6 cm.
7. Reaction to three Binet pictures. Enumeration, description, or interpretation.
11. Resists suggestions.
12. Copies (a) square; (b) diamond.
16. Draws designs from memory.

For some of these tests, substitutes, more or less adequate, were found. For the choice between two pictures, Irwin's suggestion of the choice between the tactual impressions made by feeling two fabrics was substituted. Comparisons adopted were:

- (a) serge and silk.
- (b) velvet and serge.
- (c) velvet and Brussels carpet.

For the lacking elements in a picture no substitute was found. For the 5 and 6 cm. lines were substituted (Irwin) 4 cm. and 6 cm. sticks. These sticks were round and 7 mm. in diameter, and were put into the subject's two hands with the request, "Give me the longer stick." For the first part of the reaction to three Binet pictures (enumeration), was substituted (Irwin) a box or basket containing a doll, baby shoe, shoe-string, marble, penny, baseball, coat button, and a teaspoon. Simply naming these articles as they were taken out of the box constituted passing the test. For the lines, used as visual stimuli in the *resisting suggestion* test, were adopted, (Irwin) cubes of wood, measuring 15 mm., 22 mm., 29 mm., and 36 mm. These were used in pairs,

* See "A Point Scale for Measuring Mental Ability," Yerkes, Bridges, & Hardwick—Baltimore, 1915.

beginning with the smaller, and putting one into each hand of the subject. The larger of the two was put into the right hand, in the first three of the six trials, and then, without changing the method, two 36 mm. cubes were put into the two hands three times over. For the two *drawing tests*, copying square and diamond, and drawing from memory, no parallel substitutes were found for the blind.

Further additions were made to the Point Scale for the Blind. The numbers given are those found on the Point Scale for the Blind as given on pages 6 and 7.

2. Size-Weight Illusion. (Goddard.) Two wooden cylinders of equal weight (55 gm.) and each 35 mm. long, but of different diameters, one being 19 mm. and the other 61 mm. in diameter, were put into the two hands of the subject, and he was asked to give to the examiner the heaviest one. This was repeated with the larger cylinder in the other hand.

4. Memory for digits. To the Yerkes-Bridges span for digits was added another item. The subject was tested, if he repeated seven digits, on an eight digit span.

6. Adaptation Board (Goddard). We scored on the first two *changed* positions of Pintner's procedure, described later.

10. (a) Touches examiner's right hand. The examiner, sitting opposite S. with his hands upon his knees, informs S. fully of these facts, and asks S., after due deliberation, to touch his (E's) right hand (Irwin).

(b) Orientation. S., standing and facing north is asked to point out the other three cardinal points of the compass. Likewise standing and facing east, he is asked to point out in turn, the other three points of the compass (Irwin).

13. Finger Tapping. Knox Lines. The blind subject is given the Knox lines upon the palmar surface of the distal joints of the fingers of his left hand (if he is right handed). The forefinger is considered point *one* just as the cube at S.'s left is considered point *one* in the Knox cube tests; and so on, *two*, *three* and *four* are the fingers toward and including the little finger, the little finger being point *four*. The fingers are touched with the rubber end of a pencil, the pencil is put into S.'s right hand,

and he is asked to do just what E. has done with the pencil in touching his own fingers.

15. Reversing series of digits, three digits to six, inclusive. Terman used three digits reversed as an VIII yr. test, and five digits reversed as a XII yr. test.

Slight changes were necessary in the methods of using two of the Yerkes-Bridges Point Scale tests, which were retained, using three given words in a sentence, and arranging disarranged sentences.

17. Composing a sentence containing three given words. The blind subject could not conveniently write the sentence. Instructions were given very much as to a seeing subject; the three words were mentioned at least three times; and the statement was made at least twice, and these words were to be made into *one* sentence. He was asked to give the sentence orally, as soon as he had it ready. This procedure is not a marked departure from current methods for this test, as many examiners with seeing children are now writing the sentence themselves, asking the subject to give it orally.

22. The disarranged sentences were printed in New York Point, each one being printed on a single line. The lines were separated by wide spaces. The subject was asked to read the top line aloud. He was then told in detail that these words had been shuffled from a sentence,—mixed up like cards in a pack when shuffled, and his problem was to make a good sentence out of the words, using each word he had read, and using no word twice. The words were then repeated to him and the time noted. He read the words with his fingers as often as he liked.

The Point Scale for the Blind, a replica of our record blank, is given on pages 6 and 7. Description of the tests and the procedure in giving them follows.

DATE.....

EXAMINED BY.....

NAME BORN.....

HOME ADDRESS NATIONALITY.....

1. Naming objects in a basket. 5 Objects, (1). All the 8, (2). (2)
2. Size-Weight Illusion, (alternate hands). (2)
3. Repeats: (a) It rains. I am hungry. (2)
(b) His name is John. It is a very fine day. (2)
(c) It is not necessary to hurt the birds.
It is night and all the world rests in sleep. (2)
4. Memory span for digits: (a) 374 581 (1)
(b) 2947 6135 (1)
(c) 42871 92736 (1)
(d) 461572 516283 (1)
(e) 2749385 6195847 (1)
(f) 37158264 26149738 (1)
5. Compares, twice: (a) Wooden cylinders, 4 and 6 cm. long. (1)
(b) Weights, 6 and 15 grams. (1)
(c) Weights, 9 and 18 grams. (1)
6. Adaptation Board. Over right, (1). Over toward S., (1). (2)
7. Resists suggestions, cubes: (1 for each resistance.) 1.—2.—3.— (3)
8. Defines: (In terms of use, 1 each; superior to use, 2 each):
(a) Chair
(b) Horse
(c) Fork
(d) Baby (8)
9. Chooses the *nicer feeling*, (a) serge and silk, (b) velvet and serge,
(c) velvet and carpet (1 each). (3)
10. (a) Shows examiner's right hand and left hand. (2)
(b) Faced north, points E., W., and S., (1). Faced east, points S., N.,
and W., (1). (2)
11. Gives words for three minutes: 30-44, (1); 45-59, (2); 60-74, (3);
75—, (4).
1" 30 sec.—2"—3"—4"—5"—6"—Total. (4)
12. Differences: (a) Apple and banana (2)
(b) Wood and glass (2)
(c) Paper and cloth (2)
13. Finger Tapping. Knox Lines: (a) X. Y. (2)
(b) B. C. D. (3)
(c) E. F. G. (3)

RECORD BLANK FOR POINT SCALE
 MENTAL MEASUREMENTS OF THE BLIND

C. M. A.....MENTAL AGE.....

.....SCHOOL GRADE.....TOTAL CREDITS.....

14. Counts backward: 20-1, (2). One omission or transposition, (1). (2)
15. Reverses series of digits, (1 of 3) (a) 283 427 395 (1)
 (b) 6528 4937 4293 (1)
 (c) 31879 69482 52961 (1)
 (d) 358164 174928 813692 (1)
16. Comprehends questions: (2 each).
 (a) Missed train
 (b) Someone unkind
 (c) Action versus words
 (d) Forgive easier (8)
17. Composes sentence containing *Columbus*, *money*, *river*, or three words of equal difficulty.
 Three words in two, (2). Three words in one, (4). (Vary the words). (4)
18. Arranges weights: two trials. All correct but one, (1); correct, (2) (2)
19. Sees absurdity: (1 each)
 (a) Unlucky cyclist
 (b) Three brothers
 (c) Suicide
 (d) Eighteen pieces
 (e) Last car (5)
20. Defines:
 (a) Obedience (2)
 (b) Charity (2)
 (c) Justice (2) (6)
21. Analogies: (a) Oyster is to shell as banana is to
 (b) Arm is to elbow as leg is to
 (c) Head is to hat as hand is to
 (d) Truth is to falsehood as straight line is to
 (e) Storm is to calm as war is to
 (f) Known is to unknown as present is to (6)
22. Puts disarranged sentences together: (2 each)
 (a)
 (b) (6)
 (c)

II

INSTRUCTIONS FOR THE POINT SCALE MEASUREMENT OF THE BLIND. GIVING TESTS AND EVALUATING RESPONSES³

1. *Naming objects in a box.* The objects in the box were mentioned above. The box is placed before the subject as E. says to him: "Here is a box in which you will find a number of different things. Please pick them up and name them as you lay them out on the table, one at a time." If he fails to find some of the smaller objects, he should be asked if he is sure he has not missed something. The test is a test of ability to name the objects. Credit two points for all objects named. Seven objects named, one point credit.

2. *Size-Weight Illusion.* Ask the subject to hold his hands upon the table ready to receive what you put into them. Then place simultaneously one of the cylinders in each hand, and ask him to give you the heavy weight. Taking both cylinders, repeat the test, placing the large one in the other hand. Credit two points for both trials correct,—that is, the smaller cylinder judged heaviest. No credit if S. does not get the characteristic illusion in both trials.

3. *Repeating sentences.* Say to the subject: "Listen to me, and when I have finished, say just what I have said." Be sure the subject is attending and then say: "It rains. I am hungry." Likewise, the other pairs of sentences used, (b) and (c). Credit two points for each pair of sentences, (a), (b), and (c) correctly repeated. No credit allowed for any pair of sentences in which an error is made.

4. *Memory for digits.* Begin in the same way as in 3. Repeat the first three digits given, asking the subject to say exactly what you say. Pronounce the numbers without emphasis at the rate

³In some cases these instructions follow Yerkes exactly. See "A Point Scale for Measuring Mental Ability," Yerkes, Bridges, Hardwick, pp. 139-159.

of two per second. If S. fails, give him the three digits of the second column. Succeeding in the first or second trial, he is allowed one point credit. If he fails twice no credit is allowed. Discontinue the test if a subject fails in both trials for any given number of digits. The same rule regarding credit holds for each one of the six lines. One point credit is allowed for each number of digits from three to eight inclusive, making a total possible credit of six points for this test. Mark each trial plus or minus as it is made.

5. *Comparison of 4 and 6 cm. sticks, and 6 and 15 gm. and 9 and 18 gm. weights.* (a) The subject is asked to hold his hands to receive what E. puts into them. E. then places the 4 and 6 cm. sticks, one in each of his hands, saying to him, "Give me the long stick." E. then takes the sticks and repeats the experiment, with the long stick in the other hand. One point credit is allowed when correct judgments are given in both trials. Hesitation constitutes failure. The blind subject, however, may be allowed to place the sticks side by side in his hands.

(b) and (c) Use the Stoelting cubes of the weights designated, putting the 6 and 15 gm. weights into S's hands. Say to him, "Give me the heavier." If he does this successfully, repeat, putting the heavier weight in the other hand. If both trials are correct he is allowed a credit of one point. If either judgment is wrong, no credit is allowed. Proceed in the same way, and make credit allowance by the same rule, with the 9 and 18 gm. weights.

6. *Adaptation Board.* This board is one-half inch thick and measures 22 x 28 cm. There are four round holes in the board. The centers of these holes are 55 mm. from the sides and 70 mm. from the ends of the board. Three of the holes are of a diameter of 62 mm. each. The fourth hole has a diameter of 65 mm. The board is finished with shellac and wax, and the two sides are indistinguishable by touch or vision. A circular block one inch thick and 65 mm. in diameter, fits easily into the large hole, but will not enter any of the other three. Pintner's directions, which we follow, are these;

The board is held before S., in the air, at an angle of 45 degrees to the table, with the side of the board horizontal, and with

the large hole in the upper left corner to S. S. is asked to feel of the board and tell E. what he finds. The fact must be brought out that there are four round holes. The round block is then given to him. As he takes it into his preferred hand, he is told that the block will fit into only one of these four holes. He is asked to find which one it will go into. If he finds which one it will go into before he has tried each one of the four holes, ask him to make sure that it will go into no hole other than the upper left. When this is proved to his satisfaction, he is asked to hold the block in his hand and is told that E. is going to turn the board over and he must attend closely to find how it moves. This the blind subject will naturally do by keeping his free hand upon the board. The board is turned very slowly (use two to three seconds of time for this turning movement) so that the large hole comes into the upper right corner of the board. Rotate left end of board toward S. This is position *one*. E. now says to the subject, "Put the block into the only hole that it will enter." Note on the record blank which hole he tried first, second, and third, and so on until success is attained. If it is placed directly in the upper right hole, simply record (1) u. r. 1. which means Position *one*: upper right, first trial. One point credit is allowed for unhesitatingly placing the block in the upper right hole. No credit for any result less perfect. E. next turns the board over so that the large hole is in the lower right corner of the board, with similar instructions to S. to attend, and with the same slow movement. Rotate upper edge of board toward S. This is position *two*. S. is then asked to put the block into the only hole into which it will enter. One point credit is allowed for prompt and accurate placing of the block. Total credit, two points.

Note:—A third movement by which the large hole is brought into the lower left corner of the board, and a fourth, by which the large hole is changed from the lower left to upper right corner, result in *third* and *fourth* positions, which are recommended to be used in this test. Proposed scoring: two points credit for all four correct, and one point credit for any three correct, allowing for missing position *one* from lack of training, or

position *four* because of the inherent difficulty in following rotation of the board upon its diagonal.

7. *Resisting suggestions.* The five cubes, one 15 mm., one 22 mm., one 29 mm., and two 36 mm., constitute the material for this test, and seem to be satisfactory substitutes for Binet's lines, which vary from 4 cm. to 7 cm. The procedure is as follows: Having S. hold his hands to receive whatever E. will put into them, E. places simultaneously the 15 mm. cube in S.'s left hand, and the 22 mm. in his right, saying to him, "Give me the big cube." Next E. places simultaneously in S.'s left hand the 22 mm. cube, and in his right, the 29 mm. cube, asking him to hand over the big cube. Next E. places simultaneously the 29 mm. cube in S.'s left hand and one 36 mm. cube in the right, with the same request, "Give me the big cube." Next, without a change in the method or change of voice, E. places one 36 mm. cube in each of S.'s hands. Likewise this is repeated two more times, with due shifting of blocks, simulating the sounds and time intervals of an actual change of blocks. It is best to alternate the large cubes (36 mm.) between the two hands. There may be a slight difference in weight, and possibly a difference in temperature. Credit is allowed, as for the lines. The subject is credited with *resisting the suggestions* in each one of the fourth, fifth, and sixth trials when he hands back the cube in his left hand as the largest, and when he says, "They are just the same." One point credit is allowed for each one of these three trials when he gives either "equal" or "left larger."

8. *Defines chair, horse, fork, baby.* Say to the subject, "What is a chair?" Write on the blank exactly what he says. Likewise, with the other three words. Credit is allowed as follows: One point for each definition given in terms of use, as characteristic of a six-year old (Binet). Definitions in terms superior to those of use are credited two points each (Binet, IX yrs.). A typical definition in terms of use is: "A chair is to sit on". Definitions in terms superior to those of use are: (a) Those giving the class to which the object belongs, in addition to use; for example, "A chair is a piece of furniture to sit on"; "A horse is an animal to pull heavy loads." (b) Definitions which give the class to which

the object belongs, as, for example, "A fork is a table utensil," or "A piece of cutlery." (c) Definitions which use the word "thing" or "something" with a statement of the use, as for example, "A horse is a thing to pull heavy loads," or "A fork is something to eat with." (d) Definitions which give both a description in terms of parts or structure of the object, and its use, as for example, "A horse has two ears, four legs," etc., with a statement that "It is to ride upon and to pull wagons."

9. *Choosing the nicer feeling. Aesthetic choices between tactical impressions.* The material for this test consists of pieces of serge, silk, velvet, and Brussels carpet. These pieces are all 3 x 5 inches, and dyed black, in order that there shall be no visual differences. The subject is asked to place his hands ready to receive what E. shall put into them. The serge and silk are simultaneously placed one in each of S.'s hands and he is asked, "Which of these feels the nicer." When he has made his choice the same is repeated, the silk being placed in the other hand. He is given one point credit if both choices are correct. Silk is preferred. Two trials, alternating the hands, are given in like manner with velvet and serge, and carpet and velvet. Velvet is preferred to serge and to carpet. One point credit is allowed for each choice made without hesitation two times over in alternating hands. Total possible credits for the test, three.

10. (a) *Shows examiner's right hand.* As explained above, the examiner seats himself facing S. as he is sitting, with his knees about six inches from S.'s knees, and with his hands upon his own knees. E. then tells S. how he is sitting and where his hands are placed, and tells S. he is going to ask him to do something,—that he wishes him to do it after thinking, so he will be sure that he is doing it right. He then says to S.: "What I want you to do is this: please touch my right hand," and after about three seconds, says, "Now" or "All right." After this is done he says, "Now will you touch my left hand." This latter is merely a confirmation of S.'s knowledge of the position of E.'s right hand, if that was done correctly. A credit of two points is allowed if both right and left hands are touched correctly. No credit for results less perfect than these.

(b) *Orientation in respect to points of the compass.* Have S. stand up and face him to the north, either by reference to the table or by gently taking him by the shoulders and turning him so that he faces the north. Tell him then that he is facing north, and ask him to point to the east, then to the the west, and then to the south. Record his answers by drawing on the record blank a square; label it north, and draw three arrows indicating, mapwise, where he points for these other three cardinal points of the compass. Then face S. to the east; tell him he is facing east, and ask him to point in succession to the north, south, and west. Record on another square marked east, how he points to the other three cardinal points. One point credit is allowed for the correct pointing of all three remaining cardinal points when S. faces north. Likewise one point credit for the correct pointing to the remaining cardinal points as he faces east. Total possible credits, two points. No credit for less perfect results when facing north or facing east.

II. *Giving words for three minutes.* Say to the subject, "I want you to say as many words as you can in three minutes. It does not make any difference what the words are. When I say ready you begin and say as many words as you can before I tell you to stop. Say such words as pin, table, grass, trees, clouds, horse, dog, brook. Already, begin." With this, E. having paper and pencil in hand and stop watch ready, starts the watch and begins to write the words S. says. It is very desirable to record all the words which he says, as the free associations thus obtained afford a cross section view of S.'s mental furniture. However, when they come too rapidly, dashes may stand for words in order to record the count. Watch the time and record by half minutes. If S.'s attention lags and he says no word for twenty seconds, he should be encouraged. Ask him to go on, and assure him he knows many more words. Credit is given for words and phrases, except repetitions, as follows: one point for from thirty to forty-four, inclusive; two points, for from forty-five to fifty-nine, inclusive; three points, for from sixty to seventy-four, inclusive; and four points, for seventy-five words and upward.

12. *Differences between common objects.* Say to the subject, "You know what an apple is, and you know what a banana is," with a rising inflection in your voice, and if no sign of negation or ignorance is given, continue, "Will you please tell me the differences between apple and banana?" Record S.'s words. If he does not give two clear differences, ask him if there is any other difference. Proceed in the same way with "wood and glass", and with paper and cloth." Credit of one point is given for one correct point of difference in the case of each pair of objects, and two points for two or more differences in the case of each pair. Total possible credits, six.

13. *Knox's lines by finger tapping.* For this test E. sits opposite S., without intervening table, and has S. place his left hand (if he is right handed) in his lap, or upon his thigh, in an easy position with the palm upward. It is desirable to have the fingers fairly well extended and held comfortably well apart from one another, but no muscles must be put upon strain. Let the position be comfortable to S. E. tells S. that he is about to touch his finger tips with a rubber tipped pencil. With this he gives him illustration of the tactual impressions. Gentle but decided impressions are made, separated by time intervals of from one-half to three-fourths of a second. S. is told that the pencil is to be put into his own right hand and that he is to be asked to make the same touches on his left hand as E. has made. With this he is given a lesson in holding the pencil, rubber tip downward, between his thumb and fore-finger. With these illustrations of the kind of tactual impressions to be given and the method of holding the pencil, E. then proceeds to tap out line A, which is 1-2-3-4. E. touches in succession with the rubber tip of the pencil, at time intervals of from one-half to three-fourths of a second, the palmar surface of the distal joint of the fore-finger, of the middle finger, of the ring finger, and of the little finger, having asked E. to give careful attention to what is being done. He then puts the pencil into S.'s hand and asks him to do the same thing. The word *series* is not used in these instructions, and no verbal hint is conveyed that the order of the touches is the important thing. If S. fails to give line A correctly, it

is repeated and continued again and again until he succeeds in giving it correctly. In like manner E. proceeds to give lines X, Y, B, C, D, and so on. One trial only is allowed for each line after A. Credit is allowed for each line, correctly given, from X to G inclusive. The lines are as follows:

- A. 1-2-3-4. B. 1-3-2-4. E. 1-3-2-4-3. H. 1-4-3-1-2-4.
 X. 1-2-3-4-3. C. 1-4-3-2. F. 1-4-3-2-4. I. 1-3-2-4-1-3.
 Y. 1-2-3-4-2. D. 1-4-2-3. G. 1-3-1-2-4. J. 1-4-2-3-4-1.

Note:—It is desirable to give lines H, I, and J and record results. The Knox lines themselves afford a means of scaling intelligence, and the limits of capacity should be reached for each subject tested.

14. *Counting backward from 20 to 1.* Simply say to the subject, "Will you please count backward from 20 to 1." If there is hesitation on his part, say, "20, 19," with a rising inflection of the voice. Record omissions and transpositions, and the time used. We have allowed a credit of two points for correct counting. Where one omission or transposition is made one point credit is allowed. For less perfect results no credit is allowed. Four points credit as allowed by Yerkes and Bridges seems very high valuation for this performance.

15. *Reversing series of digits.* Terman follows Binet's digit series procedure in this test, allowing three trials. He gives credit for any one of the three trials which is correct. For instance, if, in reversing the series of three digits, S. fails on the first and second, but succeeds on the third trial he receives one point credit as he would have done had he succeeded on the first or the second trial. We adopt this procedure. S. should be given an illustration of reversing a series of digits before the first trial of three digits. The numbers should be spoken very slowly, one per second. Mark each trial plus or minus as it is completed. Proceed no further with a given number of digits when success is attained,—that is, if he reverses correctly the first series of three digits, score the credit and proceed to a series of four. When he fails on three trials in a series of digits, proceed no further with the test. Credit one point for each number of digits, three to six, inclusive, which is successfully reversed on

any one of three trials each. Total possible credits four points.

16. *Comprehension test.* Questions:

(a) "If you were going away and missed your train, what would you do?"

(b) "If someone has been unkind to you and says he is sorry, what should you do?"

(c) "Why should you judge a person by what he does rather than by what he says?"

(d) "Why do we more readily forgive an unkind act done in anger than one done without anger?"

Read to S. each question twice, unless he is evidently ready to answer upon hearing it once. Read slowly and distinctly. Record on the blank the subject's own words in answer to each. If in doubt as to whether S. *comprehends* the question, one may ask for further explanation, being careful not to ask leading questions. Satisfactory replies are as follows; (a) "wait for the next" or "take an electric car"; (b) "forgive him" or "pardon him"; (c) "because one is more sure of acts than of words" or "because one may lie in what he says, but you're sure of what he does"; (d) "an angry person is not responsible or does not realize what he does" or "an act done in anger is not intentional." For these, or answers expressing like ideas, full credit of two points for each question is allowed. For less comprehensive and intelligent answers, such as (a) "go home"; (b) "be kind to him" or "do nothing" (c) "actions speak louder than words," partial credit of one point for each question is allowed.

17. *Composing sentence containing three given words.* Write on the back of the record blank the three words which you wish S. to incorporate in one sentence, and mention the words to him, telling him that you wish him to make a sentence, using correctly these three words. Make clear by repetition both the fact that the words are to be used in *one* sentence, and what the words themselves are. It is necessary to emphasize the point that the three words are to be used along with other words to make one good sentence. It is important, especially in institutional work, to vary the words from subject to subject, and from day to day.

Binet observed that this is a test which is very likely to be talked about by children, and consequently many children come with a sentence prepared. Write down on the record blank the sentence or sentences which S. gives, and the time occupied for the completion of the sentence after the task has been set. Credit of four points is allowed for one sentence correctly using the three words given. Two points credit are allowed for the three words correctly used in two sentences. Disjointed ideas connected by "and" are to be rated as two or more sentences.

18. *Arranging Weights.* This is the Binet test. The material used consists of the five 22 mm. Stoelting cubes of weights 6, 9, 12, 15 and 18 gms. The test may be presented to the blind subject very much as to one who sees, the only points of special procedure to be emphasized being these: the cubes are set down on the table and S.'s right hand is placed upon them. E. then takes hold of S.'s left hand, and using his fore-finger as a pointer shows him where to put the weights. His instructions to S. should be these, "Here are five cubes. No two of these cubes weigh the same. They are of exactly the same size, but of different weights. I want you to find the heaviest one and place it here." With this the finger is pointed to a place on the table to S.'s left. Continuing, "Then I want you to find the one just lighter than that and place it here." Point with S.'s finger just to the right of the place designated for the heaviest. Continuing, point to three places further and further to the right, telling him to put here the one lighter than that, and here the one lighter than that, and, to the extreme right, the lightest of all. Write down any such absurd procedure as weighing two or more cubes in one hand at one time. Record time and order of arrangement. If the arrangement is correct, he is credited with two points; if the arrangement is not correct, he is asked to do the same again. If the second trial is correct, two points credit are allowed. If one and only one weight is misplaced in either trial, he is allowed one point credit. No credit is allowed for a performance inferior to this.

19. *Absurdities.* The following five absurd statements constitute the material for this test;

(a) "An unlucky bicycle rider fell on his head and was instantly killed; they took him to the hospital and fear that he can not get well."

(b) "A little boy said, 'I have three brothers, Paul, Ernest, and myself'."

(c) "A gentleman once said, 'If in a moment of despair I should commit suicide, I am going to be careful not to do it on Friday for that would bring me bad luck.'"

(d) "The police have found the body of a young girl cut into eighteen pieces. They think she killed herself."

(e) "It has been found that the last car of a train is damaged most in case of accident. It would be better, therefore, to leave off the last car."

The examiner should say to the subject, "I am going to read some sentences to you. In each one of them there is something foolish or absurd. Please listen carefully and tell me what is foolish in each one of them." E. should then repeat (a) slowly. Read it to S. two times, and ask him, "What is foolish in that?" Of course, if S. starts to answer at the end of the first statement do not insist upon second reading. So in turn each of the five absurdities should be presented. Record exactly, on the blank, S.'s response to each question, "What is foolish in that?" As in comprehension tests, further questions to satisfy E. whether or not S. understands what is absurd, may be asked, providing E. is careful not to ask leading questions. Credit of one point is given for each absurdity discovered. No partial credits allowed.

20. *Definitions of abstract terms.* The three abstract terms (a) charity, (b) obedience, and (c) justice, are used. The examiner should say simply, "What does charity mean?" and after recording the response, "What does obedience mean?" and so on. The definition of charity should express two ideas, that of unfortunates and of kindness shown to them. If the subject replies "love," ask him "What sort of love?" or "to whom is the love shown?" The definition of obedience should be "to do what you are told," or something similar. If the subject says "to obey," ask him what obey means. The definition of justice should express the idea of persons being treated according to

their merits, of fairness, or of protection accorded to people and their interests. If the subject replies "justice of the peace" or names an individual, he should be told that that is not the kind of justice meant and should be given another trial. For an acceptable response, as above defined, credit of two points is given in the case of each of the three terms; no partial credits are allowed.

21. *Analogies.* Begin this test by saying to the subject, "If I say to you, 'Ship is to water as train is to something else', what do you say that something else is?" Then repeat: "Ship is related to water as train is related to what?" If he does not comprehend, ask him what a ship is made for, and when he gets the idea that a ship runs upon water, ask him what a train runs upon. When he answers: "Track, railroad, or rails," put another question, "Man is related to boy as woman is related to what?" And then, "Seeing is to the eye as hearing is to what?" By means of these explanations illustrate to him that the fourth term is related to the third term as the second is to the first, and repeat one of the illustrations backward. For example, "Girl is related to woman in the same way as boy is related to man. Find out the relation between the first and second, and then carry that over to the third and find your fourth term. Now please answer these for yourself." Give him the three terms of each of the six analogies, as follows:

- (a) "Oyster is to shell as banana is to" (skin, peeling).
- (b) "Arm is to elbow as leg is to" (knee).
- (c) "Head is to hat as hand is to" (glove, mitten).
- (d) "Truth is to falsehood as straight line is to" (crooked line).
- (e) "Storm is to calm as war is to" (peace).
- (f) "Known is to unknown as present is to" (future or absent).

Correct answers are given in parentheses. Record his answers in full. One point credit allowed for each analogy correctly completed.

22. *Disarranged sentences.* Put before the subject a strip of paper upon which is printed in New York Point or Braille, all in

small letters, and without punctuation, but with the words duly separated:

“to asked paper my I teacher correct the”

Have him read the words and pronounce them aloud. Then say to him, “You notice these words do not make any sense. They can, however, be arranged in order to make good sense. Arrange them in your mind so that they make a good sentence. Use every word there once. Use no word that is not there. Speak the sentence to me as soon as you are ready.” Repeat the words in the order read and observe the time. So present the other two disarranged sentences:

“defends a his dog master good bravely,”

“hour for we early at park an started the.”

Record what he says and the time required. The blind subject may require more than the standard sixty seconds allowed the seeing subject. Score two points credit for each one of the disarranged sentences given in the proper order within 60 seconds from the time the task is clearly before him. The most natural forms for the sentences follow: (a) “I asked the teacher to correct my paper”; (b) “A good dog defends his master bravely”; (c) “We started for the park at an early hour.” For each of these sentences, credit of two points is allowed; but credit should be allowed also for other sentences, which, although not as natural to the adult as the above, still make perfect sense and are unquestionably, from the childish standpoint, perfectly satisfactory. Such, for example, are: under (a), “I asked my teacher to correct the paper”; under (b), “A master defends his good dog bravely” or “A good master defends his dog bravely”; under (c), “We started early for an hour at the park” or “We started for the park at an hour early.” For such sentences full credit should be allowed, and for any others including all of the words so arranged as to make sense and to convince the examiner that the child both understands his task and is able to meet all requirements except those of conventional form and elegance of expression.

III

POINT SCALE RATING OF THE INTELLIGENCE OF THE BLIND STANDARDIZING TESTS

For the practical purposes of standardizing a scale for the measurement of the intelligence of the blind, in recognition of the fact that we were working with a population among whom every one granted, there is a considerable number of feeble-minded and subnormal persons, it seemed essential to eliminate the results of the definitely feeble-minded persons. Further, in standardizing tests for the blind, we recognized the importance of eliminating records of those who were not blind. (1) In this school population of two hundred and twenty-four persons, a large number had vision sufficient to enable them to perform the tests devised for seeing subjects. Such persons were tested by the Yerkes-Bridges Point Scale. (2) Another group of subjects had insufficient vision for the general tests, yet they were able to see the black cubes upon white paper, and could thus take the Knox Line Tests in the usual way. Such persons have vision sufficient to guide them in going about. It is evident the mental processes involved in their orientation must be quite different from those of totally blind subjects.

Visual imagery with such a subject plays an important part. Poor as his vision is, his visual imagery, nevertheless, serves in some measure in that large synthetic capacity in which it serves the normal seeing subject as he puts together the smaller bits of his experience. For this reason such a subject can not be classed as a blind person for the purpose of standardizing tests for the blind. At any rate, we must first prove, as the result of tests upon large numbers of such subjects, that their mental imagery is in no wise different from that of the totally blind subject. The psychological presumption must be that their mental furniture is different from that of the totally blind, until the opposite is proved.

(3) The same caution, from the point of view of psychology, must be exercised with regard to a small group of subjects whose vision was normal until late childhood. A person whose vision has been annihilated by accident to his eyes, say at six years of age, will undoubtedly retain some visual imagery throughout his life. This visual imagery will serve in the synthetic capacity above referred to, and many of his mental processes will be differently organized from those of a congenitally blind person. Here, too, the presumption of psychology must be that the mental organization of the blind who had his vision up to, say five years, is different from that of the person totally blind from infancy. Results from mental testing of such a person must, therefore, be eliminated while standardizing tests for the blind, until the negative of the above proposition is proved. The limit of five years was set quite arbitrarily. We assume that vision lost earlier than five years, may not have made any significant difference in the mental furniture of the individual, from that of the congenitally blind person. This assumption is purely gratuitous, and it would perhaps be better to set the limit in early infancy. The number of cases of blindness in our subjects occurring after one year of age, and before five, is, however, very small. No one would seriously question the advisability of classifying blind persons who had lost the use of their eyes in early infancy through gonorrhoeal infection, as blind persons. Visual imagery can play a very insignificant rôle in the mental organization of a person whose eyesight was destroyed when he was three months old.

For practical purposes of standardizing tests for the blind, we have, therefore, designated those persons having vision sufficient for the regular tests, *Group 4*; those persons whose vision was sufficient for the Knox Cube test, but not adequate to the regular tests in general, are designated as *Group 3*; those who are totally blind but have lost use of their eyes at or later than five years of age, are designated *Group 2*; those remaining after these eliminations, who are considered totally blind from or soon after birth, are designated as *Group 1*. The subjects of *Group 1*, are the ones whose results are considered in the standardi-

zation of the Point Scale for the Blind, and in that of individual tests for the blind.

The chronological age of a subject is reckoned as his nearest birthday on the day of examination. For example, a subject is considered ten years old until he passes ten years and six months. If he was born on the 25th of October, 1904, and was examined on the 25th of April, 1915, he would be classed as a 10-year old. If he were examined on the 26th of April, 1915, he would be classed as an 11-year old. He would continue to be classed as an 11-year old up to and including the 25th of April, 1916.

Table I presents the Point Scale scores of all of the one hundred and forty-two blind subjects of Groups 1, 2, and 3, arranged in the chronological age groups of the subjects, and in the order of the points scored, the lowest score for each year appearing first. In this table it is noticed, for example, under age XII that the average attainment for eleven persons tested is 64.4 points, and the median attainment is 64, whereas the lowest score is 23 points, and the next is 37. Considering the average attainment of these eleven persons as a provisional norm for a twelve-year old blind person, we find the co-efficient of intellectual ability of the first to be 0.36, and that of the second, whose score is 37, to be 0.57. With the elimination of these two scores of manifestly inferiorly endowed persons, from the age group, the average would go considerably higher, and their own co-efficients of intellectual ability would go correspondingly lower. Comparing these attainments with the scores in the earlier years, we find only four cases, in the total of thirty-seven VIII, IX, X, and XI-year old subjects, which are lower than 37. One of these is an VIII-year old whose score is 36. The average of five IX-year olds, of whom two are presumably feeble-minded, is exactly 36. The only VII-year old tested made 44 points, and the average of three VIII-year olds is 45.3. In the light of such comparative data alone, it is reasonable to question the integrity of the intelligence of these two XII-year old children. On the other hand, our XIII-year olds (table I), nine in number, average 73.3 points, and the lowest scores 60 points, which, con-

sidering the average for the nine as a provisional norm, gives him a co-efficient of intellectual ability of 0.82.

We can not insist too strongly that these results are from such a limited number of blind persons, that we can not consider that

Ages	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
Scores	44	36 48 52	15 24 43 46 52	41 41 44 44 49	28 44 57 50 57	23 37 47 58 58	60 60 64 66 69 73	62 64 66 71 72	66 71 74 77 88	42 67 79 86 87	74 75 78 83 89	76 81 82 88 92	65 73 76 78 85	78 80 81 83 86	61 73 83 90 91	66 70 93 97 98	76 81	86
Medians	44.0	48.0	43.0	59.0	59.0	64.0	73.0	80.5	87.0	86.0	86.0	88.0	87.0	91.0	90.0	93.0	78.5	86.0
Av. Dev.	—	5.3	11.8	9.0	11.3	16.3	9.0	9.5	7.4	10.8	7.2	5.7	7.6	6.8	8.3	11.8	2.5	—
Averages	44.0	45.3	36.0	56.6	61.2	64.4	73.3	78.0	82.5	79.9	84.7	86.6	84.1	88.5	83.3	84.8	78.5	86.0

TABLE I. Points scored on the Point Scale for the Blind, by the one hundred and forty-two blind subjects of Groups 1, 2, and 3, arranged in the chronological year groups of the subjects, and in the order of points scored, with median and average attainments.

we have valid norms in these median attainments. There is, however, an evident increase year by year from VII to XXIV, with only insignificant exceptions. From VIII to IX, there is a dropping of 5 points, which means either that we have unusually bright VIII-year olds, or unusually dull IX-year olds. As remarked above two IX-year olds are probably feeble-minded. X and XI-year scores both have a median score of 59. This is interesting in relation to the facts (1) that Binet offered no XI-year tests in his 1911 series, and (2) that Yerkes and Bridges find relatively a very small number of points difference between the average attainments of X and XI-year old children of English speaking parents. The falling back about one point at XVI and at XIX and XXI are incidental to the small numbers of scores here assembled. In view of the very small and uncertain steps in development of the varieties of mental ability tested by this scale, from XV-years onward, it is surprising to find such indication of advance as there is in these later adolescent years.

The irregularities of the curve of progress in attainment may be due (1) to the mixed psychology, or different mental processes, of the persons whose scores are here massed; (2) to the presence of the scores of mentally deficient persons in spots in the table; or (3) to the relatively small numbers dealt with in year groups. The first possibility is obviated, by selecting scores of Group I; the second by selecting from Group I, the scores of only those persons the integrity of whose mental endowment is above suspicion. These selections are now presented. The third possible source of irregularity can only be corrected by the examination of many more blind.

The Point Scale is new, and fine points of its meaning with respect to the measurement of intelligence have not been worked out. It is a question as to what co-efficient of intellectual ability represents definite mental deficiency. We may consider provisionally that the co-efficient of intellectual ability of 0.75 marks off mental defect. This means one who scores 75 per cent or less of the average for his age group is a defective.

The assembled scores of the subjects blind from birth or early childhood, together with the median attainments of year groups

and averages of the same, do not result in any smoothing up of the curve of progressive attainment. On the contrary, there is a marked increase in irregularity of averages produced by eliminating Groups 2 and 3. This probably is the result to be expected from the considerably smaller number of data considered. As argued above, though, this seems to be the procedure demanded by our present knowledge of the psychology of the blind.

Age	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII
Scores	44	52	46 52	44 49 52 59 62 64 67 72 73	47 57 59 59 62 64 69 83 87	37 58 81 87 88	60 60 64 73 77 90	78 83 90 91 93	66 74 87 88 90	80 86 87 96	74 78 83 93	76 81 88 92 94	76 87 90 94	78 80 81 91 97 99	61 73 83 90 91 93	66 70 73 90 97 98	76 81
Medians	44.0	52.0	49.0	62.0	59.0	81.0	68.5	90.0	87.0	86.5	80.5	88.0	88.5	86.0	86.5	93.0	78.5
Av. Dev.	—	—	3.0	8.0	9.5	11.0	9.2	4.4	7.8	4.2	6.0	5.8	5.2	8.0	9.5	11.8	2.5
Averages	44.0	52.0	49.0	60.2	65.0	70.2	70.7	87.0	81.0	87.2	82.0	86.2	86.7	87.7	81.8	84.8	78.5

TABLE II. Scores of seventy-eight subjects of group I, arranged in year groups and in order of scores, with medians and averages.

Some vision, and early vision leaving vestigial visual imagery, are factors which can be expected to make great differences in the mental organization. In the curve of averages we have most of the drops in the late adolescent years, after 16. We present these results that each investigator may have the full data of Group I at his disposal, and form his own judgment as to the reasonableness of our principles of selection of the normal subjects of the group.

Table III presents in the same manner as tables I and II the

Age	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII
Scores	44	52	46 52	52 59 62 64 67 72 73	59 59 59 69 83 87	81 87 88	64 73 77 90	78 83 90 91 93	87 88 90	86 87 96	83 93	81 88 92 94	90 94	91 97 99	90 91 93	93 97 98
Medians	44.0	52.0	49.0	64.0	64.0	87.0	75.0	90.0	88.0	87.0	88.0	90.0	92.0	97.0	91.0	97.0
Av. Dev.	—	—	3.0	7.0	10.3	2.3	7.5	4.4	1.0	3.3	5.0	4.2	2.0	2.6	1.0	1.6
Averages	44.0	52.0	49.0	64.1	69.3	85.3	76.0	87.0	88.5	89.7	88.0	88.7	92.0	95.7	91.3	96.0

TABLE III. Scores of the fifty-two subjects of Group I (blind from birth or from earlier than five years of age) after the elimination of the feeble-minded and subnormal, with medians and averages.

points scored on the Point Scale for the Blind by the fifty-two normal subjects of Group 1. Those upon whom there is general agreement of mental defect, have been eliminated. This cutting-down of the number of subjects presents very small numbers for averaging. The regularity of the progression, which is manifested, is surprising, in view of the very small numbers in year groups. We find only four points in the curve wherein these averages are plotted in Figure 1, where a recession is manifest. This curve is the solid line. The first recession is at IX years, the one subject at VIII scoring 52 points. At IX, two subjects average 49 points. At X, the median and average of seven subjects are 64 points. The probabilities are strong that we have an exceptionally bright VIII-year old. Again, the XIII-year average recedes nine points from the XII-year average, and the median, twelve points. The XII-year results are a remarkable advance upon those of XI-years. The three XII-year olds, whose results are here averaged, are all unusually intelligent persons. The recessions at XVII and XXI-years are not very significant. They are small in amount and the progress in the development of intelligence beyond XVI-years is very slight as compared with such progress between VII and XIV. Recognizing that IX and XIII are low and XII is high, we have a fairly trustworthy guide of the attainments to be expected of normal blind children from VII to XV-years in the average attainments presented in Table III.

Figure 1 presents the graphs of (1) the average attainments by year groups, of the one hundred and forty-two blind subjects of Groups 1, 2, and 3 (dotted line), (2) averages for the seventy-eight subjects of Group 1 (dash and dot line), and (3) averages of the fifty-two normal subjects of Group 1 (solid line).

For practical purposes and from the combined results of point scale and year scale examinations, there seemed no reasonable doubt as to the subnormality of any one of the twenty-six subjects of Group 1, whose score has been omitted from table III. From the other groups resulting from classification by vision, we eliminated large numbers as being subnormal in mentality. Of the eighty-two with vision sufficient for the regular tests,

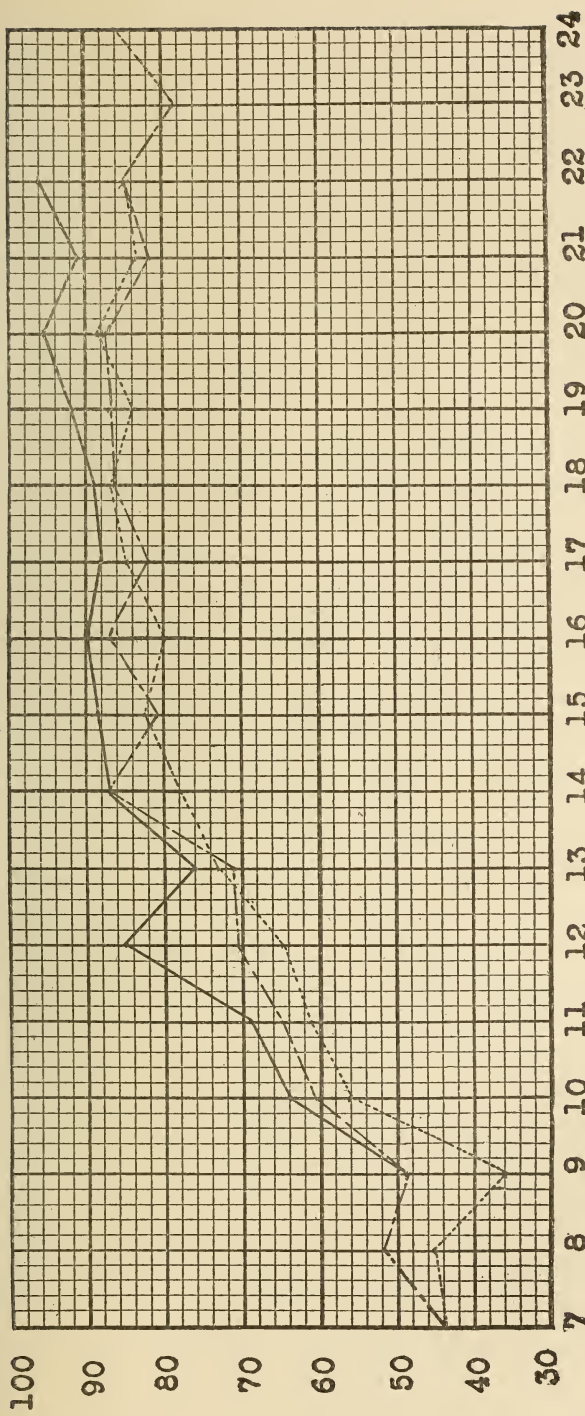


FIGURE I. Average of scores for year groups of blind subjects.
 (1) Dotted line (.....) averages of one hundred and forty-two subjects of Group I, 2, and 3.
 (2) Dash and dot line (-.-.-.-) averages of seventy-eight subjects of Group I.
 (3) Solid line (——) averages of fifty-two normal subjects of Group I.
 Ordinates = points scored; abscissae = chronological ages in years.

we classed thirty-three as subnormal. Of the forty-one with vision sufficient for some orientation (seeing blocks) we classed nineteen as subnormal. Of the nineteen blind persons who have lost sight since early childhood, four were classed as subnormal. In all of the two hundred and twenty-four blind persons examined, eighty-two, or 36.6 per cent were rated as subnormal. Twenty-one of these eighty-two were considered definitely feeble-minded. A few examples taken at random will illustrate how these classifications were made.

The lowest rating found among the XII-year olds of Table II is that of a boy of 11 years and 11 months. His Point Scale score is 37 points. This is a lower attainment than that of any single one of the twenty-one younger subjects of this group. His co-efficient of mental ability is 0.53 if the average for the five of the year group is taken as the norm, and 0.46 if the median attainment in this group is accepted as the norm. By the year scale this subject passed sufficient Binet VI-year tests to warrant considering six his basal year. Above this he counted thirteen pennies, got the size-weight illusion, managed the adaptation board, counted from 20 to 1, gave days of the week, and months of the year, repeated three digits backward, gave similarities of two things (3 of 5), and resisted suggestions (cubes). He did not know right and left, could not repeat five digits, failed on VIII-year comprehension tests, did not arrange weights, or know the date, got only one of the Knox lines (X), could not use three words in a sentence, or explain absurdities. These failures put him somewhat under VIII-years in mental development, and he is classed as feeble-minded.

The next highest score among the XII-year olds of Table II is 58 points attained by a girl of 11 years and 7 months. This gives a co-efficient of mental ability of 0.83 by the average of the group, and 0.72 by the median. She failed in the absurdities; in the comprehension tests; gave only forty-three words in three minutes; did not compose a sentence with three given words; failed to arrange any sentence; did not arrange weights or define abstract terms; and gave only one analogy. Judged by Binet

standards her limit is found at X-years, and she is one and a half years retarded. She is therefore classed as subnormal.

The lowest score in the X-year group, Table II, is 44, that of a boy of 9 years and 10 months. From the average of the group he has a co-efficient of mental ability of 0.73. This boy passed Binet VII-year tests, but failed to count backward from 20 to 1; he did not arrange weights; could not give similarities of two things; could not repeat six digits, or give four digits backwards; could not make a sentence using three given words, or give rhymes, or see absurdities, or arrange sentences; and he gave only thirty-four words in three minutes. He is therefore slightly under a IX-year level, and is retarded about a year. This boy has a brother and a sister in the school. They are all slow and subnormal.

A boy of 16 years and 11 months made a score of 78. This is close to the average for his age. He was unable to touch examiner's right hand, and uncertain of relations of points of the compass. He did not make a sentence using three given words. He could not give similarities of three things; he could not solve problems of fact, or give differences between president and king, or between abstract terms. He has a marked hydrocephaly. He is subnormal.

A young man of 20 years and 9 months scored 61 points. His co-efficient of mental ability by the median attainment of XXI-year olds is 0.70. He gave 55 words in three minutes. He could not repeat seven digits, or reverse five. He could not repeat twenty-two syllables. He failed on absurdities, and on comprehension tests. He got only one analogy, and failed to compose or arrange sentences. In fact he lacks the machinery for thinking. Has a mental age of ten years. He is feeble-minded.

A young woman of 22 years and 1 month, made a score of 66 points. Her co-efficient of mental ability by the average for the year group is 0.78. She gave fifty-three words in three minutes. She could not repeat seven digits or reverse five, gave only X and Y of the Knox lines, failed on the XI-year comprehension test; failed on orientation tests; failed to arrange weights; and

completed only one analogy. Her mentality is that of one about $10\frac{1}{2}$ years old. She is feeble-minded.

A young woman of 22 years and 7 months scored 76 points. She could not make a sentence using three given words. She gave only thirty-eight words in three minutes; she saw only two of five absurdities; she could not repeat seven digits; she failed to resist suggestions and she could not solve the problems of fact. She is a peculiar and definitely limited personality. Subnormal best designates her mentality.

These data make clear the grounds upon which this division of the subnormals was made. It is, however, a grave question to what extent, if any, these subnormals should be eliminated for standardization of tests. While there can be no question, as stated above, that this population is loaded above the average with feeble-minded, there is, on the other hand, no doubt the subnormals who are not definitely feeble-minded should be allowed to counterbalance the exceptionally well endowed, in computing averages and medians.

In order to approach this question with good vision we may cut across each year group at 25 per cent above and 25 per cent below the average for that year group. This will afford some insight into how much our groups are over-weighted with defectives. Calculation of these 25 per cent values above and below the average for each year group of Table II reveals four scores below and four above these limits. Forty-four in X, 47 in XI, 37 in XII, and 61 in XXI are those below the limits of 25 per cent less than averages. All other scores of Table II, eliminated in Table III, are inside of this 25 per cent limit. Eighty-three and 87 in XI, 88 in XII, and 90 in XIII are above the limit of 25 per cent more than averages. The numbers of cases above and below, are therefore, the same,—four in each case. The aggregate amount of departure from the limit is, however, much greater in the lower scores. By this showing we have no great overloading with feeble-minded in the group of blind subjects, and since the curve of averages for the total seventy-eight subjects of Group I presents a more even curve of progress in attainment, up to fourteen years, it seems we have in the average

attainments of these seventy-eight, more reliable provisional norms than in those of the selected fifty-two of Table III. We proceed, therefore, to present the data from all of the seventy-eight subjects of Group I. These data are so presented, however, that anyone who wishes may eliminate the feeble-minded and subnormal from his consideration.

IV

DETAIL OF ACHIEVEMENT OF THE BLIND BY THE POINT SCALE

In order that this work may be put most conveniently at the service of other workers in this field, and may be made the basis of further standardization of this point scale or of any of the tests used herein, we present herewith, in Table IV, the scores of each one of the seventy-eight blind subjects, in the order of chronological ages, for each one of the twenty-two tests described above. The subjects considered subnormal for purposes of practical classification are designated by letters in the column before the year of age. Others are designated by numbers. From the total scores and the ages given, Tables II and III, may be reconstructed.

	Yrs.	Mo.	Sex	Gr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Totals	
1.	VII	3	M.	I	1	2	4	3	3	1	2	6	3	3	2	1	6	0	0	0	4	0	2	1	0	3	0	44
2.	VIII	4	F.	II	2	0	6	3	0	3	6	3	6	3	4	2	4	3	2	1	3	0	0	1	2	1	0	52
3.	VIII	7	M.	II	1	2	2	3	3	1	3	8	3	3	3	2	6	2	2	2	0	2	2	0	3	0	52	
4.	IX	0	M.	I	2	0	4	4	3	0	8	2	4	2	4	0	3	4	1	3	3	0	2	1	2	0	46	
5.	IX	7	M.	II	2	2	4	4	3	0	8	3	1	3	5	6	2	3	3	0	2	2	2	2	0	0	62	
6.	IX	7	F.	III	1	2	6	6	3	1	0	8	3	0	2	6	4	2	3	4	2	2	2	0	2	0	59	
a.	IX	9	M.	I	1	2	4	3	3	2	3	8	2	0	1	3	5	0	1	4	0	1	0	0	1	0	44	
7.	IX	10	M.	II	1	2	4	4	3	2	3	7	3	4	4	6	3	2	2	3	2	5	2	2	1	4	72	
8.	IX	10	M.	IV	2	2	6	5	3	1	2	7	3	4	4	6	3	2	2	5	2	2	1	2	4	4	49	
b.	X	0	M.	II	2	2	4	3	3	2	3	5	3	2	3	5	2	2	2	2	2	0	0	1	2	1	0	64
9.	X	1	F.	III	2	2	4	5	3	2	3	7	3	4	3	6	7	2	3	2	3	0	2	2	0	2	0	73
10.	X	1	F.	III	2	2	6	6	3	2	1	8	3	2	3	5	1	2	4	8	2	2	5	2	4	0	64	
11.	X	5	F.	III	2	2	6	5	3	2	3	8	3	3	4	6	3	0	4	6	0	1	1	2	1	2	67	
12.	X	6	M.	II	2	2	4	5	3	2	3	8	3	2	4	5	4	2	1	4	0	2	0	0	3	0	59	
13.	X	8	F.	II	2	2	4	4	3	2	3	7	3	3	4	0	6	2	1	3	2	2	1	0	1	0	59	
c.	X	8	F.	III	2	2	4	4	3	2	3	7	3	3	4	0	6	2	2	1	6	0	2	0	2	2	0	57
d.	X	10	F.	III	2	2	4	3	3	0	3	6	3	2	2	4	4	2	2	2	2	0	0	1	0	2	0	47
14.	X	10	F.	IV	2	2	4	5	3	2	3	8	3	4	3	6	5	2	4	6	2	2	2	4	3	6	83	
15.	X	11	F.	III	2	2	4	4	3	2	3	7	3	3	3	1	6	6	2	3	4	2	2	2	2	4	69	
16.	XI	0	M.	II	1	0	4	6	3	0	3	6	3	4	4	6	3	2	0	4	0	2	4	2	2	0	59	
17.	XI	2	M.	IV	1	2	6	5	3	2	2	8	3	4	4	6	6	2	3	7	4	2	4	6	5	2	87	
e.	XI	7	F.	III	2	2	4	4	3	2	2	7	3	4	4	1	6	5	2	3	4	0	0	1	2	1	0	58
18.	XI	8	F.	IV	2	2	4	5	3	2	3	8	3	4	1	6	8	2	4	6	0	2	3	2	5	6	81	
f.	XI	11	M.	I	2	2	4	2	2	2	3	7	3	0	1	3	1	2	1	2	0	0	0	0	0	0	37	
19.	XI	11	F.	IV	2	2	6	6	3	2	2	8	3	4	4	6	5	2	4	8	4	2	5	4	4	2	88	
20.	XII	1	M.	V	2	2	4	6	3	2	3	6	3	2	4	6	8	2	4	6	4	2	5	4	2	6	87	
21.	XII	7	M.	IV	2	2	4	6	3	2	1	8	3	2	2	4	5	2	4	4	4	2	1	0	3	0	64	
g.	XII	8	M.	III	2	2	4	4	3	2	0	8	3	4	2	5	6	1	0	4	4	2	2	0	2	0	60	
22.	XII	8	M.	VI	2	2	6	4	3	2	3	7	3	4	3	6	7	2	4	8	4	2	5	2	5	6	90	
23.	XII	9	F.	IV	2	2	6	4	3	0	3	8	3	4	4	6	3	2	1	6	4	2	2	4	6	2	77	

TABLE IV. Showing the scores for seventy-eight blind subjects (Group I), for each one of the twenty-two tests of the Point Scale for the Blind. Also ages in years and months, and school grades of each subject at time of examination.

	Yrs.	Mo.	Sex	Gr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Totals	
h.	XIII	0	F.	IV	1	0	6	3	3	2	1	8	3	3	1	6	5	2	3	4	2	1	1	2	3	0	60	
24.	XIII	2	M.	V	2	2	4	6	3	2	1	8	3	3	2	6	6	2	0	8	2	2	2	4	5	1	73	
25.	XIII	8	M.	IV	2	2	6	6	3	2	2	8	3	4	2	5	6	2	4	8	2	2	3	2	4	2	78	
26.	XIII	8	M.	VIII	1	2	6	6	3	1	2	8	3	4	4	6	7	2	2	6	4	2	5	2	3	4	83	
27.	XIII	II	F.	VIII	2	2	6	6	3	1	3	8	3	4	4	6	7	2	4	4	4	2	5	6	2	6	90	
28.	XIV	1	F.	VII	2	2	6	6	3	1	3	8	3	3	2	4	6	7	2	3	4	2	4	6	6	6	91	
29.	XIV	2	F.	V	2	2	6	6	3	2	3	8	3	3	2	4	6	2	4	8	4	1	5	6	6	4	93	
30.	XIV	7	F.	VI	2	2	4	4	3	2	3	7	3	4	4	6	8	2	3	8	2	2	4	6	5	4	88	
i.	XIV	II	M.	V	2	2	4	2	3	2	3	7	3	4	3	5	6	2	2	4	2	2	5	2	1	0	66	
31.	XV	I	F.	VI	2	2	4	6	3	2	3	8	3	3	4	6	5	2	4	8	4	2	4	6	5	4	90	
j.	XV	4	M.	V	2	2	4	3	3	2	2	8	3	4	4	6	4	2	1	5	4	2	3	6	2	2	74	
32.	XV	4	M.	V	2	2	4	3	3	2	2	8	3	4	4	6	5	2	3	7	4	2	4	6	4	6	87	
k.	XV	10	M.	VI	2	2	4	5	3	2	1	8	3	4	4	5	6	2	3	6	4	2	3	6	1	4	80	
33.	XVI	0	M.	VII	2	2	4	4	3	2	3	8	3	4	4	6	6	2	3	6	4	2	5	6	3	6	87	
34.	XVI	1	M.	H.S.	2	2	6	6	3	2	3	8	3	4	4	6	6	1	4	8	4	2	5	6	5	6	96	
35.	XVI	1	M.	VI	2	2	6	6	3	2	3	8	3	4	4	5	5	2	2	8	4	2	5	6	4	4	86	
m.	XVI	II	M.	VII	2	2	4	6	3	0	3	6	3	2	4	5	2	2	5	4	2	4	2	3	4	4	74	
36.	XVII	0	F.	VIII	2	2	6	6	3	2	3	8	3	1	3	4	0	2	4	6	2	2	3	5	1	4	78	
37.	XVII	5	M.	H.S.	2	2	6	4	3	0	3	8	3	3	4	6	4	2	4	7	4	2	4	3	6	3	4	83
38.	XVII	6	M.	H.S.	2	2	6	5	3	2	3	8	3	4	4	6	6	2	4	8	4	1	4	6	4	6	93	
39.	XVII	7	F.	H.S.	2	2	6	6	3	2	3	8	3	4	4	6	6	2	3	8	4	1	4	6	4	6	92	
40.	XVIII	8	M.	VIII	2	2	6	6	3	0	3	8	3	4	4	6	6	2	4	7	4	2	3	6	5	6	94	
n.	XVIII	9	F.	VII	2	2	4	5	3	2	3	7	3	4	4	6	7	2	4	7	2	4	2	5	6	3	6	88
41.	XVIII	9	F.	VI	2	2	6	6	3	2	1	8	3	3	3	5	6	2	3	6	4	2	0	4	1	4	76	
o.	XVIII	9	F.	VII	2	2	4	6	3	2	3	8	3	4	4	6	6	2	4	5	0	2	3	6	3	6	81	
42.	XVIII	9	F.	VII	2	2	4	6	3	2	3	8	3	4	4	4	4	2	2	8	0	2	3	4	2	6	76	
43.	XVIII	9	M.	H.S.	2	2	6	4	3	2	3	8	3	4	4	6	0	2	4	8	2	4	2	3	6	4	90	
p.	XIX	2	F.	VIII	2	2	4	6	3	2	2	8	3	4	4	6	8	2	4	7	4	2	4	2	6	4	94	
q.	XIX	7	F.	VIII	2	2	4	6	3	2	2	8	3	4	4	5	6	2	3	6	4	0	5	6	4	6	87	
44.	XIX	7	M.	H.S.	2	2	4	5	3	1	3	8	3	4	4	5	2	2	4	4	4	1	4	4	3	6	78	
					2	2	6	6	3	2	3	8	3	4	4	6	7	2	4	8	4	2	5	6	4	6	99	

Continuation of Table IV.

	Yrs.	Mo.	Sex	Gr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Totals
45.	XIX	7	M.	H.S.	2	2	6	6	3	2	1	8	3	3	4	6	4	2	4	8	4	2	5	6	4	6	91
46.	XIX	9	F.	H.S.	2	2	6	5	3	2	3	8	3	4	4	6	6	2	4	8	4	4	5	6	6	6	97
r.	XIX	11	F.	VII	2	2	4	5	3	2	3	7	3	4	2	6	6	2	4	7	4	2	3	4	2	4	81
s.	XX	5	F.	VII	2	2	4	5	3	2	3	7	3	4	2	6	7	2	4	4	4	2	3	4	3	4	80
t.	XX	8	F.	VII	2	2	4	6	3	2	2	8	3	2	1	5	3	2	3	6	4	0	3	6	2	4	73
u.	XX	9	M.	VIII	2	2	4	4	3	2	3	8	3	3	2	5	6	2	2	2	0	2	1	4	1	0	61
v.	XX	9	M.	H.S.	2	2	6	6	3	1	3	5	3	3	4	6	4	2	4	8	4	2	4	6	2	6	83
47.	XX	9	M.	H.S.	2	2	6	6	3	2	2	8	3	2	4	6	4	2	4	8	4	2	5	6	5	4	90
48.	XX	11	M.	H.S.	2	2	6	4	3	2	2	8	3	4	4	6	6	2	4	8	4	2	5	6	4	6	91
49.	XXI	2	M.	H.S.	2	2	6	6	3	2	1	8	3	4	4	6	6	2	3	7	4	2	5	6	5	6	93
50.	XXI	6	F.	H.S.	2	2	6	6	3	2	3	7	3	4	4	6	7	2	4	7	4	2	5	6	6	6	97
w.	XXI	7	F.	VIII	2	2	4	5	3	2	3	8	3	4	1	6	2	2	3	5	0	1	4	6	2	2	70
x.	XXII	1	F.	V	2	2	4	4	3	2	3	6	3	2	2	5	2	2	2	4	4	0	3	6	1	4	66
51.	XXII	2	F.	H.S.	2	2	6	6	3	2	3	8	3	4	4	5	8	2	4	8	4	2	4	6	6	6	98
52.	XXII	4	F.	H.S.	2	2	6	4	3	2	3	7	3	4	3	6	6	2	4	8	4	2	5	6	5	6	93
y.	XXII	7	F.	H.S.	2	2	4	3	3	2	1	7	3	4	1	6	6	2	4	7	0	2	2	6	3	6	76
z.	XXII	8	F.	VI	2	2	4	6	2	2	3	7	3	2	3	5	5	1	2	7	4	0	5	6	4	6	81

Continuation of Table IV.

CHANGES RECOMMENDED IN THE POINT SCALE FOR THE BLIND.
FINAL AVERAGE SCORES FOR SUBJECTS EXAMINED.

1. Changes in Tests.

(1) Change the verbal memory Test 3, in conformity with Yerkes' recommendations as given on page 137 of "A Point Scale for Measuring Mental Ability."

(a) It rains. I am hungry. (1)

(b) His name is John. It is a very fine day. (1)

(c) The sun is very large and red. Our train was more than two hours late. (2)

(d) It is not necessary to hurt the poor little birds. It is night and all the world rests in sleep. (2)

The total of possible credit points remains the same (6).

(2) Change the administration of Test 6. Give all the four *changes* of position according to Pintner's directions. Score *one point* credit when any *three positions* are reacted to by unhesitatingly putting the block into the right hole, and *two points* credit for the same correct placing without hesitation in all *four* of the *changed positions*.

(3) In Test 8 ask for definition of "spoon" instead of "fork." This avoids much hesitation which does not imply ignorance, and the oft recurring question "What kind of a fork?"

(4) In Test 13 give in addition the (d) group of Knox Lines, H, I, and J. Give one point credit for each of these three lines, correctly repeated.

2. Changes in Credits.

(1) In Test 1 give one point credit for correct enumeration of eight objects, and the same when one small object is not named because not found.

(2) In Test 2 give one point credit for two correct responses (handing back the smaller cylinder as heaviest) twice, once from each hand.

(3) In Test 10 (a) give one point credit for correctly touching without hesitation both the right and left hand of the examiner.

(4) In Test 13 give one point for each of the lines H, I, and J correctly repeated.

These changes in credit allowances take off three points where they are too easily attained, putting tests 1, 2, and 10 (a) practically on a level with 5 (a) and the three parts of 9. This seems a reasonable adjustment. For these three points we add three to be obtained for lines H, I, and J. This will tend to bring out more differences in the higher reaches of intelligence development. This is a desideratum of importance.

3. Changes in the order of tests.

With the experience gained from testing these blind persons, some changes in the order of tests seem desirable. The order recommended follows fairly closely the order of average amounts of attainment of the seventy-eight blind subjects. These subjects do not comprise many children of less than ten years of age. Some allowance is made for this fact in determining the order of easier tests. The percentage relation, of the aggregate actual attainment of all the subjects, to the maximum possible attainment, is shown for each of the twenty-two tests in Table V, also the average score of seventy-eight subjects on each test. The

No.	Designation of Test	Possible Score	Average Score	Percentage Attainment
5	Comparison of Sticks and Weights.....	3	2.97	99.1
9	Choosing the "nicer feeling".....	3	2.97	99.1
2	Size-Weight Illusion.....	2	1.90	94.9
1	Naming Objects in a Box.....	2	1.88	94.2
8	Definitions, "chair, horse," etc.....	8	7.51	93.9
14	Counting backwards from 20 to 1.....	2	1.87	93.6
12	Differences between common objects....	6	5.50	91.6
7	Resisting suggestions	3	2.49	86.6
6	Adaptation Board	2	1.68	83.9
18	Arranging weights	2	1.68	83.9
4	Memory for digits	6	4.91	81.8
3	Repeating sentences	6	4.82	80.3
10	Orientation	4	3.20	80.0
15	Reversing series of digits.....	4	2.92	73.1
11	Giving words for three minutes.....	4	2.88	72.1
16	Comprehension	8	5.63	70.4
20	Definitions of abstract terms.....	6	3.86	64.3
13	Knox Lines by Finger Tapping.....	8	5.09	63.6
17	Three given words in a sentence.....	4	2.49	62.2
19	Absurdities	5	3.10	62.1
22	Disarranged sentences	6	3.38	56.4
21	Analogies	6	3.19	53.2

TABLE V. Average scores of seventy-eight blind subjects on twenty-two tests of the Point Scale for the Blind, with the percentage relations of the aggregate scores, on each test, to the total possible scores on the same.

numbers of tests are given as in the Provisional Point Scale for the Blind as we used it.

Recommended order of tests with changed scoring;

1. Choosing twice the "nicer feeling" of two fabrics;
 - (a) Serge and silk (1)
 - (b) Velvet and serge (1)
 - (c) Carpet and velvet (1) (3)
2. Comparing twice
 - (a) 4 and 6 cm. sticks. (1)
 - (b) 6 and 15 gm. weights. (1)
 - (c) 9 and 18 gm. weights. (1) (3)
- ✓ 3. Size-Weight Illusion, twice. (1) (1)
- ✓ 4. Naming seven of eight objects in a box. (1) (1)
5. Counting backwards from 20 to 1. (2)
- ✓ 6. One omission or transposition. (1) (2)
6. Defining in terms of use (1 each); superior to use (2 each).
 - (a) spoon
 - (b) chair
 - (c) horse
 - (d) baby (8)
7. Giving differences (1 or 2 each).

Apple and banana
Wood and glass
Paper and cloth (6)
8. Adaptation Board. Three changed positions correct (1).
Four changed positions correct (2).
9. Resisting suggestion of size. (Blocks.) (1 for each of three resistances). (3)
10. Arranging weights, two trials. All correct but one (1). All correct (2). (2)
11. Repeating: (a) It rains. I am hungry. (1)
 (b) His name is John. It is a very fine day. (1)
 (c) The sun is very large and red. Our train was more than two hours late. (2)
 (d) It is not necessary to hurt the poor little birds. It is night and all the world rests in sleep. (2) (6)

12. Repeating digits; (1 of 2 correct).
- | | | | |
|-----|----------|----------|---------|
| (a) | 374 | 581 | (1) |
| (b) | 2947 | 6135 | (1) |
| (c) | 42871 | 92736 | (1) |
| (d) | 461572 | 526283 | (1) |
| (e) | 2749385 | 6195847 | (1) |
| (f) | 37158264 | 26149738 | (1) (6) |
13. Reversing series of digits, (1 of 3 correct).
- | | | | | |
|-----|--------|--------|--------|---------|
| (a) | 283 | 427 | 395 | (1) |
| (b) | 6528 | 4937 | 4293 | (1) |
| (c) | 31879 | 69482 | 52961 | (1) |
| (d) | 358164 | 174928 | 813692 | (1) (4) |
14. Orientation. (a) Touching examiner's right and left hands. (1)
 (b) Faced north, point E., W., and S. (1)
 (c) Faced east, point N., S., and W. (1) (3)
15. Knox Lines by Finger Tapping. Each line (1)
 (a) X Y (c) E F G
 (b) B C D (d) H I J (11) ✓
16. Giving words for three minutes: 30-44 (1). 45-59 (2).
 60-74 (3). 75 or more (4). Record by half-minutes on back. (4)
17. Comprehending questions. (2 each).
 (a) Missed train
 (b) Someone unkind
 (c) Action vs. words
 (d) Forgive easier (8)
18. Defining: (a) Charity (2)
 (b) Obedience (2)
 (c) Justice (2) (6)
19. Using three given words in a sentence. Write on back.
 Three words in two (2); three in one (4). (4)
20. Seeing absurdities (1 each).
 (a) Finely dressed gentleman
 (b) Unlucky bicycle rider
 (c) Three brothers
 (d) Guide Post
 (e) Last car (5)

21. Putting together disarranged sentences (2 each).
 (a) My teacher
 (b) A good dog
 (c) We started (6)
22. Completing analogies (1 each).
 (a) Oyster is to shell as banana is to
 (b) Arm is to elbow as leg is to
 (c) Head is to hat as hand is to
 (d) Truth is to falsehood as straight line is to
 (e) Known is to unknown as present is to
 (f) Storm is to calm as war is to (6)

The changes in scoring recommended in 1, Naming objects, 2, Size-Weight illusion, 6, Adaptation board, 10 (a), Touching examiner's right hand, and 13, Tapping Knox lines, can be effected from data at hand for the seventy-eight subjects of Group I. These changes in credit for the tests mentioned and the resulting new scores for each subject are indicated in Table VI.

Number of Subject	Old Score	Change in Score Test I	Change in Score Test II	Change in Score Test VI	Change in Score Test X	Change in Score Test XIII	New Score
I.	44	0	-1	0	-1	0	42
2.	52	-1	0	0	-1	0	50
3.	52	0	-1	0	-1	0	50
4.	46	-1	0	0	-1	+1	45
5.	62	-1	-1	-1	0	+1	60
6.	59	0	-1	-1	0	0	57
a.	44	0	-1	0	0	0	43
7.	52	0	-1	0	-1	0	50
8.	72	-1	-1	0	-1	0	69
b.	49	-1	-1	-1	0	0	46
9.	64	-1	-1	0	-1	+1	62
10.	73	-1	-1	-1	0	0	70
11.	67	-1	-1	0	-1	0	64
12.	59	-1	-1	-1	0	0	56
13.	59	-1	-1	0	-1	0	56
c.	57	-1	-1	-1	-1	0	53
d.	47	-1	-1	0	0	0	45
14.	83	-1	-1	-1	-1	0	79

TABLE VI. Designation of the subjects (78) same as in Table V. Shows old scores, changes in credit as recommended for tests 1, 2, 6, 10 and 13, and resulting new scores.

15.	69	-1	-1	-1	-1	0	65
16.	59	0	0	0	-1	0	58
17.	87	0	-1	0	-1	+1	86
e.	58	-1	-1	0	-1	+1	56
18.	81	-1	-1	0	-1	+2	80
f.	37	-1	-1	0	0	0	35
19.	88	-1	-1	0	-1	0	85
20.	87	-1	-1	0	0	+2	87
21.	64	-1	-1	-1	-1	0	60
g.	60	-1	-1	0	-1	+1	58
22.	90	-1	-1	0	-1	+1	88
23.	77	-1	-1	0	-1	0	74
h.	60	0	0	-1	-1	0	58
24.	74	-1	-1	-1	-1	0	70
25.	78	-1	-1	-1	-2	0	73
26.	83	0	-1	-1	-1	+1	81
27.	90	-1	-1	-1	-1	0	86
28.	91	-1	-1	0	-1	0	88
29.	93	-1	-1	-1	-1	+2	91
30.	88	-1	-1	0	-1	+2	87
i.	66	-1	-1	0	-1	+1	64
31.	90	-1	-1	0	-1	0	87
j.	74	-1	-1	0	-1	0	71
32.	87	-1	-1	0	-1	+2	86
k.	80	-1	-1	0	-1	+1	78
33.	87	-1	-1	0	-1	+2	86
34.	96	-1	-1	0	-1	+1	94
35.	86	-1	-1	0	0	0	84
l.	74	-1	-1	0	0	0	72
m.	78	-1	-1	0	0	0	76
36.	83	-1	-1	0	-1	0	80
37.	93	-1	-1	0	-1	+1	91
38.	92	-1	-1	-1	-1	0	88
39.	94	-1	-1	0	-1	0	91
40.	88	-1	-1	0	-1	0	85
n.	76	-1	-1	-1	-1	0	72
41.	81	-1	-1	-2	-1	+3	79
o.	76	-1	-1	0	-1	+1	74
42.	90	-1	-1	0	-1	0	87
43.	94	-1	-1	0	-1	0	91
p.	87	-1	-1	-2	-1	0	82
q.	78	-1	-1	0	-1	0	75
44.	99	-1	-1	0	-1	+1	97
45.	91	-1	-1	0	-1	0	88
46.	97	-1	-1	0	-1	0	94
r.	81	-1	-1	0	-1	0	78
s.	80	-1	-1	0	-1	+1	78
t.	73	-1	-1	-1	-1	0	69
u.	61	-1	-1	-1	-1	0	57
v.	83	-1	-1	0	-1	0	80
47.	90	-1	-1	0	-1	+1	88
48.	91	-1	-1	0	-1	0	88
49.	93	-1	-1	0	-1	+1	91
50.	97	-1	-1	0	-1	+1	95
w.	70	-1	-1	0	-1	0	67
x.	66	-1	-1	-2	-1	0	61
51.	98	-1	-1	0	-1	+2	97
52.	93	-1	-1	0	-1	+2	92
y.	76	-1	-1	-1	-1	+1	73
z.	81	-1	-1	0	0	0	79

Continuation of Table VI.

These new scores are arranged by year groups and in the order of attainment, with medians and averages for each year group in Table VII. Figure 2 shows a graph of the averages of these scores by years.

Age	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII
Scores	42	50	45 50	43 46 50	45 53 56 57 60 62 64 69 70	35 50 80 85 87 88	58 58 60 70 74 88	73 81 86 88 91	64 71 86 87 87	78 84 86 94	72 76 80 91	72 79 85 88 91	74 82 87 91	75 78 78 88 94 97	57 69 80 88 88 91	61 67 92	73 79
Medians	42.0	50.0	47.5	60.0	57.0	80.0	65.0	86.0	86.0	85.0	78.0	85.0	84.5	83.0	84.0	92.0	76.0
A. D.	—	—	2.5	8.8	9.7	16.2	7.7	5.0	7.8	4.5	5.7	5.6	5.5	8.0	10.1	12.8	3.0
Averages	42.0	50.0	47.5	57.9	62.2	68.6	68.0	83.8	79.0	85.5	79.7	83.0	83.5	85.0	78.8	82.4	76.0

TABLE VII. Revised Point Scale scores of seventy-eight blind subjects, by year groups, with medians and averages for these groups.

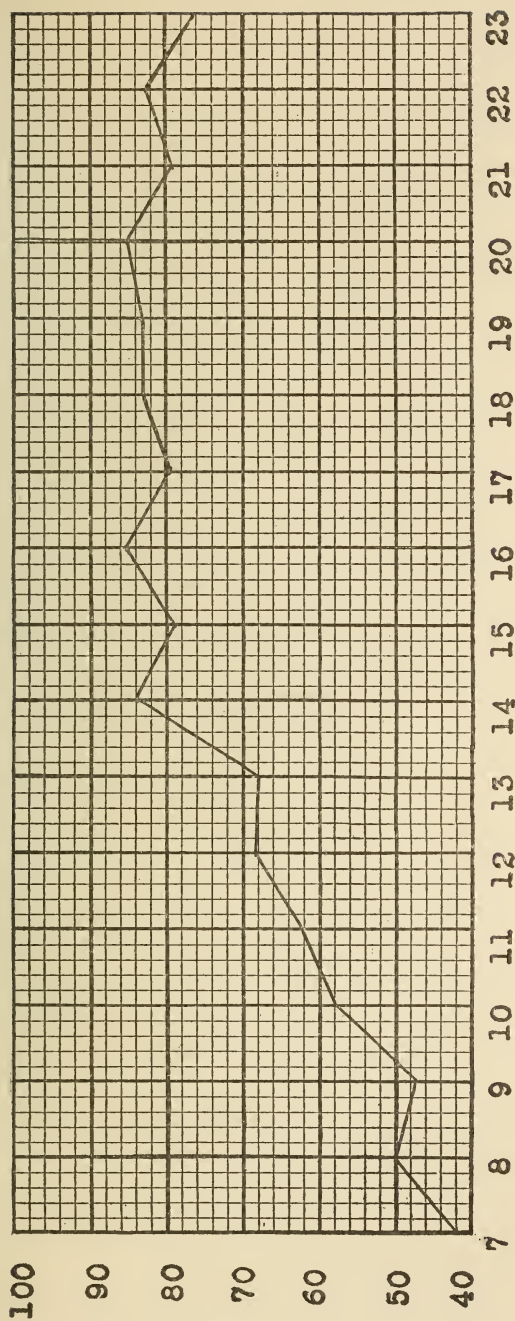


FIGURE 2. Showing the graph of the average scores of blind subjects (Group I) from VII to XXIII years, by the revised point scale for the blind.

VI

POINT SCALE COMPARISONS OF BLIND AND SEEING SUBJECTS

One of the strong points in favor of a point scale for measuring intelligence is the facility it affords for comparing the mental ability of one social group with that of another. Could we give the same tests to the blind which Yerkes and Bridges applied to the mental measurement of Cambridge school children, we should be able to state the percentage relations, year by year, of the one group to the other, and to see the relative order and rate of development of mental processes. This direct comparison is impossible, but we can compare the achievements of the blind upon such of the Yerkes-Bridges tests as they performed, with the total performances of Cambridge school children. Seventy-two points of possible credit are common to the two point scales. The scores of the seventy-eight subjects of Group I, blind from birth or early childhood, without eliminating any for any cause whatever, were counted up for these seventy-two points of possible Yerkes-Bridges credit. These scores were then raised to a percentage basis. For instance, the lowest scoring twelve-year old subject made a record of twenty-four points on the seventy-two points common to the two scales. This, divided by seventy-two, yields 33 per cent, which is, for the purpose of comparison with seeing children, considered this child's Yerkes-Bridges score. These scores were averaged for year groups. These averages for year groups are plotted as a curve in the solid line of Figure 3. The dotted line indicates the Yerkes-Bridges averages for four hundred and sixty-eight children of English speaking parentage. In comparison, the blind score lower from IX to XIII years inclusive. But the amount of departure from the tentative norms for seeing children, is at no point greater than the differences which Yerkes and Bridges find between the language groups at XII and XIII years.⁴ These differences can not be made the ground, therefore, for maintaining a *general* mental inferiority of the blind, even in these years. And the

⁴ See "A Point Scale for Measuring Mental Ability"—Yerkes, Bridges and Hardwick, p. 67.

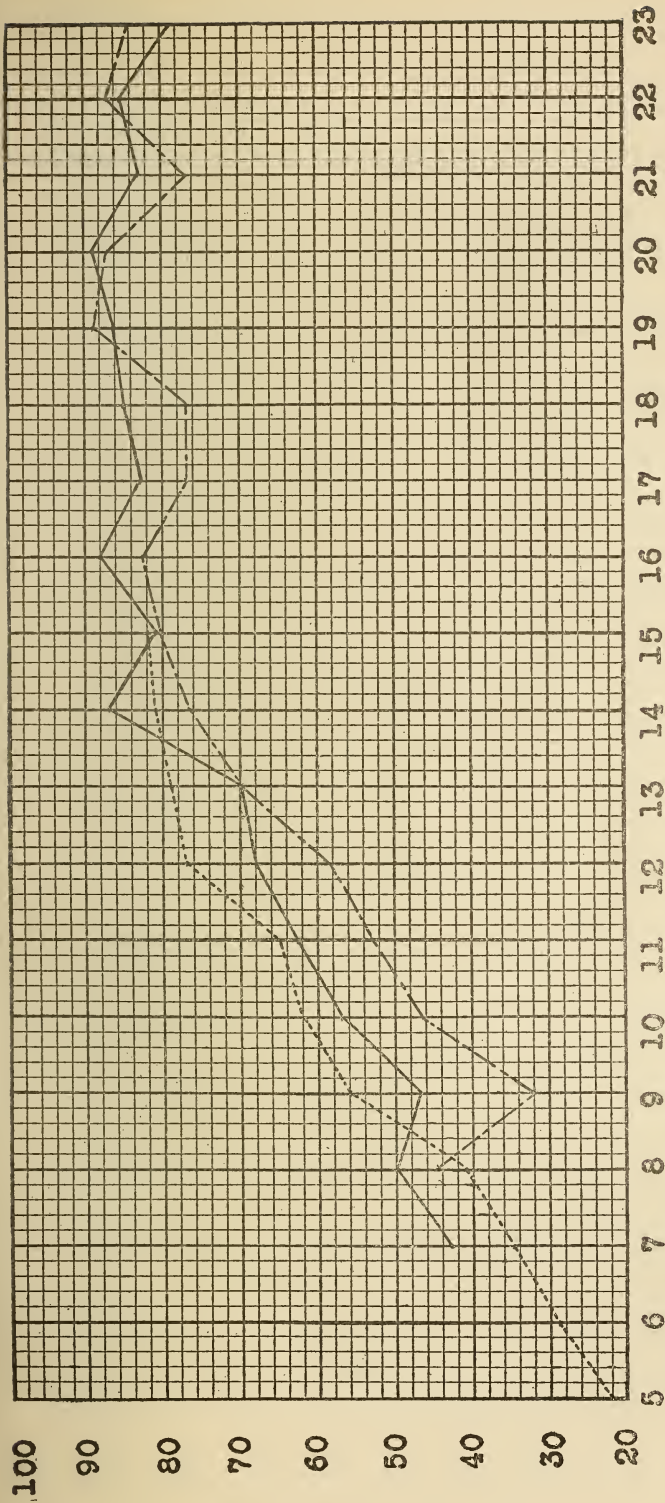


FIGURE 3. Averages of points scored by year groups:
 (1) Dotted line (.....) Yerkes-Bridges averages for children of English speaking parents. (468).
 (2) Solid line (——) averages of points scored on 72 points of Yerkes-Bridges Scale, by seventy-eight blind subjects, these scores being raised to percents. (78).
 (3) Dash and dot line (—·—·—·) averages of eighty-two partly blind subjects (Group 4) by the Yerkes-Bridges Scale. (82).
 Ordinates = points scored: abscissae = chronological ages in years.

indications, at VII, VIII, and XIV-years, are for a superiority in the mental processes tested by these tests. When the irregularities, inherent in the small numbers examined, are removed from this curve, it is highly probably there will be a much closer correspondence with the attainments of seeing children, year by year. It will be observed there are only one VII-year, one VIII-year, and two IX-year olds represented in this curve, presenting the averages of year groups of blind children. This comparison with the Yerkes-Bridges results seems to indicate that we have in the point scale a reliable means of measuring the intelligence of blind persons, and that the intelligence of the blind is not markedly inferior in grade, or different in quality from that of seeing subjects.

One other comparison of a part of this population with Cambridge School children is possible. Eighty-two subjects had vision sufficient for taking the Yerkes-Bridges Point Scale tests. The scores of these subjects are arranged in the order of attainment in year groups in Table VIII, and averages calculated. These subjects comprise all persons in the school of the visual capacity stated, whether feeble minded or supernormal. These averages are plotted in Figure 3, in the dash and dot line.

The inferiority in achievement of these partly blind subjects, in the four years from IX to XII, inclusive, is much more marked than that of the totally blind. They are generally inferior to the totally blind. This fact, together with the marked irregularity of the curve after XVI years, indicates that the group is more heavily laden with distinctly inferior mentalities,—that there is more feeble-mindedness among the blind who see, than among the really blind. In other words, some subnormality of vision has been made the excuse for constituting the school an asylum for some feeble-minded persons who should be in institutions for the feeble-minded. After eliminating such persons from this group, the average attainments of the remaining subjects, year by year, come very close to those of seeing subjects.

In view of these comparisons of attainment of blind and partly blind subjects with those of seeing subjects, there is no ground afforded for the view that the blind subject as such is lower than

the seeing subject in his ability to adapt himself to circumstances. The curves exhibited in Figure 3 certainly indicate that the blind subject has, on the tests afforded by the Point Scale of Yerkes and Bridges, the same kind of mental adaptability to circumstances as the seeing subject, and in approximately the same

Age	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
Scores	36 54	32	35 36 49 55 60	36 50 59 69 60	39 39 59 60 61 72	51 56 66 72 72	50 60 74 76 77	55 69 74 80 87	75 80 85 90	59 71 75 85 85 87 88	53 62 67 75 76 86 89	89	80 90 91	77	82 85 86 96	80 89	90
Av.	45.0	32.0	46.4	53.5	58.2	69.8	76.5	80.4	82.5	77.1	77.0	89.0	87.0	77.0	87.2	84.5	90.0
M. V.	9.0	—	9.3	10.5	7.7	8.2	9.2	9.7	5.0	9.0	11.5	—	4.7	—	4.3	4.5	—

TABLE VIII. Points scored on the Yerkes-Bridges Point Scale by the eighty-two partly blind subjects of Group 4, arranged in chronological year groups of the subjects and in the order of points scored.

measure. His mental furniture is different. It is needless to comment upon the necessity which the blind person finds laid upon him to build his world of other than visual imagery. But that he constructs his world and organizes his experience successfully, under this handicap, these figures testify. They make it plain that the blind child is not a defective because he is blind. A good cortex and good nervous system are not made incapable of normal adjustment in society by the lack of visual apparatus. On the other hand, there is an unusually large percentage of sub-normal and feeble-minded in the population of this school. There is a considerable number in each one of our groups who fall so far below the average attainment for their ages, that they have to be considered defectives. These are blind persons in whom blindness proceeds from the same cause as does disease of the encephalon. They are feeble-minded, and they are blind, because they are hydrocephalic, have had encephalitis, now suffer from syphilitic degeneration of cortical cells, or are suffering from other pathological deterioration of brain and optic nerve. Such factors can and do cause both sense and brain defects. Taking into consideration the very heavy incidence of the gonococcus as an etiological factor in blindness (*ophthalmia neonatorum*), and that this infection is in no wise connected with feeble-mindedness in parents, but rather with their loose morals, we should expect to find relatively small numbers of blind children who are feeble-minded. If we could completely eliminate this cause of blindness the percentage of feeble-minded among the blind would materially increase; for of the other causes of blindness, nearly all are liable to cause brain disease or brain defect, which in turn, entail dementia or amentia. There would be fewer blind but of these a larger percentage would be defective.

In view of these facts, it is imperative to have a means of separating, for instructional purposes, the normally endowed blind and the mentally defective blind. This Point Scale for the Mental Measurement of the Blind has been devised with a view to facilitating the mental examinations of the Blind, and separating the two classes. This relatively small amount of data is put forth in order to stimulate the gathering of more data so that the averages may more closely approximate true age norms.

VII

INDIVIDUAL BINET-SIMON TESTS FOR A YEAR SCALE

We present now the results obtained with single tests such as were used in the Point Scale, and many other intelligence tests. These data furnish means for a more rigid evaluation of results on the Point Scale, and for more accurate placing of tests in a Year Scale. The results obtained, with our relatively small number of blind subjects, point the way, at least, to the places these tests may be expected to occupy in a Year Scale for Measuring Mental Ability. Such a Year Scale would be a modification of the Binet-Simon Scale for measuring intelligence. It would be adapted to the Blind. This attempt to standardize simple tests;—to assign them to their places in the development of intelligence, leads to a further comparative study of blind and seeing subjects.

As a matter of routine, each examination of a blind subject covered a long list of tests outside of the Point Scale, as outlined above. A large Year Scale Record Blank was used upon which we had listed, provisionally, by years, all the Binet Tests adapted to the blind; and many others from sources already mentioned. As the Point Scale examination proceeded the plus and minus checks were made upon the Year Scale Blank, and when the Point Scale tests were completed, other year tests were administered according to the ordinary procedure,—to secure a basal year and get for the subject all the credits he could earn beyond that year.

As observed above, our data for contributing information on the value of Year Scale Tests, before the age of ten, are meagre. We present first what facts we have concerning the tests of Binet's 1911 series, as this is generally familiar. Then follow various supplemental tests. Roman numerals indicate the year, and Arabic numerals, the place in the tests of a given year assigned by Binet and Simon in the 1911 series.⁵ The numbers in


⁵ See "Mentally Defective Children"—Alfred Binet and Th. Simon. Translated by W. B. Drummond—London, 1914. Also "A Method of Measuring the Development of the Intelligence of Young Children"—Alfred Binet and Th. Simon. Translated by Clara Harrison Town. Lincoln, Ill.

parentheses, after P.S. indicate the Point Scale for the Blind number of the tests as given on pages 6 and 7.

III 3, (P. S. 1). Enumeration of objects in a basket. A substitute for the Binet enumeration of objects in a picture. Of fifty-two normal blind children, one VII-yr. old, one IX-yr. old, two X-yr. olds, two XI-yr. olds, and one XIV-yr. old failed to name all of the objects. The coat button figures in every one of these cases but the last. The XIV-yr. old pulled the shoestring out with the doll and failed to name the former. One of the XI-yr. olds missed the penny and button, and one of the XII-yr. olds, the shoestring and button. The button is not a familiar object to these children. A knife or a small bottle might be substituted. This test is a good substitute for Binet, III 3. All failures were due to carelessness. Limit in age is lower than can be fixed by our subjects.

IV 4, (P. S. 5 (a)). Comparison of 4 and 6 cm. sticks. A substitute for comparison of 5 and 6 cm. lines of Binet. Uniformly perfect score. May be an easy four-year old test.

V 1, (P. S. 5 (b) and (c)). Comparison of two weights, 6 and 15 gm., and 9 and 18 gm. Binet's method used with repetition of each comparison. Uniformly perfect records by all our normal blind subjects. Clearly below the age limits of our subjects.

V 5. Patience. Binet's visiting cards are not suitable as a test for the blind. Tactually presented the problem is too difficult. We used two blocks of wood $2\frac{1}{2} \times 4$ inches, $\frac{1}{2}$ inch thick, but bevelled to $\frac{1}{4}$ inch at edges. One of these was cut along one diagonal. The presentation is the same as with the Binet cards, with this exception: The limitations of the tactual sense for space perception dictate the presentation of the whole block first, and then the two pieces laid thus: . The bevel prevents an apparent fit when one piece is turned over. The blind subject gets the two pieces off the table and manipulates them up near his face. Four X-yr. olds, who tried this, all succeeded. These are their records of time and moves:—16 sec., 3 moves; 30 sec., 5; 50 sec., 4; 80 sec., 7. We have 25 other records up to 21 years. All were successful. One can get no standard from such

limited data. It looks, however, as if, with a limit of thirty seconds after the task is fairly presented and allowance of four or five moves, it might be a fair X-yr. old test for the blind child. Binet's Patience Test is a V-yr. test. Extensive use with younger children may indicate lower limits for this, but it is clearly a more difficult task for the blind than is the card for the seeing child.

VI 2, (P. S. 8). Definitions. Four asked for. Of three IX-year olds, one gave all in terms of use and the others each gave three of four in terms of use. Of seven X-year olds five gave four definitions each in terms superior to use, one gave three, and one gave only one in terms superior to use. It seems probable that three of four definitions given in terms superior to those of use constitute an easy X-year test for blind children.

VI 5, (P. S. 9). Aesthetic Choice of Tactual Impressions. Two pieces, one of silk and one of serge, are put into S.'s hands, and he is asked which feels the nicer. The same with velvet and serge, and with velvet and carpet. In only one case of the fifty-two normal blind subjects was there any variation from "*silk* feels nicer than serge, *velvet* feels nicer than carpet, and *velvet* feels nicer than serge." In that case the boy gave *silk* once and *serge* once, as feeling the nicer of these two. This test is clearly at a lower limit of age than that of any person we tested.

VII 4. Counting 9c in blocks. (Binet's giving value of nine sous, three of which are double, and Goddard's counting value of stamps,—three one-cent and three two-cent stamps). Our test consists of counting the value of three large blocks, which in play are considered pieces of candy worth 2c each, and three small blocks considered pieces of candy worth 1c each (Irwin).

At VII years one of one succeeds.

At VIII years one of one fails.

At IX years two of three succeed.

At X years three of six succeed.

At XI years three of four succeed.

Beyond XI all succeed.

Ten seconds seems to be ample time after the problem is definitely comprehended. Is probably a VII-year test.

VIII 1, (P. S. 12). Differences. Two distinct differences between each of two of three pairs of objects:

- (a) Apple and banana
- (b) Wood and glass
- (c) Paper and cloth

The objects compared are different from those of Binet, and two differences are required, in each case.

At IX years one of three subjects succeeds.

At X years five of seven subjects succeed.

At XI years five of six subjects succeed.

With the standard adopted this is probably a X-year test for the blind. There is a chance it will go lower, with more numerous results.

VIII 2, (P. S. 14). Counting backward from 20 to 1. Six of seven X-year olds do this without any error, in an average of 14 seconds each. Eighteen seconds is the longest time recorded. Of three IX-year olds one does it without error in 15 seconds; one, with one error in 20 seconds; one utterly fails. One VIII-year old does it without error in 17 seconds. Very likely an VIII-year test. Our group of IX-year olds are exceptionally slow.

VIII 4. Day and Date. The day of the week, the year, and the month, were known, and the day of the month within three days, by one VIII-year old, by four of seven X-year olds, and by five of six XI-year olds. One VII-year old and three IX-year olds failed. It is probably a high X-year test for the blind.

VIII 5, (5 digits) (XV-years seven digits). Memory Span for Digits. In repeating digits the blind seem superior. Repeating six digits is probably an VIII-year memory span for the blind. It is done by one VIII-year old, two of three IX-year olds, and seven of seven X-year olds, and four of six XI-year olds.

Repeating 7 digits.

At X years five of seven succeed.

At XI years four of six succeed.

At XII years three of three succeed.

At XIII years two of three succeed.

At XIV years five of five succeed.

Repeating 7 digits is probably an average accomplishment of a X-year old blind child.

Repeating 8 digits:

At XIV years five of five succeed.

At XV years one of three succeeds.

At XVI years two of three succeed.

At XVII years two of three succeed.

At XVIII years four of five succeed.

This may be a XIV-year test for the blind.

Goddard's standards are: 3 digits = VIII years,

6 digits = X years,

7 digits = XII years.

Terman's standards are: 5 digits = VII years.

6 digits = X years,

7 digits = XIV years,

8 digits = XVIII years, or high adult.

IX 3. Naming Coins. The five coins, penny, nickel, dime, quarter, and half dollar, were laid on the table, and the subject was asked to name each, as he handled it. Absolute accuracy was required for credit. Results on this test are very unsatisfactory. The differentiation of a penny and dime by a blind person depends upon a special piece of knowledge, the milled edge of the dime. For the institution child this is very special.

At IX years one of three succeeds.

At X years three of five succeed.

At XI years one of three succeeds.

At XII years two of two succeed.

At XIII years one of two succeeds.

At XIV years three of three succeed.

It may be a XII-year test.

IX 4. Months named. The months were named correctly by a VII-year old, by one of two VIII-year olds, by one of two IX-year olds, and by seven of seven X-year olds. Each of these gave them in 10 seconds, or less. Most gave the three checks, "What month before April; July; November?" correctly. Giving all the months with no error in 10 seconds, and three checks correctly, is probably an VIII-year test.

IX 5. Comprehension. We used the questions of Terman's 3" Degree Comprehension series, and recommend also his 1", 2", and 4" Degree Comprehension Tests, as designed for years IV, VI, and XI respectively. This 3" degree series, two of three correct, he finds standard for VIII years. The questions are as follows: "What's the thing for you to do"

- (a) "When you have broken something which belongs to someone else?"
- (b) "When you notice on your way to school that you are in danger of being tardy?"
- (c) "If a playmate hits you without meaning to do it?"

Scores for 3" degree, VIII-year:

At VII years one gives only one correct answer.

At VIII years one succeeds.

At IX years one of three succeeds.

At X years six of six succeed.

May be an VIII-year test for blind. Data are too limited for standardizing the test. Certainly lower than a X-year standard.

4" Degree Comprehension. (Terman, XI-year test, two of three answered correctly.)

- (a) "What ought you to say when someone asks your opinion about a person you don't know very well?"
- (b) "What ought you to do before deciding something very important?"
- (c) "Why should you judge a person more by what he does than by what he says?"
- (d) "Why do we more easily forgive an unkind act done in anger than one done without anger?"

Our subjects failed to score 75 per cent cases correct before XII years. Three XII-year olds tried and each gave two correct. Of five XI-year olds tried, one made no score, two gave one correct answer each, one gave two, and one two and one-half. Probably a XII-year test for the blind.

X 1, (P. S. 18). Arranging Weights. By the Binet standard, two of three trials correct, this looks like a high X-year test for blind. Binet placed it at X years for seeing children.

At VII years one succeeds.

At VIII years one fails.

At IX years two fail.

At X years four of seven succeed in 1" or 2" trial. Only one fails in both 1" and 2" trials; one in 1" and 3"; and one in 2" and 3".

At XI years five of six succeed, or 83.3 per cent (1" or 2" trials). By the Yerkes-Bridges standard (either one of two trials correct), it is much easier. One at VII years, one at VIII years, and two at IX years all pass.

X 3, (P. S. 19). Absurdities.

Yrs. of Age	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
No. of	1	1	2	5	4	5	5	5	4	5	5	5	4	5	5	5
Absurdities			1	2	4	5	4	5	4	5	4	4	3	5	5	5
each subject				2	4	3	2	5	4	4	3	3		5	5	4
saw through				2	2		1	4								
				1	1			3								
				1	0											
				0												

TABLE IX. Shows the numbers of the five absurdities (see instructions for the P. S. for the Blind, No. 19) each one of the fifty-two normal blind subjects saw through and explained. Arranged in year groups and in the order of achievement.

Our results possibly indicate the following age norms for the blind in "Absurdities":

Five absurdities out of five = XX years.

Four absurdities out of five = XIV years.

Three absurdities out of five = XI years.

Two absurdities out of five = X years.

Four of five correct is clearly an easy XIV-year test.

X 5, (P. S. 17). Three given words in a sentence. A XII year test for the blind.

At XI years one of six succeeds.

At XII years two of three succeed.

At XIII years three of four succeed.

At XIV years four of five succeed.

At XV years two of three succeed.

Three words in two clauses or sentences. A high XI year test.

At X years three in seven succeed.

At XI years four in six succeed.

At XII years two in three succeed.

At XIII years four in four succeed.

All who attain either result do it in less than 60 seconds.

XII 1, (P. S. 7). Resisting suggestions. Wooden cubes placed in the two hands. Results: One VII-year, one VIII-year, and one IX-year old succeed. One VIII-year old fails.

Resisting two of the three (numbers 4, 5, and 6), by giving "left larger" or "just the same," constitutes a pass. At X years five of seven "resist the suggestion" (four of these make 3 in 3).

At XI years six of six resist the suggestion. Probably a lower than X-year test for the blind. In Group 4, (subjects saw the lines and took the regular Binet test) forty-five records, including two VIII-year olds and two X-year olds, are practically all passes. This, too, indicates a lower than X-year test.

XII 3, (P. S. 11). Words given in three minutes. Free association. (See description, P. S. 11). Giving forty words in three minutes seems to be the normal accomplishment of a VII or VIII-year old blind child. Sixty words normal to X years; eighty words normal to XIV years.

Yrs. of Age	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	40	48	46	92	106	112	84	128	129	108	126	168	132	96	126	124
			44	76	87	92	69	87	110	86	101	91	119	86	115	91
			16	73	82	37	54	85	83	57	89	91	78		94	65
				73	71		50	56				70	77			
				67	51			53								
				57	36											
					34											

TABLE X. Presents the numbers of words given in three minutes by normal blind children in order of age and accomplishment.

XII 4, (P. S. 20). Definitions of abstract terms. (Obedience, charity, and justice). One of three correct. Normal for XI years.

At VIII years one of one succeeds.

At IX years neither of two succeeds.

At X years four of seven succeed.

At XI years four of five succeed.

At XIII years three of three succeed.

Two of three correct.

At XIII years two of four succeed.

At XIV years four of six succeed.

At XV years three of three succeed.

Probably normal for XIV years. The same figures hold for three of three correct at XIV and XV years. This also is a XIV-year attainment.

XII 5, (P. S. 22). Disarranged sentences. Presented in New York Point.

Two of three correct.

At X years one of eight succeeds.

At XI years two of two succeed.

At XII years two of three succeed.

At XIII years two of four succeed.

At XIV years three of four succeed.

At XV years three of three succeed.

The blind child often requires longer than 60 seconds. Finger reading is a slower and more absorbing process. A XIV-year old test for the Blind.

XV 2. Rhymes. Three for each one of three words in three minutes.

At IX years none of two succeeds.

At X years six of seven succeed.

At XI years five of six succeed.

Twenty-eight older persons, tested, all succeeded. A X-year test.

XV 3. (P. S. 3 (c)). Verbal Memory. Binet used twenty-six syllables. We used twenty syllables in two sentences. "It is not necessary to hurt the birds. It is night and all the world rests in peace." Absolute accuracy necessary to score. Given in the Point Scale after two shorter sentences.

At VIII years one of one succeeds.

At X years four of seven succeed.

At XI years one of eight succeeds.

At XII years one of three succeeds.

At XIII years two of four succeed.

At XIV years five of five succeed.

At XV years none of three succeeds.

At XVI years two of three succeed.

May be a XIII-year test for the blind. This is not a satisfactory

verbal memory test. Terman's XI-year, one out of three correct, works much better, and is probably placed about right for the blind.

XV 5. Problems of Fact. Add to the two of Binet, Terman's "White man walks sitting down." Credit for two of three correct.

At XI years two of three succeed.

At XII years two of two succeed.

At XIII years neither of two succeeds.

At XIV years one of five succeeds.

At XV years three of three succeed.

At XVI years one of two succeeds.

At XVII years two of three succeed.

At XVIII years one of four succeeds.

At XIX years one of two succeeds.

At XX years three of three succeed.

At XXI years three of three succeed.

At XXII years two of three succeed.

No standard derivable from these data. Not a satisfactory test for seeing persons. For the blind, the limitations of experience present special difficulties.

Adult 3. Differences in meaning between abstract terms. Terman's five pairs substituted for Binet's three pairs:

Laziness and idleness.

Poverty and misery.

Character and reputation.

Pride and pretension.

Evolution and revolution.

One clear difference stated for each one of three of the five pairs necessary for a pass (Terman).

At X years one of one fails.

At XI years one of one fails.

At XIII years two of two fail.

At XIV years three of three fail.

At XV years three of three fail.

At XVI years one of two succeeds.

At XVII years three of three fail.

At XVIII years one of three succeeds.

At XIX years one of two succeeds.

At XX years one of one succeeds.

At XXI years one of two succeeds.

At XXII years three of three succeed.

Unsatisfactory results. Seems safe to consider it a high adult test for the blind.

Adult 4. Differences between king and president of a republic. Two of three necessary to score. All fail up to and including XIII years.

At XIV years one of three succeeds.

At XV years four of four succeed.

At XVI years one of two succeeds.

At XVII years three of three succeed.

A low XV year test for the blind.

Binet 1908 Series, X year. Memory of Selection read once to subject.

“FIRE DESTROYS THREE HOUSES”

“New York, Sept. 5. A big fire in Kingston last night destroyed three large houses in the centre of the town. Seventeen families are without shelter. The loss is more than thirty thousand dollars. While saving a child in his cradle, a barber’s boy had his hands very seriously burned.”

This is a modified form of the Binet 1908 X-year test. Goddard recommends an easier one as a IX-year test. Terman uses a similar story as a X-year test. He has twenty-one items, allows three mistakes in reading and requires eight items. Seeing subjects read the selection aloud once. To the blind the above selection was read once very carefully. At X years seven subjects gave 14, 12, 11, 10, 8, 6, and 3 items. At XI years five subjects gave 13, 12, 12, 11, and 4 items. All good results were attained in less than 60 seconds after the reading. Eight items in 60 seconds is indicated as a X-year test for the Blind. Possibly eleven or twelve items may prove to be an XI-year standard. The *news item* feature of the selection is confusing. The blind subject does not understand the repetition. The two places mentioned often lead him to speak of two fires. A simple narrative would be better. Thorndike’s Shipwrecked Sailor is recommended.

Designation of Test	Year assigned by Binet, 1911.	Year assigned by Goddard.	Year assigned by Terman.	Tentative year place for the Blind
Comp. of 6 & 15 gm. wghts. and 9 & 18 gm.	V	V	V	Below VII
Defins. sup. to use.	IX	IX	IX	X
Diff's bet. 2 things.	VIII	VIII	VII	VIII?
Count. backward 20-1	VIII	VIII	VIII	VIII?
Day and date	VIII	IX	IX	X+
Memory Span, 5 digits	VIII	VIII	VII	
Memory Span, 6 digits		X	X	VIII?
Memory Span, 7 digits	XV	XII	XIV	X?
Memory Span, 8 digits			XVIII	XVI?
Nam.ing Coins		X (9 pieces)	VI (4 pieces)	XII? (5 pieces)
Naming Months	IX	IX (1 omiss.)	X (no omiss. 3 checks)	VIII? (3 checks)
Comprehension, 3" Deg.			VIII	IX
Comprehension, 4" Deg.			XI	XII
Arranging Weights	X	IX	X	X+
Absurdities	X (3 of 5)	XI (3 of 5)	XI (4 of 5)	XI (3 of 5) XIV—(4 of 5)
Three words in two sentences	X	X ½ succeed XI all "	IX	XI+ (3 words in 1 sent. XII)
60 words in 3 minutes	XII	XI	XI	X
Definitions of 3 abs. terms	XII	XII	XII	XI (1 of 3) XIV (3 of 3)
Disarranged sentences	XII	XII	XII	XIV
Rhyming	XV	XI	IX	X
Problems from Facts	XV	XII	XIV	not derivable
Difference bet. 3 of 5 abstract terms	Adult	Adult	XVI	High Adult
Differences bet. King and President	Adult	Adult	XVI	XV

TABLE XI. Standards of Tests by years by (1) Binet, (2) Goddard, (3) Terman, and (4) for the Blind.

In table XI we exhibit in parallel columns the years for which Binet (1911), Goddard, and Terman, have considered twenty-three tests standard, in so far as each of these investigators *has proposed* standards for these tests. In the fourth column the years are set down which are pointed out as probable standards for these tests from the survey of blind subjects herein reported. Of these the following tests come at *later* years for the Blind than for seeing subjects:

1. Definitions superior to use.
2. Day and date.
3. Naming coins.
4. Comprehension tests.
5. Absurdities.
6. Disarranged sentences.

The following come at earlier years:

1. Memory Span for digits.
2. Naming months.

As we had so few subjects under ten years of age, every suggestion of standard below ten must be received with great caution. Such tests as (1) Enumeration of Objects in a Basket, (2) Comparison of 4 and 6 cm. sticks, and (3) Aesthetic Choices between kinds of fabric, are certainly standard for years below X. But no definite standard can be set from our data for any one of these tests.

Our substitute for Binet's Patience, (V yr.) necessitated by the sensory limitations of the blind, seems to be a much more difficult test for the blind, than is the *Patience* with cards for the seeing subject. The *Block* Patience is provisionally placed as a X-year test for the blind.

In substituting blocks for the lines of Binet in the "resisting suggestion" test, one *may* have adopted a radically different standard of suggestion. Only a long series of experiments with normal subjects would prove what tactual differences in cubes are comparable to visual differences of 1 cm. in lengths of lines from 4 to 7 cm. The method of presentation is not parallel. As to the mental processes involved in the judgments made, however, there can be no doubt that this block test exhibits the same

“suggestibility resulting from heedlessness or lack of attention,”⁶ in the blind who fail, as do Binet’s lines in the seeing who fail. Also the same elements of character and emotion and feeling come into play in this block test as in the line test.

Our results place this certainly as low as X, and indicate it may go lower. Binet and Goddard consider the *lines suggestion*, a XII-year test. Terman lowers it to IX. This accords with the writer’s experience with the line test with delinquents who prove defective. In scores of records this test stands with a *plus* check, whereas all other XII and XI-year tests are marked minus. Results from the pupils at the Ohio State School for the Blind, who see sufficiently to take the line test, also bear out the same point, that this quality of critical attention, and resistance, to the easy path of habit, is a quality of mind which emerges between IX and X years of age.

* See a Meth. of Measuring the Devel. of the Intell. of Young Children, Binet and Simon. Trans. of Dr. Town, p. 53.

VIII

OTHER INDIVIDUAL TESTS FOR A YEAR SCALE

I. Knox Lines, revised by Pintner. Pintner's provisional standards are:

1 of lines X and Y correct = V year.

1 of lines B, C and D correct = VI year.

2 of lines B, C and D correct = VII year.

1 of lines E, F and G correct = X year.

Group 1 with Fingers.

Group 1 with Fingers.

Age	10	11	12	13	14	15	16	17	18	19	20	21	22
Nos. of subjects tested.	7	6	3	4	5	3	3	2	4	2	3	4	3
Of lines B, C, & D, two correct.	2	6	3	2	5	3	3	2	4	2	3	3	3
“ “ E, F, & G, one correct.	5	5	3	3	5	3	2	1	4	3	3	3	3
“ “ E, F, & G, two correct.	2	3	2	2	5	2	2	1	2	2	1	0	2
“ “ H, I, & J, one correct.	2	1	2	1	2	2	1	1	1	0	1	2	3
“ “ H, I, & J, two correct.	0	0	2	0	1	2	0	0	1	0	0	0	2

Group 4 with Cubes.

Nos. of subjects tested.	2	2	6	6	6	5	2	3	3	—	2	—	2
Of lines B, C, & D, two correct.	2	2	5	6	4	5	2	3	4	—	2	—	2
“ “ E, F, & G, one correct.	2	1	3	6	5	4	3	3	3	—	2	—	2
“ “ E, F, & G, two correct.	0	1	1	4	4	2	1	2	2	—	2	—	1
“ “ H, I, & J, one correct.	0	0	1	2	1	3	1	1	2	—	1	—	—
“ “ H, I, & J, two correct.	0	0	0	1	1	2	1	0	0	—	0	—	—

TABLE XII. Gives the numbers of subjects in age groups of Group 1 and Group 4, and the numbers of subjects reaching various stated standards with the Knox Lines by *finger* and *cube* methods.

The data from the blind subjects working with finger touching (Group 1), and from others with sufficient vision to use the cubes (Group 4) are presented for comparison with these standards in Table VII. *Two* correct, of lines B, C, and D, as a cube test, seems to be lower than X for seeing subjects, but about an XI-year test for the blind. *One* correct, of E, F, and G gives promise of working out to a less than X-year test for both seeing and blind subjects. If this system of evaluation is adopted, (year standards) *one* of E, F, and G correct is apparently a better and easier standard than two of B, C, and D.

Further, on this line of year standards, *two* of E, F, and G correct, seems a fair XIV-year standard for the blind, and XIII-year standard for seeing subjects. *One* of H, I, and J may be a XV-year standard for both classes. It must be allowed, however, that these results do not afford a sufficient basis for more than the most preliminary guessing as to year standards. Unless larger numbers later indicate a more even progress of accomplishment, following the years, one must question whether these Knox Lines measure any mental capacity which develops through these adolescent years from X to XX. The lines, whether perceived visually or tactually, do present an admirably graded series of spacial and temporal *plans*, or organizations of motor coördinations, to be carried out by the subject. They undoubtedly have a valuable place as year tests below X, and are well worth preservation as an integral part of a point scale. It may well be a somewhat specialized mental capacity,—this ability to schematize and set in their relations to each other, in time and space, a series of tactual or visual stimuli, and to represent them through one's own activity. Auditory and visual memory are clearly recognized as such fields of wide individual variation. The existence of such individual variations, and these varying independently of age development, is an argument, however, not against an attempt at measurement, but against measurement of mental process in terms of years of age. It is an argument against year scales, and for such a scale as will measure mental process by mental process,—the only known unit of mental measurement. Such a scale is the point scale.

The Finger Tapping Test demands memory for temporal and spacial relations, constructive imagination, and facility in motor coördination. It is not the same kind of construction and execution, as those employed in the Cube Test. Not only is the structural material different, inner and outer tactual imagery, with no visual, but the pattern must seem much more intimately a part of one's self. For all this intimacy though, a series consists of a number of frequent and habitual movements, which are so habitual that they are hard to coördinate by voluntary direction. One encounters here the difficulty of control and

Years of Age	No.	Finger Tapping	Cube Test		Cube Test
		Blind Subjects	Seeing Subjects	O. S. S. B.	Pintner's school children
		Group 1	Group 4		
		Av. No. of lines passed	No. lines passed	Av. No. of lines passed	Av. No. of lines passed
IV					0.43
V					1.41
VI					3.22
VII	1	0			4.12
VIII	2	3.00	2	6.50	4.60
IX	2	3.00	1	2.00	4.59
X	10	4.10	5	4.60	5.29
XI	9	4.33	4	5.00	5.68
XII	5	6.00	8	5.62	5.66
XIII	6	5.50	8	7.25	5.66
XIV	5	7.40	8	6.50	6.55
XV	5	6.80	6	6.83	6.45
XVI	4	6.00	3	8.00	7.05
XVII	4	6.00	3	6.33	
XVIII	5	6.80	5	6.60	
XIX	4	6.25	1	7.00	
XX	6	5.80	3	7.00	
XXI	6	5.50	0		
XXII	5	6.00	2	6.00	

Table XIII sets forth the average numbers of the eleven Knox Lines given correctly by each year group of subjects of Group 1 and Group 4. We also give Pintner's average numbers of lines passed at given years by children in the public schools.⁷

organization of reflexes. The processes involved seem more difficult, on comparison of the *finger tapping* results of Group 1 with the *cube* results of Group 4. In nine of fourteen years, where results are at hand for both groups, we find the cube tests of Group 4 averaging higher, whereas Group 4, in average attainments by Point Scale, runs lower than Group 1 (*cf.* figure 3).

In seven of ten comparable year groups, Pintner's subjects also show results superior to those of blind subjects. These data as to different numbers of lines for the seeing (Pintner's results with cubes, one line subtracted) and for the blind (with finger tapping) seem to suggest the following as tentative and provisional standards.

⁷ See "The Standardization of Knox's Cube Test," by Rudolph Pintner, *The Psychological Review*, Sept., 1915, page 395. Pintner counted Line A in his scores. We may assume Line A was always correct. Subtracting one from each of his averages, we have reasonably satisfactory data for comparison with our averages.

	Seeing (Cubes)	Blind (Tapping)
Three lines	VI years.	VIII years.
Four lines	VII years.	X years.
Six lines	XI years.	XII years.

2. Adaptation Board (P. S. 6) (Goddard, with Pintner's technique). Summary Record of blind subjects: (a) First trial correct in three of four changed positions.

At VII years one of one succeeds.

At VIII years one of one fails.

At IX years one of two succeeds.

At X years six of seven succeed.

At XI years five of six succeed.

(b) First trial correct in four changed positions.

At X years three of seven succeed.

At XI years one of six succeeds.

At XII years three of three succeed.

At XIII years two of four succeed.

At XIV years none of five succeeds.

At XV years three of three succeed.

At XVI years three of three succeed.

One trial correct in three of the four positions, seems to be a low X-year test, six out of seven, or 85 per cent, attaining to this or better. The data below X are too limited, however, to preclude moving this standard lower. All of the four positions correct, first trial, seems to be a XV-year attainment for the blind subject.

3. Size-Weight Illusion.

Below X years two of four succeed.

At X years seven of seven succeed.

Above X years forty-eight of fifty succeed.

Standard for some age below X.

4. Knows Birthday. The date of birth is assumed to be that upon the institution records. This record is not infallible. This impairs the value of the test for institution cases.

At VII years one of one fails.

At VIII years one of one succeeds.

At IX years two of three succeed.

At X years five of seven succeed.

At XI years five of five succeed.

At XII years three of three succeed.

At XIII years three of four succeed.

At XIV years five of five succeed.

At XV years two of three succeed.

A purely information test. Not of much value in measuring development of mental capacity. Is probably a VII-year standard.

5. Season of the year. "What season of the year is this?" was followed by "What season came before this?" "What season comes after this?" All three were answered correctly in all of thirty cases of Group I tested. These thirty include one VII-year old, two VIII-year olds, two IX-year olds, and seven XII-year olds. The test evidently falls in the years earlier than VII.

6. Repeating digits backward. Numbers are given at the rate of one per second, and three trials are given before recording a failure. Reversing three digits may be an VIII-year test. Our one VIII-year old fails on three and succeeds on four digits. One IX-year old reverses four and another reverses five digits. Reversing five may be a IX-year test. Reversing six digits is accomplished by 80 per cent of the XIV-year olds, and only 50 per cent of the XIII-year olds, but 100 per cent of the three XII-year olds. Probably a XIV-year test. It may be a XII-year test. Terman considers reversing of three digits an VIII-year test, and reversing five digits a XII-year test.

There are some indications that the blind show the same advancement over seeing subjects in reversing as in repeating series of digits. This is to be expected. The subject who is to reverse a series is often heard to repeat the series as given before reversing it. Ability to give a series reversed depends first upon ability to *remember* the *series*.

7 Similarities of two things (Terman). Credit for three of five correct. "In what way are _____ and _____ alike?"

(a) "Wood and coal?"

(b) "Apple and peach?"

- (c) "Iron and silver?"
- (d) "Ship and automobile?"
- (e) "Cat and bird?"

At IX years three of three fail.

At X years four of seven succeed.

At XI years five of six succeed.

A high X-year test for the Blind. Terman considers this a standard accomplishment for IX years.

8. Similarities of three things (Terman). Credit given for three of five correct. In what way are ———, ———, and ——— alike?"

- (a) "Snake, cow, sparrow."
- (b) "Wool, cotton, leather."
- (c) "Knife-blade, penny, piece of wire."
- (d) "Rose, potato, tree."
- (e) "Book, teacher, newspaper."

At XI years one of six succeeds.

At XII years two of three succeed.

At XIII years two of three succeed.

At XIV years four of five succeed.

Seemingly a XII-year old test for the blind. Terman considers this a standard XII-year accomplishment.

9. Naming days of week backward. In fifty-four records there is only one error in this test. One of three IX-year olds made this single omission. One VII, and one VIII-year old performed the task correctly. Probably a VII-year test or even VI. Eight seconds time is sufficient.

10. Naming months backward.

At IX years none of two succeeded without error.

At X years four of seven succeeded without error.

At XI years five of six succeeded without error.

Appears to be a high X-year test.

11. (P. S. 10 (a)). Touching right hand of examiner, sitting opposite with his hands upon his knees.

At VII years one of one succeeds.

At VIII years one of one succeeds.

At IX years three of three succeed.

At X years four of seven succeed.

At XI years five of six succeed.

The only failure among thirty-nine subjects of groups 2 and 3 is one at VIII years. This is probably a VI or VII-year test. The percentage of failures at X dictates caution and accumulation of more data.

12. (P. S. 10 (b)). Orientation. Knowledge of the relative positions of cardinal points of the compass. Requires accuracy in both tests, pointing to the other three cardinal points of the compass when facing north, and when facing east. This appears to be a XV-year test for the blind. With seeing subjects of the same school, it is clearly a test falling lower than X years.

Results with the blind of Group 1 :

At VII years one of one fails.

At VIII years one of one succeeds.

At IX years one of three succeeds.

At X years four of seven succeed.

At XI years four of six succeed.

At XII years three of three succeed.

At XIII years two of four succeed.

At XIV years two of five succeed.

At XV years two of three succeed.

At XVI years three of three succeed.

At XVII years two of two fail.

At XVIII years three of four succeed.

In Group 3, twenty-three subjects from X to XXI all succeed.

13. Problems of Enclosed Boxes (Terman). One large box containing :

(a) Two smaller; and one inside of each of these latter.

(b) Two smaller; and two inside of each of these latter.

(c) Three smaller; and three inside of each of these latter.

The question in each case is, "How many boxes all together?" Two of the three must be answered correctly. A box was put into the hands of the blind subject, and he was asked the three hypothetical questions in order, in regard to that box.

Results :

- At X years one of four succeeds.
 At XI years four of five succeed.
 At XII years three of three succeed.
 At XIII years two of three succeed.
 At XIV years one of five succeeds.
 At XV years two of three succeed.

Only two failures with twenty-one subjects above XV. It seems quite possible this may prove a lower standard test for the Blind than for Terman's seeing subjects. For the present we must consider it a test for XV years.

14. (P. S. 21). Analogies. (Yerkes and Bridges. Adopted from Stanley Wyatt.)

Age	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Nos. of analogies correctly completed.	3	1	3	4	5	5	6	6	5	5	6	5	6	6	5	6
Each no. is the record of one subj.			2	4	3	5	5	6	5	4	6	4	4	6	5	6
			2	3	4	3	4	4	3	3	3			4	4	5
			2	2			1	3			3					
			2	2				2								
			2	1												
				1												

TABLE XIV. Numbers of analogies correctly completed shown by age groups of subjects.

The total number of analogies was six. (See description, P. S. 21). These results of analogy tests with blind subjects indicate a value of the test as in itself constituting a scale for intelligence measuring. Two of the six analogies completed indicates a level of IX years or beyond. Three of the six completed indicates a level of XII years or more. Four of the six completed indicates more doubtfully a level of XV years.

15. Arithmetical Reasoning (Terman). Two of three problems correct. Sixty seconds each.

- (a) "A man earns \$20 a week and spends \$14. How long will he require to save \$300?"
 (b) "If three pencils cost 5c, how many can one get for fifty cents?"
 (c) "At 15c a yard, how much will 7 feet of muslin cost?"
 At X years one of one succeeds.
 At XI years one of four succeeds.

- At XII years one of two succeeds.
 - At XIII years two of three succeed.
 - At XIV years four of five succeed.
 - Beyond XIV twenty-one of twenty-three succeed.
- Clearly a XIII-year test for these blind subjects.

Summary of tentative year values of Tests, other than Binet's, for mental measurement of the blind:

1. The Knox Lines given and represented upon fingers.
 - For X years one of E, F, and G, correct.
 - For XI years two of B, C, and D, correct.
 - For XIV years two of E, F, and G, correct.
 - For XV years one of H, I, and J, correct.
2. Goddard's Adaptation Board. (Pintner's four moves).
 - For X years or lower, 1" trial correct in three of four positions.
 - For XV years 1" trial correct in four of four positions.
3. Size Weight Illusion.
 - For lower than X years.
4. Knows birthday.
 - For lower than VIII years.
5. Knows season of the year.
 - For VII years or lower.
6. Repeating digits backward.
 - For VIII years reversing three digits.
 - For IX years reversing five digits.
 - For XIV years reversing six digits.
7. Similarities of two things.
 - For X years, high. (Terman, IX years).
8. Similarities of three things.
 - For XIV years. (Terman XII years).
9. Naming days of the week backward.
 - For VII or VI years.
10. Naming the months backward.
 - For X years, high.
11. Touching right hand of examiner, sitting opposite with his hands on his own knees.
 - For VII or VI years.

12. Orientation. Cardinal points of the compass.
For XV years.
13. Problems of enclosed boxes.
For XV years.
14. Analogies.
For IX years, two analogies completed.
For XII years, three analogies completed.
For XV years, four analogies completed.
15. Arithmetical Reasoning.
For XIII years. (Terman XVI years).

Arrangement of the individual tests (including Binet Tests), under the years for which they are provisionally indicated as standard by these examinations of fifty-two blind persons. For VII or VI or lower:

(Data are insufficient for a more accurate placing of these tests.)

Naming days of the week backward.

Touching right hand of examiner.

Size-Weight Illusion.

Knowing birthday.

Knowing season of the year.

Comparison of 6 and 15, and 9 and 18 gm. weights.

Memory Span for five digits.

Naming *forty* words in three minutes.

For VIII.

Differences between two things.

Counting backward from 20 to 1.

Memory Span of six digits.

Reversing three digits.

Naming the months.

For IX.

Comprehension, Terman's 3" Degree (2 of 3).

Reversing five digits.

Two of six analogies completed (Wyatt).

For X.

Definitions superior to use.

Day and date.

Memory Span for seven digits.

Arranging weights.

Naming 60 words in three minutes.

Rhyming.

One of E, F, and G, Knox Lines correct.

Three positions of Adaptation Board, 1" trial.

Similarities of two things (3 of 5).

Block Patience.

Resisting suggestion (Blocks).

For XI.

Three of five "absurdities" explained.

Three words in two sentences.

One of three abstract terms defined.

Two of B, C, and D, Knox Lines correct.

For XII.

Naming five coins.

Comprehension, Terman's 4" Degree (2 of 3 cor.).

Three of six analogies completed (Wyatt).

For XIII.

Arithmetical reasoning (Terman). (2 of 3 cor.)

For XIV.

Four of five "absurdities" explained.

Three abstract terms defined.

Disarranged sentences put together (2 of 3).

Two of E, F, and G, Knox Lines correct.

Reversing six digits.

Similarities of three things (Terman). (3 of 5 cor.)

Naming 80 words in three minutes.

For XV.

Differences between president and king.

One of H, I, and J, Knox Lines, correct.

Adaptation Board, four positions correct 1" trial.

Orientation. Cardinal points of the compass.

Problems of enclosed boxes.

Four of six analogies completed (Wyatt).

For XVI.

Memory Span of eight digits.

For High Adult.

Differences between abstract terms.

Many other intelligence tests of years III to VII, beside those mentioned above, are adaptable to the blind. No difficulty will be found in standardizing sufficient tests for each year, of the year scale, for the blind.

IX

THE MENTAL ORGANIZATION OF THE BLIND COMPARED WITH THAT OF SEEING SUBJECTS BY MEANS OF INTELLIGENCE TESTS

Reference has already been made to the comparative rating of intelligence of blind and seeing subjects as these are revealed by point scales for measuring intelligence. Therein we found no reason to concede any superiority, in the matter of adaptability to his environment, to the seeing subject. There appeared no fact making for the inferiority of the intelligence of the blind, because of his sense defect. It was recognized, however, that the deprivation of visual imagery makes necessary the use of an entirely different architectural plan, for the blind person, in putting together the elements of his experience.

We are now in a position to draw some inferences as to the differences in the composition or organization of experience in seeing and blind persons, as the results of the different age norms for various tests for the two classes of subjects. The blind seem, from the survey of this small group of persons, totally blind from birth or early childhood, to come *later* to the successful performance of the following tests:

1. Naming coins.
2. Giving day and date.
3. Pointing out remaining points of the compass when facing one.
4. Knox lines on fingers.
5. Patience with blocks.
6. Arranging disarranged sentences.
7. Definitions in terms superior to use.
8. Comprehension.
9. Absurdities.
10. Similarities.


1 and 2. No significance need be attached to 1 and 2. Naming coins is a matter of special training, of which the institution child has very little. Further, as already noted, the differentiation of a cent and dime by tactual impressions alone, is a very special process. Highly intelligent blind adults often take considerable time to distinguish these coins. There is no vital difference between the psychological processes of the congenitally blind in this test, and those of the subject with good vision, performing this experiment with his eyes closed. Giving day and date depends upon formal instruction, and is bound to vary with the practice of the school attended.

3. In the serious difficulty many of these subjects exhibit when asked to point to the remaining points of the compass while they know they are facing in a given direction, we encounter a real difference between the mental processes of blind and seeing subjects. Without vision it is impossible to get the same conceptions of space, and those space conceptions which are developed will be matured much more slowly. This is partly because human space conceptions utilize visual imagery,—in fact are largely visual schemata,—and the blind must find their own tactual and inner tactual substitutes for these, in order to construct the spacial aspects of their own experience, and come into possession of a framework upon which they can organize the communications of seeing subjects, and the literature they read. This construction of other than the visual imagery is in general a slower process, and results in an organization less adequate for the purposes of such larger orientation as is called for in this test. This test exhibits one of the marked handicaps under which those persons labor who are blind from birth or early childhood. No other imagery can be made to play the part of the visual in affording the large framework for spacial arrangement. Even in the matter of *pointing*, the blind rarely use the index finger alone, and very frequently the fingers are not extended. This follows naturally from the inability to appreciate fine differences in location. Could they see their own hands and arms, and could they sight a straight line, the procedure would take on a very different aspect to them. It would at once assume

definiteness of conception and precision of movement, which it lacks for them as blind. Even the poor vision of Group 4, very few of whom can see to read, but all of whom can see the way about, suffices to supply the synthetic space factor, so that their pointing is more definite, and their conceptions of location much more adequate.

4. Repeating Knox lines impressed by means of tactual imagery would hardly be expected to present the same amount of difficulty as the orientation test. However, it is an open question in the psychology of the genesis of space perception, in how far *visual imagery* affords the *scheme*, in the mind of a subject with normal vision, for the synthetic organization of outer and inner tactual impressions. It does seem clear that seeing subjects differ widely in this respect. Some habitually use visual forms for this purpose, and others make almost no use of visual forms for such synthesis. The results on the E, F, and G lines, and the higher age levels of given performances with the blind in average numbers of lines passed, however, do seem to indicate a greater difficulty with this sort of performance on the part of the blind. The assumption that visual imagery is the necessary synthetic factor for the seeing subject which binds together and organizes the inner tactual elements in a series of movements like a Knox line, would explain the poorer performance in the blind. The absence of vision, on such a theory, necessitates poorer work by the blind. We must not lose sight of the different character of the performance (finger tapping as compared to cube test) discussed on page 45. There is the interference of attention,—a characteristic embarrassment in endeavoring to reorganize reflex and automatic movements. Both the absence of visual imagery, and the difficulty of getting control of automatized movements, play parts in the explanation of this relative retardation of the blind in repeating Knox lines.

5. In the Block Patience we have excellent illustration of the function of visual imagery as the synthetic element, by which the imagination organizes the special elements of experience. This evidence comes both from the procedure of the subject and

from the indication that this is probably a X-year test for the blind, whereas it is a V-year test for seeing children. If the blind child has any vision whatever, he gets the two pieces of the dissected block up very close to his eyes. The blocks, it will be recalled, are laid thus:  on the table before him, after he has explored the whole block. The natural procedure for one proceeding wholly by touch would be to work with the blocks on the table, just as the seeing child works with the cards.

6. The longer time required for the arranging of the disarranged sentences is to be explained by the fact that reading by touch is slower than by vision. The blind subject is handicapped in speed of apperception, by his sense limitation. All of the tests involving space organization of experience which show retardation of the blind because they lack the synthesizing visual imagery, likewise involve and betray a lack in the blind of manual and general motor facility. Because they lack the guidance of visual control of their movements, the blind are less dextrous. For the same reason the blind person is less resourceful in dealing with his environment. To a certain extent he lacks initiative as compared with the seeing. By virtue of his sense deficiency, the environment makes fewer appeals to the activity of a blind child, than to a no more talented seeing child. The blind sits and reads or talks while the seeing child is trying out his powers, physical and mental, upon problems which have been thrust upon him.

From this compulsory reflection,—this way in which he is thrown in upon himself, we might expect the blind child to develop an agility of his wits and an effectiveness of the constructive imagination, superior to that of the seeing child. That this is not the case is shown by the backwardness of the blind in such tests as *comprehension*, *absurdities*, and *similarities*. That he is not more agile and skillful in handling such little problems demonstrates again that the really useful training of imagination and reasoning power occurs only by the personal handling of problems as they confront one in real life. There is no such thing as a perfection of pure reasoning *per se*. One learns to reason and to construct useful forms only as he is confronted

with practical difficulties, obstacles to the fulfillment of his desires. The constructive imagination organizes as the hands work out solutions to problems. In controlling movements constructive thinking is born and organized. So again this lack of mental agility falls right back upon the lack of manual dexterity, which in turn is traceable to the sense defect. The blind child does not experiment with the facts of life because they do not come to meet him as they do the seeing child, and because he can not exercise such skillful control of his own movements without vision. Because he does not experiment, he does not get the only effective training in that mental gymnastics which eventuates in constructive imagination,—in building up, as the result of his own maneuvers, the world of his inner experience, and gaining that power which deals more and more effectively with novel situations.

The tests in which the blind show themselves superior to seeing subjects are:

1. Repetition of digits.
2. Reversing series of digits.
3. Arithmetical reasoning.
4. Rhyming.
5. Naming the months.

These are results which one might predict from the sense defect and the kind of formal training which results. Verbal memory for figures is absolutely essential to any progress in arithmetic by the blind. And the arithmetic must be largely oral. Series of numbers remembered, is the first essential to reversing a series. The arithmetical problems are simple oral arithmetic problems. Reversing a series and the solution of these problems seem to involve, at first sight, the same kind of mental ability as that we just found underdeveloped in *comprehension* and *absurdity* tests. It is the same with a difference. Numbers and number work may be highly abstract, whereas these absurdity tests and comprehension tests deal with practical situations. To deal with the latter, one must actualize in his imagination the really human situation to a nicety of detail. In numbers we have a line of mathematical conceptions which serve as examples

of the purest logic. One can handle them successfully without any reference to the real world. It is in the application of his powers to practical problems that the blind finds himself handicapped.

The same point is emphasized by contrasting rhyming, in which the blind is proficient, with reasoning out of complex situations, in which he is backward. The purely formal language manipulation (rhymes) is a thing he practices upon. The child joy, in sound as such, has made a great appeal to him. But the practical use of language to depict actual situations does not get at him so intimately for the situation does not confront him so closely. He can not grasp its intricacies because he lacks the capacity to see it in the large. These proficiencies of the blind result in part in his interest in the purely formal, and in part from the accidents and emphases of his school instruction.

PARTIAL SCALES FOR MENTAL MEASUREMENT EMERGING FROM
THE USE OF BINET AND OTHER SINGLE TESTS

1. In the year scale employed by Binet, the use of pictures serves at once as a partial scale; mere enumeration being a III-year performance, description, a VII-year performance, and interpretation, indicating a XV-year level. Likewise, Binet's 1911 series uses memory span for digits as follows:

- 2 digits = III years.
- 3 digits = IV years.
- 5 digits = VIII years.
- 7 digits = XV years.

For the blind these standards are advanced. We followed Yerkes in introducing 4 and 6 digits, and Terman in introducing 8.

2. Terman's suggestion, introducing 3 and 5 digit series to be given backwards, led us to series of 3, 4, 5, and 6 digits. This test entails memory span for digits, and, in addition, a longer retention and manipulation while retained. It is a complex reconstruction of a series of ideas, entailing a skillful division of attention.

3. Terman's 1'', 2'', 3'', and 4'' Degrees of Comprehension constitute a valuable elaboration and grading of the material of Binet's IX and X-year *comprehension test*. This grading of the material has constituted of it a scale for measuring a subject's capacity to manipulate ideas which are complex and concrete, but presented purely verbally. It measures power for constructive thinking.

4. Terman's *similarities* of *two* and of *three* objects present two measurement levels of the development of analytic thinking. This kind of analytic thinking is later in its appearance than Binet's Differences. Roughly we have a three member scale series in the Difference test and these two grades of Similarities.

5. Binet's XII-year test of 60 words given in three minutes,

has been converted into a scale by the Yerkes-Bridges method of scoring. One can just as well standardize words for years. Forty words and 80 words seem as definitely standard for given years, as do 60.

6. Binet's 1908 X-year *Memories of a Selection Read*, or a simplified and lengthened narrative, either given to the subject to read aloud, or read to him, has in the number of items remembered, and the time required for recollection, the elements necessary for yielding standards for several levels of intelligence development. The number of items recalled is the important feature.

7. Wyatt's Analogies, which Yerkes and Bridges use, afford an efficient measure of the higher development of the capacity to maneuver ideas in relation to each other. The mental processes measured are not unlike those of the similarities tests. They are primarily analytical. They involve more free association to get the right idea into the field of attention. The scale is constituted by the numbers of the six analogies given correctly and the correlation of these numbers with stages of development.

8. The Knox Lines (Knox Cube Test) as developed by Pintner, constitute a scale for assessing intelligence development. Pintner has grouped the lines and endeavored to correlate performance in groups with years of chronological age. Because of irregularities of the grading of the lines it seems to me highly desirable to scale individual performances on the total number of lines, out of the eleven lines given, which given subjects re-present correctly.

9. Binet's X-year Test of Five Absurd Sentences, likewise, contains the germs of a scale setting standards of performance. The absurdities themselves are of different degrees of intricacy of organization. They could easily be developed into a series of much greater range of intricacy. In this Binet series, however, 1, 2, 3, 4, and 5 correct answers may each be correlated with a grade of intelligence development.

The point of this presentation of the germs of scales for intelligence measuring, which emerge from year scale tests and

the results therefrom, lies in this: Considered from the point of view of developmental psychology, the complex of mental performance measured by any given Binet test, is not something which emerges full formed, as Athene from the head of Zeus, at a given moment, or in a given year of the child's life. All these capacities for complicated performance grow gradually. We know that it is useless in general to present the problems of geometry to children of less than thirteen years of age. Likewise, it is useless to expect a ten-year old to answer more than one or two of Wyatt's Analogies, or an eight-year old to deal intelligently with more than two of Binet's Absurdities, or to *interpret* the pictures.

Upon this foundation rests the justification of any Point Scale for measuring the development of intelligence. The aim is to measure all the mental capacities of a given subject, and, as a result of his attainments in all these various lines, to compare him with other persons of similar origins, age, sex, training, and station in life, and to bring out of this comparison a statement not only *quantitative*, as to *how much* he is above or below the average of his class, but also a *qualitative* statement from the point of view of the psychology of character formation, as to what elements or *what kinds* of *mental organization* are inadequately or super-abundantly represented in his make-up.

The point scale, therefore, is not merely an attempt to economize effort in mental examination, and to secure the same results, as obtained by a year scale examination, in an easier way. It is a far more ambitious undertaking, actuated by an intelligent appreciation of the need for the application of rigidly scientific methods to the analysis of human nature. If our psychology is a science of mental processes,—if psychology does constitute any real analytic knowledge of the make-up and development of the inner nature of human beings, this knowledge must be applied in this field of mental tests. We must standardize performance (functioning) in all possible fields, when these fields are marked out by a logical procedure, and we must provide measuring instruments of precision for each one of these fields, which shall enable us to arrive at percentage values of any individual's

performance therein. Of course, psychology has not marked out these fields. Meanwhile, practical situations will not wait. The demands come from every side for the assaying of human nature. Human beings who are delinquent, or otherwise presenting problems to courts and school systems, are sent to psychologists for analysis. The courts and schools and parents are clamoring for expert guidance in the solution of their problems.

It seems that this practical field is the proper laboratory in which to work out the classification and development of human organization. Practical psychology must set about the scientific study of just this problem. Its solution will be found in the study of the shortcomings and perversions of human nature, rather than in what is commonly called the psychological laboratory, where normal persons work with measuring instruments of precision. And it is with this conviction firmly organized within his plan of procedure, that the psychologist proposes a point scale to replace the cruder year scale for measuring intelligence. It is not an instrument of precision, and it can not proceed upon the basis of a logical analysis of human nature. Such analysis does not exist. Until such exists any method of assessing intelligence development must be crudely applied. Procedure in mental examination upon such analysis of human nature as we do possess,—measuring in all persons certain actual human capacities to perform, is the only rational procedure, and one which necessity lays upon us. It is also the procedure *most* likely to produce a more logical analysis of human nature. It is the best application of the logic we possess, and holds out the best promise of bringing us forward to a better logic.

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The Process of Generalizing Ab- straction; and Its Product, the General Concept

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I. INTRODUCTION

The investigation which is here reported aims to make a contribution to the psychology of generalizing abstraction and its final product, the general concept. In arranging our experiments, our essential purpose was to ensure the presence of a genuine process of generalizing abstraction; to provide favorable conditions for an accurate introspective analysis and description of this process and its product; and then to obtain from a number of trained observers a complete and detailed account of the mental contents and factors involved in the process, and of the form in which the general concept which resulted from this process appeared in consciousness. Our endeavor has been to throw light upon the following questions: What are the events which transpire in an observer's consciousness after he has been confronted with a task whose successful performance necessitates the act of generalizing abstraction? What is the form in consciousness of the general concept? Does this form vary, in proportion to the age and deep-rootedness of the concept? Does there exist in any or all observers a specific consciousness of generality or of universality, when dealing with features which appear in every member of a group of objects? Do there exist marked individual differences in abstracting and in concept-form? If such differences exist, in what do they consist?

The investigation was conducted in the Psychological Laboratory of Clark University, during the years 1912 and 1913. Throughout the experimentation, our first debt has been to Professor J. W. Baird, who suggested the problem, and contributed generously of his time and energies both as advisor and as observer. It is a pleasure to take this opportunity of expressing our thanks to him, and to our other observers, whose patience and good will made the investigation possible. We are also indebted for many helpful suggestions and criticisms to Professor Mary W. Calkins, to Dr. Ivy G. Campbell, and to Dr. Arthur H. Sutherland.

II. HISTORY OF THE PROBLEM

A. GENERALIZING ABSTRACTION. a. **Non-experimental.** Until comparatively recent times, but little attention has been accorded to the processes of generalizing abstraction and of concept-formation; interest had centered rather on the question of the general idea.

Nevertheless, a few writers of antiquity and of the middle ages attempted to approach the problem. Aristotle (3, 134-145) wrote of an intellectual agent (since known as δ ποιητικὸς νοῦς), by which he meant the essentially active side of the mental life. In virtue of this νοῦς, we abstract; and abstraction is for Aristotle the ignoring of the accidental and the retaining of the general. Concrete sense-experiences are the original source of our knowledge. The intellect can never know these as they exist in nature; but their essence becomes present to the understanding in the form of abstractions.¹ Among the post-Aristotelian philosophers and the scholastics we have nowhere succeeded in finding a genuine contribution to a theory of abstraction, although numerous non-psychological classifications of various sorts of abstraction were attempted. A number of the schoolmen, notably Thomas Aquinas, advance a doctrine which in its essential points resembles Aristotle's conception of the acting νοῦς. Knowledge, wrote St. Thomas, is derived from the material of sense through the activity of the "intellectus agens," a higher agent which strips the objects of understanding of their particular features; and he calls this process abstraction (2).

Numerous theories of generalizing abstraction and of abstraction in the broader sense² appeared between the close of the medieval period and the rise of the experimental method. These may be classified roughly, according to the mental contents or factors which they emphasize, as follows: *a.* Theories which emphasize ideas or imagery: According to these theories, which are for the most part mechanical, abstraction consists in the mutual inhibiting of those part-contents which vary, together with the fusing and strengthening of those which recur.³

¹ Cf. Zeller, Aristotle and the earlier Peripatetics, Eng. tr. by Costelloe and Muirhead, I, 192 ff., esp. 207-209.

² In many instances writers have used the terms "abstraction" and "generalization" interchangeably, and have employed the expression "abstraction" when they obviously meant the process which we have called "generalizing abstraction."

³ Herbart, 36, 16 ff., 140-150; Psychologie als Erfahrungswissenschaft,

b. Theories which emphasize both imagery and subjective activities, *i.e.*, theories of comparison, "distinction of reason": According to this group of theories (generalizing) abstraction consists in the perceiving, or becoming aware, or immediate knowing, of similarities which exist in the diverse contents of consciousness.⁴ The well-known theory of the dissociating and emphasizing of common features in virtue of the fact that they possess varying concomitants may be classed in this group. This view, known as the theory of dissociation by varying concomitants, was formulated by James (43, 1, 502-508) and by Ribot (71, 8). Ehrmann (29) holds that the process of abstraction is completed in the condensation of residual traces left by similar experiences, together with the gradual elimination of those residues which are not repeatedly renewed by experience (65-72). In the course of the condensing, similarities arise the more definitely, the higher the degree of attention which has been accorded them (77).

c. Theories which stress subjective factors: According to these theories, abstraction consists in the singling out of certain qualities of ideas by attention, together with a concomitant receding of other ideas in consciousness. To a certain extent, the limitation of attention itself necessitates abstraction. The authors who have advanced these theories have for the most part preserved a distinction between abstraction and generalization.⁵ The ten-

Werke, Bd. V, 498. Volkman, 83, 3, 241-249, esp. 242. Galton, 30; 31, 184, 349. Huxley, 41, "generic image" theory, 93 ff.

⁴ Berkeley, 13, 240, 245. Hume, 40, 17-25. Bain, 10, 541-544. Schumann, 74, 107 ff. Cornelius, 19, 50-57.

⁵ The Port-Royal Logic, 4, esp. 45. It is interesting to note that such a distinction was made as early as 1662! Laromiguière, 50. Berkeley, 13, 249. Hamilton, 34, 2, 277-290; 3, 116-170. Mill, 59, 380-413. Sully, 78, 390 ff, 417. Meinong, 56, 196; 55. Mally, 54. Mach, 53, 250-255.

The issue between the "distinction of reason" theories and the attention theories of abstraction underwent a long discussion in the German literature, where it was raised when Schumann (74) brought the Müller (and Cornelius, 19, 20, 21) theory of abstraction into relation with the *Gestaltqualitäten* of Ehrenfels (Vjsch. f. wiss. Phil. 1890, 3, 249-292) and the *Komplexionen* of Meinong (Zsch. f. Psychol. 1891, 2, 245-265). Especially at first the abstraction issue was closely bound up with that of the nature of higher complexes; out of this emerged the question of whether abstraction is to be

dency to stress the factor of attention has been carried still farther and modified by such psychologists as Wundt, Lipps, and Eisler.⁶ These authors regard abstraction as based upon the fundamental psychological function of apperception. It is the active bringing of certain contents into focal consciousness; and it may either be non-planned, or it may be brought about by reason of a certain motive (logical abstraction). For Lipps, abstracting apperception implies that the separated part-contents are seen in the relation of belonging to that from which they have been separated. It is usually true that the apperceived elements belong to many ideas, but this fact is secondary. When the elements have been analyzed out in diverse perceptions we have generalization.

d. Motor theories: Within very recent years there has become conspicuous in the literature a tendency to regard generalization as a function which belongs in part at least to the response side of mind, rather than to the receptor—the sensory and ideational side proper. Perceptual contents become formed into classes in virtue of the coöperating, accommodating, and adjusting of the motor processes which mark their impingement upon the organism and which constitute the reactions of the organism to them. Generalization is therefore a progressive organization of motor processes. (Baldwin, 11, 1, 220-229, 3, 95-98; 10, 306-316.) The arranging of new cases under an individual concept, *i.e.*, generalization, does not consist in the comparing of the new instance with the old, feature by feature, but rather in the determining of whether the new case suits the attitude evoked by the old. If the motor attitude or response evoked by any perception is similar to that which is habitually evoked by certain other past perceptions of the organism, the new perception belongs to the same group as do these latter.⁷ The upholders of the motor view of generaliza-

identified with awareness of similarity (Schumann-Müller, 74; Cornelius, 19, 20, 21), or whether the two are different, and awareness of similarity presupposes abstraction (Lipps, *Zsch. f. Psychol.* 1900, 22, 383-385. Mally, 54. Meinong, 55, 56).

⁶ Wundt, 86, 3, 544-547; 87, 1, 49 ff, 101-103, 2, 11-14. Lipps, 51, 115-124. Eisler, 27, 1, 7.

⁷ Betz, 14, esp. 211-225. Cf. also Bergson, 12, 201-212; Müller-Frienfels, 63, 64, 65; Hobhouse, 38.

tion have for the most part turned their attention not so much to the nature of the generalizing activity carried out on "attitudes" as to the part played by the generalized "attitude" in meaning and in the concept; hence we shall defer further consideration of this view for the present. (Cf. below, pp. 22 ff.)

b. Experimental. In our review of the literature we have found only four studies which were concerned primarily with the processes of abstraction or of generalizing abstraction. These were published by Külpe (49), Mittenzwei (61), Grünbaum (33) and Moore (62). Külpe was the pioneer investigator in the field. His experiments and those of Mittenzwei dealt with abstraction in the broader sense, as the accentuation of certain portions of a more or less unified momentary mental content; those of Grünbaum and of Moore dealt rather with generalizing abstraction, or the singling out of the similar contents of two or more groups.

Külpe's method consisted in presenting four nonsense-syllables, printed in four different colors and arranged in different groupings, the observers being instructed to observe and afterward to reproduce as many of the figures as possible. In addition to this general task, Külpe at times introduced one of four special tasks: to discover the number of visible letters; to note color and position of color; to note the form of arrangement of the syllables; and to discover as many letters as possible, with their spatial positions. The outstanding result of Külpe's investigation is insistence upon the significance of the task assigned, both for the number and nature of the elements reproduced, and for the actual content of the observers' consciousness during the observation of the stimuli. Positive abstraction is most marked and successful when it follows after the establishment of a definite pre-disposition for the partial content which is abstracted; while the forgetting of that which is not accentuated is more complete, the more definite and difficult the task. But not only are the non-accentuated contents more rapidly forgotten; they are actually not present to the observers' consciousness during the noting of the stimulus,—for instance, the observers believed that no color had been present, when the *Aufgabe* related to the reproduction of some other feature. Külpe believes that these remarkable dif-

ferences in the content of consciousness which follow upon different *Aufgaben* are not differences in sensation, but rather they are differences in the observers' mode of apprehension. Since psychology ascribes certain specific attributes to sensation,—since sensations consist in certain determined part-contents,—it follows from these findings that one must distinguish between psychic processes and our consciousness of them. For our consciousness, there are abstract ideas; for psychic reality, there are only concrete ideas. Külpe defines abstraction as the process by which the logically or psychologically *wirksam* is separated out from that which is logically or psychologically *unwirksam*. Mittenzwei (61) worked in Wundt's laboratory; and he definitely regards abstraction as an aspect of apperception. An important point of departure for him was the theory of the "distinction of reason." Such a view, he maintains, springs from the assumption that experience comes to us with uniform clearness. The view, together with the discussions which have arisen from it (*e.g.* footnote 5, p. 3) is rendered unnecessary if we recognize the fact that our experiences are from the outset differentiated in degree of clearness. Apperception becomes abstracting apperception when it has as its object the part-contents of a single idea or perception, instead of a group of discrete mental contents. So Mittenzwei's problem becomes one of producing in his observer's mind a simple perception, and of determining the relative degree of consciousness of its various parts. In this way he rigorously ruled out generalization, or perception of similar elements in different contents, which he finds has frequently been confused with abstraction.

Degree of consciousness is identical, for Mittenzwei, with degree of clearness. The degree of clearness of an element depends upon two things,—the potency of the element for perception, and the activity of the noting subject, or the concentration of attention. He utilized the difference limen for measuring the degree of clearness of the parts of a perception, assuming that the amount of change necessary for the perception of difference in a feature is inversely proportional to its previous degree of clearness. His method was two-fold: *a.* He determined the

difference limina for the changes in extensity, intensity, and spatial position in a single luminous disc; and *b.* he exposed six small luminous discs within a single dark one, and varied one or all of the former as regards position, size, and intensity. The observer was always asked to state whether he perceived a change, and if so to describe its nature and (in the second method) its position. Mittenzwei employed procedures with and without knowledge of 1. the element to be changed, 2. the nature of the change, and 3 (method *b*) the position of the change.

Mittenzwei found that limina were smaller when procedure with knowledge was employed, although the degree of lowering varied according to the factor changed. The limina for increase and decrease of size varied, as did those for vertical and horizontal displacement. Judgments regarding position of change were seldom false or indefinite, whereas, those regarding nature of change were more frequently so. In general, the limen was smaller if the observer knew what factor would vary; it was still smaller if he knew the position of the change; and it was smallest if he knew the nature of the change. Mittenzwei believes that he has demonstrated the inequality in the degree of consciousness of the parts, both noted and unnoted, of a single perception. This inequality exists whether the attention-attitude with which the perception is approached be free and undetermined (procedure without knowledge) or determined by 'abstracting narrowing' (procedure with knowledge). In the latter case, the abstractive narrowing was immediately effected and was experienced as a peculiar mode of apperception. He lays great stress upon this finding, for he believes that both the Hume-Müller-Cornelius school and the Meinong school have failed to consider it, and so have advanced unnecessary hypotheses ('*distinctio rationis*') and have entered into superfluous discussions.

Both Külpe and Mittenzwei preserved, in a very commendable fashion, the distinction between abstraction and generalization. Külpe's finding that under certain conditions observers may abstract from color-quality so as to be totally unaware of it is very significant. His interpretation of this phenomenon as due to the observer's mode of apprehension of real psychic

processes which (in view of his psychological doctrine of the attributes of sensation) must include perception of color, has been contested by Rahn in very able and penetrating fashion. Rahn suggests the alternative of modifying the systematic psychology of sensation, rather than the reviving of the doctrine of the inner sense in the manner proposed by Külpe (68, p. 76). Mittenzwei has undoubtedly succeeded in adding an important contribution to the mass of evidence for the existence of degrees of focality of experience, although the quantitative value of his results is open to serious question. As a number of investigators have pointed out (notably Grünbaum, 33, and Rubin *Zsch. f. Psychol.* 63, 1913, 385 ff), Mittenzwei's fundamental assumption that the degree of clearness of a content can be determined by means of the limen for perception of difference is discredited by his own results, inasmuch as he found that in the same part-content difference limina varied considerably in different directions (increase and decrease of intensity, vertical and horizontal displacement). Moreover, in procedure without knowledge it seems unlikely that the degree of clearness of any part-content is of sufficient constancy to be measured by the difference method; on the contrary, the clearness must vary from moment to moment with slight changes of fixation or subjective factors overlooked at the time.

The next and last two investigators to make a specific attack upon the problem were Grünbaum (33) and Moore (62), the former working in the laboratory at Würzburg and the latter at Leipzig and at the University of California. Both used essentially the same materials; and both investigated the apprehending and abstracting of identical components from contents which were otherwise non-homogeneous.

Grünbaum insists that Mittenzwei has erred in identifying abstraction with apperception. The essence of abstraction consists for Grünbaum in accentuating a part of a content at the expense of the other components of the content; and the discovering of points of similarity in the visual stimuli, under definite instruction, constituted the accentuation which was chosen for investigation in Grünbaum's experiments. His

method consisted in presenting, simultaneously, two groups of geometrical figures, these latter being so arranged that one figure was common to both groups while all the other figures of the two groups differed from one another. The observers were instructed to discover the common figure, as well as to note as many other figures as possible. These figures, both common and non-common, they were afterwards asked to draw from memory; and finally they were asked to identify as many of the figures as possible in a recognition-test.

In presenting his results, Grünbaum lays great stress upon the influence of the experimental tasks upon *I.* the nature of the content of the observers' consciousness, *II.* their mode of procedure, and *III.* the nature and number of the figures drawn and recognized. He also discusses *IV.* the awareness of similarity, and *V.* the effect of the presence of the similar figures upon the nature and number of the figures drawn and recognized.

I. The influence of the task upon the nature and content of subsequent consciousness manifested itself *1.* in the nature of the conscious processes which immediately preceded the exposure of the figures, *i.e.*, in the observers' preparation or attitude. Four different sorts of these *Einstellungen* appeared, but Grünbaum regards them as representing a series of developmental stages of the same phenomenon. They may be described as: *a.* attention to a means of solving the problem, or efforts to image the coming situation; *b.* quiet waiting, together with the thought 'how can I do it?' and kinaesthetic rhythm, the number of strokes agreeing with the number of expected figures and an accented stroke coming where the common figure was expected; *c.* no awareness of means but only of '*Zielstrebung*'; *d.* neither imagery of means nor *Zielstrebung*, the observer being unable to describe how the *Aufgabe* was present. The fourth of these attitudes proved to be the most successful, and the first the least successful. The *Einstellung*, then, includes three components: the *Aufgabe*-consciousness, whose conscious form is uncertain but it is characterized at least by internal speech, *Bewusstheiten* or empty waiting; the intention or *Zielstrebung*; and the awareness of means, sensory schemata, and the like. Of the two

latter components, either or both may be lacking; and they are more likely to be lacking as the experiments progress (369-375). 2. The influence of the task upon the nature of the observer's consciousness also manifests itself in a sense of effort or strain, and in an increased certainty of performance and an increased expectation when the number of figures is relatively large (396-404). 3. The *Aufgabe* also reveals itself in its directing the attention from the non-common figures, even though these may be objectively conspicuous. It tends throughout to give rise to a reproduction of common figures, and to check those associated ideas and meaning-complexes which do not concern the immediate relation sought (455ff.). 4. The *Aufgabe* has a characteristic effect upon the way in which the awareness of having reached a solution enters consciousness,—the observer reporting that his experience was to be described as 'My problem is solved' rather than as 'I've found a similarity'. This constitutes one of the ways in which the *Aufgabe* tends to eliminate the meaning experience as such.

II. The influence of the *Aufgabe* upon the mode of procedure varies with different observers, and also with the number of figures presented. Grünbaum distinguishes six modes of procedure, and eight degrees of rapidity of performance; they may be classified as follows: 1. The method of exclusion; the observer here selects a figure of one group and looks over the other group for one like it. 2. The method of successive comparison; the observer here looks from one group to the other until a figure is recognized. The common figure may or may not acquire prominence before its identification as such; in the latter case, it may be accompanied by a peculiar awareness of the task or by a conjecture of identity. 3. A rapid comparison is made, and the two figures spring into prominence in rapid succession or even simultaneously. 4. The method of intuition; the observer hits upon the common figure and knows at once that it is common, without having seen the other. This method is rare and inexplicable to Grünbaum. In the first two methods, the consciousness of similarity is aroused gradually and is accompanied by voluntary effort; in the last two, it is rather

sudden, often attended by surprise, and involuntary. The observers frequently changed their method because the one they first employed failed; moreover, the methods vary with the number of figures, 1 and 2 being more frequent when the groups contained two figures, 3 when they contained three or four, and 3 and 4 when they contained five. This fact Grünbaum believes to be due to the necessity for rapid comparison when the number of figures is large (375-390).

III. The majority of the figures reproduced and recognized by the observers were common figures. As regards the performance of the main task, to note the similar figures: After pointing out various sorts of errors which frequently appeared in the drawings, Grünbaum reports the interesting finding that as the objective difficulty of the task—number of figures—increases, the percentage of successful performances is at first lessened, but later it becomes for a time relatively greater, after which it falls off rapidly. This is due to the fact that when a certain degree of objective difficulty has been reached, a subjective factor of increased effort asserts itself, appearing as increased expectation, more rapid perception, and greater certainty. As regards the secondary task, the drawing of as many figures as possible: The observer's efficiency is here greater when he directs maximum attention to the main problem, especially if the latter is not solved. The solving of the main task affects the performance of the secondary one in two ways: it narrows the field of consciousness, bringing about an indisposition to examine new figures; and it sets up a retroactive inhibition of the non-similar figures already noted.

IV. The awareness of similarity is independent of the apperception of the similar contents; for it may be present when the contents themselves can not even be recognized, and it may be absent when the similar content is clear. If the awareness of similarity is to appear it is necessary that there be a determination for likeness comparison. On this basis he criticises Ebbinghaus' treatment of similarity, which makes the latter a perception, like awareness of time and space, as immediate and direct as that of the objects themselves (445-450). The peculiar nature

of the relational experience is obvious, because entirely different perceptions lead to the same relational experience. Moreover, unclearness of an ideational element is different from that of a relation; the latter is rather uncertainty than clearness proper, such as is given with the content itself. Upon this basis Grünbaum criticises Mittenzwei's identification of abstraction and apperception; abstraction of relations occurs, although these have no apperceptive (clearness) grade. We have already mentioned the distortion produced by the *Aufgabe* in the awareness of similarity, in virtue of which this became describable as awareness that the problem had been solved rather than as awareness of similarity proper.

V. The effect of like figures appeared not only in their greater clearness when recognized as such, but also in the fact that when they were not recognized as such they were nevertheless more frequently reproduced and recognized than were the unlike figures. Moreover the number of repeated figures thus included was greater than would normally follow from the fact that there were twice as many repeating figures exposed. Grünbaum concludes that the like figures, even when not recognized as such, reinforce each other in consciousness (430-433).

For Grünbaum then the abstraction of likeness consists positively in an apperceptive accentuation and separation of the like figures under the influence of the task, and negatively in the regression of the unlike figures. This regression is brought about in two ways: *a.* The momentary field of consciousness becomes narrower,—the observer is not disposed to note other figures; and *b.* there is a retroactive forgetting of the previously-noted unlike figures, when the like ones stand out. So great is this retroactive inhibition that figures once wrongly taken for similar are forgotten.

Grünbaum has made an admirable attack upon the problem of generalizing abstraction. The importance of his findings regarding the modifications of consciousness which follow upon the observers' understanding of the particular task of his experiments can scarcely be exaggerated.⁸ His study falls short, how-

⁸ In this respect, of course, Grünbaum's research accords with the studies of Marbe, Watt, Ach, and others of the Würzburg school. Marbe's introspective

ever, on the analytic side,—the question of the detailed nature of the contents themselves; and the reason for this is to be found in the inadequacy of his introspective data. For example, his treatment of the 'intuitive' mode of procedure and of the accentuation of the identical features before their identity was discovered leads the reader to suspect that the observers have totally missed certain obscure processes which, because of their rapidity and indefiniteness, tend to vanish almost immediately from consciousness leaving only their final stage.

Moore's (62) method consisted in the successive presentation to his observers of groups of five geometrical figures, each group containing one figure which recurred in all of the groups, and four which were wholly novel. The exposure-time was a quarter of a second; and between each pair of groups a blank space was exposed for the same length of time, the observers being in-

investigation of the judgment consciousness resulted negatively, so far as the discovery of a psychological criterion of the judgment was concerned; but Marbe postulated an extra-psychological criterion, the *intention* with which the observer made his judgment. (Cf. *Experimentell-psychologische Untersuchung über das Urteil*, Leipzig, 1901.) This cue led in the hands of later investigators to the doctrine of the *Aufgabe*. Watt (84) undertook, by varying the experimental task, to investigate the nature and influence of the intention. Using the method of constrained associations, he varied the instructions in six ways, and noted the effect of these different tasks upon the subsequent processes and upon the reaction-word. He found that the task, or *Aufgabe*, as it has come to be known in the literature, had a profound effect upon the later mental events. It usually happened that only those words which were in harmony with the task appeared to consciousness and were given as reaction-words; when an unsuitable word did appear, it was rejected or ignored by the observer. The *Aufgabe* was at first clearly present to consciousness, in terms of motor-kinaesthetic adjustments to the apparatus, concrete and verbal imagery, and other contents; as the experiments proceeded, however, it receded in consciousness and degenerated to mere adjustment to the apparatus. Ach (1), working with the free and the choice reaction, showed in striking fashion the enormous influence of the observer's preparation or intention upon the later processes; he regarded the *Aufgabe* as exerting a determining influence upon later consciousness, and he used the expression *determinierende Tendenz* to designate this influence. Ach also sharpened the issue of the *Bewusstheit*, and so of imageless thought. The interest of his successors was directed toward this latter problem more than to that of the *Aufgabe* proper. (Cf. Messer, 57; Bühler, 17; also Titchener 82.)

structed to react by depressing a key (thus stopping the apparatus) as soon as they were sure that they had seen some figure twice, without waiting until they knew more about the figure.

Moore found that the process of abstraction, as present in his experiments, included four processes. They were 1. The breaking up of the group, consisting in the accentuation of the common element and the neglect and positive casting aside of the varying elements. 2. The perception of the common figure, which ranged from a vague idea of some kind of a figure being repeated without definite information as to the nature of that figure, to a correct and clear image of the repeating figure. For the apprehension of the figure as repeating, Moore found that the 'mental image' (by which he obviously means the visual image) 'plays no essential part'. The observer sees and holds something that fits in with some form of 'mental category,' *i.e.*, that calls up certain generalizations already present. The essential factor of the perception is the memory that the figure belonged to such and such mental categories. This finding is based upon such introspective statements as the following: "idea of some kind of a figure", "certainty of a common element", "feeling that there was a common element". 3. The process of memory. 4. The process of recognition. This latter often overlaps the process of perception; but it involves the factors of certainty and uncertainty, any degree of which may attend any degree of completion of the perception.

Moore concludes that the product of the process of abstraction consists in an imageless mental content, under which appropriate incoming perceptions are subsumed. This content possesses meaning in its own right, and is qualitatively distinct from sensations and images. The mental categories are to be regarded as the products of past experience. Our investigation was prefaced by a repetition of the work of Moore; we shall therefore defer our criticism until a later section.

Ach, in his experiments on the choice reaction (1, 219-223; 239-250) distinguishes certain kinds of abstraction which resulted from the various determining tendencies set up by the tasks which he imposed. In certain of his experiments he showed cards bearing letters to each of which a certain

finger-movement was prescribed as a reaction, the observer being asked to react to any letter he chose. Ach found that in many instances the observer determined in advance to react to a certain letter, with the result that during the exposure this letter alone was apprehended, the observer "abstracting" from the other letters. Ach calls this "simultaneous determined abstraction"; he differentiates it from "successive determined abstraction," a form in which certain non-essential stages in the reaction-course were abstracted from. Both forms of abstraction Ach explains as functions of attention and of the determining tendency; they are economies of consciousness which bring about a more rapid arrival at the goal by the dropping out of useless processes. They were doubtless phenomena of the same sort as those noted by Külpe (49); cf. p. 5.

B. THE GENERAL CONCEPT. a. **Non-experimental.** Throughout antiquity and the scholastic period, the problem of the nature of the concept was attacked almost exclusively from the viewpoints of logic and of metaphysics.

The ancient philosophers, assuming that reality lies in the universal, were in the main interested in the question of the relation of the universal to the data of sense. For Plato, universals were Ideas to be attained only by the intellect; they were the essence of reality, and they existed apart from the world of sense with its many delusions. Aristotle attacked Plato's doctrine of a world of Ideas existing apart from the world of sense. He found reality rather in the concrete sensible particular, and held that the universal exists only in, or along with, the particular. The issue raised by Plato and Aristotle gave way to the problem of realism and nominalism, which was the main object of discussion during the medieval period, especially during the early part. As Dewey has pointed out (22), the medieval issue was in a sense the reverse of the problem of the ancient philosophers. Plato and Aristotle held that the real is universal, and their discussion was mainly concerned with its relation to sense-perception. The scholastic issue was that of whether the universal is real. The scholastic problem was formulated by Porphyry (220-300 A.D.) as follows (7, 428ff.): 1. Do genera and species have a substantive existence, or do they reside merely in naked mental conceptions? 2. If they have a substantive existence, are they bodies or incorporeals? 3. Is their substantive existence in and along with the objects of sense, or is it apart and separable?

It will be sufficient for our present purposes merely to summarize the main positions which were advanced in the subsequent discussion of these questions, without attempting to trace their development or to enumerate their sponsors. These positions were: 1. Realism (*Universalis ante rem*). The universal idea has substantive existence apart from and above particular ideas. Only genera are substances and have real existence; individuals are their attributes. Leading advocates of this view were Scotus Erigena, Anselm, and William of Champeaux. 2. Nominalism (*Universale post rem*). The general idea exists only as a name for a group of particulars which alone

have real existence. Roscellinus and later, William of Occam were leading exponents of scholastic nominalism. 3. Conceptualism (*Universale neque ante rem nec post rem, sed in re*). Scholastic conceptualism was rather an intermediate position between the extremes of realism and nominalism than an attempt to set forth the universal as present to the mind in terms other than mere names or individual ideas. The universal has a real existence, but in the individual and as an individual and not as an essence. It is a predicate (*sermo*) reached by a comparison of individuals, and based upon similarity in individuals themselves. Individuals possess similarity in virtue of the universals being arche-types or modes which exist in the mind of God. This position is hardly to be regarded as conceptualism in the modern sense; nevertheless it is a decided advance, psychologically, upon the positions of extreme realism or nominalism. Leading exponents were Abelard, Vincent of Beauvais, and in a large measure, Thomas Aquinas.⁹

With the scientific revival of the sixteenth century, involving as it did the abandonment of the *a priori* speculation which constituted for the most part the method of the scholastics in favor of the methods of observation and induction, it was inevitable that the problem of the universal concept should assume a totally different aspect. While the chief aim of those who subsequently wrote concerning the concept was for a long period epistemological or otherwise non-psychological, nevertheless their mode of approach was in an increasing degree psychological; and the nominalism, so-called, which was advanced at the opening of the modern period and thereafter must be sharply separated from nominalism in the scholastic sense. The problem was now that of what mental content is present when a universal concept or general or abstract idea is thought. It is this problem which has continued down to the present, and with which our present interest is mainly concerned.

The answers to this question have been numerous and variable. Practically every philosopher and every psychologist who has set forth his views in any manner which approaches systematic completeness has expressed himself more or less explicitly upon

⁹For more complete historical accounts of the medieval problem of the Universals, cf. the standard histories of philosophy; also Bain, 7, 428 ff.; Dewey, 22; Eisler, 27, under the following headings: *Nominalismus, Realismus, Allgemein, Allgemeinvorstellung, Begriff, Abstrakt, Abstraktion*. Hamilton, 34, 4, 297-313; J. S. Mill, 59, 380-413; James Mill, 58, 247-260, 276 ff; Sully, 78, 2, 346 ff.; Aveling, 2-21.

the subject. Therefore we can attempt only a tentative grouping of those views which seem to lend themselves to psychological interpretation.

a. Modern Nominalism. This designation has ordinarily been applied to the view that that which is universal is never an image or idea, but rather a name which designates a group of objects that possess certain common characters.

The position was set forth in its most extreme form by Hobbes (37), who adds: "And, therefore, for the understanding of a universal name, we need no other faculty than that of our imagination, by which we remember that such names bring sometimes one thing, sometimes another, into our mind."—4, 19-26. In another passage, we read that "one universal name is imposed on many things for their similitude in some quality, or other accident; and whereas a proper name bringeth to mind one thing only, universals recall any one of those many."—3, 21. It is probable that the issue was not an important one in Locke's mind; at all events his treatment of the problem of the general idea is rather obscure (53, 2, 14 ff., esp. 18-19; 274). Locke holds that words become general by being made the signs of general ideas; and in these latter, we represent no one particular member of a group, yet all at once. The consequences of Locke's presentation, however, were very important; for it led Berkeley to his famous denial of abstract ideas (13, 240 ff.). Ideas, for Berkeley, always involve images of particular objects; they become general by being made to represent or to stand for all other particular ideas of the same sort (245). Or a particular idea (image) may be attended to in part. ". . . It must be acknowledged that a man may consider a figure merely as triangular, without attending to the particular qualities of the angles, or relations of the sides. So far he may abstract; but this will never prove that he can frame an abstract, general, inconsistent idea of a triangle. In like manner we may consider Peter so far forth as man, or so far forth as animal, . . . inasmuch as all that is perceived is not considered" (249). Berkeley is followed by Hume. "Abstract ideas are . . . in themselves individual, however they may become general in their representation. The image in the mind is only that of a particular object, though the application of it in our reasoning be the same, as if it were universal." (42, 20). When we have found a resemblance among several objects which often occur to us, we apply the same name to them. As a result of this, the subsequent hearing of the word raises one of the individual ideas "along with a certain custom; and that custom produces any other individual one, for which we may have occasion." This same custom, or habit, brings it about that when we make a statement regarding the individual idea which occurs that is not true of other ideas to which the name also applies, these latter "immediately crowd in upon us, and make us perceive the falsity of the proposition" (21). In this way, some ideas are particular in their nature, but general in their representation. "A particular idea becomes general by being annexed to a general term; that is, to a term, which from a customary conjunction has a relation to

many other particular ideas, and readily recalls them in the imagination" (22). Hume goes on to discuss the "distinction of reason." "'Tis certain that the mind wou'd never have dream'd of distinguishing a figure from the body figur'd, as being in reality neither distinguishable, nor different, nor separable; did it not observe, that even in this simplicity there might be contain'd many different resemblances and relations. Thus when a globe of white marble is presented, we receive only the impression of a white color dispos'd in a certain form, nor are we able to separate and distinguish the color from the form. But observing afterward a globe of black marble and a cube of white, and comparing them with our former object, we find two separate resemblances, in what formerly seem'd, and really is, perfectly inseparable. After a little more practice of this kind, we begin to distinguish the figure from the color by a *distinction of reason*; that is, we consider the figure and color together, since they are in effect the same and indistinguishable; but still view them in different aspects, according to the resemblances, of which they are susceptible, . . . A person, who desires us to consider the figure of a globe of white marble without thinking on its colour, desires an impossibility; but his meaning is, that we shou'd consider the colour and figure together, but still keep in our eye the resemblance to the globe of black marble, or that to any other globe of whatever colour or substance" (25).

It is evident that neither Berkeley nor Hume was a nominalist in the extreme sense, for two reasons: 1. For both writers, the particular image which is aroused by the general term is different, potentially or actually, from one not so aroused. It is one in which we are aware of its resemblance in some respects to other ideas (Hume); or which stands for other ideas of a similar sort (Hume, Berkeley) or in which we attend only to certain parts (Berkeley). 2. For both Berkeley and Hume, words are not the only contents which are universal. Both point out the conditions under which particular ideas may become universal, *i.e.*, by being made to stand for other particular ideas of the same sort, or by being annexed to a general term. Berkeley and Hume, then, find in the general concept not only the particular image and the general term, but also certain modifications of the former; and Hume finds in addition a certain habit in virtue of which the general term calls up any one of a group of images, or an image which represents a contradiction of a statement made about the general concept itself. Even Hobbes adds to the general term and the particular image the remembrance that such names bring sometimes one thing, and sometimes another, into consciousness; moreover, it is not unlikely that he had in mind the additional phenomenon which later writers definitized as the awareness of similarity. So it appears that from the psychological point of view, at least, Berkeley and Hume must be classified as conceptualists rather than nominalists; and indeed, the rigidity of Hobbes' nominalism is open to question.

The nominalism, so-called, of Berkeley and Hume has survived in the literature and has taken on a number of different aspects, according to the modifications of the particular image or other factors which have been stressed as characteristic of

the general idea. These aspects may be described as follows:

1. No general image exists. Individuals which bear certain resemblances tend to become associated, in accordance with the law of association by similarity; and a name is then applied to the whole group. This general term, when later encountered, calls up certain particulars. The extreme form of this view has been presented by James Mill (59, 247-293). Another form is that of Taine (80, 1). Our experiences arouse in us certain tendencies. These appear as gestures, bits of mimicry, repugnances, shocks, vague solicitations, which perhaps we can scarcely distinguish: and they result in expression, of which one form is a name. When we have seen a series of objects which possess a common quality, we experience a tendency which corresponds only to this, and which results in a certain mimicry, in "spontaneous" language, and in a name in our own language. This name afterwards has the property of arousing in us images of individuals which belong to the group.
2. Another group of writers, more or less explicitly following Hume, have laid special emphasis upon the awareness of the similarity which furnishes the basis for the grouping under a common name, or upon the *distinction of reason* itself as envisaged by Hume. Brown (18, 2, 452-497) holds that there is a general notion which corresponds to a general term, and which consists not in a general representation of the attribute but in the notion or feeling of resemblance between the individual representations. We give a name to the circumstance of felt resemblance, and this name is applied afterward only where this relation of similarity is felt. The feeling of similarity is unique and indescribable for Brown. In Germany G. E. Müller (as quoted by Schumann, 74, 107-112) and Cornelius (19, 20, 21) have extended and amplified the Humian notion of the distinction of reason. The expression "abstract idea" means the idea of a content, with an additional awareness of the similarity which this content holds to others in certain respects. The awareness of similarity is unique and unanalyzable; it must be taken as a fact of experience.
3. A number of writers have emphasized the rôle of attention,—a general idea is a partic-

ular image in which a certain part is stressed by attention.¹⁰ Hamilton, J. S. Mill, Stewart, and others of the associationist school accepted "nominalism" in one or more of the forms above distinguished.¹¹

Another large group of thinkers, whose method has been genetic rather than analytic, have posited the existence of general imagery, in the sense of imagery whose details are so indistinct that it may "represent" a large number of particular objects. When objects which possess certain similarities are repeatedly perceived, fusions are formed in which the oft-experienced similarities become relatively more emphasized in consciousness, while variable features weaken or wholly disappear. This view is not necessarily contradictory to that of Berkeley and his successors; it is the product of a different mode of approach to the problem. The general image is in itself particular; but it is indefinite, it contains only the features which are common to a group of individuals, and it has been evolved by the gradual elimination of the purely individual features. This view is represented in the "composite image" theory of Galton and Huxley.¹²

Erdmann has given an exceedingly thoroughgoing analysis of the fusion of memorial residues of perception (29, 72-78). According to Erdmann, individual features do not disappear, but they persist as a more or less vague background from which stand out the similar features, which are emphasized by apperceptive fusion. This background may be static or dynamic, *i.e.*, changing; it tends toward the static when few individual differences are present, and toward the dynamic when many and important individual differences exist.

c. Another group of psychologists, although likewise genetic in their mode of approach, make the concept a higher fusion-product of active apperception. The leading exponent of this view is Wundt.¹³ He holds that connecting active apperception, operating upon a basis of pre-formed association-tracts, forms unitary connected ideas or agglutinations, which latter in turn become apperceptive fusions by progressive loss of their yet recog-

¹⁰ Höffding, 39, 164-173; Ribot, 71, 136; Meinong, 55, 56.

¹¹ Hamilton, 34, 2, 277-314; J. S. Mill, 59, 380-413; Stewart, 76, 173.

¹² Galton, 31, 184, 349 f.; 30; Huxley, 43, 93-94. Cf. also Ziehen, 88, 151-171.

¹³ Wundt, 86, 3, 543 ff, esp. 546; 88, 1, 43 ff; 85, 327-328; 87, 309-310.

nizable original part-contents in virtue of the continuation of the apperceptive activity. These fusions also continue to lose various of their elements through condensation and displacement, and come to have certain elements stressed, so that their total character becomes altered. Thus they are enabled to enter into many thought connections. Such a fusion, with its many connections, is a concept. These numerous connections can no longer be present in consciousness at one time in a single idea, but only in a series of thought acts. The concept is carried in consciousness by a representative idea, which is in itself not different from any other memory idea, but whose essence as a representative idea consists *a.* in the fact that it may be changed at will into another idea of the same concept, without interfering with the course of thought; *b.* in the accompanying awareness of this vicarious significance, which is marked by the presence of a peculiar feeling which Wundt calls the *concept feeling*. This consciousness is based on vague processes which run their course in the obscurer regions of consciousness, and which have to do with other possible representative ideas, together with the feelings bound up with them. It is not necessary that any of these ideas enter clear consciousness as such; instead, their presence becomes realized as a more or less intensive concept-feeling. The elements which have come to dominate in the concept are fixed by being named; and the word comes more and more to serve as the representative idea. When the concept-relations become so numerous as to include contradictory ideas, so that the word alone can serve as the representative idea, the concept becomes abstract. Hence the concept may be defined, according to its psychological development, as the synthesis of a dominating single idea with a series of connected ideas,—the synthetizing being accomplished by apperception.

Similar positions are advanced by Lipps (51) and Störring (77). According to Störring, the representative function of the concept idea is not present immediately in its accompanying concept-feeling; but instead it is present mediately, through an interpretation of the concept feeling, which latter reduces to dim background memory-images. In certain instances, these obscure images take the place of the representative image, but for the most part earlier experience of the possibility of their occurrence is sufficient. The interpretation of the concept-feeling is based on this earlier experience.

d. Still another view of the concept is one which holds that generality inheres neither in the word nor in the image, but rather in one's response to either, whether that response be overt action or its opposite pole, reference.¹⁴ This motor or response view of the concept may be formulated briefly as follows. Every percept or image has, bound up with or immediately following it, a certain essentially motor phenomenon which has been variously referred to as a tendency, an action, a response, an adjustment, and an attitude. This motor phenomenon is in its very nature general, since it occurs in practically identical form in response to many situations of exceedingly diverse sort, which possess in common the characters that serve to release it. The response then becomes the criterion of the class; and when it is aroused by any percept it constitutes the understanding of that percept. Animals have concepts in so far as they react in certain definite ways to many situations in common. When the response takes the form of a word and thus becomes fixed, and the common element in the diverse perceptions comes into clear consciousness, a higher sort of concept is evolved.

Among the numerous exponents of this type of view are Paulhan, Mach, Bergson, Hobhouse, James, Dewey, Royce, Baldwin, Gore, Betz, Müller-Frienfels. Bergson (14, 201-212) distinguishes two kinds of memory: "an entirely contemplative memory which apprehends only the singular in its vision," and a motor, or habit memory, which "stamps the note of generality on its action." The former is concerned in the recollection of differences, the latter, in the perception of resemblance; and both play a part in the general idea. Bergson stresses the utilitarian origin of perception; we grasp what we need in any situation. Where resemblances exist, the similarity acts objectively like a force, and provokes reactions which are identical. Genera are experienced before being represented. Dewey (23, 116-134) writes: "Fa-

¹⁴This view is intrinsically not new; the factor of response was recognized by Taine and, in an implicit way at least, by Hume, while the significance of emotional response was commented on even by Berkeley and some of the associationalists (Berkeley, 13, Introduction, § 20; Edmund Burke, *A Philosophical Inquiry into the Origin of our Ideas of the Sublime and Beautiful*, 1756). Burke remarks that such words as virtue, honour, persuasion, docility effect the passions directly, arousing no image at all. Fouillée held that mental states are not to be regarded as representations, but rather as means of reaction and passion (*La psychologie des idées-forces*, Paris, 1893). The list could be extended widely. At present this position is much in vogue, and it is being developed more or less explicitly by a large number of writers.

miliar acquaintance with meanings signifies that we have acquired in the presence of objects definite attitudes of response which lead us, without reflection, to anticipate certain possible consequences. The definiteness of the expectation defines the meaning, or takes it out of the vague and pulpy; its habitual, recurrent character gives the meaning constancy, stability." (125). According to this view a concept is not a mere residue; it is an active attitude, an expectation of certain modes of behavior. Concepts are general because of their use and application, not because of their ingredients. Gore (32) definitely identifies meaning, either of percept or image, with response, whether this response consist in overt action or in reference, which latter is the opposite pole of overt action. When an appropriate response has been found, imagery tends to drop off and becomes vague and "abstract" enough to be called a concept. However, it retains its importance as signal and guide to the activity.

Again, the concept has been regarded as a system of tendencies, which may or may not be accompanied by images (Paulhan, 66). And Royce (72), in his discussion of the importance of classification in science, is led to stress the significance of the consciousness in which we are aware of accepting or inhibiting certain acts by which we treat two or more objects as belonging to classes that exclude one another. Abstract ideas are products of an organized union of negative and positive tendencies.¹⁵

A number of psychologists have attempted to bring the motor tendency itself into closer relation with conscious processes,—to show wherein its conscious coefficient consists. Foremost among these are Betz (14) and Müller-Friemfels (63, 64, 65). Betz points out that when we actually meet concept-words in hasty reading, we usually understand them without thinking of concrete illustrations or calling up memory pictures.¹⁶ His rather ingenious solution of the difficulty is as follows: The essence of the concept lies in an attitude,—e.g. in a movement of tracing, in a general bodily reaction, and the like,—which is *vorgestellt*, or ideated (projected?) into space before the subject, and so becomes an object. When the attitude is not so projected but is merely experienced, it is only a feeling state; and Betz's understanding of the names of colors, for instance, is essentially of this sort. Such words he frequently encounters without experiencing any trace of a color image, but only a feeling,—with green, for

¹⁵ Cf. also Mach, 53, 250-255; Hobhouse, 40, chapter on the concept; Miller, 60.

¹⁶ This fact had long been recognized, of course, even by the associationists, and had been explained in various ways: Cf. Berkeley, 13, 251-253; Burke, *op. cit.*; Taine, 80, 1, 3-6; Stout, Proc. Arist. Soc. 2, 1894, 115-123; and others.

instance, a calm, agreeable feeling. An object is recognized when the attitude it evokes fits in with one which has frequently been experienced in the past. The projected attitude or series of motions may generate traces, which are vaguely visual in nature. He illustrates this phenomenon by the triangle-attitude, where the series of movements involved in tracing a triangle may leave a concrete outline in external space. But the traces are prone to disappear and must frequently be renewed or re-generated by the movements which constitute the attitude. The movements are relatively stable, but they undergo slight variations, and with them, the generated traces alter. A series of such (visual) tracings is a general idea, as opposed to the concept, or generating attitude itself. The general idea is distinguished from memory images in that it is generated by the attitude, is variable, and is accompanied by the consciousness that it may be varied.

Müller-Frienfels maintains that the motor tendencies which are set free by all sensory stimuli have feelings as their correlates in consciousness; these combinations of motor dispositions and their feeling-symptoms he calls *Stellungnahmen*. And it is *Stellungnahmen*, and not images, which constitute the determining factor in all perception and recognition. They possess an essentially typifying or selective character; and they are present in many and diverse sensory situations which, in virtue of their evoking the same *Stellungnahme*, are subsumed under the same concept. Ideas are reproductions of perceptions, and not of sensations; in the idea, the imagery tends to fade but the determining *Stellungnahme* persists; and so the idea represents a higher degree of typification than does the perception. The presence or absence of concrete imagery depends largely upon the context in which the idea occurs; if this context is descriptive or particular, imagery tends to appear; while if it is abstract, the idea becomes reduced to a *Stellungnahme*. Among the motor elements which constitute the reaction, the verbal tendency is of paramount importance; it formulates the concept and makes it complete.

The concept is for Müller-Frienfels not a word, nor a word plus an image; it is a direction or tendency bound up with the word, which has as its consequence a readiness to act, and which appears

to consciousness as a feeling of understanding. I understand a concept when I can work with it; and this capacity makes itself valid in consciousness as a specific feeling. The ability to visualize is only one possibility of realization, along with many others. That which makes the concept-word different from one which is not understood,—for the concept-word is characterized by the fact that it is understood,—is the fact that in the case of the former certain specific feelings, or *Einstellungen*, or processes of *Gerichttsein* are present; and these are merely the mental symptoms of the presence of the activity-disposition set free by the word.

The school of "objective psychology" approaches the problem of the concept from a purely objective point of view, and envisages the concept as a highly developed system of reflexes. This position has been most clearly and adequately set forth by Kostyleff (47, esp. 192-208; 48). For Kostyleff, the objective notion of the reflex must take the place of the subjective notion of representations. The abstract notion of a man, a horse, etc., is that which is common to all the nervous currents produced by the concrete impressions of the particular men, horses, etc., which we have experienced. It is a group of reflexes, peripheral in the animal, peripheral and central in the developed man; and it involves a functional consolidation of the common elements of nerve courses.

Closely related to the present group of theories is the position set forth by James (44, 47-75), which is a thoroughgoing pragmatism. James distinguishes the content—the image component—of the concept from the function, or meaning aspect, *i.e.*, the concept as an instrument for symbolizing certain objects from which we may expect certain activities. The only criterion of the meaning of a concept is the particular consequence which follows it. Two concepts are the same when we can substitute one for the other without changing what follows. Concepts furnish us with means of handling the perceptual flux.

b. Experimental. The experimental investigations which have been in any way concerned with the concept have invariably had to do with the apperception of understanding of general terms. Ribot, Jones, Bagley, Binet, Taylor, Schwiete, Kakise, and Jacobson¹⁷ employed familiar words, alone or grouped in phrases and sentences; certain of them also employed unfamiliar words, or foreign and meaningless words. Aveling

¹⁷Ribot: 69; 71, 113-136. Jones; 47, footnote, p. 110. Bagley: 6. Binet: 15. Taylor: 81. Schwiete: 75. Kakise: 46. Jacobson: 42.

(5) used nonsense-words, and arranged conditions under which his observers came to associate these with meanings (embodied in sets of homogeneous pictures of familiar subjects). The conditions of all of these experimenters—with the possible exception of Aveling—were widely different from ours; hence a very brief summary of their findings will suffice for our present purpose. The experiments have revealed the presence of all varieties of concrete imagery, from highly particular and definite forms to exceedingly vague and schematic and unclear forms.¹⁸ The importance of imagery for meaning and understanding has been variously estimated, some finding imagery adequate, and others holding that the essence of the concept consists in a meaning content which is imageless. Ribot distinguishes a concrete type of individual, who experiences imagery of a concrete sort in connection with the word; and a verbal,—visual and auditory,—type, who finds nothing in consciousness but a visual or auditory image of the stimulus-word itself. A large proportion of his observers reported that nothing at all was present to their consciousness. This latter finding led Ribot to maintain that the ideational part of the concept is often below the level of consciousness, and is unconsciously represented by a word. Both Binet and Taylor are inclined to regard visual imagery as of little importance. Binet concludes that thought involves the constant working of choice, of direction; in generalization, it is the *intention*, *i.e.*, the direction of thinking, and not the image, which constitutes the general. Taylor goes so far as to say that visual imagery, while often useful, may impede the understanding; this latter is the case with abstract terms. Jones, on the other hand, concluded that words always have imaginal mental equivalents. Jacobson found that the word-meanings were given not in static and constant logical form, but rather in the form of associated imagery—visual, auditory, kinaesthetic—touched off by the habit or momentary disposition of the observer under the given stimulus, and representing partial meanings, exemplifications, etc. They varied, for consciousness, as the associations did; and they were psychologically adequate to the demands of the occasion. Certain of

¹⁸ Cf. also Watt, 84, 364 ff.; Messer, 57, 51 ff.

these image associations were regarded as meanings by the observer, others were not. The observers were not aware of any introspective difference between the two sorts of associations; there was no "feel" of "belonging to" understanding. The processes which constitute meaning cannot be selected from the reports by the experimenter, but can be distinguished only by the observer himself.

Bagley finds abundant imagery in connection with the apperception of sentences; he also finds a "mood," by which he means the mind's adjustment to external conditions, the mood being a more constant factor than the imagery. Bagley is unable to give a full and definite account of this "mood"; and the advocates of imageless thought do not hesitate to interpret it as an imageless meaning-content (Moore, 62, 82 f.). Schwiete holds that the nature and amount of the imagery depends upon the experimental task or momentary purpose; he also points out certain conditions under which visual imagery impedes understanding. There is no uniform, simultaneous image which serves to represent a word.

Both Schwiete and Kakise discovered a rather mysterious first stage of understanding, which they designate by such expressions as "concept feeling," "feeling of familiarity," or "feeling that the meaning of the stimulus-word could be comprehended." Schwiete finds that the familiarity is accompanied by the feeling that representative images can be called up; and he believes that the two sorts of content consist in vague organic and affective experiences, with exceedingly dim and obscure concrete images. Kakise is not so definite in his analysis of the feeling of familiarity; he regards this consciousness as an attributive coloration of the word, and he explains it as occasioned by rudimentary revivals of past experience. Both Schwiete and Kakise report a later stage which is characterized by an abundance of concrete imagery; and it is doubtless this stage which Jacobson hits upon. For Jacobson's observers were asked to introspect only upon the final ten seconds of a one-minute exposure of the stimulus-word; and hence the conditions of his experiment were such as would rule out of his observers' introspections the early experience which

had proved so difficult of analysis in the experiments of Kakise and Schwiete.

Aveling, investigating the growth of meaning, arranged conditions under which his observers came to associate meanings (embodied in sets of homogeneous pictures of familiar subjects) with certain nonsense-words; he then investigated the functioning in judgments of these words, with their acquired meanings, presenting a word with a modifier and verb, and asking the observer to supply a predicate. By using different modifiers,—“all,” “no,” “the first,”—he aimed to induce respectively three sorts of meanings, affirmative and negative universal, and particular; and the observers were especially asked to note whether the meaning had a general or a particular reference in consciousness. The results were as follows: 1. Four stages tended to occur in the growth of meaning, ranging from an initial stage in which the words merely served as antecedents to the revival of visual imagery of one or more of the pictures, to a final stage in which the stimulus-word could hardly be discriminated from its meaning, in which latter no imagery was discovered. 2. Abstract, imageless mental concepts are present in thinking. Visual imagery varied and became progressively vaguer, yet at the same time the meanings remained certain; the strong and growing association obtained between the word and the meaning—imageless concept—under which the pictures and their images are subsumed. The presence of such concepts is indicated in the protocols by such expressions as “knew what it meant,” “had idea of,” etc., absence of imagery being sometimes reported. Imagery may be regarded as a by-product of the concept; its function is to impart stability to the latter. 3. Universal meanings tend to be present as concept; in particular meanings, imagery is prominent. 4. The meaning of the word, in the judgment, may be accompanied by no awareness of any reference to one or more pictures; by conscious reference to everything that could be included in the word; and by conscious reference to all or some of the pictures associated with the word. Such reference Aveling calls “conceptual overknowledge”; and he regards it as a separate conceptual ele-

ment, forming a fusion with the meaning-content, for the reason that it is described by the observers in the same terms as those used in describing concepts,—“awareness of,” “idea of,” etc.

C. SUMMARY. STATUS OF THE PROBLEM. **a. Generalizing Abstraction.** Most of the views of abstraction which we have found, both experimental and non-experimental, have agreed in making abstraction the accentuating or the attending to certain part-contents, with the ignoring or discarding of others. The extent to which the non-accentuated contents are ignored is a subject of disagreement. Another unsettled problem is the extent to which the process of abstraction is to be brought into relation with some definite preceding content, *i.e.*, a purpose or task or *Aufgabe*. The non-experimental writers have not stressed this factor so explicitly as have the experimental investigators. Külpe and Grünbaum especially have traced the influence of the experimental task upon later consciousness, stressing both its positive (furthering) and its negative (inhibitory) aspects. Moore points out that the solution of the task has an inhibitory influence upon the memory of variable figures (62, 124 ff.); but his interest lies more in the structural side and in the question of the presence of imaginal or imageless mental contents than in the process aspect of the consciousness aroused by his experimental conditions. Mittenzwei's envisagement of the process of abstraction is somewhat broader; he identifies abstraction with a phase of apperception (in the Wundtian sense). His application of the expression “abstracting narrowing” to the apperception which occurred in procedure with knowledge leads one to suspect that he is not unmindful of the significance of preceding processes in abstracting apperception; but he does not stress the task in explicit fashion.

At the present stage of our knowledge, then, it appears that one has a fairly wide range in the sort of conscious situation to which one may apply the term “abstraction.” It seems to the present writer that the term “abstraction” should be applied only to the accentuation of a present perception or other mental content, considered in relation to some previous conscious situation. It seems likely that extended experimentation will reveal many sorts

of determination in addition to a specific conscious purpose, or intention, present as the acceptance of some task in explicit conscious fashion.

Many writers have failed to distinguish between abstraction and generalizing abstraction. The two are closely related; but generalizing abstraction is the narrower concept. Abstraction is generalizing abstraction when the abstracted contents are features which are common to a group of experiences; in other words, when the previous conscious situation is one in which features which are similar to the ones at present attended to have likewise been stressed.

b. The General Concept. The widest differences of opinion exists as to the nature of the general concept. The two most fundamentally different groups of theories are the motor and the cognitive—those, on the one hand, which find the essence of the concept in a motor phenomenon or tendency, with or without a conscious co-efficient of kinaesthesia or feeling, and, on the other hand, those which attempt to envisage the concept in ideational terms. Many writers have, implicitly or explicitly, recognized both the motor and the ideational factors. Wide differences of opinion exist regarding the imaginal or cognitive form in which the concept appears to consciousness. Those who hold that the concept is “carried” by a word, or by a concrete image, or by both, regard the concept descriptively, as particular; or genetically, as schematic or generic. The image, regarded as particular, is considered as *a.* standing for others; *b.* attended to or accentuated in certain parts; *c.* accompanied by an awareness of its resemblance in certain respects to other images; or *d.* accompanied by the feeling that it represents other images, which could be substituted for it.

The experimental investigators have varied in the importance of the rôle which they have ascribed to imagery; and many have regarded the concept as essentially imageless. Schwiete has pointed out the rôle of the task in determining the nature and amount of imagery; Bagley found a mental adjustment, or “mood”; and both Kakise and Schwiete discovered a baffling ini-

tial stage of understanding which they called the concept-feeling, or feeling of familiarity. It seems not unlikely that the two latter experiences were of a functional rather than of a structural nature,—responses or tendencies aroused by the hearing of the stimulus-word. A highly probable explanation of the baffling nature of this initial stage of understanding is to be found in the fact that our adult apperception of familiar words has reached an extreme degree of mechanization, as has been demonstrated in a striking manner by Sutherland (79, 35-41). This fact renders the task of analysis extremely difficult; and as Sutherland points out (79, 36), it necessitates the application of a method different from those which have heretofore been employed.

Both Moore and Aveling strongly emphasize the existence of imageless mental contents which possess meaning. As will presently appear, we repeated the work of Moore, and we were unable to confirm his findings (p. 33). We shall at present defer criticism, except to point out that Moore's imageless meaning-content is confessedly nothing which evolved under the conditions of his experiment; it is a highly developed content which was already present in consciousness in a highly mechanized form (62, 187 f.); and we may here anticipate our finding that Moore's introspective conditions were not favorable for the task of analyzing such a content, whose baffling nature has many times been pointed out.¹⁹ Aveling's conclusions are open to serious criticism, we believe, on account of his mode of interpreting his introspective reports; many of these reports contain no reference to the imageless mental concept, and indeed some specify that the meaning of the "nonsense word" was given in imagery. Certainly, Aveling's data contain no adequate proof that his observers actually recognized the concept as co-elemental with such factors as sensation or affection. Moreover, in his discussion of "conceptual overknowledge," Aveling does not do justice to the fact that he had explicitly asked his observers to watch for particular or general reference. In the light of our own findings, we believe that such instructions as these would constitute a particularly favorable

¹⁹ Cf. J. R. Angell, *Imageless Thought*, *Psychol. Rev.*, 1911, 18, 295-323; M. R. Fernald, *Psychol. Bull.*, 1910, 7, 88-96.

condition for the interpretation of vague and fleeting structural contents, or even essentially functional factors, as an awareness of generality.²⁰ Both Moore and Aveling apparently consider only two alternative modes of conscious representation of the concept,—more or less concrete visual or auditory imagery on the one hand, and imageless content, on the other (Aveling, 103 f.; Moore, 132 ff.). Both of these writers underestimate not only the significance of verbal imagery, but also the possible significance of kinaesthetic and affective contents; moreover, they have disregarded the possibility of a functional interpretation of their findings.

We may conclude, then: 1. *As to abstraction*: No method which aims to throw light upon the accentuation of mental part-contents can ignore the significance of previous conscious processes; and 2. *As to the concept*: The conscious form of the concept may vary widely; no one image or group of images serves exclusively for its conscious representation; and the hearing of the concept-word is followed, in many cases at least, by a period of familiarity whose analysis is very difficult and regarding whose nature a wide difference of opinion exists. It seems likely that this initial period of familiarity is closely connected with a high degree of mechanization of the word, and hence that in any investigation of the concept, the application of a different or modified method is highly desirable. Such a method we have attempted to employ.

²⁰ Cf. below, pp. 178 f, 202 f. We have stated our criticism of Aveling in greater detail in *Amer. J. of Psychol.*, 1913, 24, 276 ff.

III. DESCRIPTION OF OUR EXPERIMENTS

A. PRELIMINARY EXPERIMENTS. Our investigation began with a repetition of the work of Moore (62). Our procedure and findings were briefly as follows. From Moore's published cuts (62, p. 118) we photographed his geometrical figures to the size specified by him; and we reproduced them in the form of rubber stamps. Using these stamps, we constructed discs similar to those which he describes. Each disc contained thirty rows of five figures each, the rows being arranged radially, and the figures being separated from one another by the space of six or seven millimeters. Each row contained one common figure, which recurred in every group, and four wholly novel ones. An apparatus was constructed which exposed for one quarter of a second each row of five figures, alternating with blank areas of similar size and shape. The instructions to the observers were identical with those of Moore: "Look for the repetition of some one figure; react by pressing a key" (which stopped the exposure apparatus) "as soon as you are certain that you have seen some figure repeated." The observer was afterwards asked to give an introspective account of the processes involved in carrying out the instructions. Our results in this preliminary study were, briefly, as follows:

a. We confirmed Moore's finding that the common element becomes accentuated at the expense of the surrounding elements. b. Our results differed from those of Moore, in that our observers showed marked differences in procedure, ranging from a systematic attempt to hold in imagery some figure, selected arbitrarily or by reason of the fact that it attracted attention, on the one hand, to mere passive attention, on the other hand, the observer here delaying the reaction until a figure appeared familiar. c. We were unable to confirm Moore's statement that the process of perceiving the common element is accomplished by an act of assimilating the perceived data to known mental categories (mental contents which possess meaning in their own right, and which are qualitatively distinct from sensations, images, and feelings). Our observers invariably reported a recognition which was frequently kinaesthetic in nature, and which usually involved visual images or part images of the repeating figure; these images, however, were often exceedingly vague and evanescent, and they were frequently forgotten soon after they had fulfilled their function.

We soon discovered that the method employed by Moore does not provide favorable conditions for introspection. The succession of exposures was so rapid and the series was so long that our observers found it difficult to remember what events had occurred during the earlier exposures. For these reasons this method was abandoned after a few months' trial, and an attempt was made to devise a more promising procedure.

B. PROBLEM. The purpose of our investigation was twofold. We aimed to investigate: a. The process of generalizing ab-

straction; and *b.* the product of the process of generalizing abstraction,—the general concept. Our approach to these problems has been a genetic one. We were concerned not so much with the ready-made general concept as with the procedure and the processes by which this complete and developed form is ultimately reached. Accordingly it seemed expedient to examine these procedures and processes not only in cases where the observer was already familiar with the materials presented, but also at various stages or progressively increasing degrees of the observers' familiarity. Accordingly we set ourselves the task of devising such experimental materials and such an experimental procedure as would not only induce in our observers a genuine process of generalizing abstraction, but would also induce such a process of generalizing abstraction as could be examined and described at various levels or degrees of development. It was, of course, essential that the process of generalizing abstraction should arise and should run its course under conditions which should be optimal for introspection,—in order that the observer might be able to furnish a complete and detailed introspective description of its behavior and of the mental components involved. Moreover, precautions were taken throughout that the observers should never be explicitly instructed to perform an act of generalizing abstraction, but only that they should be assigned a task whose successful accomplishment necessitated such an act.

C. МЕТОД: **a. Materials and apparatus:** In order to ensure the presence of a process of generalizing abstraction, it seemed desirable that the material employed should possess various features which exhibited a certain unity and contextual dependence.²¹ Moreover, the materials and the instructions must be such as to lead the observer to accentuate and to separate certain features of this material from their fellows. Accordingly we chose materials which consisted of drawings of figures which were sufficiently homogeneous to constitute members of a group. These drawings were of unusual shapes; they did not even approximately represent known objects. Each of the drawings possessed certain characteristics which were common to all the

²¹ Facsimile reproductions of our materials will be found in the appendix.

other members of the group; and each drawing also possessed certain characteristics which were peculiar to itself alone or to only a few of its fellow-members of the group.

Each group contained ten drawings. Each drawing was made on a sheet of four-ply white cardboard, measuring 20.5 cm. by 12.5 cm.; and under each drawing, the "meaningless" group-name was printed in large, bold capitals. The ten cards of each series, with an initial and a final blank card, were bound together in the form of a booklet; and they were exposed in order by means of a simple exposure-apparatus. This apparatus consisted essentially of two blackened boards of thin wood, each 17 cm. by 36 cm., joined along longitudinal edges at right angles. The horizontal board served simply as a base for the exposure-apparatus; the vertical board was pierced by a narrow vertical aperture, 7 cm. by 1 cm., at a distance of 7 cm. from the end. The booklet of cards was cut in index fashion along one end, and fastened by means of thumb-tacks through the last (blank) card in such a way that the indexed edge adjoined the aperture in the vertical board. The experimenter controlled the exposures by means of a piece of metal rod, whose end was bent in the form of a hook. The hook was thrust through the narrow aperture from behind; and by moving it upward over successive edges of the index excisions, the experimenter dropped the cards, one by one, exposing the drawings successively. With a slight amount of practice, the experimenter was enabled to time these exposures very accurately, by counting the ticks of a stop-watch. It was, of course, possible to interrupt the series of exposures at any time, by simply allowing the balance of the cards to fall together.

Four serial groups of drawings were employed. The names chosen to designate these groups were "Zalof," "Deral," "Tefoq," and "Kareg."

b. Observers: Our observers were five in number. All had served on previous occasions as observers in experimental problems, and all possessed a high degree of skill in introspecting. With one exception, they were members of the department of experimental psychology of Clark University. They were Dr. J. W. Baird, Dr. S. W. Fernberger, Dr. E. O. Finkenbinder, Dr. Miriam Van Waters, and Dr. Elizabeth L. Woods.

c. Procedure: The procedure during an experiment was as follows: 1. The observer was given the following instructions: "You are to be shown a series of ten drawings of figures which represent a group or species. The group name will be shown with every drawing; it is Zalof (or Deral, etc.). These drawings do not represent real objects; they are to be regarded merely as drawings. Do not attempt to associate them with familiar ob-

jects but confine your definition to what is shown. If such associations occur spontaneously, however, do not inhibit them. Each drawing will be exposed for three seconds, when it will be followed immediately by another. After all have been exposed, you will be given the task of defining the group name, Zalof (or Deral, etc.). You will be asked to furnish detailed introspective accounts not only of your experiences during the examination of the series, but also of the mental processes involved in defining the group name.” 2. The exposure of the series was then commenced, the exposure-time being three seconds for each drawing. Very early in the experiments, it became evident that it is impossible for an observer to give a complete account of his experiences during so long an interval as that required for the exposure of the ten cards. Accordingly, we introduced the variation of interrupting a series after two or three cards had been exposed, for the purpose of obtaining an account of the procedure up to that point.²² 3. After the observer had given an account of his procedure in examining the series, he defined the group name; then he furnished an account of the mental processes involved in the act of defining. At a stated interval, usually of one week, after the initial exposure of the series, the observer was given the instructions: “Tell me everything you remember about the Zalofs (or Derals, etc.); then give an introspective account of your process of recall.” He was afterwards shown the same series a second time, and allowed to continue his examination. On the recompletion of the series of exposures he was asked once more to define the group name, or, if he preferred, to modify his previous definition, adding any new features which he had discovered. This procedure continued through successive sittings until a stage was reached where further examination of the original series failed to reveal new features,—after which

²² Experimentation revealed the fact that the observers experienced no disturbances of such a nature as to interfere with their ability to introspect, when the series was interrupted without their being forewarned; consequently, we adopted the practice of not informing the observer when a pause was to be made. The reason for so doing was to avoid interference, so far as possible, with the normal examination of the whole series.

the exposure of the series was discontinued, but the act of recalling was still continued through a number of additional sittings.

d. Plan of the Experiments: The experimentation was carried on during the spring and fall of the year 1912 and the spring and summer of the year 1913. Our aim was to distribute the experiments in such a way that at the expiration of a certain time our observers would be in possession of the four concepts, in different stages of familiarity, and that the appearance and the behavior of the concepts under different conditions could be examined. Accordingly, the following experimental arrangement was adopted. A certain group,—the Zalof series,—was first employed; and after the presentations had been repeated, in successive sittings, until new features were no longer being discovered by the observer, a new (second) series was introduced. This was followed in similar fashion by a third and a fourth series. In the meantime, the recalls of earlier series were continued throughout.

IV. RESULTS

A. THE PROCESS OF GENERALIZING ABSTRACTION. THE CONSCIOUSNESS OF THE OBSERVERS DURING THE PRESENTATIONS OF THE SERIES.

a. **Introspective Data.** In the case of every observer, the hearing of the experimental task—to observe the figures so as subsequently to be able to define the group name—was at times followed by an experience which was characterized by the fact that the visual regard was confined, in succeeding figures, to certain definite features which had attracted notice. The chance noting of any feature—its momentary standing-out in consciousness—did not mark the termination of all experiences with that feature, as in chance observation; but instead it marked the beginning of a series of experiences in which attention returned, upon the exposure of each later figure, to the region of that feature. In other words the observers usually ceased at an early date to regard the figures as wholes; after the first two or three exposures the figure percepts came to be composed of contents of which certain repeating features were the most prominent, and the features which were not repeated were the least prominent. This peculiar continuous and progressive series of changes in the contents of consciousness and in their clearness-relations constituted the essence of the process of generalizing abstraction, as it occurred in our experiments. It was frequently, but not always, initiated or accompanied by kinaesthetic, organic, affective and by verbal contents, all or any of which sometimes functioned as an intention to investigate the characteristic which had been noted.

The different observers varied in the readiness with which their noting of a feature was followed by the appearance of an intention to investigate the feature, and by an actual investigation, *i.e.*, a process of generalizing abstraction. They also differed as to the number and persistence of such investigations; and finally, they differed in the nature of the sensory and imaginal qualities which constituted the mediums and the accompaniments

of their intentions to investigate and their actual investigations, although of course the conditions of the experiment were such as to insure the presence of a relatively large amount of visual material.

The following are typical illustrations of the introspections of our several observers :

TABLE I

This table indicates the number of times that each group of figures was presented to each observer, together with the date of each presentation. The asterisk affixed to certain dates indicates that the recall of the date in question was chosen for publication in this paper.

Name of Figure-Group	Serial No. of Presentation	Observer A	Observer B	Observer C	Observer D	Observer E
Zalof	1	Nov. 12*	Nov. 12	Nov. 23	Nov. 27*	Nov. 18*
	2	Nov. 19*	Nov. 18*	Dec. 6	Dec. 4*	Nov. 25
	3	Dec. 3	Nov. 25*	Jan. 15*	Dec. 11*	Jan. 13
	4	Jan. 14*	Dec. 5*	Jan. 31	Feb. 5*	Jan. 25*
	5	Jan. 28	Dec. 10	Feb. 18*	Feb. 12	Jan. 27*
	6		Jan. 14	Feb. 25*		Feb. 12
	7		Jan. 21			
	8		Jan. 27*			
	9		Jan. 30*			
	10		Feb. 6			
Deral	1	Dec. 10*	Feb. 27*	Apr. 2*	Feb. 5*	Dec. 9
	2	Jan. 21*	Mar. 3*	Apr. 15*	Feb. 12	Dec. 16*
	3	Jan. 28	Mar. 13*	Apr. 22*	Feb. 19*	Jan. 11
	4	Feb. 4	Apr. 1	Apr. 29	Feb. 26	Jan. 18
	5	Feb. 11			Apr. 16	Jan. 25
	6				Apr. 23	Jan. 27
Tefoq	1	Feb. 18*	Jan. 27*	May 5*		Feb. 3
	2	Feb. 25*	Jan. 30	May 13		Feb. 8*
	3	Mar. 11	Feb. 10*			Feb. 12
	4	Mar. 18	Feb. 17*			Feb. 19*
	5	Mar. 25*	Feb. 24*			
Kareg	1	Apr. 1*		Mar. 7*	Mar. 5	Feb. 26*
	2	Apr. 15*		Mar. 11*	Apr. 24*	Mar. 5
	4					Mar. 14

OBSERVER A

Zalof (first presentation of series, Nov. 12, 1912). 1. (First figure). "During the exposure of the first figure, I observed carefully in order to note what its main characteristics were. I noted the branches and the central parts,—the central circle and the three 'balls' distributed around it. My attention was keen, and I made an effort to hold these features in mind,—I glanced away and observed a visual image of them." 2. (Second figure). "During the exposure of the second figure I made an effort to distinguish the differences between the second and the first. I noted the same characteristics which I had observed in the first figure, *i.e.*, I saw the branches and the central parts." 3. (Third and succeeding figures). "In the third figure I noted these same characteristics; I was aware also that the shape was different,—the red hearts were long. This observation was somewhat disturbing; I made an effort to hold the shape of the central parts in mind visually, and to compare it with the central parts of the following figure. The fourth figure I found to be thick; it was very large and perfectly round, and the branches were smaller. I noted the central parts. The fifth and sixth figures also clearly contained the central parts and branches. In a number of these figures I noted that the central parts were similar in general character to those which had disturbed me in the third; they contained round centers and heart-shaped surrounding figures. In the seventh figure, I noted that the central parts were not colored red, but instead were simply marked out in black lines; these I noted particularly, and at the same time I called up a visual image of the centers of other figures, which were red; I was thus aware of the redness in the one case and the absence of red in the other.

Thereupon I simply abandoned these processes, and observed the oncoming figures. I have forgotten about my observation of the eighth and ninth figures. The tenth, as I remember it, did not have three branches. It looked like earthworms, having pseudopodia in all directions. Then I accepted it, mentally noting the variations and regarding it as a possible exception. During the exposures, I was aware of a verbal association with trilobites; this occurred, I think, during the sixth or seventh exposures; it consisted in a verbal image of the word 'trilobite,' with a visual awareness of the threeness of the present figure. The association persisted for some time." (Describe more fully your noting in the second figure of the same characteristics which you had observed in the first.) "As the second figure was exposed I was actively holding in mind a visual image of the first; and, indeed, with the exposure of later figures, I almost invariably was aware of visual images of the preceding member, or of several preceding members of the series. These images, when they occurred, were held somewhat to the left of the percept; I can not say whether or not I actually super-imposed image and percept. The process was quick and flashing; the similar features were there, and stood out; I could not help seeing them."

Deral (first presentation of series, Dec. 10, 1912). "During the exposures I observed and attended to various aspects of the figure. I first picked out the straight line in the left periphery, next the general shape, and then a combination of features which appeared like a mouth, from which something

seemed to protrude. (The reference is to the boundary-line between the two parts of the figure, and the right-hand part, the former appearing as an open jaw, and the latter as an object protruding from this jaw.) I also attended to and noted certain variable features, especially the different colors, which I ruled out, thus forming the definition and meaning as I proceeded. At times, I expressed my findings in vocal-motor verbal fashion, as a method of learning; when the blue color appeared, I said 'all right, blue'; and similar verbal imagery appeared in the case of the red figure. No associations appeared until about the third exposure, when my observation of the straight line in the left periphery was attended by an association of a geometrical figure. Then I had a visual association of a sponge which had built upon a sloping rock, or one which had been cut off from its base by a slanting incision, instead of one which passed across in a plane perpendicular to the axis of the animal. I glanced down at the name once or twice, but it did not become fixed or learned. Toward the close, I began to review the features which I had discovered, selecting the essential ones and looking for suitable words. These were slow to come. At first the word 'object' appeared; then several other words."

Tefoq (first presentation of series, Feb. 18, 1913). First, second and third figures. 1. (First figure). "During the first exposure I attended to the central part; it was the most intricate feature, and demanded most attention; I also noted the ragged edge." 2. (Second and third figures). "During the exposure of the next two figures, I observed that the central parts were the same; I also noted the outer edge. I anticipated the third figure, in visual imagery. During its exposure I glanced over the peripheral parts; immediately I was aware of a visual image of the first figure,—the ragged edge being prominent." (Fourth figure and remainder of series). "In the first figure, I noted the outline, and the little indentation in the lower periphery. Then I saw the center, and noted parts of it which I had not seen before. I observed that the center, in this case, was large; I was immediately aware of a visual image of the first figure of the series, in which the central part was large. The first (fourth) figure persisted in visual imagery, and was compared directly with the second (fifth) when the latter was exposed. This had the same characteristics, except that the center was larger and the peripheral line more irregular. In the fourth (seventh) figure I attended first and most to the periphery, which had projecting lines all around; the center was scarcely attended to at all, and I have forgotten what it was. In the next figure I noted the smallness of the center, and was immediately aware of a visual image of a figure containing a very small center,—the second or third of the series, I believe. I noted the same features in the later figures; I was aware of eye-strain, incidental to looking at the periphery and the 'Chesapeake Bay' indentation in its lower part. I am not certain that I noted all these features in each figure, as I was unable to attend to all of them."

Kareg (first presentation of series, Apr. 1, 1913). 1. (First figure). "During the exposure of the first figure I noted various characteristics. My attention fell first upon the outside border, and I noted the two-lobedness of the figure. I noted the lines, and looked for some system; the figure appeared

so simple, however, that I did not look very persistently. The vocal-motor verbal imagery appeared 'this is an easy one'; before and during this verbal imagery I was aware of an attitude that the figure was easy." 2. (Second figure). "The second figure appeared, and I looked for the same features. I observed that this figure possessed depth, a characteristic which I had not observed in the first figure; the left-hand side seemed to proceed forward to a point, and had many flat sides. The outline was something like a duodecagon. I was just starting to count the sides when the third figure appeared." 3. (Third figure). "The characteristics which I had noted in the first two figures did not appear so plainly; I can not remember what I attended to." (Describe your looking for the same features in the second figure.) "This consisted partly in my actual perception of these features; my regard passed along the same course. The instant I discovered the protruding, tri-dimensional character of the second, I was aware of a visual image of the first figure in which I tried to observe this tri-dimensionality, but without success. I was not definitely aware that I was actually looking for the same thing, attempting to get the sameness out of the figures." (Fourth, fifth and sixth figures.) "My procedure was very similar. While observing the first (fourth), a visual image of the second of the series came in. This was incidental to a failure to perceive depth in my percept. It meant that some of the figures have depth while some do not. I turned my attention away from this feature and allowed the depth aspect to drop out of my mind. The next figure, however, possessed tri-dimensionality; the left-hand figure had many sides, and I began to count them, being aware at the same time of a very faint memory that I had not counted the sides of the previous figure (second) in which I had noted tri-dimensionality. From my counting I found that there were six sides. I noted that the sides were not uniform but had different shapes; this act consisted simply in fixating upon one corner. I just succeeded in finishing my counting when the card dropped. I did not note the right-hand side at all but I was vaguely aware of its shape." (Describe your counting of the sides.) "I simply glanced from the right side upwards and around to the sides. I noted at once the other three sides at the bottom; and then the whole thing was seen as possessing six sides." (Seventh, eighth, ninth, and tenth figures.) "In the first figure, I looked for the sixness. I actually said to myself 'two, four, six' as my glance passed around the figure. I did not succeed in observing the details of the little figure, but noted only its form. In the next figure, however, I detected only four sides. So far my counting had consisted in simply noting the number of sides as a group; with the last figure, however, I began to count the corners, checking them off by saying 'one, two, three,' etc. I did not have time to finish my counting, or to determine whether there really were six. With some of the figures, the surfaces, if they existed, were not sufficiently clearly demarcated for satisfactory counting."

The following are representative introspections selected from A's accounts of his later examinations of the series.

Zalof (second presentation of series, Nov. 19, 1912). "During the fore-period, I was aware of a number of visual images of the Zalof figures. While

the early exposures were being made, I noted that the figures differed in various respects from my visual imagery; but despite this the differences were recognized and familiar. They seemed to 'fit in' and to force me to accept them. During all of these earlier exposures, however, my attention also went to the particular features of the shape, as it varied in different figures. When the series was about half exposed, I became conscious of the definition which was to follow; this consciousness was present in the form of an attitude, and a summing up of what I had seen. I began to 'play' with visual images of figures which I had already had, noting the points of difference. The word 'plant' came in verbal imagery, with attention to the terminations of the branches; these appeared as roots of trees, although I did not actually call up visual images of tree roots. I began anticipating the coming figures, in visual imagery, recalling each before it appeared. Oncoming figures conformed at times to my images. The image of the tiny figure was actually smaller than the figure itself, as it appeared today. Toward the last of the series, when I was particularly active in anticipating the oncoming figures, I was aware of a feeling of liveliness, although this did not amount to actual strain."

Zalof (fourth presentation of series, Jan. 14, 1913). "During the first exposure I was aware of a definite feeling of familiarity; I could observe every part very readily and easily. I noted one novel feature,—the fact that the end of each branch divided into two series of sub-branches. All through the presentation of the series, I attended to this characteristic, finding it to be present in every figure. No other characteristics stood out clearly in my consciousness. I was continuously aware, either in the visual percept or in visual imagery occurring between the percepts, that I was looking for this terminal division of the branches. Between successive exposures, I anticipated the next figure in visual imagery, seeing in the image this twofold division at the end of each branch. My anticipation was sometimes correct and sometimes not correct; but in either case I invariably found the dual arrangement. I failed completely to notice the single figure which had an uncolored center; I noticed the thicker ones and then the thinner one. I correctly anticipated the little figure. But the essential part of my procedure was my act of observing the twofold division at the ends of the branches. At one time I was aware of an intention to include this feature in the definition; this was present in schematic and vocal-motor verbal imagery of the words 'two groups of branches.'"

Deral (second presentation of series, Jan. 21, 1913). "During the fore-period I was aware of a number of visual images of Derals, particularly prominent among which was one whose uncolored part bore fine hair lines. During the presentation of the series, I looked carefully at each figure, noting the important features. I attended to the various shapes, and to the finer details, also to the color. The first figure seemed distinctly novel, *i.e.*, it was entirely different from any of my visual images. The yellowness was somewhat shocking; yet it was not seriously considered; I knew that the figures were not all yellow, as my visual images contained different colors, —red and blue, for instance. In each of them, the color was the last thing to

become prominent. I was aware at this time of a visual image of the experimenter drawing the figure, and introducing color with an intent to create one more distraction. In the second figure, the essentials were the same but the size and shape and color differed; the latter features were not all noted. As the series continued, my attention was attracted by those characteristics which were the most striking in the figures. If there was a marked variation I turned to it; if the color was different, I looked at the color. I simply looked at the figures, under the general influence of the situation. I did not attend long to similarities, *i.e.*, I did not stop to look at the lower straight line; it was there and did not demand turning my eye to it. I believe, however, that if this line had had a different angle I should have turned to it immediately. For a time I anticipated, in visual imagery, the figure with black hair-lines in the uncolored part; this proved to be about the seventh figure, and the lines were actually shorter and more widely separated than in my visual image. After the seventh or eighth exposure, I began to note the tentacles upon the right periphery of some of the figures, and to review the figures in visual imagery, by way of summarizing the main points, and also of observing the presence or absence of tentacles in the uncolored side."

Tefoq (second presentation of series, Feb. 25, 1913). (First four figures). "During the exposure of the first figure I noted the little black marking on the end of the central figure, which I had forgotten. I was immediately aware of visual images which had been present during my recall; in some of them I saw this marking. I noted also the little 'Chesapeake Bay' indentation in the lower periphery, and observed that it was similar to the little black marking on the end of the central body. In the third figure, the 'Chesapeake Bay' indentation was smaller. As the figures were exposed I looked at each one carefully; and occasionally verbal images appeared which were descriptive of features which I noted. In the third or fourth figure I noted a bluish drab color; I then recalled, in visual imagery, the colors which I had seen; my images included a brownish figure, and a yellowish one. At about this time I also noted a small blue triangle in one of the figures. It seemed rather incidental; *i.e.*, I could not make it out in any of a number of visual images of figures which I had previously seen, which came up at the time. Then the last figure appeared. I attended to nothing except this triangle; I was unaware of the periphery. I do not know what color it was nor how big it was." (Last six figures). "During the exposure of the first figure my attention was strongly attracted by the fact that the marking on the end of the central body was white instead of black. I did not see the triangle at all. My noting that the marking was white was attended by visual images of figures which I had seen upon previous occasions, in which this marking was present. I noted the periphery, and saw that the 'Chesapeake Bay' indentation was present. In the following figures I observed the triangle, and looked over the particular characteristics of size, smoothness, roughness. The figure whose contour was particularly rough was attended by visual images of three or four figures which I had seen on previous occasions, and in which I particularly noted the periphery, comparing it with the present figure."

Tefoq (fifth presentation of series, Mar. 25, 1913). (First five figures.)

"During the foreperiod I was aware of many visual images of Tefoq figures which I had seen during previous sittings. I saw them as actually presented; and at times I could see the cards flap down before my eyes. I made an attempt to anticipate the figures in their proper order; I saw the first three clearly. I was aware of an attitude of searching for new details, which consisted in my manner of attending, my close observation. I was also aware that I had not yet made a good careful observation. In my imagery I was aware also of snatches of the central region. The first figure was exposed. My attention fell upon the central region and the border. Both of these features were familiar; the figure stood out as identical with one of my particular images of a figure seen the other day; it was familiar. My regard reached the 'Chesapeake Bay' indentation and I noted its oneness, *i.e.*, the fact that all of the projections extended on one side. I counted these projections, and examined the branches carefully; I found that there were four branches and that the lower one was divided; at times, however, I thought I made out five or even six. I had visual images of previous figures, in which the 'Chesapeake Bay' indentation was also oneness; I had forgotten to mention that fact, however, in my recall. During the subsequent exposures, I looked at the central region, to observe whether the same sort of projections were present in the marking on the end of the angular body. I noted a little irregularity, which I also found in the next figure." (Last five figures). "During all of these exposures I looked at the two features of the 'Chesapeake Bay' indentation and the marking on the end of the central angular figure. The order of my observation of these features varied in the different figures. I started out with the 'Chesapeake Bay' indentation, but the figure was small and I did not succeed in counting its projections. I noted the little irregularity in the central marking. The moment I finished the observation of a figure, I was aware that these things to which I had attended were common; this awareness was present as an attitude; it was a vague and schematic summary of visual images in which these features stood out. During the last exposure, I noted again the arrangement of the projections of the 'Chesapeake Bay' indentation, which I had noted on a previous occasion. Visual images appeared, in some of which, however, I was unable to see this feature. In spite of this, however, I let it stand as a general feature. This was largely in the way I attended to it."

Kareg (second presentation of series, Apr. 15, 1913). (First, second and third figures) "During the exposure of the figure I recognized the presence of lines indicating depth, and I was aware of slight surprise in finding them on the very first figure. This appeared as a visual image of a figure to come later, a figure possessing these lines which indicated depth. I was aware of a familiar toning; this consisted in the readiness and ease with which I perceived the lines. It seems absurd to say that I had a visual image of the figure as seen in the past, yet there was something of that character clearly present. I definitely recalled in this way that I had perceived no order or arrangement during my previous perception of this same first figure. This came as I attended to the visual image. I began to count the number of

sides in the first figure, but could not do so. I did not note the other (the right) end at all. When the second figure appeared, my attention during its exposure was occupied by counting the sides. I found five, and then I counted again. In my first counting I started at the bottom of the figure and passed around it in a clock-wise direction; I counted 'one, two, three' in verbal terms, and then simply perceived two more, glancing over them. My fixation seemed to end at a point which was further to the right of the center than my starting-point; I then attempted to look at the figure as a whole, but failed, and the card dropped. The next figure was just black and dull; no sides were distinguishable; I simply noted my other features. The figure had a dent in it at the right end, but that had no significance. As I noted this dent I attempted to recall whether or not it was really a characteristic that I had noted the other day, *i.e.*, I tried to call up a visual image of what I had seen on the previous occasion." (How did you refer to a past occasion your visual image which appeared during your observation of the first figure?) "That is partly an awareness of the situation and the stimulus of the present, which seemed to be at the time a background of consciousness." (Fourth, fifth, sixth and seventh figures) "My attention was occupied largely by efforts to count the sides of certain of the figures. I could not distinguish sides in the first figure; immediately my attention wandered, and my regard passed down to the name. I was aware of a vocal-motor and auditory verbal image of the word 'Carrigan.' My attention dwelt on the 'E-G.' The small figure seemed to have five sides; another had seven. Toward the last,—during the exposure of the fourth figure,—I became disgusted and abandoned the criterion of the possession of sides. I felt that the presence or absence of sides was not essential; I was aware of an association of the figures with worn rocks; and it occurred to me that in the case of those figures in which the sides were not clear, the sides might have been worn off. I looked for a similar tri-dimensional arrangement in the small part of the figure (right) sometimes I saw them and sometimes I did not. I looked for the indentation; I did not find it, but I did note that one surface had a straight vertical edge, which might become an indentation." (Describe more fully your disgust.) "The feeling was very slight. It was mostly present as an attitude of turning away after noting in a figure that there was no sides to count." (Were you aware of any emotional toning?) "No emotion was present at all. If affective toning was present, it was very slight. I was aware of slight pleasantness when the association with the worn stone appeared, during the exposure of the fourth figure." (Eighth, ninth, and tenth figures) "I simply looked at the figures, noting the features of each as it appeared. I was very indifferent. In the second figure I noted a concavity at the bottom; I called up several visual images of past figures, but could not determine whether they had this dent. In the third figure, I noted lines; there was a suggestion of a seven-sided figure."

OBSERVER B

Tefoq (first presentation of series, Jan. 27, 1913) 1. (First figure)
 "During the first exposure, I was aware of the complexity of the figure, and of the difficulty I would have in learning all its features. This awareness

consisted in a behavior of my attention and fixation; my regard passed in rapid movements around and around the figure. I obtained an excellent impression of the form. I noted the central figure, which was like a pair of steps; I observed that it had some sort of device on the end. I noted a little triangle, colored blue. The outside of the central body was washed in green, and I noted somewhere a brown color. I was much surprised to find that the figure was not like any sort of vegetable or animal organism, with which I am familiar; and I was utterly at sea as to what category to place it in. I was aware of an association of one of the figures with something Egyptian, which came in sketchy visual imagery of a picture in a history text-book showing the building of the pyramids." 2. (Second and succeeding figures) "When the second figure appeared I noted first the general form and then I began an attempt to name the colors, and the colored parts. I noted the step-like central figure. I do not now remember all the colors; but I remember seeing brown and green. Then I looked for the little triangle and it was slightly different in shade,—greenish instead of the blue I had seen before. The word 'step' was present in auditory and vocal-motor verbal imagery; during the whole exposure, the state of my attention was non-voluntary and very intensive; the surprise at the uniqueness of the figure never left me; it consisted in the keenness of my attention and in my halted and shallow breathing. During the succeeding exposures, I observed these features, trying to memorize them, and supplementing my visual perceptions with vocal-motor and auditory verbal descriptions."

Deral (first presentation of series, Feb. 27, 1913). (First, second and third figures. 1. (First figure) "During the exposure of the first figure, my attention was very keen and pointed. I described to myself, in auditory and vocal-motor verbal fashion, the things that I saw; and I was aware of a feeling of mental effort; shallow breathing and bodily tensions. All of these contents together constituted an effort to learn the characteristics of the figure quickly. The vocal-motor verbal images were 'fish-like thing,' 'dots,' 'has tail.' No name seemed to occur to me for the colored splash against which the figure was placed (the left-hand part of the figure). I was aware only of a very vivid visual perception of that part of the figure. I noted the little sharp point which occurs on the left-hand side." 2. (Second figure) "During the exposure of the second figure, the word 'fish-like' occurred again. Then the word 'color' appeared, rather emphatically. There was something in my mind which made me conscious that the form was about the same, but the color was different. Toward the close of the exposure, and about the time that the third figure appeared, the word 'simple' was present in the same manner." 3. (Third and succeeding figures) "During the exposure of the third figure, the word 'fish' occurred. I was aware of pleasantness, and of casting about in my mind for terminology in which to describe the forms. The design of the figures was rather pleasing." (What was that consciousness, which you reported during your observation of the second figure, that the form was about the same but the color different?) "There was an actual perseveration of the first figure in visual imagery, which appeared with the second; and both the first and the second were present in visual imagery with

the third figure; I was also aware of considerable pleasurable toning. My consciousness of similarity lay chiefly in my final satisfied repetition of the words 'fish-like' and 'fish.'" (Fourth, fifth, sixth and seventh figures) "Before these exposures began, I had a very definite pre-perception of my 'fish.' I had a visual image of one of the figures with pink shading behind it, and of another figure, with green. They were drawn in black; and the little foot at the bottom was noticeable (base of the right-hand figure). The colored shading went around to the top, and the little point on the extreme left was present. I was annoyed when the first figure appeared, my annoyance consisting in a sort of organic and kinaesthetic shrug; and I said to myself, 'Tara's Hall,—no, Tara's Harp.' There was much strain then, in my eyes and forehead and the upper part of my body,—a feeling of mental effort. I was searching for some sort of a description which would apply to these figures as well as to my beautiful little 'fishes,' *i.e.*, the first three figures. I was conscious of passing my eyes over and over the figure. The word 'foot' occurred in auditory terms as I noted the little 'foot' on which the right-hand part of the body rested. With that mental echoing of the word 'foot' I was aware of an association with the clams we used to look for in the summer; and the word 'clam' was present, together with a brief visual image of a stretch of the beach where we dig for these clams. I tried to utilize that in my description of this right-hand part; I am conscious that it was held in the focus of attention for some time. My dissatisfaction grew slightly less as the exposures continued, but it did not disappear by any means. The tension still remained. As I looked at the different figures, my attention turned first to the right-hand side of the figure, which invariably gave me a definite impression of lying over the other side. At one time the word 'shadow' occurred in auditory and vocal-motor verbal imagery." (Eighth, ninth, and tenth figures) "During the exposure of the first figure, I noted the general shape of the colored background of the left-hand figure, and the foot of the right-hand figure; and the point on the extreme periphery of the left-hand figure; as I noted these features, the following verbal images appeared: 'harp again,' 'foot,' 'point.' A pleasant affective toning appeared; I was conscious of the fact that the figures were similar to each other; this consisted in a remembrance of the word 'harp' as I had previously pronounced it, with a visual image of one of my harp-like figures in which the harp-like outline of the figure was a conspicuous characteristic. As the series continued, I noted the foot and the point in each figure. I also noted the name which had previously escaped me."

The following are B's introspective accounts of her subsequent examinations of the several groups:

Zalof (second presentation of series, Nov. 18, 1912). "During the recall and fore-period,—the interval immediately preceding the exposure of the first figure,—I was aware of a visual image of one particular Zalof, which had long tendrils projecting from its triangular body, and red inner parts which extended into the tendrils. When the first figure appeared, I observed that it was an exact copy of my visual image, with one exception,—I am not

certain whether there was an inner body. When the second figure was exposed, I noted the presence of a fourth inner body and also the presence of the bifurcations and the dual division of the terminal sub-branches. These two points stood out, without any volition or searching on my part. In the next exposure, I was aware of a definite willing to note these two points, of the fourth inner body and of the two divisions of sub-branches. The words 'definition to be amended' were present briefly, in vocal-motor terms. I observed these points in successive members of the series; I was invariably aware of pleasantness and relaxation,—absence of tension; my eye had time to explore the whole figure. The series seemed shorter than the previous one; at its close I was aware of a visual image of a Zalof with the large end-body and no arborizations which I had not seen in this series; the verbal imagery appeared, 'there must be one (figure) missing.' I was also aware of a halting of my mental processes and of rather shallow breathing."

Zalof (third presentation, Nov. 25, 1912). "During the fore-period I was aware of setting myself a problem or *Aufgabe* to note carefully. The fact that the series was repeated made me wonder if I were failing to observe minute features. These contents, in conscious terms, were as follows, in so far as I can recall: a certain tenseness as though to prepare for close attention; imagery concerned with previous sittings in this experiment, auditory, or giving introspections and of words of my definition, together with unpleasantness. These seemed to constitute my consciousness of dissatisfaction with my own performance. I was also aware of a fleeting visual image of the first Zalof of the series, and of vocal-motor verbal imagery of naming the features I noted. This was attended by shallow breathing. It may be interpreted as a questioning attitude. The exposures began to come and I observed them, my observation losing immediately any voluntary form, and being instead just the natural thing to do. With the first exposure, I was aware of decided pleasantness. The figure came into consciousness easily. I noted the two features which I had not previously observed, namely, a shading at the ends of the branches and the presence of red inner bodies distributed about the central parts. My awareness that I had not previously observed these features consisted simply in visual images of figures which I had seen before, in which these features were lacking. I remember also the tiny Zalof. I noted presently that these two new features did not occur in all Zalofs; before I made this discovery I had been aware of auditory verbal imagery of naming them as if included in a definition."

Zalof (fourth presentation of series, Dec. 5, 1912). "Throughout this series, I was aware of pleasantness, which accompanied the consciousness of obtaining a clear visual perception of the object, the time being sufficient for a fairly leisurely examination of the whole figure. This consisted in my consciousness that my eye had travelled over the whole figure. With the exposure of the first figure, I was conscious of the verbal imagery 'three,' 'no shading,' and 'red.' With the last verbal image I was aware of a dim flashing visual image of a Zalof containing blue. With some of the figures I was aware of auditory and vocal-motor verbal imagery 'no lines.' There was a very decided recognition of every figure as it appeared,—or an attitude of

affirmation. Before each presentation came, I was aware of muscular tension in my shoulders and eyes and neck, which seemed to be a wondering whether I would discover something which I had previously failed to note. Then as the figure appeared I examined it and was aware of this affirmative attitude. In so far as I can remember, the essential thing about the attitude was my organic reaction to the figure. There was a certain ease and lack of tension about my observation of it; no attitude of questioning, no strain; occasionally there was a reference to a former time and place, vague associated imagery of the conditions under which I had previously seen the figures; but I am positive that that did not always occur, and that when it did it was vague and rather unessential. I noted a figure which lacked shading. In this experience, I was aware of a definite reference to a past experience, when I had observed this particular figure. Once or twice, particularly with the pudgy Zalof and the tiniest one, I was aware of a vocal-motor 'there you are.'"

Zalof (eighth presentation of series, Jan. 27, 1913). "During the exposure of the first figure I noted the presence of a little pointed prong, in one of the bifurcations at the ends of the tentacles placed between the pairs of sub-branches. When I noted this, I was aware of intense surprise; I pulled myself up suddenly, there was a distinct halt in my breathing, and I leaned forward with much keener attention. I watched in extremely close fashion to see if I could observe this same feature in the next Zalof. It occurred. I was again aware of intense surprise. My attention remained exclusively upon these bifurcated ends of the tentacles; I absolutely neglected to look at the centers or anything else. In the next figure, the tentacle was bifurcated in the same way; but the notch did not occur in the same crotch of the branches in which I had observed it in the first two or three Zalofs. At this time, I was aware of an influx of visual imagery and kinaesthesia: memories of Zalofs of the Identification Series,²³ which I had rejected because their bifurcation was not correct. The kinaesthetic contents consisted in strain localized in my shoulders and forehead and eyes. Throughout the series I watched attentively for this feature. I sometimes found it and sometimes did not; I was aware of intense confusion."

Zalof (ninth presentation of series, Jan. 30, 1913). "During the period immediately preceding the first exposure I was aware of memory images concerned with my last sitting; the imagery was almost entirely visual, having to do with a pointed protuberance which I had observed between the bifurcations at the ends of the tentacles. I was aware of visual images of several Zalofs, having this feature, and also of very scrappy auditory verbal imagery of my discussion of the feature, in my previous definition. All of this, together with an intensive bodily adjustment for attention and pleasantness, constituted an *Aufgabe* to observe this feature in the coming series. When

²³ The reference here is to a series of experiments in classification, in which the observer was presented cards bearing analogous drawings which might or might not embody some or all of the essential features of any group, and in which he was asked to indicate whether the drawing was a Zalof (or Deral, etc.).

the first figure appeared, my eye passed hastily to the extremity of each tentacle, and I looked for the little prong. I did not succeed in observing it. I noticed almost nothing else in the figure. Then the second exposure appeared. Again my regard passed about the ends of the tentacles and I was aware of a definite surprise at not finding the prongs; this consisted in some additional kinaesthesia incidental to an increase in the closeness of my attention; I moved a trifle nearer to the apparatus, and my eyes passed rapidly around and around the figure. I began to be aware of doubt regarding the validity of my definition of the day before. The words 'I wonder if I did not see that after all, occurred. But in the last tentacle I noted the prong; immediately I was aware of a visual image of the first figure, and I recalled that the prong had actually been present there. In the next figure, I noted the prong again, my attention having gone first to that region of the figure. Toward the close of the exposures,—my attention having been keen all the time—I noted a Zalof which had no red in its center; the central parts were absolutely black. I was intensely amazed; I was aware of utter astonishment and confusion and chagrin, and of wondering how I could possibly have missed this absence of red in one of the figures upon each previous exposure. The chagrin was not a very unpleasant experience. I was somewhat amused instead. My state of mind was much as if somebody else, instead of myself, had observed this group day after day and had failed to notice that one of its members lacked the red center. It is difficult to describe the structure of all of this. For a time I absolutely held my breath. A large amount of imagery crowded into my consciousness, auditory, kinaesthetic and visual, having to do with past definitions in which I had always included mention of the red center as essential, with bodily attitudes which had not been present as I rejected members of the Identification Series because they were black in the center, and with numerous of my past sittings, with the figures I had observed. Presently I was aware of an imaginal gasp of breath, attended by a vocal-motor strain of saying 'A-a-aah!' Then I became aware of doubt as to the validity of my definition in general. This consisted chiefly in a recall of my previous sitting, in which I had noted the presence of a horn between the bifurcations and had later discovered that it was not there at all; it was attended also by auditory and vocal-motor verbal imagery of the words 'horn' and 'bifurcations.' Afterwards, I observed the red centers; I noted in one that the central bodies were drawn in black but were surrounded by red shading. This observation contributed to my consciousness of doubt as to the validity of my observations. Presently I was aware of visual imagery of Zalofs of the Identification Series (cf. footnote 23, p. 50), in which the presence of blue centers was prominent; these, together with my percepts, functioned as an idea that the Zalof might have either black or red centers, but certainly not blue ones." (Will you describe more fully your first observation of the absence of red in one of the Zalofs? What eye-movements preceded its observation?) "I had directed my eyes first to the ends of the tentacles; and just as the card was falling I noted that center. I did not obtain any impression of its form; I was simply conscious of its being all black, just in a sweep of the eyes across it."

Tefoq (third presentation of series, Feb. 10, 1913. First, second, and third figures). "During the fore-period I was aware of an intention to observe very closely. This was present in a kinaesthesia of bodily adjustment, organic sensations. During the exposure of the first figure, my attention went to its size; I thought 'Gee! smaller than I thought!' in vocal-motor and auditory verbal imagery. The words 'little step' and 'little triangle blue' appeared in the same sorts of imagery. During the exposure of the next figure, the following words appeared in auditory vocal-motor imagery: 'steps green,' 'triangle blue'; then 'wonder if color is constant, after all.' Then 'where is my brown?' also in verbal imagery. Finally, 'main body green,' 'little triangle blue.' The third figure was presented; immediately I noted the central part, and again the verbal images appeared, 'main body green, little triangle blue.' These were rapidly followed by the verbal imagery 'I must find that out every time.' I noted the background of the third figure; it claimed my attention, and I was aware of a desire to examine the backgrounds of the first two figures once more." (Fourth and remaining figures). "Apparently I had an *Aufgabe* to note the color of the main body of the central figure and the little triangle, and also the position of the triangle; and also the background. I started out by observing these features, and my experience was almost the same as that which I have described in introspecting upon my observation of the first three figures, except that now when I noted that the little triangle was arranged along the upper part of the central figure, I said 'yes.' I noted the background in the first few figures; the first was white, the next one was darker, and the next was black. Afterwards I always observed these features: the central figure, with the marking on its end and the pale green of its sides, and the little blue triangle over the back side of the stair (central figure). The backgrounds continued to differ in color. Suddenly, in the latter part of the series, auditory imagery of my former descriptions flooded in; in this way I remembered that I had believed that both brown and green were present in the Tefoq figures. Afterwards I watched for these colors; and they appeared in the next one or two figures. I noted in these figures my other features: a design in the end of the steps, and the insert in the lower periphery; but not in a very focal manner. I noted a figure,—about the fifth,—which had fringes all around it, and I wondered if the rest would be fringed. The word 'whiskered' came in, accompanied by a tendency to smile. Throughout the series I invariably noted that the top of the steps (central figure) was pale green, that the little blue triangle was present at the back of the steps, that the end of the steps was more or less variable but never colored, and that the background was present, uncolored or in various colors, and with irregular outlines."

Tefoq (fourth presentation of series, Feb. 17, 1913. First, second and third figures). "During the fore-period, I anticipated what I would do. I called up in visual imagery everything that I know about the Tefoqs and I described my visual images in auditory and vocal-motor verbal fashion. In this way I was aware of the 'stair-step' region, with its green wash along the top, and with its little blue triangle appended; and also of the leaf-like background. I was aware of pleasantness and keen attention. When the first figure appeared, I began observing it hastily to determine whether these features were present.

I noted the coloring. The sides of the stair-like figures impressed me by their compactness; they stood out prominently,—seemed different from any which I have seen. My eyes passed around the peripheral boundary. About this time I became aware that my observation had occupied a good deal of time and that the exposure might terminate before I had noted all of the features. This consisted in a quick turn of my attention to these features: the green wash on the top of the central step, the blue triangle. I did not have time, however, to note the design on the end of the steps. I became aware of having four definite things to do, although I had not gone so far as to visualize or name what all these four things were. The first two were present in visual imagery; and the other two spatialized themselves as a sort of kinaesthesia in my hand,—as if I were moving my hand in a short vertical sweep out here in space (indicates hand). During the exposure of the second figure I noted that the background contained curved shading lines; this did not impress me as novel, but it came out with somewhat greater distinctness than usual. I devoted the rest of the exposure to directing my attention to and naming these four features, in turn; the green wash on top of steps (central figure), the blue triangle, the design on the end of the steps, and the inset in the lower periphery. I noted that the green color was extended down over the step. And I made an effort to recall the first figure in visual imagery so as to note whether this had been the case in the first figure. During the exposure of the next figure I again directed my attention to the four features, and named them.” (Fifth, sixth, seventh and eighth figures) “I made a definite attempt this time to determine in addition whether or not the green wash extended over the whole step. As soon as this feature had been investigated, my eye went to the little blue triangle, then to the design, and then to the inset in the lower periphery. During each exposure I was conscious first of the general size of the stair-step and the general appearance of the background. The background of the first figure was rather highly colored; another background contained black shading lines. Toward the close, I was aware of a diffuse feeling of satisfaction, together with a definite idea that I had the general color and form of the Tefoqs fairly well in mind. This idea consisted in an auditory and vocal-motor verbal image of ‘green,’ attended by a recall in visual imagery of two of the figures,—first one, and the little figure whose end design was relatively large and rather different from that of most of the others.” (How did you know that the design in the last mentioned instance was different?) “This was simply a matter of my attention centering upon the design very consciously for an appreciable time. In the case of the designs on the other figures, my attention went off to something else as soon as the design entered the field of vision.” (Eighth, ninth and tenth figures.) “In these figures, I noted the green wash on the sides of the central stair-like figure, which went down over the front part. I also noted the end, with its black design. I noted that the little blue triangle was pale, but that it was nevertheless distinctly blue. The word ‘blue’ appeared as I made this observation. I then noted the background. There was some sort of an awareness that these backgrounds were distinct and different from each other; and I discounted them mentally in some way,

as an interesting fact, but one irrelevant to my problem. This was present simply in an attitude, together with my visual percept and my imagery of different backgrounds. I made no effort, and had no inclination to note just what these characteristics were; my attention simply passed easily to something else." (Were you aware of your procedure, in connection with these backgrounds?) "No, not explicitly."

Tefoq (fifth presentation of series, Feb. 24, 1913. First five figures). "I was aware in the fore-period of setting myself the task to observe whatever might appear. During the exposure of the first figure, I looked at it, without pursuing any definite course of observation. Presently I was aware that time was passing. Then I noted the central parts, and said to myself, 'wash of green,' 'blue triangle.' Then I noted visually, with much eye-strain, the contour of the outline. During the exposure of the second figure, I noticed the background particularly, my attention focusing upon it first. I was aware of the little curved shading lines. Then my regard passed over my criteria of the green wash, the blue triangle, and the design in the end of the steps. Then I observed the inset in the lower periphery, noting that it faced to the right. I wondered if it always faced in this direction; this wondering consisted in an effort to visualize the next card, which failed so far as any definite imagery was concerned, but resulted in a visual image of some sort of a Tefoq, localized on the next card. During the exposure of the third figure, my attention fastened first upon this little inset in the lower periphery: this constituted a vague consciousness that I was to examine it and see if it faced toward the right. Presently I noted, with a shock of surprise, the presence of a pink background. The surprise consisted in slightly shallower breathing and somewhat more close visual attention to the color; then came verbal images of 'pink' and 'never described before.' This constituted a consciousness of wondering if I had never noticed that pink, or whether I had noted it but never described it. During the exposure of the next figure, my attention went once more to the background which was dotted; then it turned to the inset at the bottom. I found that the inset faced to the right. I then noted visually and verbally the 'wash of green,' 'blue triangle,' 'design in end.' In the last figure, I noted the brown background. The rest of my procedure consisted in the same visual and verbal noting of my criteria. . . ."

Deral (second presentation of series, Mar. 3, 1913. First five figures). "During the first exposure I found myself passing my eye over the whole figure several times, always beginning at the foot of the right-hand side and proceeding up and around and down to the foot again. I found myself saying in vocal-motor and auditory fashion,—'fish,' 'scales,' 'did not remember.' There was a vague verbal process, 'that is how you got fish idea, first had scales.' I was aware of keen attention, and of pleasurable affective toning; I also had a remembrance of my previous sitting and of having seen the fish-like figures. The word 'harp' rushed in, also, together with some visual imagery of a real harp. Then the second figure appeared. Here my attention was attracted by the presence of a sharp corner in the right-hand figure, which corresponded, in form, to the corner which I had previously noted as a feature of the extreme left-hand figure. I decided to watch for this feature: I attended keenly to the point, passing my regard immediately to the other point

and the edges. As the next figure appeared, my attention centered on this point in the right-hand figure. In these figures and in the later ones, I noted invariably that my old criteria,—the presence of an uncolored right-hand figure, with the foot on which it stands, with this definite little corner which points over toward the left-hand figure, and the colored left-hand figure,—all remained constant. During these exposures there was some sort of an attempt to find a better descriptive term. The word 'harp?' occurred many times in auditory imagery, with a questioning accent." (Last five figures). "During these exposures, I was particularly interested in the lower parts of the figures. I observed that the lower line of the left-hand side contained a very sharp angle. The word 'corner' was distinctly present in auditory imagery but my observation consisted mainly in the visual perception of this basal angle. My attention also went to the right-hand side of the right-hand figure; I noticed that there was always at least one little hump. In the margin of my consciousness there was always a fairly good visual perception of the other features, of general form, color and shading. The fact that these features remained in the margin of my consciousness might be interpreted as an awareness of the fact that they were not essential to my perception of a Deral as such,—that they were individual peculiarities. Several features attracted my attention at times,— the cilia on the right-hand figures and the vivid colors, maroon and green. In the next to the last figure, the left-hand part extended almost twice as high as it did in the rest of the figures. I noted in every instance the presence of the sharp little point." (Describe more fully the manner in which the basal corner of the left-hand part came to attract your attention.) "During the exposure of the first five figures, I observed that one of them had this sharp point. The presence of this feature, was not clearly in consciousness at the time, nor did I recall it at first; it was not a part of my visual imagery. During my introspection, when I began to describe the general form of this right-hand side, I started to say something about a circular end upon which it rested, but was aware that my visual imagery was deficient at this point. Then a visual image of that sharp corner which I had previously seen flashed into consciousness; that initiated my interest in the feature. During the last five exposures, I watched for it."

Deral (third presentation of series, Mar. 13, 1913. First five figures) "Before the exposures began, I was aware of a visual image of that first Deral. In my visual image, the right-hand part of the figure was very accurate but the vivid yellowish or orange brown of the left-hand figure was absent. My image, moreover, had not contained clearly the cilia along the right-hand periphery. In the exposed figure the vivid coloring impressed me first and then the presence of the cilia. I noted the fish-like structure of the right-hand figure, whereupon I was aware of auditory verbal imagery of the word 'fish.' The word 'harp' occurred when my eyes passed to the left-hand figure. I noted, in clear visual perception, the sharp corner upon which the left-hand figure stood; I also corroborated my statements regarding the right-hand side. During the exposure of the second figure, my procedure was slightly different. I noted a feature which I had previously noted but had

forgotten to report, in my recall immediately previous to the perception of the series. This feature was the curving inset in the right-hand periphery. As I noted this I was aware of manual motor imagery of tracing and visual imagery of the situation, in which I had described it to you before; I was also aware of a sort of chagrin, which consisted in certain organic and kinaesthetic images which were very non-focal, and also in a consciousness of myself in this previous situation,—some kinaesthetic imagery of myself in the chair before the apparatus. As the figures continued to be exposed, I was impressed first always by the vividness of the coloring of the left-hand figure, and then by the bow-like shape of the right-hand side; afterwards I corroborated my other criteria,—the little tail at the base of the right-hand figure, the point on which the left-hand figure stands, the general triangular shape of both, and the oval harp-like top of each. The figures impressed me as being rather larger than I had remembered them in my visual imagery, and as more highly colored than I remembered them." (Describe your corroboration of these last criteria.) "It consisted, I think, just in attending to them. There was a very unclear image of something like 'H'm' which occurred as I attended to them; this was so vague that I can not say whether it was auditory and vocal-motor or purely vocal-motor. I think the most immediate factor is simply a more or less conscious directing of my attention to these features severally in turn, and a satisfaction with which the attention passes to the next region of the figure." (Last five figures) "My procedure this time was slightly different. During the exposure of the first figure, the cilia attracted my attention strongly; I had to pull my attention away from them with a conscious effort in order to notice the other features. I noted the base of the right-hand figure, and its triangular shape; also the top of the figures. . . ."

OBSERVER C.

Kareg (initial presentation of the series, Mar. 7, 1913. First, second and third figures). 1. (First figure) "Before the exposures began I had two visual images of the word 'Kareg,' which you had pronounced; in one image, the word appeared in printed form; in the other, written in your handwriting. When the first figure appeared, there came the vocal-motor verbal image 'queer creature.' I was aware of no effort to bring up analogous forms from my past experience; the verbal image 'crystal' appeared, in vocal-motor terms. My attention was diffuse, distributed over the whole figure." 2. (Second and third figures). "With the second figure, there came a vocal-motor verbal image of 'turtle' and a visual image of a turtle. Then the following vocal-motor verbal fragments appeared,—'lumpy at left-hand end, tied up close at right.' I immediately experienced a kinaesthesia of my left hand, as if I were squeezing something, and an accompanying visual image of a small rubber balloon, half filled with air, and squeezed up in my own hand. Also there was a feeling of constriction around my waist, consisting in touch and pressure components, together with some slight change in respiration,—shallowness of breathing, and a feeling of an insufficient quantity of air." (Were you aware of directing your regard to one part of the figure more than another?) "No, my attention was distributed over the whole figure." 3.

(Remainder of series.) (Fourth, fifth, sixth and seventh figures) "My observation of the first two figures (fourth and fifth) was accompanied by shock and surprise,—a kinaesthetic 'pulling myself together' which consisted in a quick adjustment of my whole body for close attention. It was accompanied by pleasurable affective toning. Immediately the following vocal-motor verbal process appeared: 'Big lump may be on right.' My attention became more diffuse; this was bound up with relaxation. The vocal-motor verbal content 'crystal-like' appeared, and a visual image of the word 'crystal' printed; then came a tiny light bluish green figure (sixth). At this point I was conscious of leaning forward and of a kinaesthesia in my right hand, as if I were holding up the card; the whole was accompanied by unpleasantness. Vocal-motor verbal images of 'unlike,' 'something I have lost.' When the last exposure had been made, I had a visual image of the word 'unsymmetrical' in my own handwriting; and I was aware of kinaesthesia in my right shoulder of lop-sidedness and off-balance, as if my right shoulder were bowed under a heavy weight."

Deral (first presentation of series, Apr. 2, 1913. First, second and third figures.) 1. (First figure) "My attention was focused rather broadly upon the figure as a whole. There was rapid eye-movement over the outline of the figure, with a sense of surprise, a kinaesthetic gasp, in the throat. There was a pull,—a kinaesthetic strain more towards the left than the right,—to the left, with a tendency to focus, after the first exploration of the outline, upon the sun-colored mass structure on the left." 2. (Second figure) "Before the second figure appeared, I had decided to focus upon the left-hand side, but particularly upon the region where the two halves of the figure joined. When the second figure appeared, I focused my regard upon the small angle in the boundary line; next in point of prominence in consciousness was the upper periphery of the left-hand figure. The vocal-motor verbal image 'harp-shaped' came up, with a visual image of the written word 'harp.' There also appeared a visual image of a razor-back clam, half out of its shell." 3. (Third figure). "I remember little about the third figure; my focus was still upon the upper left-hand part, and before I focused upon the angle, the card dropped. While I was observing the figure there was a kinaesthesia of hurry,—strains in the back of my neck, and kinaesthesia of shaking my head; with the termination of the exposure, there came a kinaesthesia of my right hand holding up the cards." (Fourth, fifth and sixth figures) "In general, my procedure consisted in a diffuse attention to the whole figure, with rapid running of my eyes over the outlines of both parts of the figures; I especially noted the relation of the angles in the left periphery, and in the median line. With the first figure, I experienced a kinaesthesia of drawing a line which might connect the corners of these two angles, and a vocal-motor process of saying the word 'oblique' to myself in a lingering fashion; all this time my regard was focusing on that region where the line between the two angles might be drawn. In the second exposure (fifth figure) I noticed, in addition, that the figure on the left was colored, and that the figure on the right was drawn in black and white, had dots, and was a reduplication of the left-hand figure. When the last figure appeared, I had a visual image of a flash of green on another card, and a

strong kinaesthesia in both hands of pushing the cards up, with an innervation to move toward the apparatus. I noted the relation of the two angles; and the vocal-motor verbal image 'another unsymmetrical' appeared. After the exposures had been completed, I wondered if the direction of my imaginary oblique line connecting the corners of the angles in the left periphery and median line might not be an essential feature." (Describe your wondering if the direction of the imaginary oblique line might not be an essential feature.) "It consisted in a persistence of the sensation of focusing; the muscular strain incidental to being focused upon one place was still present, and with it was a clear visual image of the line. There was also present a warmth, an emotional toning of excitement, which was distinctly pleasurable, a self-satisfaction. All of these persisted together, after the exposures were over. When I said that I wondered if the oblique line was not a common feature I was merely designating what all this meant for me. The main thing was the emotional component." (Seventh, eighth, ninth and tenth figures) "In the first figure (seventh) my attention focused narrowly upon the right-hand part; I noticed spine-like markings along the edge, and had visual imagery of cactus spines. Then came a bit of definition,—I said to myself in rapid, vocal-motor verbal imagery, 'right side always spine-like projections.' The next figure was smooth; I had a vocal-motor verbal image of 'the deuce!' with surprise; I experienced also a sort of *Einfühlung* of smoothness,—a tactual impression, in my hand and also over my ribs, of smoothness,—*Einfühlung* in the sense that I was smooth. Then the sea-green color of a figure attracted my attention; other aspects of the figure seemed far off in the periphery, as seen by indirect vision. Then,—I do not remember the order,—I recall that when the red figure appeared, it was extended upwards in a flame-like structure, different from the others; the vocal-motor verbal image 'distinction' occurred just as my regard had moved to the top of the figure."

Tefoq (first presentation of series, May 5, 1913). 1. (First figure) "In the fore-period there came a very definite, clear image of the word 'Tefoq' in my own handwriting, together with visual imagery of bright clear colors and fine lines, and the vocal-motor verbal experience 'wonder what you are going to perpetrate now.' With the whole came a kinaesthesia of narrowly focused attention. When the initial figure appeared, my attention went first, involuntarily, to the little included figure extending off to the right. I noticed that this seemed like a shelf, or a step, or a tuck; and that one side was blue. I noted the perspective. Then my attention went to the figure as a whole, running rapidly over the form, and the vocal-motor verbal image 'map' appeared, attended by an association with a large map. This was a visual image of a map in which one portion was definite and specialized, and the others drawn in indefinite washed-out tones. Then a vocal-motor verbal image 'oyster' appeared; and then, just as the figure was being withdrawn, my attention went to the indentation, at about the middle of the bottom edge, when the vocal-motor verbal image 'what relation?' appeared. When the card dropped, I had a tendency to anticipate another figure; this experience consisted in a visual image of the same oyster color, in an oval roundish mass,

localized upon the next card." 2. (Second figure, exposed separately) "My attention went in an involuntary fashion to the little angular included figure; and the vocal-motor image 'sharply bent in hinge' occurred, not quite so clearly as my former verbal images had been; next a visual image of a scroll; next a visual image of a large drawing of a snail; my attention was on the figure, but there was a 'feeling' of a transparent thing at the left, a sort of a visual image of a large illustration of a snail. Just as the figure was withdrawn, I was trying to identify the place on the lower surface where the indentation had appeared in the first figure. There was a fairly definite visual image of this indentation as it had appeared in the first figure, but I can not say whether there was an indentation in the second or not." (Was there any consciousness of similarity between this figure and the one before?) "The second figure was apprehended as a separate figure; the nature of the kinaesthesia of examining it,—rapid fixation upon one point after another,—was that of examining a separate distinct figure. In connection with my verbal image 'hinge,' however, I experienced something suggestive of a consciousness of similarity. I identified the corresponding part of the figure as the same thing I had described before as a *tuck* or *step*, and I was conscious that it had now been moved to the right. All this was in kinaesthetic terms; my fixation was upon the center of the included figure; and there was a recurrence of the previous fixation, which had been nearer the center of the whole figure. Moreover, I had at the very outset a vague consciousness that this figure was like the other." (Describe this consciousness.) "It was very vague; it consisted more in the form of my attention and kinaesthesia in the fore-period than anything that went on during my examination of the figure itself. In the fore-period, I had a visual image of the first figure, with persistence of the eye-movement, and of the kinaesthesia of examining it, *i.e.*, kinaesthesia of eye-movement around the figure,—of following the little indentation, and of fixating upon some point off toward the right. All of these factors were present in the fore-period; I would interpret them as an *Aufgabe* to re-discover, if possible, these same features in later figures." 3. (Third and remaining figures. Third and fourth figures) "I fixed in both cases upon the little scroll-like drawing in the very center of the figure (C here refers to the figure on the end of the angular central body, which seems to extend toward and face the observer). I counted the parts of this figure, finding three; I was aware that this figure bore a schematic resemblance to the inset in the lower periphery of the whole figure, both having a triple formation." (Fifth and sixth figures.) "I fixated upon the central scroll-like figure. Then there was a rapid movement of my fixation to the indented lower boundary and an identification of the main outlines of the scroll and indentation. Vocal-motor verbal images of 'yes' and 'coincident.' In the second exposure, my attention ran over the figure as a whole; I noticed that it was smaller than the others, but that the same relation held between the scroll-like figure on the center, and indentation in the lower surface of the whole figure. With this last, came a vocal-motor verbal 'yes.' My attention centered very narrowly on this one point; I noted that the color of the first figure was darkish orange." (Describe the noticing that the second was smaller than the others.) "No definite presentations of any other figures

came up, but the kinaesthesia itself, the sensations of moving my fixation around the figure,—was smaller, more compact. An awareness of the other figures was present only in the general consciousness that the present kinaesthesia was less extended." (How was this awareness present in your consciousness that the kinaesthesia was *less* extended?) "In the fact that this kinaesthesia bore with it a sense of being restricted." (Seventh and eighth figures) "I obtained only a general impression of the first figure, which I have now forgotten. When the second appeared I went rapidly over it twice, from left to right. Then my fixation passed across in a more restricted breadth of sweep, in a line right through the figure. A kinaesthetic tendency appeared, which seemed to pull my regard down toward the lower right part of the figure; this I inhibited. There was a fairly clear visual image of the internal part of the first figure of the whole series, which I had called a step; with it an indefinite vocal-motor verbal 'step.' This internal part appeared to the right; and I can not remember what it was, except that it was black. I detected many points of difference between the present figure (eighth) and my image of the first. The latter was a simple hinge or step; the perceived figure included a triple figure and was more complex; the word 'complex' came in vocal-motor imagery. I experienced a kinaesthesia as of trying to draw both figures side by side." (Ninth and tenth figures) "In the fore-period, I had a kinaesthesia of fixation. When the figure came, there appeared an affective toning of interest and surprise, and the vocal-motor verbal image 'entirely different.' Then I rapidly explored the whole figure; I next fixated a little blue triangular projection, which arises from the internal angular figure. Then I fixated again upon the 'scroll' in the internal figure, and compared the 'scroll' with the indentation in the lower surface of the figure. As the exposure closed, my attention was on the color, and the word 'lilac' was present in vocal-motor imagery. When the next figure came, my attention at once went to the region of the triangular projection from the internal figure. Indeed, before the figure had appeared, I had attended to the region in which the triangle would appear. I found that the triangular projection was present, and identified it with the one in the previous figure. There appeared a vocal-motor image of the word 'same.' I then noted that the internal figure was not placed the same way in the main figure that it had been before. I can not now remember what the difference was, but it impressed me at the time; there was a kinaesthesia of the right hand, and a changed kinaesthesia of balance, the direction of which I can not remember."

The following are C's introspective accounts of her subsequent examinations of the several groups:

Zalof (third presentation of series, Jan. 15, 1913). "My attention seemed to be concentrated on the *Aufgabe* of giving a definition. This appeared in the form of kinaesthetic strains in the throat, with vocal-motor imagery, and with a strain of attention present throughout the body, in the muscles and in the whole mechanism for focusing. Each figure, as it appeared, seemed known, or usual. After about three exposures, vocal-motor verbal imagery appeared,—'I don't think there are any exceptions.' Then, shortly after this,

my attention was attracted by the center figure itself. I noticed three elongated, lumpish, heart-shaped figures, parts of each overlapping the others. I had an idea of running over the periphery to see if that carried out the central design; but another stimulus-card came in before I did that, and was attended by a renewed vocal-motor and kinaesthetic strain of defining. Toward the end, there appeared in vocal-motor terms, the words 'I wonder if I am over-looking anything,' and there was a general kinaesthetic strain with unpleasant affective toning, which constituted a consciousness that probably I was." (Describe this 'seeming known' of a figure.) "My attention was on the definition; when I said that a figure seemed familiar, I was really interpreting what a certain process meant. The process itself was the diffuse attention, its rapid shifting over the figure itself."

Zalof (fifth presentation of series, Feb. 18, 1913). "My attention, as I began to observe the figures, was narrowly concentrated. I counted the dendritic processes, with actual innervations of the words 'one, two, three,' seeing them, however, in indirect vision. At about the fourth exposure, my attention happened to concentrate on the top processes at the left, and immediately the words 'divided in two' appeared, in vocal-motor terms. Then immediately there came a feeling of hurry and nervous tension, with a volitional *Aufgabe* of counting the number of the divisions on the end of each branch. With each subsequent exposure, my attention went to the end of the branch, and the vocal-motor verbal image 'divided in two' came up. There was a marked pleasantness at finding a new feature. The *Aufgabe* of defining came in, as a vocal-motor verbal image 'include.' At about the third from the last exposure, I began an attempt to look hard and rapidly, in a systematic manner, at each part of the figures; with the noting of each characteristic I was aware of an affirmative process, which consisted in a slight innervation of the muscles concerned in nodding. When the last figure appeared, however, I noted an exception to it, as regards the number of projections; I can not remember whether it had three or four branches. I was aware of muscular tensions,—in the brows, of squinting and in the hand and body, of pushing the card back into view." (Describe the volitional *Aufgabe* of counting the number of divisions.) "It had to do with the vocal-motor set, and the eye-movement set; there was some vague, fleeting organic factor beyond that. It did not last, but was almost immediately succeeded by the actual counting."

Zalof (sixth presentation of the series, Feb. 25, 1913). "In general, I first observed each figure as a whole, my fixation being on the center; then my regard passed over the extremities of the figure, and I counted them, 'one, two, three.' When the second figure appeared, I called up memory images of previous figures and compared them with the present perception. As I did this, and counted the branches, there was a generalized muscular and vocal-motor process of assent; the muscular process was a kinaesthesia of a general nod, or movement forwards, in the whole trunk, hand, and head, while the vocal-motor process was verbal imagery of 'yes' or 'the same,' which accompanied attention to the images. About this time a volitional process appeared; it came in a sort of internal speech,—'now get it,' preceded by muscular strain, and in the quickness with which the attention shifted from the center

to and around the periphery; this process of hurrying appeared in each subsequent exposure. With the next figure, I had a feeling of surprise; then a vocal-motor verbal process, 'no change.' Then there appeared a feeling of expectation of the last card, which persisted throughout the remainder of the series; this came as a visual image of a blotted figure off at the left; with a kinaesthesia, particularly in my left hand, of moving toward the left; I had a feeling that the last figure had four arms: all which I had so far seen, however, had three. In the sixth figure, I noted for the first time a variation consisting in a number of fibrils about the center, passing off in all directions. The verbal images 'figure' and 'unrelated' came up in fragmentary vocal-motor fashion. These projections seem to bear no relation to the rest of the Zalofs. I noted in the sixth and in all the rest, three main branches, each dividing into two. Towards the last, my expectation of the last figure became more and more intensified; there appeared innervations of the brow as of frowning, and narrower concentration. When the last figure appeared, I first counted rapidly the number of branches; then my regard concentrated intensively upon the last one, and relief and pleasure appeared. The last exposure seemed longer."

Kareg (second presentation of series, Mar. 11, 1913. First, second and third figures). "In the fore-period, I was aware of an *Aufgabe* to examine details. This was present in terms of a faint visual image of a large, lumpy Kareg, with kinaesthesia of focusing, and of quick, rapid changes of fixation, with affective toning. Besides these, there was a general internal suspense,—organic and respiratory, and changed heart-beat. When the first card appeared, my attention centered narrowly on its details; I tried to count the lines. I seemed to distinguish groupings of four, and the vocal-motor verbal image 'groupings of four' appeared. The stimulus seemed to last longer than usual; this fact aroused surprise. I had the feeling of being able to count all the lines. When the second figure appeared, I found, no such grouping of lines; the vocal-motor process 'not so complex as Zalof' appeared. The third card was exposed. With this, there was a kinaesthetic relaxation of the attention, most distinct in the eye-muscles, but present also in a slight slumping of the back. The whole constituted a feeling that there were no minute detailed differences." (Fourth, fifth, sixth and seventh figures). "In each of the first three of these figures I was aware of a crystal-like arrangement. I fixated the central portion of the larger half, and attempted to count the planes; I found four in one case, and five in another. Then came a vocal-motor verbal process: 'are there the same striations in small figure?' Attention went to the small end of the last figure, no other part being seen; the perception that this part was plain was followed by the vocal-motor verbal image 'No.'" (Eighth, ninth and tenth figures) "In the first figure, my attention went to the larger part of the figure, where I perceived striations. I was aware of a vocal-motor verbal image 'there are striations.' In the next figure my attention went to the small end; the outline here seemed squarish. The larger part was egg-shaped. The vocal-motor verbal process appeared 'is that a distinction?' my attention being upon the squarish small figure. With the next figure, I looked first at the smaller part, for squarishness; the

vocal-motor verbal process 'nothing definite' appeared, and I had a feeling of being baffled; unpleasantness, discouragement. My attention went to the central part; a vocal-motor verbal process appeared 'that is a turtle,' attended by a visual image of a large mud-turtle. This increased in intensity; then the vocal-motor verbal image 'foolish' came up."

Deral (second presentation of the series, Apr. 15, 1913. First, second and third figures) "In the first exposure, I tried to observe the figures as a whole, and to identify the visual image which had appeared during the preceding recall, with the stimulus before me. I was at once conscious of a discrepancy: *i.e.*, my attention fastened upon the finger-like projection of the left-hand side. As the next card appeared, my attention immediately focused on the angle of the right-hand figure, where it overlaps the left-hand (colored) one. I saw that this angle was very acute; the vocal-motor verbal process appeared 'very acute.' I then noticed a sort of little square foot-like structure upon which the lower right-hand figure rested. There was no clear separation between the second and third figures; when the third came, my attention focused immediately upon the part which I had last seen in the second, *viz.*, the lower part of the right-hand figure. The vocal-motor verbal image 'definition' appeared, with a slight kinaesthesia of turning away from the apparatus and focusing my attention away from the stimulus card. All this constituted a consciousness that the feature of the lower right-hand side should be included in the definition." (Fourth, fifth and sixth figures.) "In the first exposure my attention fastened upon the angle in the boundary line between the two figures, in an attempt to identify the acute angle formerly found; I had a visual image of this angle, localized below the percept. I found no angle at all, and immediately experienced surprise and unpleasantness. Just as the exposure was being withdrawn, I attended to the whole figure, and perceived the angle, higher and not so acute as in my image. In the next two exposures, my attention swept over the figure as a whole, and ended in close concentration upon the lower part of the right-hand figure. The vocal-motor verbal image 'varies in size' appeared at this point, in the last figure, and also some sort of a consciousness that this foot-like formation at the lower right was always present. This, at the time of the observation, consisted in a kinaesthesia, involving slight innervation, in my right hand, as if the hand were drawing, in rapid succession, three short lines. This was later interpreted to mean that the feature attended to was always present. After the last card had disappeared, I had a visual image of the dots in the upper right-hand corner of the figure, localized off in space."

Deral (third presentation of series, Apr. 22, 1913). (First, second, third and fourth fingers) "In the fore-period I had visual images of a number of Derals,—about three,—localized on the apparatus; then, of many cards allowed to fall together.²⁴ I was aware of a desire to see the whole series, and of wishing that you would not interrupt the presentation. When the first figure appeared I discovered how scrappy my visual images had been; I was aware of much surprise and keen attention; I noted particularly the little foot at the

²⁴ When a series was interrupted for introspection, the cards not yet exposed were allowed to fall in a group.

base of the right-hand side, which I had included in a previous definition. Then my fixation passed upward, along the curved periphery of the right, where I discovered a break which I had not before noted. My attention went to the upper left-hand side, where I recognized the finger-like process. The vocal-motor verbal image appeared 'I had forgotten that.' During the next exposures, my attention went first to the little foot at the lower right, then to the break in the right periphery, and then to the finger-like upper left part. During the last exposure, it occurred to me that I was not paying any attention to the boundary-line between the two figures. My focus moved to this feature, but I made no definite discovery; before I could grasp the position of the angle in relation to the rest of the figure, the exposure terminated. I was conscious of holding my focus with much energy and innervation, after the card dropped." (Describe your recognition of the finger-like process in the upper left of the first figure.) "When my focus of attention and regard passed to this region, I had a kinaesthetic set, in eye-movement and probably in hand-movement as well, for an angle. The perception of the curved outline brought a change in the kinaesthesia and a surprise. The recognition that I had previously noted this curve occurred immediately; it consisted in this reversal of the kinaesthetic process of adjustment for angles." (Describe the statement: "It occurred to me that I was not paying any attention to the boundary line.") "This consciousness followed upon a perception, in indirect vision, of the angle in the boundary; it was bound up with the kinaesthetic jerk to the angle, and with vocal-motor strains, partly innervations, such as 'angle,' 'distinction,'—words used in my previous recall in describing the boundary."

OBSERVER D

Zalof (initial presentation of series, Nov. 27, 1912). 1. (First figure) "During the exposure of the first figure, I was keenly aware of intense concentration upon the apprehension of the figure. I noted principally its triad arrangement, and also the three processes which extend from the three corners of the body." 2. (Second figure) "Immediately when the second figure appeared, I caught myself tending to say 'triangular,' and I was conscious of the fact that this figure had a triad arrangement. I was also aware of the fact that the internal part of the creature was drawn in red ink. When I found a repetition of certain characteristics which I had seized upon in the first figure, there was a very intensive feeling of pleasantness." 3. (Third and succeeding figures) "The consciousness of triad arrangement was present throughout the series. Several times I had auditory and vocal-motor images of the word 'triangularity,' with a tendency to actually pronounce the word 'triangle' or 'triangularity.' I was aware of a shock of surprise when a particularly compact figure appeared during the second half of the series; but an instant later I apprehended its triad arrangement and its three terminal processes. Surprise was also present earlier when I observed that some figures were not exactly symmetrical; sometimes I was conscious of a distinct feeling of unfamiliarity, succeeded by a feeling of familiarity, when I apprehended the triad arrangement. I was aware, in numerous cases, of distinct visual images of figures that had appeared earlier; my procedure, however, did not consist in comparing a present figure with visual images of past ones.

Pleasantness recurred when I found my tentative generalization confirmed; it decreased in intensity as the series progressed. Moreover, I found myself searching in each succeeding figure to see whether these red central organs were present. They were, for the first half of the series. Later, a figure occurred in which they were absent. Immediately I was aware of the fact that this was not a common characteristic. I was aware of a shock of surprise and a feeling of slight dissatisfaction when the first uncolored figure appeared. During the whole series my attention was concentrated upon the figures, and not upon the name Zalof which appeared below each figure." (Describe the feelings of familiarity and unfamiliarity.) "I can not be sure; I doubt if they were anything but definite affective tonings, pleasant in the former, and unpleasant in the latter case."

Deral (initial presentation of series, Feb. 5, 1913). 1. (First figure) "When the first figure appeared, I was at first impressed by an irregularly-shaped mass of color to the left, and a smaller irregularly-shaped mass of uncolored material attached to it, on the right. I attended particularly to the form of the colored mass, and deliberately and voluntarily sought to find a means of remembering this peculiar shape. A woman's sleeve occurred to me, in vocal-motor verbal terms, while I attended to this; and I observed a slight similarity in form between the figure and a grotesque sleeve." 2. (Second figure) "When the second figure appeared, I was immediately aware of an irregular mass of color; and of an irregular outline, uncolored, to the right of this. I seemed to forget the lady's sleeve. Now I seemed to be more interested simply in the spatial position of the colored and uncolored halves. I was impressed by the fact that the colored half was always to the left, and the uncolored one to the right. I can not say whether the two general forms,—the colored and the uncolored sections,—were the same; what I was distinctly aware of was that the color was at the left and the uncolored part at the right. I also detected the presence of short isolated hairs; I am not sure that they were universal." (Describe in more detail the 'being impressed by the fact that the colored mass was always at the left,' etc.) "With the appearance of each successive figure, I found myself taking the attitude,—rather than actually asking the question,—'will the colored part be at the right?' and I became more and more interested in this feature after my 'suspicion' had been more or less confirmed. The colors were different; but I can not now describe what colors were present. I remember noting that the colors were all different, and I seemed to lose interest in the color-quality. Again, the figures were different in size; and size did not impress me intensively. (How was the attitude 'will the colored part be at the right?' present?) "It consisted in my direction of attention and regard to the right, and in a *Bewusstseinslage* of curiosity; I am not sure that this description is adequate."

The following illustrate D's introspections upon his later examinations of the several series:

Zalof (second presentation of series, Dec. 4, 1912). "When the first figure appeared, I found myself attending very carefully to its details; I ran my eye from one to another, fixating various parts of the figure successively. I

observed, first, the triangular form; secondly, the red part, also triangular in form; but to this I paid little attention, as I remember. Then at the end of each long arm I observed, for the first time, that the group of projecting processes was made up of two divisions,—in other words, that it showed a paired arrangement consisting of two tiny limbs, on which were terminal processes. This observation led to a feeling of rather intensive pleasantness; then to a wondering whether the paired arrangement would be repeated. I approached the next figure with the definite *Aufgabe*: 'Will there be a paired arrangement?' I found that there was, whereupon pleasantness returned. This same *Aufgabe* persisted throughout the whole series; I consciously and deliberately observed that paired arrangement of the terminal processes. As soon as I had solved my *Aufgabe*,—found that a paired arrangement was present,—my attention went to other characteristics,—to form, arrangement, shape of center, etc. In every instance, an intensive pleasantness attended my affirmation of their presence. I was aware of no verbal motor imagery of triangularity. Nor was I aware of anything which might be called a *Bewusstheit* or an awareness of relation, present exclusively in non-sensory terms. Everything I was aware of was constituted of imaginal material." (In what terms were the *Aufgabe* and the expectation present?) "Auditory and vocal-motor verbal 'will I find it next?' all overlaid with a tenseness which I can not localize definitely."

Zalof (third presentation of series, Dec. 11, 1912). (The observer had, in the recall, wrongly described the number of groups of terminal processes as three.) "At the very outset, I was distinctly aware of an *Aufgabe* to verify the features which I had named in the immediately preceding recall. The *Aufgabe* may be described as follows: I had a distinct remembrance of those characteristics which I had found to be essential; and my procedure simply consisted, with the appearance of each figure, in verifying my remembrance. When the first figure appeared, I noted its triangular form, and its three prolongations. Before I had time to examine the number of terminal processes, the figure disappeared. With the second figure, my procedure was the same, as also with the third and fourth. Not until this time did I discover that the terminal processes are not three in number. Upon this discovery I experienced a *Bewusstseinslage* of uncertainty and doubt and confusion; a general emotional complex of strain and unpleasantness. Meanwhile, I was devoting my attention, with the appearance of each figure, to an observation of the number and arrangement of these terminal branches which were present, each bearing a more or less variable number of sub-branches. My uncertainty and strain and doubt (vacillation) was exceedingly intensive during these acts of observation; and it lasted throughout the last half of the series. Even after the series had been exposed, I was still in doubt as to how the number and arrangement of terminal processes are to be described. Throughout this latter half of the series, I was only dimly aware of the body and the non-peripheral parts of the 'arms' of the figure; and I was wholly unaware of any name. In a word my attention was concentrated almost exclusively on the terminal processes, and particularly upon those that appeared at the left and the upper part of each figure; occasionally my regard swept for an instant to other groups."

Zalof (fourth presentation of series, Feb. 5, 1913). "When the first figure appeared I immediately became aware that my first image of the preceding recall corresponded with this first figure. I was aware of running my eyes over the figure, beginning at the right, passing over to the left, and then to the lower part. Suddenly I noticed that the figure was upside down, as compared with my first image. All of these processes occupied only about one-third of the exposure-time. Then my attention turned to the number of groups of terminal arborizations. These I found to be arranged in pairs; and I remembered that in a previous introspection²⁵ I had described an arrangement consisting of three divisions instead of two. With each subsequent figure I first examined the terminal arborizations, noting particularly the numerical arrangement,—whether two or three divisions were present,—and I saw in succeeding figures that although the terminal branches were sometimes irregular and confused, yet the bi-partite arrangement could always be made out. This feature was the main objective point of my *Einstellung* throughout the exposure; with the appearance of each new figure, my attention went immediately to the terminal processes. I did, however, notice in addition that the body was large and the processes short, in certain instances, while in others, the processes were long, and the body small,—not greater than the cross-section of the processes themselves. This diversity of relative size attracted my attention and held it more or less continuously throughout the exposure of the series. My attention was also attracted, but in less intensive degree, by the presence of red in certain instances, and its absence in others. The presence or absence of color was never focal in consciousness; I seemed to regard it as non-essential. I did not direct my attention; though my attention was intensely concentrated, it was attracted, rather than directed by myself."

Deral (third presentation of series, Feb. 19, 1913). "Before you began to expose the series, it occurred to me, 'now I'll have an opportunity to see whether one side projects further back or not.' This was my only *Aufgabe* and it had no influence upon my immediately subsequent procedure. For when the first figure appeared, my attention was immediately attracted by the light brown on the left-hand side, whereupon the vocal-motor verbal image appeared 'Damn it! I said it was blue!'" (In his previous recall, the observer had described the first figure as blue.) "Three figures or so had appeared before I remembered to look for that posterior projection of one side; from that time on, my attention went out to that character, first of all, as each succeeding picture appeared. Several times my conjecture was confirmed; the colored side went back further than the other; then came a figure in which the two sides seemed at first to extend the same distance. Closer examination revealed the fact that the colored side projected farther back; I still held to my clue, but the next figure led me to abandon it. Meanwhile certain other characters had also attracted my attention, and had been investigated together with the criterion of the backward projection of the colored half. The first of these was a straight line; the 'snout-like' lower extremity of the uncolored part seemed 'straight across' and rectilinear. Almost at the same time I had observed a peculiar scalloped effect along the

²⁵ Recall, Dec. 11.

margin of the gray side. I wondered whether the 'snout' had been present in the earlier figures. The scalloped edge was repeated in several figures; but one figure appeared in which it was absent. This led me to abandon my 'scalloped' criterion. I had also early observed that the notch was different in form and size from that which I had expected; it was large and not 'little' as I had said. That arrested my attention and came with a shock of surprise which was unpleasant, and characterized by an abrupt cessation of mental functioning, but it lasted only for an instant. This may have been due to a reflection upon the fact that my definition itself was still valid, whatever the size of the notch. Again, during the process of observation, it occurred to me that the thing looked like an animal with something on its back; the vocal-motor verbal image occurred 'are those figures uncolored animals with loads?' I experienced a tendency to smile, with this interpretation." (Describe your 'wondering whether the snout' had been present before.) "I was aware of an attempt to recall the visual images of the first few figures, and to observe, in those images, whether the rectilinear 'snout' character is present. This attempt failed; I could call up visual images in which the color, the notch, and the rectilinear side were present; but the 'snout' region was always too vague to decipher." (What is your process of looking to see if the 'scallop' character is present?) "I was clearly conscious of turning my attention to the part of the figure in which that character appears. I was not aware of any act of comparing visual imagery in search of scallops. If the character were unmistakably present or unmistakably absent, my attention swept elsewhere. In the case where the scallops were not present, this procedure was especially evident. The case where I was in doubt as to whether the 'farther back' criterion was present shows the opposite procedure; I was here aware of eye-movement and of estimating which side extended farther back. The figure in question was colored blue."

Kareg (second presentation of series, Apr. 24, 1913). (First three figures.) "I was conscious, in the fore-period, of a definite *Aufgabe* to count the number of sides of the left-hand part of the figure. This *Aufgabe* was present in vocal-motor verbal terms; the words 'I am to count the sides' were present, in vague and abbreviated form. Immediately upon the appearance of the first figure I started to count, beginning at the lower right and proceeding in a clockwise direction. Then the second figure appeared, and I started to count at the angle on the extreme left, and proceeded to the right, counting simultaneously the upper and lower sides of the figure. Proceeding in this fashion, I discovered that these were two groups of three sides each. Then the next figure appeared and my counting was interrupted, because this figure was not a perfect hexagon; I was in doubt as to where one side ended and the next began. I then looked at the figure as a whole, and decided that it was hexagonal; I was still uncertain, however. Meanwhile, I had been aware of the presence of color, evenly and uniformly distributed; and more dimly, of the rest of the figure, corresponding to the handle of the dumb-bell and to the other ball, together with internal details of the left-hand half." (How did you count?) "By means of eye-movements, accompanied by vocal-motor imagery of 'one,' 'two,' 'three,' etc." (Fourth, fifth and sixth figures)

"Here, as before, I had an *Aufgabe* to count. The structure of this *Aufgabe* was less definite than in the former case; but it was distinctly present. Immediately upon the appearance of the first figure, I set to work to count. In this figure, the sides were not clearly demarcated, and I had difficulty in determining whether six were present. I also observed the color; it was dark gray, with a trace of bluish. The right-hand section and the connecting part of the figure were never in the focus of consciousness; I was dimly aware of their presence. With the next figure, the *Aufgabe* of counting was again present; here counting was easy and I found six sides. The differences in shading of the sides of the figure were marked, in the present instance; and I counted the number of different shadings. My attention was attracted to the right side by the presence of its plane surfaces. This side had not been present so prominently in consciousness at any other time. My procedure was thus concerned for the most part with the counting. I was, however, distinctly aware that some of the figures were very much smaller than others." (Will you describe the counting?) "It was distinctly verbal,—vocal-motor and auditory imagery of the words 'one, two, three,' etc.; I held my attention and regard upon one side and named it, then passed to the next. I am positive of the accuracy of my counting." (Seventh and eighth figures) "Again the *Aufgabe* to count was clearly present. I set out to count the number of sides in the left-hand part of the figure, following around the periphery. Before this was completed, however, I abandoned the procedure, and counted from internal details, instead of from the peripheral sides. My attention passed next to the right-hand part of the figure, when I became aware of a *Bewusstseinslage* of questioning: "Is this half also hexagonal?" That *Bewusstseinslage* was largely affective or emotional. I believe that it took its origin from the observation of the fact that the periphery of the right-hand figure included a straight side from which two sides radiated, at angles identical with those of a hexagon. After the expiration of my *Bewusstseinslage* of questioning, I noted that the rest of the figure was not definitely regular in outline; I attempted to differentiate sides, and to count, but in this I did not wholly succeed. I reached the conclusion that this periphery was also irregularly hexagonal in form. The next figure was so small that I had great difficulty in differentiating details. However, I was conscious of approaching it with a definite *Aufgabe*, of the nature of a *Bewusstseinslage* of questioning: "How many sides are present?" I started to count, but the figure was small, and the sides were not clearly marked. I got an impression of hexagonality. Then my attention swept to the right-hand half, where the same *Aufgabe* was present. I did not succeed in determining the number of sides with any certainty or satisfaction; but I obtained an impression of hexagonality, rather than any other polygonality or of rotundity. In these figures I searched for clues among the internal details which would aid me in determining the number of sides; I was aware of an *Aufgabe* for such a search. I distinctly remember that in the last figure the shading was formed by dots; but I could not quite make out from their distribution whether or not they were intended to represent a figure which was hexagonally,—or pentagonally,—pyramidal. At no time did I pay more than a brief, passing

attention to the connecting part of the figure, or to the color. I was not clearly aware of it during my actual observation." (How was the initial *Aufgabe* present?) "I set the definite problem to myself, I am tempted to say, in verbal form; vocal-motor verbal imagery of a definite instruction." (Last two figures) "Again, there was present in the fore-period a definite *Aufgabe* to count the number of sides. This appeared in vocal-motor verbal terms: 'Count the number of sides.' When the first figure appeared, I was aware of definite differences of shading in the side next to the connecting part; I set out to count the number of sides from these, but failed; the rest of the figure seemed to be approximately uniform in its shading. But still I obtained an impression of hexagonality. Immediately afterwards I was impressed by the fact that the connecting part was exceedingly short. While still observing this the next figure appeared, and here again I found the connecting part to be exceedingly short. Then my regard passed to the left-hand side and I started to count; I had no difficulty in distinguishing six sides.

OBSERVER E

Zalof (initial presentation of series, Nov. 18, 1912). 1. (First figure) "During the exposure of the first figure, I attended to the general shape. The part of my definition which referred to the general shape was made at this time. Extraneous associations with some low form of animal life were continually present, which I tried to inhibit, but without success. The red central structure of the figure corresponded to the nucleus of a cell-body; I was also aware of visual images of starfish, dissected so as to reveal the central nervous system." 2. (Second figure) "During the exposure of the second figure, my attention, so far as I can remember, was upon the forking of the limbs, and particularly upon the red central body." 3. (Third and remaining figures). "During the next few exposures I verified the features which I had noticed in the first and second figures. This verification was done by comparing the present figures with visual images of past figures. I also noted certain differences, particularly as regards length of limb. After the series was about half over, certain of these visual images gave way to vocal-motor verbal images,—'three-armed,' 'red center.'"

Kareg (first presentation of series, Feb. 26, 1913. First, second, third and fourth figures) 1. "During the exposure of the first figure, I was aware of close attention; the left-hand body attracted more attention than did the right, and I observed that it appeared somewhat pyramidal. I was aware of an association with various stones which I have seen, which had been worn by the action of water." 2. "During the exposure of the second figure this association with stones became stronger. I was aware of a vocal-motor verbal image 'that one is a pyramid,' my attention being upon the left-hand part of the figure, accompanied by a kinaesthesia in my left hand, as if indicating the left part of the figure." 3. (Third and succeeding figures). "During the exposure of the third figure, I was aware of the vocal-motor verbal image 'no, it isn't' (pyramidal) 'but three-dimensional,' my attention being directed upon the left part of the figure. I was also aware of a vocal-motor verbal image 'last one was blue.' During the exposure of the fourth figure, I was aware of the vocal-motor verbal image 'this is awful small and

seems pretty flat." (Fifth, sixth, seventh and eighth figures) "My attention during the exposure of these figures was attracted particularly to the right-hand part of each figure. I noted in some cases that this part was triangular, and in others that it was not; as I made these observations, vocal-motor verbal images appeared as follows: 'it is triangular'; then, with the next figure, 'no, it is not'; and with the next, 'it is.' During the exposure of the last two figures, affective toning was conspicuous. The next to the last one aroused marked pleasantness; and the vocal-motor verbal image appeared 'darned pretty painting.' The last figure, on the other hand, aroused extreme unpleasantness, largely because of its smallness. I was aware of strain in the eye-muscles, and of the vocal-motor verbal images 'seems uncolored,' and 'so darned small can hardly tell shape.'" (Ninth and tenth figures) "During the exposure of the first figure, the vocal-motor verbal image occurred, 'triangle right, very small.' With the last figure, I was aware of unpleasantness and of considerable imagery,—'uncolored, but shaded' and 'triangle.'"

E's subsequent examinations of the several series are illustrated in the following introspections.

Zalof (fourth presentation of series, Jan. 25, 1913). "During the exposure of the series, my procedure was passive; my attention roamed over the figures, and wherever it happened to focus for a time, I noted that region in vocal-motor verbal imagery of words which I had employed in my definition: 'nucleus is red' and 'pseudopodia present,' etc. In each case, my visual and verbal noting was affirmative in character."

Zalof (fifth presentation of series, Jan. 27, 1913). "During the first three exposures, my attention wandered over the figures in a passive fashion. I verified the regions upon which my regard happened to fall, in vocal-motor verbal images. During the exposure of the third figure, however, my attention happened to focus upon the fibrillae at the extremity of the limbs. Immediately the vocal-motor verbal image 'two groups' appeared. During the succeeding exposures, I attended actively to these terminal pseudopodia, verifying my new find each time in vocal-motor verbal imagery. The exposures seemed longer than usual; at one time appeared a vocal-motor verbal image of 'this (exposure) is very long.'"

Deral (second presentation of series, Dec. 16, 1912). "During the first two exposures, my procedure consisted in verification of the statements of my definition. The vocal-motor verbal images of the features mentioned in my definition appeared; they were as follows 'notch,' 'colored-uncolored,' 'size,' 'relative size,' 'pseudopodia.' As each verbal image appeared I turned to the corresponding feature in the figures and verified its presence. The verification consisted largely in vocal-motor imagery of words such as 'yes, that's it' which occurred when my attention fell upon the features which I had mentioned in the definition; at times, the verification was merely a short period of relaxation. In the third and subsequent exposures, my attention was attracted to the pseudopodia. During the last three exposures, I observed in addition the lower edge of the colored portion. Towards the last, came the vocal-motor verbal image 'uncolored right.' The ex-

posure-time of the first five figures of the series seemed much longer than that of the later figures." (What was the relative order of your attention to the two features of the lower edge of the colored portion and the pseudopodia during the last three exposures?) "There was no constant order; the feature which I had observed last in one figure I observed first in the succeeding one."

Tefoq (second presentation of series, Feb. 8, 1913). (First, and second figures.) "During both exposures my attention was confined to the central body and the small blue triangular body. During the exposure of the second figure I noted a change in the relative sizes of the central and external parts. This consisted in perceiving that the central body of the second figure was very small. Upon this the vocal-motor verbal image appeared 'size varies; change definition.' My perception of the external part was indirect." (Third and remaining figures.) "My procedure during the exposures consisted in noting and verifying numerous features. I noted a number of features in the first figure, in terms of attention to them with concomitant descriptive vocal-motor verbal images; I then carried on an active examination of the next few exposures, to determine whether these same features were present. In a number of cases, my investigation of a feature was abandoned for the reason that the feature failed to appear in a figure. One such case was my observation of the color of the large circular body; a figure appeared in which this part was not colored, but contained black striations; I had vocal-motor verbal imagery of 'circular body need not be colored, but if not colored has striations.' My investigation of this last possibility persisted until a figure appeared in which the background was neither colored nor striated. In one figure, I noted the color of the triangle, and immediately had a vocal-motor verbal image of 'triangle blue,' followed by the vocal-motor verbal image 'last one was not blue.' Other features which I noted in visual and verbal terms and which I investigated were the coloring of the top and of the sides of the central body; the vocal-motor verbal images 'top of picture-frame uncolored' and 'side green' appeared as soon as I noted these features. These verbal images played a part throughout the series in my verifications of the presence in successive figures of the features." (How complete was your vocal-motor verbal imagery?) "It was nearly as complete as my statements have represented it." (Do you think these words were imaged, or were you at times aware of actual innervation in your vocal organs?) "Innervation was undoubtedly present at times." (Will you describe your process of verifying the color of the top and sides of the central body?) "I fixed upon these parts, and sometimes noted them additionally in vocal-motor verbal fashion,—'is green,' etc."

Tefoq (fourth presentation of series, Feb. 19, 1913). "During the exposure of the series, my procedure was for the most part passive; I attended to parts upon which my fixation happened to fall, and noted these parts in vocal-motor verbal fashion; the verbal imagery being always in the nature of an affirmation. Some features, however, I investigated in an active fashion; I investigated in this way the color of the sides of the 'picture-frame body' to determine whether they were always green. I invariably found that they were green, and at the close was aware of the vocal-motor verbal image 'that

is right, always green.' Again, I investigated at the same time, the top of the picture-frame body and noted that when this was black the crow's-foot design was white, and *vice versa*. This feature, however, was not investigated as systematically as that of the green color of the sides. At times I noted other features,—that pink of the last figure, and the smallness of one Tefoq; during the exposure of this small figure, the vocal-motor verbal image appeared 'almost too small to see if sides are green.' The notch in the lower periphery also attracted my attention several times, towards the beginning of the series."

b. The Process of Generalizing Abstraction. 1. *Nature of the Process*: In the case of every observer, the verbal perception of the task of defining the group-name was followed by the initiation of a peculiar behavior of consciousness and attention toward the succeeding figures, which resulted more or less directly in the observer's reaching a decision as to which of the features were present in every member of the group. This behavior of consciousness may be described as follows. At the outset, in any series, the observers "locked" closely at the figures; they reported an intensive and more or less wide attention to the stimuli, and an awareness of several or all of the more conspicuous features—the general shape and the grosser details. Usually, this examination of the initial figures was non-deliberate in character, although attention was closely concentrated; the observers were conscious of no attempt either to look over the whole figure in a systematic fashion or to note and remember a certain definite feature or group of features. Sometimes, however, the observers made a distinct effort to hold the features in mind, visually; they looked away and called up visual imagery, or they sought for an association (*A*, observation of initial Zalof figure, p. 40. *D*, observation of initial Deral figure, p. 65).

Some observers reported a somewhat extensive course of attention, with awareness of practically all of the prominent characters (*B*, observations of initial figures, pp. 46 ff.), while other observers noted particularly some definite feature or features (*E*, observations of initial figures, p. 70 ff.). With some observers, certain variations in the noting of the initial figures were apparent, variations which depended in part upon the simplicity of the figure, and in part at least upon the stage of advancement of the experiment—the number of previous observations of other series. These variations appeared particularly in the case of *B*; in the somewhat simple Zalof figure, where the few prominent details were well-marked and conspicuous, the shiftings of *B*'s focus were not only unhurried, but they were accompanied by pleasant-

ness. In the case of the more complex Tefoq figure, on the other hand, *B* reported a period of rapid shiftings of attention, which she labelled a consciousness of complexity (p. 46 f.). In the case of *C*, when the figure was relatively simple, attention distributed itself in a diffuse manner over the stimulus as a whole. When, on the other hand, the figure was complex, attention was attracted or "pulled" toward certain definite features (*cf.* examinations of initial Kareg and Tefoq figures, pp. 56, 58).

In their examinations of the second figure of each series during the initial presentations, the observers invariably reported a focal awareness of those features in the stimulus whose fellows had been noted in the first exposure.²⁶ The more conspicuous of these repeated features flashed out in consciousness without any additional awareness of effort incidental to eye-movements of searching for them. The shift of attention to them was thus bound up with the rate and fact of their standing out. Attention seemed to be claimed primarily, and with some observers, at least, exclusively by these features. With some observers, the shift of attention to the repeating feature was occasionally deliberate in nature; the clearing-up of the feature was preceded by a moment of search, or it followed upon a more or less definite self-instruction.²⁷ It rarely happened that an observer noted a novel feature during the exposure of the second figure (*E*, Zalof, forking of limbs, p. 70).

During the observation of the later figures of the several series, the processes were much the same. The observers reported that the features which had claimed attention at the outset continued to stand out prominently in consciousness as long as they proved to be repeating characteristics. If these were conspicuous, they

²⁶ For the awareness that the features were similar, *cf.* pp. 92 ff.

²⁷ *Cf.* *C*, Deral, 2, the determination to focus upon the left-hand part of the figure, p. 57; Tefoq, 2, the persistence of the visual image of the first figure, together with eye-movement kinaesthesia of fixating it, which came to function as an intention to investigate the same features in the second, and the attempt to identify in the second figure the indentation which had been noted in the first, with the visual image of the first, p. 59. Clearly, however, the focussing upon specific identical features was not invariably deliberate in *C*'s case; *cf.* Tefoq, 2, "my attention went involuntarily to the little included figure," p. 59. *B* reported upon a few occasions that she made a deliberate search for a feature; this search occurred when the feature was somewhat obscure and did not flash out readily as the more conspicuous repeating features did: Tefoq, 2, search for the little triangle, p. 47.

stood out easily and prominently; if on the other hand they were obscure, the observer searched for them, *i.e.*, he was aware of the turning of his attention and regard to that region of the stimulus which corresponded to the regions of preceding figures in which the features in question had been observed to lie. This search was not always entered upon in a deliberate fashion, for sometimes the observers "found themselves searching" for a feature, *i.e.*, passing their regard to its region (*D*, Deral investigation of the spatial arrangement of the colored half, p. 65). Novel features were occasionally observed and investigated in the same fashion.²⁸

During the later presentations, the behavior of the observers' consciousness was much the same, save that novel features—the obscurer ones—were now being observed and investigated, and the conspicuous features which had been investigated at the outset were now receiving less attention.²⁹ These latter features.

²⁸ Cf. descriptions of observations of the later figures during the initial presentations of the groups: *A*, p. 40; *B*, p. 46; *C*, p. 56; *D*, p. 64; *E*, p. 70.

²⁹ Cf. *A*, Zalof, fourth presentation, observation of the dual arrangement of the sub-branches at the ends of the main branches, p. 43; Tefoq, second presentation, noting of triangle, p. 44; fifth presentation, central figure and indentation, p. 45; Kareg, second presentation, noting of sides, p. 46. *B*, Zalof second presentation, investigation of fourth inner body and dual arrangement of bifurcations, p. 49; eighth presentation, and first figures of ninth presentation, noting of prong, pp. 50 f.; Tefoq, third presentation, noting of greenness, of color and position of little triangle, and of inset in lower periphery, p. 52; fourth presentation, of extent of green color, p. 52; fifth presentation, of the direction of the inset, p. 54; Deral, second presentation, noting of sharp point and of basal angle of left side in the last five figures, p. 54, third presentation, observation of the bow-like right outline, p. 56. *C*, Zalof, fifth presentation, investigation of ends of branches, p. 61; Kareg, second presentation, investigation of the 'groupings of four lines' in the first three figures, and of the squarishness of the small part, in the last three figures, p. 62; Deral, second presentation, investigation of the foot-like structure on the lower right, and of the angle in the median line, p. 63; third presentation, investigation of the break in the right periphery, p. 64. *D*, Zalof, second presentation, investigation of the tentacle-ends, p. 66; third presentation fourth and succeeding figures, and fourth presentation investigation of tentacle-ends, pp. 66 f.; Deral, third presentation, investigation of the relative backward extension of the two sides, and later, of the straight line on the lower right and of the scallops, p. 67; Kareg, second presentation, investigation of hexagonality, pp. 68 ff; here, the shifting of attention to the aspect under investigation—the

were sometimes completely overlooked, or noted with a very low degree of attention. Sometimes, however, they became relatively focal; they stood out for an instant in succeeding exposures, and attention then shifted easily and readily to other regions. The observers labelled this behavior of attention as a 'verifying of the statements of the recall,' or as a "confirming of the generality" of the previously generalized feature. In many instances, especially if some newly-observed recurring feature were being investigated for the first time, these verification-processes or shifts of attention to the feature were relatively non-focal; they were apparently nothing more than vestiges of the preceding more active and highly conscious processes in the course of which the generality of the features had originally been established. They now consisted in the fact that at some time during the observations of succeeding figures the features which had been established as essential stood out in the observer's consciousness with a degree of prominence higher than that attained by the awareness of the surroundings, the apparatus, and the like; yet their prominence was much less than that attained by the features which were then being investigated for generality or non-generality.³⁰ If, however, no or few new features were claiming attention, the verification-processes occupied a higher level of attention; and indeed, these processes occasionally claimed the attention to almost as marked a degree as they had at the outset.³¹ After a time, no more novel features were observed and investigated, and the

grasping (standing-out) of any detail which seems relevant to that aspect—is particularly well illustrated: *cf.* the taking recourse to a looking at the figure as a whole, or to the nature of internal details, where the periphery of the figure did not lend itself to counting, or where hexagonality was not well marked—third, seventh, eighth, and ninth figures. *E*, Zalof, fifth presentation, investigation of terminal fibrillae, p. 71; Tefoq, second presentation, investigation of circular backgrounds, and of top and sides of central body, p. 72.

³⁰ *B*, Deral, second and third, presentations, corroboration of old criteria, pp. 54 ff.; *D*, Zalof, second presentation, attention to form arrangement, and shape of parts p. 66.

³¹ *B*, Tefoq, fourth presentation, noting of green wash, blue triangle, and design in central part, p. 53; fifth presentation, of green wash and blue triangle, p. 54 *C*, Zalof, third presentation, last three figures of fifth presenta-

observers now occupied themselves exclusively with verifying the statements of their definitions in the manner above described.

Whenever a feature under investigation was obviously present in an oncoming stimulus, the attention passed uneventfully to other regions, and the investigation persisted into the subsequent observation. When, on the other hand, such a feature was lacking, the investigation terminated more or less immediately, *i.e.*, attention in later exposures ceased to turn to the part of the figure in which this feature had appeared.³²

It is evident, therefore, that the verbal perception of the experimental task—to define the group name—initiated in the case of every observer a typical behavior of attention and consciousness which was characterized by the fact that the regard was confined, in succeeding figures, to certain definite features which had attracted notice. Upon the instigation of the general experimental task, the chance noting of a feature—its momentary standing-out in consciousness—did not mark the termination of all experiences with that feature, but instead it marked the beginning of a persistent investigating of the feature. It often happened that several such investigations were present concomitantly; when this was the case, the order of the observers' attention to the features varied in different figures; but nevertheless all features were usually observed at some time in every figure, *i.e.*, the attention passed successively to the regions in question of each figure. Or in other words, the observers usually ceased, at an early date, to perceive the figures as wholes; but after the first two or three exposures, the figures became mutilated in consciousness by an emphasizing of the similarities and a relative ignoring of the non-general features.

tion, and sixth presentation, pp. 60 ff.; Deral, third presentation, noting of little foot, p. 63. *D*, Zalof, third presentation first three figures, p. 66 *E*, Deral, second presentation, p. 71; Tefoq, fourth presentation, greenness, p. 72.

³²*A*, Zalof, first presentation, treatment of redness, p. 40; Kareg, second presentation, treatment of number of sides, p. 46. *C*, Kareg second presentation, first three figures, treatment of "groupings of four lines," last three figures of squarishness, p. 62. *D*, Zalof, first presentation, treatment of redness, p. 65; Deral, first presentation, 3, of colors nad sizes, p. 65; third presentation, of the criterion of relative backward extension of the two sides and of scallops, pp. 67 f. *E*, Tefoq, second presentation p. 72.

So much for the nature of the process of generalizing abstraction. We shall next consider its various larger aspects, as these revealed themselves in our experiments. Such a "macroscopic" view of the process includes the description of its manner of initiation, and of the sensory (or imaginal) qualities which accompanied it or served as its mediums; such a view also includes such factors as the persistence of the processes, the number of them which could run in parallel fashion, and their dominance in the observations.

2. *The Initiation of the Process of Generalizing Abstraction.* The consciousness which intervened between the hearing of the instructions and the perceiving of the first figure of the series usually contained nothing more than kinaesthetic and visual processes which functioned in their setting as adjustments to the apparatus and to the instructions. The understanding of the verbally-presented task of defining was not followed by definite self-instruction to obtain a definition in any way, but instead it was followed by the above-described specific treatment of concrete features, when the situation disclosed these.

Several of the observers at times reported the presence, during the fore-period, of rather intensive bodily adjustments for close attention, with or without visual imagery of the members of the series, which they labelled as "intentions" or *Aufgaben* to note the details of the figure, or to make a careful observation (*A*, Tefoq, fifth presentation, p. 45; *C*, Kareg, second presentation, p. 62). In the case of *B*, these intentions showed a marked though not uninterrupted, series of progressive changes as the experiments continued. It is an interesting fact that the course of this development did not begin *ab initio* with each group, but was extended over all the groups; that is, the development, which had reached a certain point in its progression by the time the presentation of the Zalof series was completed proceeded from approximately this same point when the presentation of the next series began. *B*'s intentions to observe carefully were at first rather diffuse and complex, involving organic and kinaesthetic and affective factors, and much imagery of past presentations of the series, all of which together functioned as a distrust or suspicion that past observations might have been imperfect, and that the series was being repeated in order to correct a previous mal-observation (*B*, Zalof, third presentation, fore-period, p. 49). Later, her intentions to search for new details became less and less complex in content. They appeared simply as bodily adjustments for attention, accompanied by visual imagery relating to the parts of the coming figures to be examined. She reported no reference to past situations and no affective tonings (Tefoq,

third presentation, p. 52). In her final experiments no "attitude" or "set" is reported; here *B* simply waited quietly for the appearance of the first exposure. The presence of such a series of progressive changes in the "intention" to note carefully or to look for new details is doubtless indicative of increasing experience with the problem and its solution. Excepting for such intentions to note details, the only content of the foreperiods consisted in occasional intentions to verify the statements of past definitions.

In a few instances, however, observers became aware of the task of defining to follow, while they were engaged in observing the figures. Such awareness consisted at times in a calling-up of earlier figures and visual imagery, and in noting their common features; these reviews occurred relatively early in the series, and the observer designated them as a summing up of the essentials, or as a defining attitude (*A*, Zalof, second presentation, p. 43; Deral, second presentation, p. 44). Again, these awarenesses consisted largely in more or less persistent kinaesthetic strain localized in the motor organs or in the attention-musculature together with fragmentary vocal-motor imagery of defining (*C*, Zalof, third presentation, p. 60).

Thus the processes of generalizing abstraction which occurred under the conditions of our experiment were initiated upon the standing-out for the first time of some concrete feature, without previous self-instruction or intention which related to some plan of observing, or of obtaining a definition. Under the conditions of the experiment the attracting of attention by any feature was characterized by the keenness and persistence of the attending. This keen and persistent attending to the feature, was sometimes labelled as a "decision" or "intention" to investigate that feature. It constituted the simplest form of initiation of the process of generalizing abstraction.³³

Sometimes the particular processes of generalizing abstraction were initiated in a more gradual fashion; here the investigation did not follow immediately upon the first noting of the feature, but instead it occurred only after the feature had been observed a number of times.³⁴

³³ *A*, Zalof, fourth presentation, initiation of the investigation of the tentacle-ends, p. 43. *B*, Deral, second presentation, second figure, decision to note the point in the right-hand body p. 54. Tefoq, fifth presentation, second figure, treatment of inset, p. 54. *D*, Zalof, first presentation, noting of the red center and subsequent investigation, pp. 64 f.; Deral, first presentation, initiation of investigation of spatial positions of colored and uncolored parts, p. 65; third presentation, initiation of investigation of scallops and straight side, pp. 67 f.

³⁴ *C*, Deral, second and third presentations, pp. 63 ff., behavior in conscious-

In most instances the initiation of the process of generalizing abstraction was more complex than this keen and persistent standing-out of a feature. Not infrequently a verbal characterization of the feature was present, or a representation of it in a sense-modality other than the visual, *e.g.*, kinaesthesia of tracing or of internal imitation.³⁵ Or the observers frequently reported the additional presence of visual images of other members of the series, in which they attempted to determine whether the feature was present; they often labelled this as a "wondering" if the feature had been or would be present in other figures.³⁶ Again,

ness of the perception of the angle in the boundary-line: during the second presentation, this angle was noted in the second, and looked for in the fourth, figure. During the third presentation *C* became aware of the angle in indirect vision, and then experienced what she called an awareness that she was not paying enough attention to this feature, this awareness being present in a jerk of kinaesthesia and fragments of vocal-motor verbal imagery. It functioned as the initiator of an investigation of the angle. Tefoq, first presentation, investigation of the relation between the irregular central figure and the notched indentation. During the examination of the first two figures both of these features were observed, the attention going voluntarily to the indentations in the latter. During the examination of the third and fourth figures, these features occupied the whole of attention; and during the exposure of the fifth and sixth figures, she actively compared the scroll with the indentation: pp. 58 ff. *C*'s process of investigating the base of the right-hand part of the Deral figures originated in a similar fashion; Deral, second presentation, second and third, fifth and sixth, figures, p. 63. *B*, Tefoq, third presentation, "wonder if color is constant after all," p. 52. This is undoubtedly to be explained by *B*'s previous observation of color-variations, with her subsequent tendency to ignore all colors. When she chanced to observe similarity of coloration in two successive figures, an *Aufgabe* to investigate color appeared. Deral, third presentation, remembrance of previous noting of break in right periphery, with subsequent investigation, p. 56.

³⁵ *C*, Deral, first presentation, fourth figure, noting of relation of angles, p. 57; Kareg, first presentation, "lumpy at left, tied up close at right," with kinaesthesia, p. 56; second presentation, close concentration on details, with "groupings of four," p. 62. *E*, Zalof, fifth presentation, initiation of investigation of grouping of terminal fibrillae, p. 71; Tefoq, second presentation, p. 72.

³⁶ *A*, Tefoq, second presentation, initiation of investigation of triangle, p. 44 fifth presentation, initiation of the investigation of central figure and of indentation in lower periphery, p. 45. *B*, Zalof, third presentation, initiation of investigation of shading and red inner bodies p. 49; Tefoq, fifth presentation, second figure, of investigation of extent of green color,

they mentioned tentative definings, or awarenesses that the feature might be essential, or might have to be included in the definition. These awarenesses were for the most part composed of auditory or vocal-motor imagery—more or less fragmentary—of naming the feature with additional words of definition, or of querying whether the feature were distinctive or essential; occasionally they included vague kinaesthesia of turning away from the present stimulus. Sometimes they occurred only with the second or third standing-out of the feature.³⁷ At other times, the additional components consisted in kinaesthetic and organic tensions about the eyes, throat, and elsewhere, and in marked kinaestheses of visual fixation, any or all of which were sometimes labelled as disquietude or unrest or as a feeling that something was to be done. Such contents as the above, following upon the attracting of attention by a novel feature and initiating a process of investigating that feature, were subsequently labelled by the observers as *Aufgaben*, or intentions, or volitions, to note that feature. Sometimes these factors and contents were merely described more or less fully as parts of the continuum of consciousness, and were not labelled or interpreted at all by the observers. In point of function as initial term of an investigation, and often in point of content as well, however, the non-characterized factors were identical with those which were at other times called an intention, or an *Aufgabe*, or a wondering whether a feature had been or would be present.³⁸

and later, of rightward direction of inset, p. 54. *D*, Deral, third presentation, "wondering" if "snout" were always present, with later investigation, p. 68.

³⁷ *B*, Zalof, second presentation, standing-out of fourth inner body and bifurcations, with "definition to be amended," p. 49, third presentation, naming novel features as in a definition, p. 49. *C*, Zalof, fifth presentation, "divided in two—include," p. 61; Kareg, second presentation, "is that a distinction," p. 62; Deral, first presentation, seventh figure, "right side always spine-like projections," tenth figure, "distinction," p. 58; second presentation, third figure investigation of basal foot, p. 63.

³⁸ *B*, Deral, first presentation, first figure, p. 47; Tefoq, third presentation, initiation of investigation of little triangle, p. 52. *C*, Deral, first presentation, 1 and 2, initiation of investigation of boundary-line between the two parts, p. 57; Zalof, fifth presentation, investigation of bi-partite arrangement of terminal processes, p. 61. *D*, Zalof, second presentation, *Aufgabe* to investigate terminal arborizations, p. 66.

It frequently happened that the verifications of features whose generality had previously been established were initiated by distinct intention experiences.³⁹ This was also true of the investigations of features which had formerly been noted, but whose generality or non-generality had not been established. Under these conditions, the intention-experiences made their appearance in the period before the presentation began; they consisted in states of keen attention with numerous kinaesthetic accessories, together with imagery—either concrete visual or verbal or both—of the figure to come, or the parts of the figure to be noted. Imagery of words of self-instruction was also present at times. The experiences of intending to test the generality of doubtful features occurred after a recall in which the observer had been aware of doubt regarding the generality of a feature—this doubt usually occurring in the form of a remembrance that the investigation of the feature had been inadequate, or in the form of an awareness of lacunae or inadequacies in the imagery employed.⁴⁰ In many instances, however, the process of verifying or of testing the generality of a formerly discovered feature manifested itself during the first few exposures merely as an experience of the standing-out, in more or less focal attention, of the feature itself, with no antecedent intention at all.

When an observer discovered a mistake in one of his generalizations, or when he observed a new repeating feature after he had supposed his definition to be complete, this initiated or occasioned an unusually energetic—persistent and dominating—process of investigating, and it was complicated by kinaesthetic and organic and affective contents of remarkable quantity and intensity, together with imagery relating to past experiences with that feature.⁴¹

³⁹ For the awareness that a feature was novel, or that it had been seen before, *cf.* pp. 105, 92.

⁴⁰ *Cf.* the following intentions to verify the generality of previously noted features: *B*, Tefoq, fifth presentation, p. 54. *D*, Zalof, third presentation, p. 66. *Cf.* also the following intentions to investigate the features regarding whose generality or non-generality the observers were uncertain: *B*, Zalof, ninth presentation, intention to note the terminal branches, p. 50. *C*, Zalof, sixth presentation, "volitional processes," p. 61. *D*, Deral, third presentation, p. 67; Kareg, second presentation, p. 68.

⁴¹ *Cf.* *B*, Zalof, eighth and ninth presentations, observation of the prong, pp. 50 *f.* During the ninth presentation of the Zalof series *B* noted the absence of red in one of the figures. With the tenth presentation, she reported the presence, during the fore-period, of an intensive attention-kinaesthesia, with visual imagery of a Zalof figure, and an awareness of the cards falling, present in manual kinaesthetic terms. These processes functioned as an intention; they were followed by a highly energetic investigation of the central parts and the tentacles. *D*, Zalof, third presentation, p. 66. *D*'s remembrance of the number of the divisions of the terminal arborizations had become distorted, and in his recall he had reported the existence of three terminal divisions, instead of two. Upon discovering that a figure contained two divisions, *D* experienced a marked kinaesthetic and organic complex, difficult

3. *Contents which Accompanied the Process of Generalizing Abstraction.* In thirty-two per cent. of our observations the subsequent course of the processes of generalizing abstraction, whether the feature was novel or had previously been observed, was marked by the presence in consciousness of tensions, strains, organic contents, and the like, which were occasionally labelled as an awareness of something to be done, or of hurry, or of unusually active or close attention, etc. Rapid kinaestheses of fixation sometimes contributed to such an experience, as also did fragments of verbal imagery. These contents were similar to those which marked the initiation of the process of generalizing abstraction (*cf.* preceding section); and they are doubtless to be regarded as a prolongation of the latter.⁴² These accompanying contents sometimes increased in number and intensity toward the close of the presentation; and, together with verbal fragments having to do with defining, they constituted an awareness that a definition was to follow. They did not always consist in strains and tensions, for the observers sometimes reported that they were aware of relaxation or pleasantness or both whenever the feature under investigation stood out in a figure.⁴³

The emergence and the nature of the above-described concomitants of the process of generalizing abstraction depended upon a number of conditions. Of these, the most important was *a.* the amount of resistance to the operation of the investigation-process which was furnished by the stimuli themselves. When

of exact analysis, to which he applied the expression *Bewusstseinslage* of doubt and confusion. This discovery and the *Bewusstseinslage* marked the initiation of an investigation of the number of terminal arborizations which reappeared in the next two experiments, persisting even after the actual number of divisions had been definitely established. The confusion and false remembrance evidently interfered seriously with *D*'s investigating of the true, bi-partite arrangement, making him reluctant to accept it; *Cf.* "I did not succeed in systematizing the results of my observations. *At times I seemed to find that only two terminal branches were present.*"

⁴² *C*, Zalof, third presentation, p. 60; sixth presentation, p. 61. *D*, Zalof, second presentation, p. 66.

⁴³ *B*, Zalof, second presentation, p. 49; fourth presentation, p. 49; *D*, Zalof, first presentation, p. 64. *E*, Deral second presentation p. 71.

the progress of the investigation was not interrupted, the observers sometimes reported an increasing relaxation or pleasantness and satisfaction or both,⁴⁴ although usually they reported merely an easy and uneventful passing of attention over the figure (*cf.* pp. 73 ff). When, on the other hand, but few repeating features could be found, the examination of the figures was often attenuated by diffuseness of attention, alternating with unusually numerous and intensive kinaesthetic and organic and (unpleasant) affective contents, which were sometimes labelled either as discouragement, or as a sense that more repeating features could be found with sufficiently careful observation.⁴⁵ Again, if marked differences stood out, or especially if the progress of the investigation became baffled in any way, the tension was usually more marked, and there appeared additional kinaesthetic contents incidental to closer scrutiny.⁴⁶

One of the observers, *E*, was made the subject of an experiment which threw much light upon the contents which appeared when the course of the process of generalizing abstraction was completely baffled, *i.e.*, when no common features could be found. A series of figures was exposed which was analogous in every respect to the others, save that its figures possessed no features in common excepting brightness-relations—all were black or gray upon a white background. Here is *E*'s account of his procedure:

"During the fore-period, I repeated the word 'Burad' several times, and simply fixated upon the middle of the card. (First and second figures) During the exposure of the first figure I was first aware of pleasantness which was due to the perception of the figure as a whole, and to the idea, which was present in vocal-motor verbal terms, that the figure was so complicated that I should never be able to formulate a definition of it. The next thing that impressed me was the shape; the auditory vocal motor verbal image 'circular body' appeared, followed by the images 'things sticking-out' and

⁴⁴ *B*, Tefoq, fourth presentation, fifth to eighth figures, p. 53; Deral first presentation, 2, 3, and last three figures, pp. 47 f. *C*, Kareg, first presentation, fourth and fifth figures p. 57; Deral first presentation fourth, fifth, and sixth figures, p. 58. *D*, Zalof, first and second presentations, pp. 64, 66.

⁴⁵ *C*, Kareg, second presentation, eighth, ninth, and tenth figures, investigation of squarishness p. 62.

⁴⁶ *B*, Deral, first presentation, 3, fourth, fifth, and sixth figures, p. 48; Zalof, eighth presentation p. 50 ninth presentation first and second figures observation of prong p. 51. *C*, Zalof, fifth presentation, noting of last figure, p. 61; Tefoq, first presentation, sixth, ninth, and tenth figures; pp. 59 f. *D*, Deral third presentation, doubt regarding relative backward extension of the two sides, p. 67.

'here's a triangle.' My eyes shifted to the lower left-hand edge. With the second figure there came the vocal-motor verbal imagery 'Gee! this is entirely different.' I was aware of unpleasantness and strain in my eyes and chest, with suppression of breathing. Verbal imagery of 'sort of pyramidal, but nothing like other.' No other series was in mind, concretely; but the reference was to the Kareg series." (Where was your fixation when you said to yourself, "Gee! this is different"?) "I should say that my fixation remained on that figure as a whole; there was no effort to single out any particular part." (Third figure) "I was aware of intensive unpleasantness, from the start; of strain of the brows and eyes and chest; and of inhibition of breathing, to a certain extent. My fixation at first was general. I next concentrated my attention upon the central part, and then upon the periphery. I was aware of the vocal-motor verbal images: 'that is not like anything else in the world'; then, 'circular body, that's like the first.' Then my attention happened to focus upon the four points of that outside body. The rest of the examination was occupied with the verbal processes: 'Gee! that looks like a finger punched through pie-dough.' To interpret all this, I should say that I had decided that the only feature which was in any sense common was the circular body, and that this feature was not really common. I then abandoned my attitude of comparison and simply became interested in the figure as such. Now the vocal-motor process appeared 'chopped-off' with motor reference in my hand towards this side (indicates right). I am looking for similarities, apparently." (Fourth figure) "I was almost immediately aware of the vocal-motor verbal imagery 'nothing like it,' upon which I dismissed any comparison of the figure with the others. Then I simply looked at the figure, my mind apparently blank; and I had an auditory verbal image 'one similarity,—part black, gray and white.' Now I looked at the name for the first time." (During your first vocal-motor verbal image "nothing like it"; were you aware of any way in which the figure was different?) "No; but in interpretation I may say that ordinarily I simply look at the figure passively until some element of similarity impresses me, whereupon this element is fixated carefully and examined accurately. No such similarity impressed me, in the present instance." (Fifth, and sixth figures.) "In the first one, I looked rather passively at the figure as a whole; then my attention shifted to the right, and then to the figure at the left; I experienced strain in my eyes and chest, and unpleasantness. The whole process culminated in an auditory verbal image, 'nothing doing but color.'" (Seventh and eighth figures.) "The first figure aroused extreme unpleasantness. I had a vocal-motor verbal 'Gosh! never!' meaning that I could never get a definition of these figures. When the second figure was exposed, my attention happened to fall upon the row of dots; and the vocal-motor verbal imagery appeared 'think row like that in last one.' I tried to call up the preceding figure concretely, but was unable to do so. I had not been aware of the row of dots upon the preceding figure, during its exposure with anything like maximal or focal attention; but apparently I had been aware of these dots with a low degree of attention, and there was a sort of recognition consciousness, when I saw them in the last figure." (May 7, 1913.)

The above introspection shows clearly what happened in *E*'s consciousness when his observation of the figures, under the instruction to note similarities, or essential features, was baffled by the fact that similarities could not be discovered. The observer became explicitly aware that he was looking for similarities; and it is scarcely necessary to point out the marked kinaesthetic and organic contents which accompanied the failure of the attention to fasten upon similarities.

In general, then, when marked similarities or identical features were present in succeeding figures, the process of generalizing abstraction revealed itself merely in the behavior of the attention, in the fact that identical or similar features came more and more to stand out in the percepts of succeeding exposures. The course of consciousness was relatively quiet and uneventful. When, on the other hand, similarities were obscured or absent, so that the process met with more or less strenuous resistance, its operation was marked by a corresponding amount and intensity of kinaesthetic, organic, and affective content.

b. Again, in a number of observers, the extent to which kinaesthetic and organic and affective contents made their appearance with the process of generalizing abstraction varied with the number of the observer's past experimental sittings. These contents were more numerous at the beginning of the experiments, and they almost never occurred afterwards. Thus it appears that the dropping away of such contents was one of the marks of increasing experience with the problem and its methods of solution.⁴⁷

c. Another condition which influenced the emergence of kinaesthetic and affective accompaniments with the investigation process was the extent to which new features had been discovered and investigated in the immediately previous presentations of the series. When no novel features had been observed for one or more presentations, the discovery and investigation of

⁴⁷ *C*, reported kinaesthetic, organic, affective, or verbal contents which she labelled as hurry, suspicion that features were being overlooked, discouragement, etc., in numerous instances: *e.g.*, Zalof, third and sixth presentations, pp. 61 f.; Kareg, first and second presentations, p. 57, pp. 62 f.; Deral, first presentation, p. 57. Such contents failed to appear with later presentations, *D* reported affective contents with the first two presentations of the Zalof series, and at no subsequent time: p. 64, p. 66.

such a feature was more frequently marked by bodily tensions, of surprise, and the like.⁴⁸ *d.* Or such contents were likely to emerge when the investigated feature was one which had previously been investigated and established or remembered as general or non-general, but whose generality or non-generality the observer had later been led to doubt.⁴⁹

At times, when the operation of one or more investigation processes was delayed, either by an unusually slow investigation of another feature or by attending to a striking variable, the observers reported an awareness that they must hurry, or that time was passing (*B*, Tefoq, fourth presentation, first figure, p. 53; in fifth presentation, first figure, p. 54). In other cases, no such awareness was mentioned, but instead the observers reported that an effort was required to remove the attention from the intruding feature (*B*, Deral, third presentation, fifth figure, observation of cilia, p. 56). The awarenesses that time was passing, or that the observation must be hurried, were not analyzed; these may have consisted in awarenesses of the duration aspect of the processes, or in the experience of increased rapidity of processes and in vague kinaesthetic uneasiness such as often marked the presence of the processes of generalizing abstraction. The investigation itself was for the moment abandoned, attention going to the intruding feature; the kinaesthetic contents which often accompanied it may have recurred and functioned as a sense of something to be done, or of time passing, thus serving as the heralds of the return of the investigation-process with which they were connected.

4. *Contents in which the Process of Generalizing Abstraction Revealed Itself.* In most instances, the structural contents whose behavior in consciousness constituted the process of generalizing abstraction consisted in the percepts of the stimuli themselves. The process was constituted by the nature of these succeeding percepts,—their shifting clearness-relations, the particular regions of them which were successively emphasized. At times, however, the process had additional contents; often the observers reported that visual images of the figures persisted or recurred, and were compared with subsequent percepts. The comparing consisted in the fact that the images were held or were projected beside the percept, and the similar or different features stood out in rapid alternation in both image and percept. Sometimes the

⁴⁸ *B*, Zalof, eighth presentation, investigation of little prong, with the respiratory kinaesthesia, the strains in forehead and shoulders and eyes, and memories of past experiences, p. 50.

⁴⁹ *D*, Zalof, third presentation, investigation of bifurcation, after *D* had erroneously remembered the number of terminal arborizations as three, p. 66.

alternation was so rapid as to make it seem as if attention went simultaneously to the similar or different features; but it is doubtful if this ever actually occurred. Again, when an observer was engaged in investigating a feature, he sometimes reported that between exposures there occurred visual images of oncoming figures in which the feature was also present, *i.e.*, he anticipated figures yet to appear, instead of retaining those which had just been exposed.

It is evident that the presence of these intervening concrete visual images in no way altered the essential nature of the process of generalizing abstraction itself. They merely served to increase the number of terms in which this process revealed itself, and to bring these terms into closer temporal juxtaposition. The succeeding clearness-relations and attention-shifts occurred in a percept-plus-image series, instead of a percept series alone.⁵⁰

5. *Dominance and Persistence of the Process of Generalizing Abstraction.* The dominance and persistence of the processes of generalizing abstraction varied widely. In certain cases, observers reported that they attended first or (rarely) exclusively to the features under investigation, in the successive exposures; or few or no individual features became sufficiently focal to be remembered in the introspection. Such dominant processes as these persisted in almost every case until the close of the series, or until the absence of the feature under investigation was dis-

⁵⁰ For illustrations of the operation of a process of generalizing abstraction upon a basis both of image and of percept, *cf.* *A*, Zalof, first presentation, p. 40; Tefoq and Kareg, first presentations, pp. 41 f., where the presence of imagery was less marked, imagery occurring when a difference stood out; Zalof, fourth presentation, p. 43, where oncoming figures were anticipated. *B*, Deral, first presentation, pp. 47 f. *C*, Tefoq, first presentation, pp. 58 ff.; Zalof, sixth presentation, second figure p. 61.

At times a process of generalizing abstraction operated almost exclusively in concrete visual imagery. This occurred when an observer noted a novel feature near the close of a series, and evoked images of the early members, in which he endeavored to determine whether the feature were present: *A*, Tefoq, fifth presentation, last five figures, noting of arrangement of indentation, p. 45; Kareg, second presentation, third and ninth figures noting of dent, p. 46. Also *A*, reviews of images of past figures with selecting of essential features: Deral, first and second presentations, pp. 41, 43 f. Tefoq, fifth presentation, last five figures, p. 45.

covered.⁵¹ Sometimes such a process persisted even through another presentation (*D*, Zalof, third and fourth presentations, investigation of terminal arborizations pp. 66 f.). Less dominant processes—where the observers reported that marginal awareness of non-investigated features was always present, or where numerous other processes were present—were sometimes persistent (*B*, Tefoq, investigations in third and fourth Tefoq presentations, p. 52 f.; *E*, Tefoq, fourth presentation, greenness pp. 72 f. Frequently, however, these processes became less focal, or even suffered more or less permanent interruption, upon the initiation of a novel investigation, or the intrusion of striking variables. Where the number of investigations was relatively great, these tended to shift in relative importance as the presentation of the series continued.⁵²

⁵¹ *A*, Zalof, fourth presentation, p. 43; Tefoq, fifth presentation, projections of black marking in central part, and of indentation, p. 45 *B*, Zalof, eighth presentation p. 50; Deral, first presentation, form of the two parts, p. 47. *C*, Zalof, fifth presentation, bifurcation of branches p. 61 *D*, Zalof, second, third, and fourth presentations investigations of tentacle-ends, pp. 65 ff.; Kareg, second presentation, investigation of hexagonality, pp. 68 ff. (here, other features were noted only when the formation of the sides was indefinite: third and fourth, and last few figures). *E*, Zalof, fifth presentation bifurcations, p. 71. In the following instances, focal processes were interrupted by the standing-out of a contradiction to the definition; *A*, Tefoq, second presentation, triangle, p. 44. *B*, Zalof, ninth presentation, prong, pp. 50 f.

⁵² *A*, Tefoq, second presentation, p. 44, investigations of *a*. the indentation in the lower periphery, present in the first, second, and fifth figures; and *b*. the blue triangle, from the third to the tenth figures, interrupted in the fifth by the noting of the central body. *B*'s failure to note the absence of red in one of the Zalof figures indicates the existence of the fluctuations in the dominance of the several investigations. Also, Tefoq, fifth presentation, investigation of direction of inset, p. 54; Deral, second presentation, dominant investigation of right, periphery gives way during last five exposures to noting of lower parts, p. 54. *C*, Deral, first presentation, investigation of relation between the two angles, p. 57; this investigation persisted from the fourth to the seventh figure, when it was interrupted by the observations of the projections upon the right periphery. Tefoq, first presentation, investigation of the scroll-like marking of the central figure, in its relation to the indentation in the lower periphery, pp. 58 ff.; this investigation began with the third figure, and persisted at least to the seventh; it was interrupted by the comparison of the second figure with a visual image, in the eighth exposure. Nevertheless a kinaesthetic pull in the direction of the indentation

6. *Number and Prevalence of the Processes of Generalizing Abstraction.* The number of possible concomitant processes of generalizing abstraction varied, both with the individual observer and with the nature of the processes. If the latter were of the introspectively more focal and persistent variety, it usually happened that only one, or at the most, two, processes were present during a single presentation (*cf.* footnote 51, p. 89). Upon relatively infrequent occasions, the number of concomitant persistent investigations was greater (*cf.* preceding paragraph). When on the other hand the processes of generalizing abstraction were introspectively less effortful and focal, as in the investigations of conspicuous features and the verifications of features previously noted, the number of concomitant processes was often greater.⁵³

The extent to which the process of generalizing abstraction prevailed in the observations varied in a manner which was dependent upon the individual observer, and upon the nature of the process itself. In a few instances an observation was dominated almost exclusively by such processes; individual features never became sufficiently focal to be remembered in the introspection. In other cases the observation was largely dominated by the investigation of one or two features, but nevertheless striking peculiarities were noted at times in a more or less non-focal fashion (*cf.* footnotes 51 and 52, p. 89). In some few instances, on the other hand, the observation was marked by the almost complete absence of the process of generalizing abstraction. Either the observer's attention went first to recurrent features, but was almost immediately attracted to any individualities in the form of the figure,⁵⁴ or else the

was reported at the time of this interruption, a fact which is undoubtedly to be interpreted as a tendency for the investigation to persist. The investigation reappeared in the ninth exposure, but not in the tenth: Deral, second presentation, investigation of the "little foot," with its interruption and subsequent reappearance, p. 63.

⁵³ *Cf.* initial presentations of the Zalof, Tefoq, and Deral series; also B, Tefoq, third presentation, where the presence of verification-processes brought the total number of investigation-processes up to at least eight, p. 52; also E, observations of the less active type, *e.g.*, Zalof, fourth presentation, p. 71; Deral, second presentation, p. 71.

⁵⁴ A, Zalof, first presentation, examination of the elongated central parts, in the third figure; Tefoq, first presentation, third, fifth, and seventh figures, attention to edge, fourth figure noting of the large central part eighth figure, noting of small central part, p. 41; Kareg, first presentation, second figure, noting of depth, fourth figure, failure to perceive depth and visual image of second, etc., p. 42.

attention-response to succeeding figures was diffuse; attention was here distributed over the figure as a whole, and when it did focalize it was attracted in the highest degree by individual peculiarities of the figure, or by peculiar variations in form of the essential features of that figure. Indeed, it occasionally happened that a whole exposure was marked by attention to a single striking peculiarity. Such an abstraction of a feature was obviously not a generalizing abstraction. In many cases each figure was compared with images of the preceding one or of several preceding ones, both as regards similarities and differences. The process of comparing usually consisted in the fact that the similarities or differences stood out concretely in these images. In noting the first figures of later presentations, the observer compared his percepts with visual images of figures which he had seen upon previous occasion; recognitions and visual anticipations of definite whole figures were common (*cf.* pp. 87 f.). In order words, in such observations the figures were handled for the most part as wholes, either in percept or in imagery; they were not mutilated in consciousness by an emphasizing of the similarities and a discounting of the peculiarities, as was the case in those observations in which generalizing abstraction prevailed.⁶⁵

Nevertheless, in observations such as these the observer, either before the close of the exposures or when directly confronted with the task of defining, frequently made a hurried review of visual images of the series in which attention turned to the common features; in other words, the typical process of generalizing abstraction asserted itself, thus tardily, and operated upon a basis of visual imagery. So, when the two varieties of observation are compared, one finds a striking difference between the one in which the figures were responded to by consciousness—attended to—as wholes and the one in which generalizing abstraction was prominent—a difference which consists in the fact that the former was marked by an enormous exaggeration and amplification of the very initial of the latter, the stage which was present during the initial observations of the first figures of the series. The processes of generalizing abstraction which were usually present from the outset were now postponed until the last moment, when they were immediately demanded by the experimental conditions. As will later appear, this postponement of the process of generalizing conditions was disadvantageous for the task of defining; the observer had not emphasized the general features during his observation, and in his final hurried attempt to do so, he was frequently swamped by details out of which he could extricate the essential characteristics only slowly and with difficulty (*cf.* pp. 173 f.).

7. *Treatment of Non-common Features.* In no case did an observer deliberately direct his attention away from features which he had previously found to be absent in some of the figures, or which he now found to be lacking in some of his visual images. Nevertheless these features behaved peculiarly in consciousness; they remained non-focal, or withdrew from the focus

⁶⁵ *Cf.* A, first and second presentations of the series, pp. 40 ff.

soon after they had stood out. The standing-out of the particular feature was often accompanied by imagery of past experiences of dealing with the feature; this imagery was kinaesthetic and visual, and it contributed to an awareness of the particular nature of the feature. In no case did the standing-out of such a feature initiate an investigation-process.⁵⁶

c. The Comparison of the Figures; Behavior in Consciousness of the Single Features. Thus far we have considered the sequence of experiences which in our experiment constituted the process of generalizing abstraction macroscopically, as it were,—*i.e.*, in its larger aspects, as a whole. We shall now analyze this process more closely, and consider its component experiences. These latter consisted in the behavior in consciousness of the percepts of the single features themselves, as these stood out in the course of the process of generalizing abstraction.

1. *The Experience of Similarity of Features under Investigation.* The persistence of any process of generalizing abstraction was primarily conditioned, as we have seen, by the observer's having discovered that the succeeding figures were similar in that they possessed certain features in common. The nature of the observer's experience of similarity depended upon the extent to which the figures resembled one another. Moreover, this experience can scarcely be considered as something apart from the general experimental task, or, as was more frequently the case, apart from the particular investigating under which it invariably occurred. The observer's attention usually focussed from the outset upon features which were identical, or nearly identical, in different figures; particular features which were present only in one figure were usually not attended to, and when they were attended to they were forgotten before the presentation of the series was completed. Failure of a feature to recur often meant its immediate oblivion. Under these conditions, when a common

⁵⁶ A, Deral, second presentation, behavior of color in consciousness, p. 43; Kareg, second presentation, behavior of the feature of the pyramidal sides of the figures which possessed tri-dimensionality, p. 46. B, Tefoq, fourth presentation, behavior of backgrounds in consciousness, pp. 53 f.; Deral, second presentation, color and shading, p. 54. D, Deral, first presentation, colors and sizes, p. 65; Zalof, later presentations, redness, p. 71.

feature which had once been observed was plainly present in succeeding figures, this feature simply stood out prominently for a short time in the concrete visual percepts, and immediately the attention passed easily, readily, uneventfully, and often pleasantly to other parts of the figure. This ready and brief standing-out of the feature, and the ready shifting of attention to other regions constituted an experience of recognition of, or assent to, the presence of the feature. If, on the other hand, the objective resemblance of the figures was not so close,—if a feature which had been observed in one or more figures and which had become the object of an investigation were obscured or absent in any figure,—the observers made a more or less prolonged examination of the region of the figure in which the feature had previously occurred. If the feature stood out upon this examination, the attention readily passed on to other features, and the process of generalizing abstraction persisted,—the investigation of the feature in question continuing during the exposure of subsequent figures. So, in its simplest form, the experience of similarity between two figures was nothing more than the concrete standing-out in consciousness of those of their identical features which had become objects of investigations, followed by an easy, uneventful, and often pleasant experience of the shifting of attention to other regions.

With the second and later presentations, it will be remembered that under the conditions of the experiment an observer was invariably asked to give an account of everything he remembered of a series before it was re-presented to him; consequently, all of the information he possessed regarding a series was present to his consciousness in the period shortly before its re-presentation. This information was present in concrete or verbal imaginal terms, or both (*cf.* pp. 152 ff.). Moreover, during the early experiments, observers often reported the presence in the immediate fore-period of visual images which embodied their total findings regarding the series. If, now, the first figure coincided approximately with this imagery, the similar features stood out in fluent and uneventful fashion as the regard passed over the figure point by point. There was no arrest, no special claiming of the regard by any one feature. In many cases, pleasantness was reported as an additional component. This easy standing-out of the same features in the percept which had been present to consciousness in the image, or, indeed, this uneventful substitution of the features in the percept for those in the image, with no arrest of attention, was again and again described by the observers as the means by which they verified the statements of their definition, or determined upon the

presence in successive figures of a certain feature or features, whose generality or non-generality was under investigation. After the exposures had begun, the succession of visual percepts was handled in consciousness in exactly the same fashion as the image-percept train had been, one percept taking the place of another percept instead of that of an image, *i.e.*, the same feature standing out clearly and easily in each.

Or in other words, the behavior of the observers' attention at the outset may be regarded as a behavior (not an explicit consciousness) of inquiring "What are the repeating features?"; and the answer to this inquiry was the standing-out of these features. As the particular processes of generalizing abstraction rapidly emerged out of the more general observations of the very initial figures, the initial behavior of attention ("what are the repeating features?") merged into behaviors of inquiring "Is it (the feature under investigation) present?"; and as before, the momentary standing-out of the feature was the answer. The situation throughout was one of question and answer, carried out in terms of behavior of consciousness rather than in terms of explicitly conscious questions and answers.⁵⁷

Usually, however, especially if the momentary investigation were vigorous and dominating, the experience of similarity was more complex than this mere facile standing-out in successive figures of features which had become the objects of investigations, together with the subsequent rapid and ready shifting of attention away from those features. It often happened that the observation of the figure was preceded by kinaestheses of strain or tension, which were dispelled as the feature or features under investigation stood out and attention passed readily on its course.

⁵⁷ *A*, Zalof, second presentation, "fitting in" of images and percepts, p. 43; fourth presentation, familiarity with first exposure, p. 43; Deral, second presentation, attention to similarities, p. 44; Kareg, second presentation, first figure, p. 45. *B*, Zalof, fourth presentation, recognition or affirmation, pp. 49 f.; ninth presentation, second figure, noting prong, with immediate turn away from prong to visual image, p. 51; Tefoq, fourth presentation, fifth to eighth figures, treatment of similar designs, p. 53; fifth presentation, "my regard passed over the criteria," p. 54. *C*, Zalof, third presentation, "seeming known" of successive figures, pp. 60 f. *D*, Deral, first presentation, investigation of the spatial position of the colored part: prominence of this in consciousness, and growing dominance and exclusiveness of investigation, p. 65; third presentation, search for "scallop" character, p. 68. *E*, Tefoq, second presentation, visual and verbal noting of features, p. 72.

More or less intensive pleasantness frequently constituted an additional content. Again, a kinaesthesia of assent (vocal or nodding) accompanied the standing-out of the feature, or some such word as "same" or "yes" was imaged.⁵⁸

At other times the experience of similar figures or features consisted in a comparing of a percept of one with concrete imagery of the other. This imagery was usually visual—the similar feature being conspicuous⁵⁹—but sometimes it was kinaesthetic (C, Tefoq, first presentation, second figure, identification of central part, with recurrence of past fixation, p. 59).

Sometimes the experience of the similarity of two features was marked by the appearance, with both features, of the image of an identical word,⁶⁰ or the verifying of a feature was accompanied by the image of a word which characterized the latter. This word was frequently identical with one which had formerly been employed, and it was often accompanied by additional imagery of words of affirmation of the feature.⁶¹

In a great many instances, the experience of similarity was immediately followed by an awareness that a feature is to be included in the definition, or is a possible common feature. In other words, the standing out of the objectively similar feature did not mean "this feature is similar to one I saw before," but rather, "my definition must include this feature," or "this feature is common." This meaning was of course in harmony with the "is-it (the feature under investigation) -present?" behavior of

⁵⁸ B, Zalof, second presentation, p. 49; Tefoq, fourth presentation, fourth and later figures, triangle, p. 53; Deral, third presentation, corroboration of criteria, p. 56. C, Zalof, fifth and sixth presentations, processes of assent, p. 61; Tefoq, first presentation, last figure, noting of triangle, p. 60. D, Zalof, first and second presentations, pleasantness, pp. 64, 66. E, Deral, second presentation, "short period of relaxation," p. 71.

⁵⁹ A, Tefoq, fifth presentation, familiarity with first figure; awareness that features attended to were common, p. 45. B, Deral, first presentation, 3, 2, and eighth figure, pp. 47 f. E, Zalof, first presentation, verification by comparison of visual imagery, p. 70.

⁶⁰ B, Deral, first presentation, "fish-like," "harp again," p. 47. D, Zalof, first presentation, 2, 3, "triangularity," p. 64. E, Tefoq, second presentation, 2, p. 72.

⁶¹ E, Zalof, fourth presentation, p. 71; Tefoq, second presentation, p. 72, etc. B, Tefoq, third presentation, "little step," little triangle blue," p. 52.

consciousness (94). It consisted sometimes in series of visual images in which the feature in question stood out. Again, it was largely verbal or kinaesthetic or both.⁶²

2. *Recognition of Non-repeated Characteristics.* The experience of similarity often occurred apart from the operation of any particular process of generalizing abstraction; this happened in the later experiments when observers recognized certain characteristics which they had found to be non-common, or certain figures. The experience here occurred at a considerable period after the previous noting of the feature. It was not different, as regards the fundamental play of attention, from the experience of similarity of a feature under investigation; it consisted largely in the behavior in consciousness of the percept of the feature itself—the feature stood out for an instant, more or less suddenly and compellingly, but did not itself block the progress of attention. Here the observer did not examine the feature in itself, but his attention passed immediately to other contents usually either to the pursuance of an investigation of another feature or to imagery of the situation in which the feature had previously been seen. The feature was readily followed by associated imagery, and thus a more explicit recognition developed, or its noting was followed by a continuation of the main tendencies of consciousness. At all events, attention usually turned to and away from it; the “interest” was not primarily “What sort of a feature is it?” or “Will it repeat?” but rather, “Where did I see it before?” or “It will not repeat.”⁶³

⁶² Cf. *A*, Zalof, second presentation consciousness of definition; fourth presentation; p. 43. *C*, Deral, first presentation, the wondering if the direction of the oblique line were common, etc., p. 58; Zalof, fifth presentation, “divided in two—include,” p. 61; Deral, second presentation, third figure, noting of “foot,” fifth and sixth figures, awareness that the “foot” was always present, p. 63. *D*, Deral, first presentation, awareness that color is always at the left, p. 65. *E*, Tefoq, fourth presentation, investigation of greenness, with later awareness of definition, p. 73.

⁶³ *A*, Tefoq, fifth presentation, first figure, where the immediacy with which imagery of a figure previously seen made its appearance was evident, p. 45; Kareg, second presentation, where the easy and ready observing of the lines and the unimpeded turning of attention to a related content were obvious, p. 45; Zalof, fourth presentation p. 43, where the experience was definitely analyzed into the ease and readiness with which the figure

Nevertheless in cases where the recognized feature had not been investigated when first noticed because of the intrusion of other contents, the recognition was followed by an investigation-process (cf. initiations of the more gradual sort, footnote 34, p. 79).

3. *The Rôle of the Conscious Situation in the Nature and Interpretation of the Experience of Similarity.* The experience of similarity, then, which was the most important component detail of the process of generalizing abstraction, always involved fundamentally a facile and rapid standing-out of the similar feature as a whole, and an unimpeded and easy shifting of the focus to other contents, whether these latter were perceptual or imaginal. This was true no matter how long an interval separated the present noting of the feature in question as similar, from the previous noting of the same feature: Thus, it was true whether the two notings of the feature occurred in rapid succession, or almost simultaneously, as when a process of generalizing abstraction operated upon a contentual basis of percept and image; it was true when the two notings were separated by a slightly longer interval, as when such a process operated upon the percepts of the figures; and it was also true when the intervening period was several days or a week, as when the observers recognized striking non-common characteristics which they had noted during a former presentation of the series. This fundamental behavior in consciousness of the (objectively) similar feature was not a meaning-content or a "knowledge" or an explicit awareness that the feature was similar to one seen before; it was rather a dynamic meaning,—a responding to it as similar. The observers treated the feature as if they had previously observed it. This experience was obviously not an immobile state of consciousness, nor was it anything so static as an attitude; no momentary pattern of consciousness, in its context, could ade-

stood out, and its failure to impede the course of attention. C, Deral, third presentation, first figure, recognition of the upper left-hand side, p. 64; here, the recognition did not occur immediately, but when it did occur it consisted in the appearance of the proper observation-adjustment, followed without more ado by the cessation of the observation of the feature itself, and a verbal interpretation of the experience.

quately describe it. It was an actual lived moment of response,—an experience, however brief, of the shifting of the clearness-relations of consciousness.

The experience of similarity was frequently characterized by this response of attention to the feature alone; and it was either described by the observer without being labelled in any way, or else it was labelled as a “verification” or a “familiarity” of the repeated feature. In certain cases, however, this peculiar standing-out of the similar feature was very rapidly followed by other contents, before attention continued its course over the stimulus. These contents consisted in kinaesthetic or verbal assent, or in other kinaesthetic and organic and affective components, which, emerging as they did, constituted a more explicit recognition or acceptance of the feature. They may be regarded as a genuine “conscious attitude” toward the repeated feature. The contents of such an “attitude” included kinaestheses and organaestheses of leaning or nodding toward the feature, or of relaxations; the affective content was pleasantness, satisfaction. Sometimes, moreover, such contents were accompanied by a visual image of the repeated feature as seen upon a previous occasion. Sometimes the observer simply described any of these additional components which were present; but in most cases he labelled them as well, using such expressions as a verification or an acceptance of the (objectively) similar feature, or a recognition of it, or a familiarity with it. These complex experiences were labelled by the observer much more frequently than was the mere standing-out of the feature itself. They constituted perhaps a less rapidly moving and more unchanging aspect of mind than did the mere attention-response of accepting the repeated feature. They partook more of the nature of products, or end-terms, of a process. They were momentary divergencies in direction, or “loops” as it were, in the normal conscious continuum of the examining of the figure,—moments of conscious comment upon the meaning of parts of that continuum. They were more dramatic, more attention-compelling; and hence they invited interpretation, or labelling.

Now the problem of the present section is to examine our evi-

dence for any light which it may throw upon *a*. the conditions under which such "attitudes" of verification or assent or recognition emerged, *i.e.*, the conditions under which such "loops" occurred in the ordinary "unanalyzed" continuum; *b*. the complexity and persistence of the "attitude"—the magnitude of the "loop"—under different conditions; *c*. the conditions under which the attention-experience of similarity or the "loop" or both were labelled by the observer; and *d*. the specific label which was applied under different conscious conditions.

Our experimental data are not sufficiently numerous for anything which approaches a final solution of these four problems. But they furnish a strong indication that *the presence or absence of a vigorous process of generalizing abstraction constitutes the prime condition of the occurrence, magnitude, content, and labelling of such "loops."* The process of generalizing abstraction constituted the form or the "direction" of contents, or the "interest," which was peculiar to our experimental conditions.

a and *b*. When a feature which was experienced as similar was at the time the object of a vigorous⁶⁴ process of generalizing abstraction, it frequently happened that no "attitude" of similarity or assent or verification at all developed. The standing-out of the repeating feature (visually, and sometimes verbally as well) was immediately followed either by the shift of attention to the next feature on the course,⁶⁵ or else, as occasionally happened, by tentative generalizing or defining of the feature (*cf.* footnote 62, p. 96). At other times a brief "attitude" accompanied or followed the standing-out of the feature. The content of such an "attitude" consisted in brief kinaestheses of nodding, or vocal-

⁶⁴The degree of vigorousness was indicated by the dominance of the process and absence of awareness of regions not under investigation, by the persistence of the process, and by the amount of tension, etc.

⁶⁵*A*, Zalof, fourth presentation, noting of sub-branches, p. 43; Kareg, first presentation, second figure, p. 42. *B*, Zalof, eighth presentation, p. 50; Tefoq, third, fourth, and fifth presentations, pp. 52 ff.; Deral, second presentation, second and later figures pp. 54 f. *C*, Deral, second presentation, fourth figure, noting of angle, p. 63, third presentation, noting of "foot" pp. 63 f. *D*, Zalof, fourth presentation, p. 67; Deral, third presentation, examination of the backward extension of the two sides, pp. 67 f; Kareg, second presentation, investigation of hexagonality, pp. 68 ff.

motor images of affirmation, or kinaesthetic relaxation, or pleasantness.⁶⁶ It sometimes happened that "attitudes" or "loops" developed with the processes of verifying the generality of features which had previously been found to be common.⁶⁷

When, on the other hand, the process of generalizing abstraction was absent,—when the feature which was experienced as similar was one which had previously been found to be non-repeating and hence was not now under investigation,—its standing-out was followed by kinaesthesia and organic and affective processes, and usually by visual imagery of the feature as seen before.⁶⁸ The "attitude" was now more complex in content, and of longer duration.⁶⁹

Hence the conscious situation,—the presence or absence of a process of generalizing abstraction,—was the essential factor upon which depended largely both the presence of an "attitude," and its nature and complexity. It is obvious that the presence of the process of generalizing abstraction would not be a highly favorable condition for the development of such "attitudes"; and at most would tend to confine any "attitude" which did develop to a brief passing affirmation. The presence of an extended "attitude" of explicit recognition would have delayed the process, and made it less efficient. Moreover, the percepts succeeded one another so rapidly that the process of comparison could readily take place in them directly, without an intermediate comparison

⁶⁶ *B*, Deral, third presentation, p. 56; Zalof, second presentation, p. 49. *D*, Zalof, first and second presentation, pp. 64, 66. *E*, Zalof, fifth presentation, p. 71; Deral, second presentation, p. 71; Tefoq, fourth presentation, pp. 72 f.

⁶⁷ *B*, Zalof, fourth presentation, the affirmative attitude, p. 50. *C*, Zalof, sixth presentation, fifth presentation, last three figures, p. 61.

⁶⁸ It is interesting to note that in those instances when visual imagery did not occur in connection with the experience of similarity, such imagery had in most cases emerged during the fore-period, or by way of anticipation of the figure, and so had recently been in consciousness. In so far, the conditions resembled those of the process of generalizing abstraction.

⁶⁹ *A*, Zalof, second and fourth presentation initial familiarity, p. 43. *C*, Deral third presentation, recognition of left contour, p. 64 f. In some cases, recognitions occurred before processes of generalizing abstraction were instituted, but not afterward; *A*, Tefoq, fifth presentation, p. 45; Kareg, second presentation, p. 45. *B*, Deral, first presentation, pp. 47 f.

of any percept with visual images. In the absence of such a rigid form or direction of consciousness as was manifested in the process of generalizing abstraction, on the other hand, conditions would be more favorable for the development of an explicit recognition. No necessity for close and hurried observation would be present, to make it unlikely that a recognitive visual concrete reference to a past situation should develop. In other words, when consciousness was characterized by the presence of a strong direction, or forward-push, such as is furnished by a vigorous process of generalizing abstraction, relatively few eddies or cross-currents made their appearance.

c. The mere attention-experience of similarity was, upon a few occasions, labelled in retrospect by the observers as a familiarity with the feature. In almost all cases, however, the experience of similarity was not labelled unless some other condition was present which drew the attention to it. In the great majority of cases this condition was the development of an "attitude," which was in itself relatively dramatic and attention-compelling, and hence invited interpretation, or labelling. Occasionally, however, a question of the experimenter's led an observer in retrospect to place a label upon an experience of similarity.⁷⁰

d. The nature of the label which the observers applied to their experiences of similarity again depended upon the presence or absence of a process of generalizing abstraction. When the feature which was experienced as similar was at the time the object of a vigorous process of generalizing abstraction, the standing-out of the feature, with any "attitude" which emerged, was in almost all instances labelled as an affirmation of, or assent to, or verification of, the presence of the feature. In some cases, the standing-out of features whose generality was being verified, together with the subsequent "attitude," was labelled in the same fashion (pp. 99 f., footnotes 65 and 66). In only one instance (*D*, Zalof, first presentation, p. 64) was an experience of

⁷⁰ *C*, Tefoq, first presentation, 2, the description of the vague consciousness that the figure was like the first: here the observer, when questioned, interpreted her initial observation of the second figure, in the light of the preceding *Aufgabe*, as a consciousness of similarity: p. 59.

similarity which occurred in conjunction with a process of generalizing abstraction labelled as familiarity or recognition. And in both of these instances, the experiences were analyzed into contents which proved to be similar to contents which had elsewhere been labelled as assent or affirmation; in one case, indeed, the observer changed the label from "familiarity" to assent ("yes-consciousness"). But when, on the other hand, the feature which was experienced as similar was not the object of a process of generalizing abstraction, the experience, when labelled, was practically always called "recognition" or "familiarity." (Cf. footnote 69, p. 100.)

Moreover, in many cases, the standing-out for the second or later time of a feature, with or without an "attitude" of assent or verification, was followed by an awareness that the feature might be general, or that it must be included in the definition, rather than by development of a reference to a past situation, *i.e.*, an elaborate awareness of similarity or a recognition. This meaning was of course in harmony with the process of generalizing abstraction.

Thus it appears that in our experiments the presence of a process of generalizing abstraction constituted the prime condition not only of the processes which followed immediately upon the experience of similarity, and which at the time constituted an important part of its conscious significance; but also of the specific label which was later applied when the observer was in a situation of communicating his experience (the introspective situation). When a vigorous process of generalizing abstraction was present, the play of the observer's attention constituted an acted question, "Is this a repeating feature?"; and the mere standing-out of the feature sufficed to answer the question,—this standing-out and the observer's conscious response to it constituting a meaning of "Yes—present so far." Thus the generalizing situation was not conducive to the development of an explicit attitude of recognition, or to the application of the label of "recognition" or "awareness that the feature had been seen before." Rather it was conducive to the application of the label of "affirmation" or "verification," and the prevalence of such a

label in our introspections is not surprising. The process of generalizing abstraction, then, especially when it was present in vigorous form, constituted a "direction" of consciousness, or a current, along whose course all contents swept. The form of response which was initiated in any situation,—whether the "attitude" in the momentary continuum, or the verbal label of the later introspective continuum,—was almost invariably in harmony with the main stream.

On the other hand, when the experience of similarity did not occur in conjunction with a process of generalizing abstraction, no situation existed which lent to the experience a "verifying" or "include-in-definition" significance (or mode of conscious response), or which placed any premium on time; and the way was open for the concrete past reference, or for more elaborate "attitudes." The "loops" in the continuum,—the departures from the path of strict noting of the figure,—were now more numerous and of greater extent. This was particularly true if no vigorous abstraction-processes were running their course elsewhere.

4. *The Experiences of Absence or Non-similarity of Features under Investigation:* When a feature which was being investigated happened to be absent or obscured in any figure, the response of the observers' consciousness was exactly the reverse, in most respects, to that which obtained when the feature was clearly present objectively. The altered region or changed aspect of the figure stood out sharply, with unusual focality, and the course of the attention and regard and the kinaesthesia of exploring were halted abruptly. Usually this halting either terminated the particular process of generalizing abstraction, or was followed by an accepting of the feature as a variation,—by verbal imagery of changing the definition, or defining the feature as a non-general one.⁷¹ Sometimes, however, the process continued, often in a more hesitant fashion. The standing-out of the changed region and the arrest of attention constituted a nega-

⁷¹ A, Zalof, first presentation, tenth figure, p. 40. C, Kareg, first presentation, "big lump may be on right," p. 57. E, Tefoq, second presentation, p. 72.

tive answer to the previously-described "Is-it-present?" behavior of consciousness.⁷²

Usually, however, the experience that a feature under investigation had changed or had failed to repeat was more complex in its conscious content. Observers reported that they named the altered region in verbal imagery—auditory or vocal-motor or both—or that the visual percept of the region was supplemented by concrete kinaesthetic and even tactual imagery of internal imitation (*C*, Deral, first presentation, eighth figure, surprise and internal imitation, p. 58). Sometimes such supplementing contents consisted in kinaesthesia of pointing out the region of the change, or of 'shift of balance' (a changed bodily attitude) (*C*, Tefoq, first presentation, last figure, p. 60).

Again, the arresting of attention and the standing-out of the altered region were in many instances accompanied by kinaesthetic and affective contents or by verbal exclamations or both, all of which functioned as surprise. In a few instances observers reported manual kinaestheses, as though they were holding back the card, or a kinaesthesia as of starting toward the apparatus. Occasionally, a period of diffuseness and inattention followed, the observer subsequently taking up the investigation of another feature.⁷³

The standing-out of the altered region was often marked by the appearance of concrete imagery of preceding figures in which the region altered in the present stimulus was prominent; and hence the nature of the differences stood out concretely.⁷⁴ Sometimes verbal imagery of the corresponding region in preceding figures occurred. The concrete and verbal imagery functioned under these conditions in a manner which was strikingly similar (*E*, Kareg, first presentation, 3, p. 70).

The affective components which followed upon the noting of change varied widely. Sometimes they consisted in pleasantness and kinaesthetic relief, which the observer interpreted as relief from the necessity of remembering the feature. Pleasantness also occurred if the change was noted at a time when numerous general characteristics had been established, and when the

⁷² *B*, Tefoq, fourth presentation, first figure, the "seeming different" of the sides of the central body in relation to the periphery, with the consciousness of longer time spent on the observation; fifth to eighth figures, awareness that one "design" was different, p. 53. *C*, Deral, second presentation, first figure, consciousness of discrepancy, p. 63. *D*, Deral, third presentation, termination of investigation of the relative backward extension of the two sides of the figure, *et. al.*, pp. 67 f.

⁷³ *C*, Kareg, first presentation, sixth figure, p. 57; second presentation, third figure, failure to note details and cessation of adjustment for close observation; tenth figure; p. 62. Zalof, fifth presentation, last figure, p. 61; Deral, first presentation, eighth figure, p. 58. *D*, Zalof, first presentation, 'shock of surprise,' p. 64.

⁷⁴ *A*, Zalof, first presentation, 3, absence of red in seventh figure, p. 40; Tefoq, first presentation, fourth figure, noting of center, p. 41; Kareg, first presentation, 3, answer to question, p. 42; Kareg, second presentation, p. 46.

discovery of one at this eleventh hour would have aroused doubt as to the thoroughness of the observation; or it appeared when a somewhat uncertain statement made in the recall was corroborated by the subsequent discovery that the 'uncertain' feature was absent. A number of *B*'s later observations illustrate these statements. At other times the affective components consisted in unpleasantness and doubt (*e.g.*, *C*, Kareg, second presentation, last three figures, pp. 62 f.). These components occasionally marked the noting of the absence of a feature when the observer had previously experienced difficulty in finding essential features, or when a number of attempts had met with failure. Such indications corroborate our view that the blocking of attention on the changed aspect,—the conscious experience of the continued and focal standing-out of that aspect and its subsequent treatment—constituted essential parts of the noting of change. Only half of the story is told—and the inconstant and variable half—if we identify the experience of the absence of a feature under investigation with the sensory qualities which enter into the percept of the altered region, and which follow immediately upon the experience. Equally essential and far more constant components of the experience are those of the manner in which these structural contents are present—their durational aspects, their degrees of clearness, and the general situation in which they occur.

5. *The Experience of Absence or Alteration of a Supposed General Feature.* It sometimes happened that the observer noted essential changes in features which, up to that time, he had regarded as general. In such cases his experience differed from his characteristic experience of noting absences (*cf.* foregoing section) in that the components of the latter experience were now present in a highly exaggerated form. The characteristic halting of the course of attention was here more prolonged, and the kinaesthetic and affective experiences of surprise were more intensive. This kinaesthesia usually included respiratory contents, especially gasping and holding the breath, and such experiences as were involved in a closer scrutiny—as of moving nearer to the apparatus. To this was frequently added imagery of past experiences with the figure—auditory and vocal-motor verbal images of defining, visual images of figures as previously seen, and kinaesthetic images of bodily attitudes.⁷⁵

6. *The Experience of Noting Novel Features.* The noting of novel features invariably occurred apart from the influence of any individual process of generalizing abstraction. It consisted essentially in the fact that the novel feature claimed and held the attention,—visually, or with supplementary verbal and other kinaesthetic imagery,—and in this far it resembled the experience of noting absence or change of a feature under investigation. But the investigation-process in accordance with which the significance accrued to the latter experience was now lacking, and the events which followed the present experience and which constituted its conscious significance were totally different. The nature of these events depended upon the conditions under

⁷⁵ *B*, Zalof, ninth presentation, noting of absence of prong, and later, of absence of red in one figure, p. 50. *D*, Zalof, third presentation, *Bewusstseinslage*, p. 66; *D*eral, third presentation, noting of change in notch, p. 68.

which the novel feature stood out. If it were relatively early in the experiments, and if the novel feature were not in a region which had been found to vary, its noting "meant" "Is it essential"? *i.e.*, it initiated a process of generalizing abstraction (pp. 78 ff.). If on the other hand the feature were obviously absent in visual images of past figures, or if it were one which the observer had previously found to vary—*e.g.*, a particularly brilliant color or different size, when color and size had proved to be different—no investigation was initiated. While it not infrequently happened that marked kinaesthetic and affective and even verbal contents appeared and functioned as surprise or as an awareness that the feature was new, these contents were brief and attention did not remain upon the region concerned. The observers were often explicitly aware of a novelty in this region and of its particularity, in terms of visual or verbal imagery; occasionally they reported a wondering that they had never noticed the feature before. This wondering consisted in a closer visual attention and in the presence of respiratory kinaesthesia, with verbal imagery.⁷⁶

Obviously the process of generalizing abstraction played much the same rôle, *mutatis mutandis*, in the experience of non-similarity that it did in the corresponding experience of similarity. It was the factor *par excellence* upon which depended the nature of the events which followed that experience. When it was present in vigorous form the whole sweep of conscious processes was for the most part harmonious with it,—the experience of a novel feature meant either the abandonment of the process or else "Is it common?," and not "That's new to me." When the experience of a novel feature occurred apart from such a process, or under conditions prohibitive of the arising of such a process, it was often followed by a marked "attitude" of non-recognition or by an explicit past reference; and (with or without the "attitude") it was often labelled as an awareness that the feature was novel, or different.

d. Individual Differences. Our introspections reveal the fact that numerous individual differences were present among our observers; these individual differences have to do with the following five main points: 1. The relative prevalence, in the observers'

⁷⁶ A, Deral, second presentation, yellowness, p. 43; Tefoq, second presentation, fourth figure, noting of end of central body, p. 44. C, Zalof, sixth, presentation, sixth figure, p. 62; Deral, second presentation, first figure, interpretation of focal attention to a feature as a "consciousness of a discrepancy," p. 63; Tefoq, first presentation, "seeming smaller" of a figure, pp. 59 f. E., Kareg, first presentation, eighth figure, awareness of smallness, p. 71.

total consciousness during the examination of a series, of the factors of intention and of generalizing abstraction, as opposed to attention to particular features, subjective reactions to the figures, associated imagery, etc. 2. The relative persistence of the processes of generalizing abstraction, *i.e.*, the readiness with which they were interrupted either by the intrusion of novel features or by the initiation of other similar processes; and the number of such processes which ran their course during a single examination of the series. 3. The contents which characterized the presence in the observers' minds of the factors of intention and of generalizing abstraction. 4. The structural terms in which the process of generalizing abstraction manifested itself. 5. The manner and degree in which the various observers supplemented their observations of the figures by other imagery, concrete or verbal.

1. *The Extent to which the Observers' Procedure was Marked by Processes of Generalizing Abstraction:* No observer reported that the factors of intention and of generalizing abstraction constituted his entire procedure. Every observer at times reported that his attention was attracted by certain conspicuous particular features, which were observed in their own right, and whose standing-out did not initiate an intention or a process of generalizing abstraction. He also reported the appearance of more or less extraneous associated imagery, which almost invariably occurred during the earlier presentations of the series. The observations of *B* and *C* were especially rich in such associations; *E* and *A* reported a moderate number of them; and *D* only a few (*cf.* initial observations of every observer). *C* and, less often, *A* and *B* occasionally reported the presence of subjective reactions to the figures,—surprise, pleasantness, unpleasantness, and the like, sometimes attended by such verbal images as "queer." Contents of this sort, however, played a relatively minor rôle in the observations of *D*, *E*, *B*, and *C*; with each of these observers, by far the greater part of the examination of the groups consisted in definite investigations of recurring features. In the case of *A*, on the contrary, such definite investigations of features played a comparatively insignificant part. The figures did not

often undergo the mutilation, at his hands, to which they were subjected in the consciousness of the other observers, and by which the common features, however obscure, were raised to a level of prominence far greater than that attained by the most conspicuous particular features. *A* treated the figures as separate wholes, for the most part, observing both the particular and the recurring features; the figure tended to persist in visual imagery in which the particular and common features were equally prominent. (For a more complete account of *A*'s type of observation, cf. pp. 90.)

2. *The Number and Persistence of the Processes of Generalizing Abstraction which Ran their Course during a Single Examination of the Series:* Our observers tend to fall into two groups, as regards the number and persistence of the processes of generalizing abstraction which they reported during any one presentation of the series. *B* and *C* represent a type whose observation was more extensive, whose investigation included the less readily nameable features of the figures, and whose processes of investigation suffered interruptions from the very extensity of their observation. *E* represents the opposite type, attending only to the more circumscribed and the more readily nameable features. He ceased to examine novel features as soon as he had investigated these definite characteristics, although his actual information regarding the figure was very incomplete, as compared with that of *B*. On the other hand, *E* never failed to note such a fact as the absence in a single figure of a feature which he had been observing. *D* occupies a position somewhere between the two types. His visual imagery was obscure as regards large parts of the contours of the figures, and he was most certain about the parts which he named; yet his imagery was more extensive than that of *E*. He never failed to note the absence in a single figure of a part which he was investigating; on the other hand, many essential features of contour escaped him, especially in the *D* group. Somewhat apart from either of the two types was *A*; when definite processes of generalizing abstraction appeared at all in his examinations of a series, they appeared singly, and occupied a high degree of attention, although they were never

unattended by an awareness of other features, involved in *A*'s recognitions of the figures as wholes. His processes of generalizing abstraction, however, were persistent (*cf.* footnote 51, p. 89).

B, reported, upon several occasions, that as many as six or seven processes of generalizing abstraction were present, in parallel fashion, during an examination of a series, and that they persisted, although the relative amounts of attention given to each varied in different figures. Certain objective data,—her failure upon a number of occasions to detect the absence of a certain feature in a single figure,—indicate that single investigations at times lapsed, for short periods at least. *C* too sometimes reported that a single examination of a series involved six investigations, but these appeared in successive fashion, certain of them, usually only one or two, being prominent for a time, then giving way to others, and later returning again. Her investigations were not markedly persistent; she reported relatively frequently the interruption of an investigation by the intrusion of a novel feature, or by the initiation of a new investigation. As a rule, *E* reported fewer investigations during a single examination of the groups; nevertheless, even in his case as many as six investigations were sometimes present in the case of the Tefoq group. The features which stood out in his consciousness, and which became the objects of generalization, were usually the more definite ones, such as he could characterize by a word—the straight line of the Deral figures, or the “forking” of the ends of the Zalof branches. He seldom examined any feature carefully, but almost from the very outset he was “interested” solely in the question of whether or not it was present or absent; and the first cursory glance at a feature was followed immediately by verbal designation of the latter and by processes of investigating its generality. For instance, the design in the end of the central body of the Tefoq group was designated as a “crow’s foot”; and this word, together with the behavior of the feature in consciousness, served to identify the feature in succeeding figures. For this reason *E*'s investigations did not cover so extensive an area of the figure as had been the case with *B* and *C*; and his actual information regarding the form of a feature was much less complete, even when he reported the same number of investigations. *D* reported fewer simultaneous investigations than *E*, but tended more than *E* to observe forms and contours which he could not at the time name. The investigations both of *E* and *D* were exceedingly persistent; they seldom interrupted before the termination of the series, unless a figure appeared which lacked the feature under investigation.

3. *Contents which Accompanied the Processes of Generalizing Abstraction:* The observers differed in the number of organic and kinaesthetic and affective contents which accompanied the essential attention-play of the process of generalizing abstraction. A certain amount of eye-movement and tension of the muscles of accommodation were accessory to the investigation, but these contents often failed to project themselves into consciousness, judging from the observers' reports. Some of the observers reported more or less definitely localized and continuous bodily tensions incidental to a sense of effort, or of something to be done. *C* represents an extreme case of this sort; in

numerous instances, especially during her earlier examinations of the series, she reported that her *Aufgaben* and processes of generalizing abstraction were attended by persistent muscular strain, in the trunk and throat. *B*, and to some extent *D* also reported at times that their investigations were marked by the presence of general bodily tensions; but such contents were not so conspicuous as in the case of *C*. *A* and *E*, on the other hand, seldom reported that additional kinaesthetic factors of this sort marked their intentions and their processes of generalizing abstraction. (Cf. footnotes 38, 40, 42, to 49, inc., pp. 81 ff.)

4. *Contents in which the Processes of Generalizing Abstraction Revealed Themselves:* The most important structural contents of the process of generalizing abstraction for all observers were probably the visual perceptions of the figures. In the cases of a number of observers, however, these perceptions were interspersed with visual images of the figures which had previously been seen. Such images were very common in the case of *A*, fairly common in that of *B*, occasionally present with *D*, and rarely with *E*. In the case of *A*, these images were sometimes present as a summing-up of past figures, and sometimes as anticipations of oncoming figures. With *B*, such images often appeared rather non-focally, and usually failed to function in any definite way; there is evidence, however, that upon a few occasions at least they contributed to her "attitude" of similarity or affirmation of a feature. Very infrequently, *D* and *E* reported a comparison of a percept with a concrete visual image. (Cf. footnote 50, p. 88.)

5. *The Manner and Degree in which the Various Observers Supplemented their Observations of the Figures by Concrete or Verbal Imagery.* In the case of every observer, certain imaginal or sensory contents at times supplemented the presence in consciousness of the perceived figures. These contents were *a*. verbal; and *b*. kinaesthetic and organic. *a*. Of these, verbal content was the most common. It was reported in remarkable profusion by *E*, who almost from the very outset named the features which attracted his attention or which he was actively investigating in vocal-motor or auditory-vocal-motor imagery. In the case of *E*, the mere repetition of the word was frequently an affirmation of the presence of a feature which he was investigating, while its repetition prefixed by "no" contributed to his noting that the feature was absent. On numerous occasions, *B*, *C*, and *D* also reported the emergence of verbal imagery of words which served to describe features under investigation. *D*'s verbal imagery consisted in words which characterized the features; that of *B* and *C* included, in addition, words which expressed deviations in the form of a feature, or which expressed its absence. *b*. Kinaesthetic and organic components occasionally served to represent features which were under investigation. When this was the case, the kinaesthesia appeared as an imaged tracing-out of the feature with the finger, or with a pencil held in the hand (*C*, *B*, *E*); or else it appeared in combination with organic components, in a manner strikingly suggestive of internal imitation of the figures. Kinaestheses of this latter sort were peculiar to *C*, and they were remarkable for their vividness and variety. *C* felt herself as "bent" or "balanced" or "smooth" (tactually) or "constricted" in a manner which resembled the figures under observation.

e. **Summary.** In the foregoing sections we have considered the consciousness of the observers during the presentation of the figures. Our aim has been to describe the process of generalizing abstraction, both in its grosser aspects and its finer component processes, *i.e.*, the comparing of the figures and the experiences of similarity and of non-similarity. The process of generalizing abstraction appeared in the nature of the successive percepts of the figures, their immediately experienced durative and shifting aspects, in the course of which repeating features became emphasized and non-repeating features became ignored. (For brief descriptions, *cf.* p. 38, p. 77, pp. 190 ff.) In addition to the nature of the process, we have described its manner of initiation—the task, its concomitant and component contents, its persistence and dominance, the number of possible parallel processes, and the fate of individual features. The more detailed components—the experiences of similarity and of non-similarity—we found to consist essentially not in the especial sensory qualities and extensities and intensities which were present, but rather in the (immediately experienced) manner in which these contents were present, their temporal aspects—rate of rise, persistence, and rate of disappearance; the events which preceded and followed them; and their degree of focality in consciousness. (For brief descriptions, *cf.* p. 97, pp. 194 ff.) This manner of being present, or behavior in consciousness, of the (objectively similar) structural contents attained its significance in virtue of the conscious trend of the moment. We finally pointed out five sorts of individual differences which occurred among our observers.

B. THE GENERAL CONCEPT AND THE EXPERIENCES OF GENERALITY AND OF NON-GENERALITY, AT THE VARIOUS LEVELS OF THEIR DEVELOPMENT.

a. **Introspective Data.** In the case of every observer, the four concepts which were evolved under the conditions of our experiment passed through a series of changes in the form in which they entered consciousness in response to the uniform task of recalling as much as possible about the series. These changes were correlative with the progressively increasing number of the

observers' examinations of the stimulus material. They may be indicated roughly as follows: At the outset, the concepts appeared to consciousness in highly concrete and particular form. As the experiments progressed, the particular concrete imagery ceased to appear, and its place was taken by imagery of more and more schematic form. Meanwhile verbal imagery was assuming a progressively more important rôle, until a stage was reached at which the concept appeared almost exclusively in verbal terms. The experiences of generality and of non-generality evolved in a somewhat similar fashion, from initial highly explicit perceptual awarenesses that the general or non-general feature was or was not common to each member of the group, to final forms which consisted in nothing more than peculiar modes of behavior of consciousness toward the essential or non-essential features, which were now present in single images only. Our observers revealed numerous individual differences, which had to do both with the temporal relations of the fundamental processes, and with the nature of the structural contents in terms of which these processes revealed themselves. These latter structural differences ("imaginal types") were especially far-reaching. We shall first present illustrative introspections from the total list furnished by each observer.

Observer A.

Zalof (first recall, Nov. 19, 1912). "I was aware of an effort to eliminate the sensations around me,—the tick of the clock, and the like. I was aware presently of a series of images, and of endeavoring to connect them associatively with the word 'Zalof.' Finally, the images seemed to be localized upon the exposure apparatus. They were very clear, but not very stable; their number was from four to eight. The word 'Zalof' was written below in every case. The visual images were at first very fleeting; and among them the most prominent was a thick-bodied Zalof. I did not attend closely to this. Then the thin one with the three long branches came to the focus of attention. About six images came afterwards; I can draw these more or less accurately. The thicker-bodied ones had red hearts in their centers." (State what you recall about the Zalofs.) "Your request was followed by fragmentary visual images of words which I had used during my previous definition; among the words, I could make out 'object' and 'animal.' Fragments of words came up also, in vocal-motor terms; these were very fleeting and indefinite. At no time did the complete definition appear; instead, I found that my visual images were before me, and dominating my consciousness. My definition is

TABLE II

This table shows the date of each recall of each series by each observer, together with the developmental stages represented by each recall. (These stages are indicated by Roman numerals; see pp. 153 ff. for description of stages. When the Roman numeral is italicized, it indicates the stage represented in the recall of non-general features.) The question-marks in the stage-column indicate a doubt as to the stage represented. The asterisks indicate that the recalls to which they are appended are included in the list of introspections which are published in this paper.

Serial Number	Observer A								Observer C								Observer B						Observer D						Observer E								
	Zalof		Deral		Tefoq		Kareg		Zalof		Kareg		Deral		Tefoq		Zalof		Tefoq		Deral		Zalof		Deral		Kareg		Zalof		Deral		Tefoq		Kareg		
(Presented)	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage	Date	Stage			
	Nov. 12		Dec. 10	?	Feb. 18				Nov. 23		Mar. 7		Apr. 2				Nov. 12		Jan. 27		Feb. 27				Nov. 27		Feb. 5		Mar. 5		Nov. 18		Dec. 9		Feb. 3		Feb. 26
1	Nov. 19	I*	Jan. 14	?	Feb. 25	III	Apr. 1	III	Dec. 6	I*	Mar. 11	I*	Apr. 15	I*	May 6	I*	Nov. 18	I	Jan. 30	I*	Mar. 3	I		Dec. 4	I	Feb. 12	I	Apr. 16	I	Nov. 25	IV*	Dec. 16	V*	Feb. 8	VI	Mar. 5	IV*
2	Dec. 3	I	Jan. 21	I	Mar. 11	III*	Apr. 15	III	Jan. 15	IV	Mar. 25	I	Apr. 22	I	May 13	I	Nov. 25	I	Feb. 3	IV	Mar. 13	I		Dec. 11	I*	Feb. 19	IV*	Apr. 23	IV	Dec. 9	V*	Jan. 11	V	Feb. 12	VI*	Mar. 7	VI
3	Dec. 10	II*	Jan. 28	?	Mar. 18	III	May 6	III*	Jan. 31	IV*	Apr. 2	I*	Apr. 29	I			Dec. 5	I*	Feb. 10	I	Apr. 1	I*		Feb. 5	I*	Feb. 26	X	May 14	IV*	Jan. 11	VI*	Jan. 18	VI	Feb. 19	VI	Mar. 12	VI
4	Jan. 14	II*	Feb. 4	II	Mar. 25	III*			Feb. 18	IV, I*	Apr. 22	IV	May 13	IV*			Dec. 10	IV	Feb. 15	IV*	Apr. 21	IV		Feb. 12	X	Mar. 5	X			Jan. 13	VI	Jan. 20	?	Feb. 26	VI*	Mar. 14	VI
5	Jan. 21	I*	Feb. 11	III*	Apr. 1	III			Feb. 25	V, II	May 6	IV					Jan. 14	IV*	Feb. 17	?	Apr. 28	IV		Feb. 19	I	Apr. 16	IV*			Jan. 18	VI	Jan. 25	VI	Mar. 5	VI	Mar. 21	VI*
6	Jan. 28	II	Feb. 18	III*	Apr. 22	III			Mar. 7	V*							Jan. 21	IV	Feb. 24	I				Feb. 26	X	Apr. 23	IV*			Jan. 20	VI	Jan. 27	VI*	Mar. 7	VI*	Apr. 2	VI*
7	Feb. 11	II*	Feb. 25	?					Mar. 11	VI							Jan. 27	I	Feb. 27	IV*				Mar. 5	X*	May 14	IV*			Jan. 25	VI*	Feb. 3	VII*	Mar. 12	VI	Apr. 16	VI
8	Feb. 18	III	Mar. 11	III					Mar. 25	VI							Jan. 30	?	Mar. 3	IV				Apr. 23	I					Jan. 27	VI	Feb. 8	VII	Mar. 21	VI		
9	Feb. 25	III	Mar. 18	III*					Apr. 2	VI*							Feb. 6	V, I*	Mar. 13	IV				May 14	I*					Feb. 3	VII	Feb. 12	VII, VI	Mar. 26	VI		
10	Mar. 11	III	Mar. 25	III*					Apr. 15	VI							Feb. 10	V, I	Apr. 21	IV*									Feb. 8	VII*	Feb. 15	VIII, VI*	Apr. 16	X			
11	Mar. 18	?	Apr. 1	III					Apr. 22	IV							Feb. 15	V, I	Apr. 28	IV*									Feb. 12	VIII*	Feb. 26	?					
12	Mar. 25	III*	Apr. 22	III					May 6	IV							Feb. 24	VI, I											Feb. 15	VIII	Mar. 5	VIII					
13	Apr. 15	IV															Feb. 27	VI, I											Feb. 26	VIII	Mar. 7	IX, VI*					
14	May 6	IV*															Mar. 3	VI, I*											Mar. 5	IX*	Mar. 12	VI					
15																	Mar. 13	VI, I											Mar. 7	IX	Mar. 21	X*, VI*					
16																	Apr. 1	VI, VI*											Mar. 12	X	Apr. 2	VI*					
17																	Apr. 21	VI											Mar. 21	X	Apr. 16	X*					
18																	Apr. 28	VI*											Mar. 26	X*							
19																													Apr. 16	X							

this: *A Zalof has three branches; at the end of each branch there are many smaller branches. The center of the Zalof has in many cases a heart; this heart is sometimes red; the smaller ones did not seem to have any heart. Some are thick and some are thin.* This was a description of my visual imagery."

Zalof (third recall, Dec. 19, 1912). (Give me a statement of what you remember about the Zalof; then introspect upon your recall.) "I was aware of an effort to make a systematic recall; and of a desire to definitize my imagery. At first, I saw the tiny Zalof, and then the large ones. I was aware in fleeting visual imagery of such things as the various shades of red in the centers, the shading lines of the centers, and the four-limbed figure which had been given in the Identification Series (*cf.* footnote 23, p. 50). I was aware of a tendency to linger on the images, investigating them in detailed fashion; this seemed to constitute a consciousness of not having examined the series carefully. I tried to recall each figure which I had been shown, dismissing all of the images of figures of the Identification Series. I was vaguely aware of verbal imagery of words such as 'animal' and 'object' which seemed to be connected with these visual images." (Will you describe what you remember about the Zalof, and introspect later?) My description is present in each of these visual images which is before me. "It is a concrete visual description, not a verbal one. The word 'Zalof' is simply a name for the whole group. I looked for a certain characteristic in each of my series of visual images; I seemed to glance across the series, as it was spatialized in visual imagery, and to pick out the common features. I was aware of the variations,—the thickness, the presence of the hearts, which were sometimes in black lines; and I was aware of the tiny image which has more than three branches. I tried to form an image of a Zalof which would stand for the whole group. This was difficult, however, because of the different sizes. I then imaged these sizes, the large ones, and the small one; and presently I was aware of the variations in the centers,—that the 'hearts' may or may not be present, and may or may not be red. But the prominent thing in my attention was the branches with their divided extremities; I was aware presently of an image which was just an outlined form, with these branches; this image would coincide with any one of the figures by simply changing its size. It had three directions and the terminal branches. I was aware of applying this image to various of my initial visual images in this fashion."

Zalof (fourth recall, Jan. 14, 1913). (Tell me everything you can remember about the Zalofs.) "Before you gave me the instructions I was aware of vocal-motor verbal imagery of the word 'Zalof.' Immediately after your words, a series of visual images began to clear up in definite fashion; an image of a tiny Zalof standing out most plainly. Each of the particular figures which I have seen stood out at one time or another. All of them were triangular-shaped, having three limbs with smaller branches at the ends. Next came a recall of the attitude of defining; this was an effort to put in words the features which I noted in each image. The words which were actually recalled were so indefinite that they did not aid my definition." (Now give the essential features of the Zalof.) "*Three large branches, and four*

smaller branches at the end of each; nothing else is essential." (Give an introspection upon that statement.) "I simply saw these features in each of a series of visual images, of which one stood out more clearly than the others. This one was not any particular Zalof of the group; while it was an individual image, it possessed only the characteristics which were common to all. It was the only image that would coincide with any or all of my individual visual images. These latter tended to disappear; and afterwards I had nothing whatever but the 'schematic' visual image. It seemed afterwards to be something which stood for all of my particular images; it did this simply in the fact that it came and predominated without any struggle or effort on my part. Afterwards, I verified my statement by referring to a series of particular visual images." (Describe that verification more fully.) "The verification consisted in the fact that a series of visual images appeared as a result of an attitude of looking for features which were present in the 'schematic' visual image. I attended first to the features present in my schematic image, common to all images. Then I attended to the things which were not common,—the central heart, with its four parts and its red color. I actually compared the successive visual images. At last came a statement in vocal-motor terms: 'There are no other characteristics common.'"

Zalof (fifth recall, Jan. 21, 1913). (Tell me what you remember about Zalof, without attempting an introspection until later.) "I immediately was aware of imagery relating to my previous experience, and of visual images of the Zalofs with their three branches, each branch ending in two groups of sub-branches. All of the variations of individual Zalofs appeared. I do not know how to get the facts out of this imagery; I do not know but what I had better give an account of the images.' (Name the essential features and the variable features.) "*The absolutely essential features were the three branches and the two groups of sub-branches at the end of each. The central 'heart' was present definitely, and it was red; in one case it had four parts, and in another case it was shaded in indefinite fashion. In another instance, the hearts extended far into the branches; here the branches were thicker.* I was aware next of two series of images, one belonging to an earlier experiment, and containing terminal branches of no constant arrangement or number, and in a single group; the other images contained sub-branches which were definitely arranged in two groups. At first I did not know which series of images to describe; I held both before my mind for a time. The images containing two groups of sub-branches tended to become more certain. *The variations which I can recall are the different lengths of the branches of the various figures, the differences in size, and the shape and direction of the branches.*' Introspection: "All of these facts appeared in my visual images; these images were more or less definitely localized in the series."

Zalof (seventh recall Feb. 11, 1913). "*Zalof is a picture, which may vary in size; it has three main branches, at the ends of each of which are smaller branches. These branches may be arranged in two groups, or in some cases in three groups. Variations may occur among the groups. In a number of cases the main branch which extends toward the left is larger than the others. The main branch which extends toward the right is usually the least regular;*

its thickness may vary. In a number of cases the relative thickness and length of the branches may vary. The hearts in the center are sometimes striated, and in some cases they are colored red. In some cases there is a red center with three protuberances. These protuberances may extend up the branches quite a distance.' Introspection: "My recall came entirely in the form of visual images; it was nothing more than a verbal description of those images. I attended to one image at a time; whether I had a series of different particular images or a single image which changed its shape, I do not know. Finally, the imagery became permanent; the succession of different images ceased, and I was aware of a single image which had no reference whatever to any particular member of the series. This image was very hazy and vague as to most features, but it was very definite in possessing three main branches. It maintained a prominent position in my consciousness with great certainty and without reference to particular figures." (What is the difference between your awareness of essential and of particular figures?) "That is simply the behavior of my attention."

Zalof (twelfth recall, Mar. 25, 1913). "*A Zalof has three main branches, at the ends of each of which are smaller branches. These latter are divided into two large groups, which groups are again divided into smaller groups of two. Then each of these last groups terminates in two divisions. In other words, there are in all eight points at the end of one of the main divisions of a branch. In some cases I believe there are actually nine of these points; when I said that I stopped and counted them in my visual image. This form is not invariably present. The central 'heart' is sometimes divided into four sections, three of which may extend up into the branches. These hearts are non-essential, for the reason that they are sometimes colored red, and sometimes not colored and inconspicuous. I am not sure that they are invariably present.*" Introspection: "At the very first I was aware of an exceedingly vague 'schematic' visual image, which I started out to describe. New parts added to it in successive fashion, which I described. Occasionally I referred to images of the original figures which appeared; at the close of my description I was aware of a series of these, which were accompanied by a memory of my experiences of the past sitting. This memory included auditory verbal imagery, of myself saying that certain features to which I happened to be attending were not common; it also included visual imagery of seeing that these features were not regular. Then my attention went to the center of a visual image and I described what I saw. When I said that the centers were non-essential I was aware of other visual images which varied with respect to the center." (How did the schematic image differ from the later particular ones?) "The particular ones were definitely localized on the apparatus, as I had seen them when they were exposed. The schematic image was not localized in this fashion; it was indefinite as to size, coloring and the like, and it consisted only in vague outline which I could not characterize as made either with pen or with pencil. The ends of the tentacles were unclear, but I knew that they were present, in terms of the attitude I took toward the image. When I described the manner of terminal division of the branches, I was aware of the thinking them out in my visual image; I was

aware of close concentration upon the past and an effort. While describing the ends I was vaguely aware that what I was describing did not apply to the whole of the group. My consciousness of the variations was very dim and unclear. I am not certain as to how it was present."

Zalof (fourteenth recall, May 6, 1913). "*A Zalof has three main branches which extend at different angles. At the ends of each main branch are smaller branches which are divided into two groups, each of which latter is again divided into two groups of two between which is a third division which is itself not divided. Thus there are eight points, each of which is divided in two, and a ninth in the center which is not divided. The central region sometimes contains a heart and sometimes only crossed lines. It may or may not be red. In some cases the hearts extend up into the main branches.*"

Introspection: "As soon as you asked for a Zalof I was aware of a visual image which was vague and indefinite; I was aware of an effort to make sure that it was really a Zalof. In making this effort, I called up the situation in the other room where I first saw this figure; and presently the word 'Deral' appeared with a visual image of a Deral. This disappeared and presently a vague 'schematic' image of a Zalof appeared, in which the sub-branches of the upper left-hand main branch presently cleared up. I remembered in vocal-motor verbal terms that the branches were divided into groups of two; I was also aware of auditory imagery of my own voice saying this. Then the arrangement of the sub-branches cleared up in visual imagery. As I attended to them these branches stood out clearly. Then other figures appeared, in which I did not see this grouping clearly. Then I turned my attention to the central region; and presently the small black lines appeared, and the extensions running up into the main branches. Then the little one appeared, localized spatially somewhat below the others. The little one was localized as number eight in the series, in terms of vague visual imagery in which the other figures were present as vague splotches. I was about to mention that the figures might vary in size; I had vocal-motor verbal imagery of saying this; but I turned away from the image of size as irrelevant, for I had observed that the size varied in the imagery."

Deral (fifth recall, Feb. 11, 1913). "*A Deral is a picture of an object which has one long straight side slanting at an angle of forty-five degrees from the horizontal. The rest of the contour shows two main divisions or lobes, which are about alike, and which come together in a large 'V'. This 'V' which opens toward the right, is filled in with another less solid looking substance which extends downward and to the right, and has a straight edge on the bottom; this lower part of it resembles a foot. Those are the essential characteristics. The non-essentials are the number of dots or the kind of dots that are placed throughout the central projecting part. The color is also non-essential.*" Introspection: "My recall began as soon as you spoke the first word of the instructions. I was then aware of quite a clear visual image; I can not say whether this image contained color, but I think that it was just dark gray and had form. The clearest thing about this image was the straight side and the lower foot. The position of this straight side was not definite; I cannot say whether it was near the lower lobe or the central part of the figure.

I went on with my description, and did not long attend to this uncertainty. The line was seen definitely, in stable and permanent fashion, as a feature common to all the group. I was aware of no fluctuations when I described it. When I was describing the lobes, I was conscious of describing from a series of visual images in one of which the lobe projected up straight, in another of which it was rather flat. I saw that the lobes were present, however, in every image. Then the central part of the figure (right-hand side) came out clearly, in a series of images; then the other essential features. Color did not appear until late. At this time, images appeared which were colored first yellow, then green, and then drab." (Describe your consciousness that the straight line was common to the whole group.) "This was largely the context in which it appeared,—the fact that it came in as it did with relation to my situation of recalling. When I was placed in the situation of looking for the essential features this straight line appeared."

Deral (sixth recall, Feb. 18, 1913). "*A Deral has a straight line at the left side, and two lobes, between which and to the right lies another part which is shaded in spots and strokes, and has a series of projections about the outside, and a straight line at the bottom. The spots and strokes and series of projections are individual differences, as also are the colors in the original two lobes.*" Introspection: "As soon as you spoke I was aware of a visual image of a Deral, which was not necessarily, however, any Deral which I had ever seen. I began to describe this image; but before I had gotten so far as to say 'two lobes' I was aware of visual images of numerous particular Derals. Then I began to describe particular features, which had become prominent in my visual imagery. Then, the lower straight horizontal line on the right cleared up in the visual images, and I described that. Just before, I had been aware of a bit of bluish drab color, and other colors, which I had not attended to; I described it later. The general features entered consciousness rather differently from the particular ones; they lacked the elements of effort which seemed to go with a description of particular features, and they were more satisfying. This was most strikingly true of the two straight lines; when these appeared in visual imagery, I was aware of no tendency to go back to particular features. Afterwards, when the particular ones appeared, I saw rather vaguely and non-focally the general features which I had already described."

Deral (ninth recall, Mar. 18, 1913). "*A Deral has one oblique straight line, which lies at an angle of forty-five degrees from horizontal; also two large lobes of which one extends upward and the other downward. Between them is a central lobe of lighter texture, which has one straight edge at the bottom. The central one has many variations, sometimes having a scale-like or wing-like, and sometimes a bow-like structure; the edge may be notched. The two large lobes may be colored in various colors, usually of a heavy, muddy sort.*" Introspection: "As soon as you pronounced the word 'Deral' I had an unmistakable visual image of a Deral. I do not know whether it was any Deral that I have seen before or not. It seemed to stand for the rest. My attention was most closely concentrated upon the single oblique line at the left I began describing this line as an essential thing, knowing that it occurred in

all of the rest of the figures. This 'knowing' was largely in my recall of earlier descriptions of the figure,—a recall present in auditory terms, of the words I had used, and in concrete terms, of the actual previous experimental situations. My description began almost automatically, as a thing that I had done many times before. When I started to describe the lobes, I attended first to the region of the upper lobe; I was immediately aware of three or four variations in the form of that lobe, which appeared in visual images of different figures, or else of the same figure changing. Then I turned to the downward-extending lobe; I was aware of a visual image of a picture I had drawn but my Deral images were uncertain regarding the lower lobe. I do not know just how the lower lobe appears. When I described the lower horizontal straight line of the projection between the two lobes, I was aware of a number of visual images of different Deral figures, showing this part in different widths. Then the other variations appeared in visual imagery; I was aware of visual images of the whole series of Derals. My attention went in succession to the markings of the right-hand projecting part,—the scales, the dots, the circles and the tiny wings; at the very last I saw one which had edges like saw teeth. I turned away from these features, as if turning my eyes to look at other parts of the figures; I then became aware of colors, seeing first the bluish drab one, then the orange one and then the gray one. My description of colors followed." (Describe your knowing that the first image stood for all of the Derals.) "That was very vague, largely present in the auditory associations with the past. I was not aware of doubt or hesitation; my description just ran its course, easily." (Were you unaware of colors until their appearance at the last?) "Yes. The first time I examined the lobes, I did not attend to anything but their shape."

Deral (tenth recall, Mar. 25, 1913). "*A Deral has a straight line on its left hand side, at an angle of forty-five degrees from the horizontal. It also has two main lobes, one extending upward and the other downwards. These are oblong. A central region extends from between these lobes which is also oblong and bent downwards, having at the bottom a foot with a horizontal straight edge. This part has many variations,—scales, edges like the teeth of a saw, dots, and tiny curved lines. The two main lobes are of various colors, which are usually dark and muddy.*" Introspection: "The moment you began your instructions I was aware of a visual image of a Deral which was not clearly the image of some particular Deral; nevertheless it partook of the nature of a particular image to some extent. It was not, however, quite definite enough for a particular image; it was indefinite—dark gray—as to color, and as to the markings of the right-hand downward-projecting part; I can not say whether this part contained dots, or scales, or whether its edges were notched like the teeth of a saw. All I attended to in this image was the lower oblique straight edge, and the lobes. Then I began to describe these features, from this image. Presently the central rightward projecting part cleared up; I had not carried my description beyond this point when I began having visual images embodying the variations; these were images of concrete Derals which I had seen, containing the lobes in different forms and also the colors; but I omitted the colors in my description at the time,

attending rather to the general features, and reserving the variations for the last. The general shape of this central lobe cleared up ahead of my description in a series of particular images; by the time I came to describe the foot at the bottom I had had visual images of all the Derals. Afterwards I turned almost automatically to the different colors, and described them; this was in many respects a recall of the images which I had had a few seconds previously."

Tefoq (second recall, Mar. 11, 1913). "*A Tefoq is a picture of an object which has a rough uneven border, more uneven in its lower periphery, and it always has an indentation which extends clear into its body, in the lower periphery. The surface is plain, smooth and undotted near the periphery; in the central region is an arrangement which shows tridimensionality; this resembles a piano-keyboard, and it has a colored object protruding from behind in every case (blue triangle).* The moment you spoke the word 'Tefoq' I was aware of nothing excepting auditory familiarity. This consisted essentially in the way I attended to the name and to the situation; I had an attitude of confidence,—an attitude of 'sure, I know that,' which was a feeling that I was able to recall the Tefoq. Immediately I was aware of the experience of previous sittings. This was visual imagery of the situation, and vaguely of the Zalof and Deral figures, from which I was aware of turning away. A more definite series of associations came in,—the situation of Doctor X's lecture about to begin, and so on,—no definite, clear-cut awareness of the situation, but just a vague background, something which gave me a setting. I had everything well under control. Then a visual image began to develop, a single one,—and I just allowed it to evolve, noting its progress. It had no reference to any particular Tefoq, but it turned out to be a Tefoq of medium proportions,—size, thickness and blackness. Then I began my description; and I turned my attention as if I were looking from the top to the bottom of the figure. Presently numerous particular images began appearing, in which I saw many little deviations. They included the little black figure and also the great big figure." (What was that consciousness that you had everything under control). "The awareness of myself, as making this recall. This was self implicit in the very awareness of attending; the awareness that I was looking for something not present but which presently appeared. It was as deep-set as my awareness that I am alive."

Tefoq (fourth recall, Mar. 25, 1913). (Tell me everything you remember about the Tefoq.) "Let me introspect! The first thing of which I was aware after your instructions was a state of searching,—concentrated attention as if to a visual image about to appear; this consciousness was followed by a flashing visual image of the central region of a Tefoq,—a vague, schematic thing, containing only the main divisions, one vertical section and one extending sidewise. Then this visual image began to become more clear, and other parts added themselves to it; thus I saw a 'notch' ('blue triangle') behind it, and the marking on the end of the central part, which has three extensions. No reference whatever to any particular figure came with the appearance of these additions; and they appeared rather slowly, being at first a mere differentiation in the regions of the central part of the figure in which they later appeared, and then they became much more definite. Still later, the image

cleared up until it became vaguely localized as the first member of the series; this localization came in terms of a vague recurrence of the previous experiment here, and fleeting imagery of the series being exposed. This image stood for all of the figures; and I made no effort to call up other ones." (Describe the manner in which that image stood for all of the figures. Were you distinctly aware that the image was a general one?) "That was bound up with my attitude during the recall. I was searching for general features, and anything that appeared to my consciousness satisfied it." (Describe your looking for general features.) "I can not describe it, except to say that it is the way that my attention is going to behave the next minute, the thing that I am going to attend to. Whatever comes will be general." (Now state your recall.) "*I remember clearly that the outline of the figure is irregular and that it contains a 'Chesapeake Bay' indentation in the lower region, which I have described. Now I have more imagery with regard to variations in color. The outline is shaded in different colors. That came in just before I mentioned it, as a flash of color,—a hazy area of drab color.*" Introspection: "The moment I turned my attention toward a statement of my recall, I attended closely to the peripheral regions. I was aware of a visual image of a Tefoq, in which the irregular periphery border was not clear, yet it was definitely irregular. Before I finished my description of the periphery, I had a definite, clear visual image of a particular Tefoq,—a member of the identification series (*cf.* footnote 23, p. 50),—which was perfectly round and had a smooth border. Presently I was aware of a series of visual images of particular Tefoqs, in which I was aware of variations in the size, thickness, heaviness of lines, and the like. My first image had contained no such particular features, but only a vague outline. The 'Chesapeake Bay' now claimed my attention; this had been more definite at the outset in my imagery than was the rest of the periphery; but presently it, too, changed into a series of particular images, which I recognized as particular in terms of situation-imagery. Then the awareness of color came in, visually." Definition, continued: "*As regards the 'Chesapeake Bay' indentations, one side of this is smooth and the other side has finger-shaped extensions.*" Introspection: "Just before I made that addition, I was aware of a further clearing-up of my imagery of the 'Chesapeake Bay' indentation. This image was sufficient in itself; it stood for the other figures, yet for some reason, a series of other figures appeared later in my visual imagery, in all of which I saw the 'Chesapeake Bay' in its new form. Yet I was aware of the generality of this feature in that first image which appeared just previous to my addition to the recall. I am not sure, however, that the nature of the 'Chesapeake Bay' was as clear and definite before the variations came in, as it was afterwards." (Describe that consciousness of generality.) "This was closely bound up with the fact that my previous images had all contained, the 'Chesapeake Bay,' as an irregular indentation in the lower periphery. My attending to this feature, and my mention of it as general, was followed immediately by this further addition, as if the image stood for the whole series. The 'Chesapeake Bay' feature came in without effort, and without any tendency for my attention to return to the series for verification. The generality

became definite and explicit when the series of particular images came in, each containing this feature, and thus verifying its generality.

Kareg (third recall, May 6, 1913). "*The Kareg contains two lobes, one of which is larger than the other. As the figures were shown to me, the large lobe is always at the left and the small one at the right. They are closely connected by a neck-like part of medium diameter. These lobes are just solid masses; they may be ball-like or they may be pyramidal, with definite edges and surfaces. The fact that this pyramidal arrangement is not always visible suggests that the figure may in some cases be worn off, as the edges are worn off a rock. The color may vary; but all are shaded in dark tones.*" Introspection: "At the very outset I was aware of a vague and fleeting visual image in which I could detect only the outline. The image possessed no definite borders; just the two lobes connected as they usually are, present as gray splotches or rather dark brown, muddy colored splotches. Then I was aware of a suspension of my attention, a pause, as if I were waiting for something else to appear. I then made an effort to call up in visual imagery all of the groups which I had seen. This was followed by an exceedingly vague image of the three-branched Zalof figure, then by an equally vague image of the central region of a Tefoq, together with vocal-motor and auditory verbal imagery of the word 'Tefoq,' and immediately afterwards the 'Chesapeake Bay' indentation in the lower periphery added itself. I continued searching for something else, but nothing appeared, presently I returned to my initial Kareg image and began to describe it. This image had disappeared during my search. When it now reappeared, it was much more definite; it contained pyramidal surfaces in its left-hand large lobe, and it seemed to be localized in the series as about the third figure. Thus it seemed to partake more of the nature of a particular figure; and yet I am not certain as to which figure it may have been. The localization was done in terms of visual imagery of the group of Karegs; a series of indefinite visual images was present extending toward the right, and this image,—the only definite one,—was localized in about the region of the third figure. As my description continued, another image appeared, the form of which tended to shift; I was aware at one time of an apparent tri-dimensionality in the small lobe. This localization imagery was exceedingly vague; I am not sure but that it partook more of the nature of motor imagery, of eye-movement; yet the whole thing seemed to be more visual than motor.

OBSERVER B

Zalof (excerpts from the introspections on the first and third definitions, Nov. 12 and 25, 1912). "My definition was a description of visual images. . . . My attention was mainly upon the three-ness of these images, a three-ness present both in vocal-motor imagery and in the visual images themselves. In my definition I included a mention of arborizations; this is wrong, because one figure lacked arborizations, possessing merely three corners whose outline was perfectly smooth. This correction came first as a clear visual image of a Zalof with no arborizations; following this visual image came a little suspension of breathing. My realization that I must not include arborizations seemed to consist mostly in this visual image."

"One or two novel features occurred; in my first image I clearly saw the minute red bodies placed about the center. I also was aware of many little black shading lines, present near the extremities of the projections. I voluntarily called up a few other images, to see if this latter feature were always present; one or two of my images lacked the shading, however, and it disappeared from consciousness. I was aware of a clear image of a figure which had a large body and short projections. My recall of the smaller central bodies occurred largely in auditory terms; the words 'nuclei' and 'little cells' appeared, whereupon I saw these features in the last-mentioned visual image."

Zalof (third recall, Dec. 5, 1912). "First came a visual image of a three-cornered organism similar to the first figure in the (Zalof) series,—that is, one with a very small body and three long tentacles; the image had black outlines, and a red center which was composed of four parts, three of which stood out in the direction of the tentacles, while the fourth lay in the middle, partially superimposed upon the others. That gave place to another image, of a Zalof with the same triangular form but with an extremely large jelly-like body having three tiny projections. Then came a Zalof image that looked pudgy, its centers being larger and red. Then there came, in visual and kin-aesthetic imagery, the situation of about three past sittings in this experiment; the first was in the other room, and the others, in this room. With the imagery of the past situation in this room, I had visual imagery of your showing me cards and asking which were Zalofs (Identification Series)*; I saw one with a blue center, instead of red. My former definition came up in scrappy auditory verbal terms, the points which I had corrected being prominent. These were that the tentacles in every case had arborizations at their ends, and that the center always comprised four separate organisms, instead of three, as I had stated in former definitions."

Zalof (fifth recall Jan. 14, 1913). "*A Zalof is a body of tri-cornered shape, which is made in black ink on white cardboard; it always has three tentacles which are divided at the end into two arms, these arms being arborized still further. The center part is made up of four red bodies, more or less oval, according as the Zalof to which they belong is more or less pointed at its corners. Three of these bodies extend in the direction of the tentacles, while the inner one overlaps these three.*" Introspection: "When you gave me the instructions, visual images floated through my mind, which related to the situations in a number of experiments where Zalofs had been exposed. My imagery included a brief flicker of the leaves falling one after the other, a visual image of you seated at the other side of the room, taking a cardboard sheet out of the drawer and asking me whether or not it was a Zalof (Classification Series, footnote 23, p. 50), upon which I saw some figures with blue centers. Then I began my definition, having before my mind a visual image of the first Zalof, which I described. When I came to 'tri-cornered shape' a Zalof flashed up which had a very fat body and short tentacles. The imagery built itself up as I described; and I was aware of auditory verbal imagery of my previous descriptions. The visual image did

* See footnote 23, p. 50.

not precede the description in every case; on the contrary, my description was in great measure the utterance of auditory verbal images of my previous definitions. I did not attempt to see the centers in visual imagery until I was already describing them. After I finished describing the center and periphery, I had a visual image of the Zalof which has little lines and shadows around its periphery, and auditory verbal imagery of saying 'some Zalofs have . . .,' and of going on to describe the shading I saw. This was inhibited; I remembered having noted Zalofs which lacked this shading, and having said to myself, at the time, something of this sort: 'No, I was wrong in saying that Zalofs are shaded off at the sides, because all do not have shading.'

Zalof (ninth recall, Feb. 6, 1913). "*A Zalof is a triangular body, which has three bifurcated tentacles and a central portion composed mainly of four bodies, three of which are oval and extend toward the tentacles, and the fourth central one of which is round. The periphery is drawn in black. The center may be black or red.*" (Describe the non-essential features.) "*Most of the Zalofs have red centers. Zalofs sometimes have a clear-cut little horn standing between the arborized bifurcations of the tentacles. I'm almost inclined to believe that this is essential. Some Zalofs have black shading near the periphery. Some had red markings around the central portions.*" Introspection: "I began to talk without visualization, just pronouncing auditory verbal memory which came to my consciousness. Visual images began to appear before I had finished the first sentence, and my account of the central portion seemed to be a description of a visual image, though it is difficult to separate this from my auditory memory, as regards the initiation of the recall. The visual images which came when I discussed the center were: a very definite image of the first Zalof; one of the fat one with stout arms; and one of the medium one with the black center. That was accompanied by an auditory verbal memory of a definition in which red had been included as an essential feature, and by a marked affective toning, similar to that which had been present when I discovered the error. The visual images seemed at times to be mere associations. When I began to describe the horn, I was aware of very distinct images of four or five tentacle ends which included such a horn and of one which did not, together with auditory verbal imagery of the word 'every' which came with a questioning inflection. When I began to give individual variations the visual imagery became very clear and detailed; they embodied different sizes of Zalofs, two different red centers—one containing small patches of red, surrounded by shading of various kinds—and they also included the tiny one with the unclear center."

Zalof (sixteenth recall, Apr. 1, 1913). "*A Zalof is the figure of a triangular shape, whose periphery is drawn in black; it has three tentacles which are bifurcated at the ends, these bifurcations being arborized. The central part of the animal is composed of four bodies, three being more or less oval in shape, and the middle body being spherical and overlapping the inner edges of the other three. Zalofs differ very decidedly in their size and in their proportions, and to some extent in their coloring. All except one have red*

in the center; this one is entirely black. Some have shading out toward the periphery; and some have shading either in dots or in cross-lines, in their central parts." Introspection: "I was aware of a great deal of auditory verbal imagery,—more than I have ever had before. Very little visual imagery appeared from first to last. Even when I described individual differences, my recall came distinctly in auditory and vocal-motor verbal images of my previous descriptions; and the visual imagery which followed was very much vaguer than that which usually comes." (Describe your verbal recall more fully.) "In the background of consciousness, during the entire recall, there was imagery that one might designate by the term 'situation imagery.' It consisted in visual and kinaesthetic imagery of being here in this room at other times, though no particular past sittings occurred distinctly; it was nothing more than a vague presentation of this room, the experimental situation you (the experimenter) sitting opposite to me, and myself in this chair describing the same figures in much the same way as I do now. All of this seemed to be the inciting motive; it seemed to touch off a mechanism that, once started, proceeded automatically. I was aware of auditory verbal recall of my former definitions whenever I started to say something in a different way; and very frequently auditory and vocal-motor verbal images of the words which I uttered preceded my speaking them. When I came to describe the center, the words 'oval' and 'spherical' appeared, followed by very faint, unclear visual images of the little bodies; then came the clearest visual image I had, which presented the tiniest Zalof whose central body I have always said could not be differentiated. The most prominent content in my consciousness was the actual activity of describing."

Zalof (eighteenth recall, Apr. 28, 1913). "*A Zalof is a body of triangular shape, having three tentacles which are bifurcated at the ends and whose bifurcations are arborized, a little horn-shaped body always appearing among them. The central part is composed of four bodies, three of which are oval and extend out in the direction of the tentacles, and the fourth of which is spherical and overlies the inner edges of the other three.*" Introspection: "For some reason, no visual or verbal imagery appeared at first; I was aware of situation-imagery, and found myself confused and in suspense, my whole body tense, as though I were listening for something. Presently I found what I was listening for; there appeared auditory verbal imagery 'Zalof is a body of general triangular shape', which came in a sort of sing-song fashion. Immediately, and throughout my recall, I was aware of relaxation,—absence of tensions and anxiety. Very little visual imagery appeared; and what there was was rather called up by the words, or it came with them; even if no visual imagery whatever had appeared, I believe I could have proceeded just the same. The visual imagery first appeared when I said 'general triangular shape'; at that time I had an uncolored image of the body part of the figure which I am fairly sure corresponds rather closely to the general size and shape of the first Zalof. The arborizations were not there."

Tefoq (first recall, Jan. 30, 1912). "*A Tefoq is a figure which is composed essentially of a sort of inverted stair-like body, about two steps of the staircase being present. It has one end turned towards the observer and this end*

has some sort of design on it;—I called it a hieroglyphic before; it does not resemble that, but it is the only term I can find for it. The design is circular, composed of lines crossing each other. The designs are not always alike, but they are all made in black. These two steps of this stair-case are not always set together at the same angle, nor do they always point in the same direction. They are colored, and placed against a background that looks like a nasturtium leaf. It is an irregularly outlined flattish thing, with a general circular form, and it has an inset in the lower side and somewhat to the right,—a little irregularity in its outline. That whole background is always a very little larger than the pair of steps; just big enough to contain the steps nicely. Generally there is more room between the background and the edge of the outline at the left-hand side than there is on the right. The colors are very interesting. I did not learn them at all; I know there was a rather vivid blue. I also remember that the figure had a little triangular piece which always appeared set up against the top line of the step. I think in the first Tefoq that triangle appeared larger than in others. On the steps the color is sometimes a rather delicate green and sometimes brown,—a very pretty sort of brown. The figure has a good deal of yellow and a little tinge of green. The brown is of a bright and sunny sort." Introspection: "My description was for the most part a matter of describing visual images which presented themselves to me. There were a number of these images, of different Tefoqs. At the outset I saw the first Tefoq of the group, but I do not now know what its color was. It had the blue and brown and green, but just on what portion of the steps these colors occurred I can not now say. Then came visual images of other Tefoqs, at different angles and with the steps projecting in different directions; but these were not very clear. My memory of the fact that the 'steps' were placed at different angles was a visual memory. The perspective is queer in these steps; they never could be real steps. They could not be viewed from any angle which would show them to be perfectly symmetrical stair-steps. I used that term because it is the only one which comes anywhere near describing the feature. Some of the 'stairways' are tilted."

Tefoq (fourth recall, Feb. 15, 1913). "A Tefoq is a body, something like a pair of irregular stair-steps, placed against a somewhat leaf-like background of irregular outline, which contains a more or less constant indentation in its right lower periphery. The stair-like part is of different sizes and orientations in different figures. The constant thing about it is its pale greenish wash of color, its triangular blue daub at the back, and a design resembling irregular flower-petals on its end facing the observer. The step-like part of the figure is sometimes entirely included in the leaf-like periphery, while at other times it is large and extends outside of the periphery at the right-hand side. The backgrounds may be uncolored, or they may be washed with color. One is brown, with much yellow; another is a pale lavenderish shade. The design in the end of the step is sometimes relatively widely extended,—its petals being an inch long; sometimes it is outlined in black, and sometimes entirely black. In one case, the petals are short and they number only four or five. The blue triangle is never quite the same; the first is the largest and

the most vivid blue. The first four backgrounds are uncolored." Introspection: "A wealth of visual imagery flooded into consciousness as soon as you asked me to recall. I had to pick and choose, and was confused in starting my definition. The arrangement of the definition seemed to be determined by auditory and vocal-motor verbal imagery of former descriptions; as I began the verbal description, visual imagery of the feature which I am describing stood out clearly. The description of the color of the steps was mechanized; when I said that all Tefoqs have a wash of green, I saw one only; yet I spoke with confidence. The structure of that was the auditory and vocal-motor verbal 'all' which appeared with my visual imagery. In my description of the other (essential) features, I had visual images of each feature in a succession of Tefoc figures. When I described the 'stair-case' I had definite auditory imagery of my own voice saying 'stair-steps', and visual images of two or three such stair-cases of different sizes and angles, the first being longest."

Tefoq (seventh recall, Feb. 27, 1913). "*A Tefoq is a curious pair of steps varying in tilt and proportion and perspective, having a wash of green coloring along the top and front of each step. The steps have a white end facing the observer, in which is set a design; and they have a tiny green,—no! a blue triangle against the back edge. These steps are set against a background of irregular form, which has a somewhat circular shape, but whose periphery is irregular. The background always has an irregular inset in the bottom, at the right of the center. This background is sometimes considerably larger than is necessary to include the 'steps', and sometimes not,—in the latter case the stair-step figure extends at various distances toward the right. Now as to particulars: The background varies exceedingly in coloring and in form. I have already described its variation in form. In coloring it varies from pure white to various degrees of black; or it may be a very good pink, a pretty yellowish bright brown, or a lavender sort of shade. I gave the colors in the order in which they occurred.*" Introspection: "I was aware of vivid visual imagery of Tefoq figures throughout my recall, excepting at the very outset, when I made my statements regarding the stair-step figure. As soon as I began to talk about the color of the steps, visual images appeared and preceded my description of the color, being present when I got as far as the words 'wash of'. The imagery embodied my pair of stair-steps as washed in with pale green. From this time on, there was more or less visual imagery; it was particularly vivid at the close. When I was talking about the design in the end, only a single image of an end occurred; the same was true when I spoke of the triangle of blue, and the inset. It was as if I were describing a single figure, of which different parts attracted my attention in turn. The generalness of those features seems to have been largely the familiarity of the words I was saying; this was simply a weakly pleasant affective toning, and an entire lack of any strain or feeling of mental effort." (When you were giving your recall, you included descriptions of particular features before you announced that you were going to mention particulars. Were you aware of this at the time?) "Yes, I think so. It was only failure to organize my material well; suddenly, when I had started to give the general charac-

teristics, my visual imagery became very clear and representative of a large number of features, and I found myself describing them. It would be necessary to actually inhibit these features, if I did not go on and describe them."

Tefoq (tenth recall, Apr. 21, 1913). *"The Tefoq is that irregular pair of stair-steps, one end of which is placed against a queer looking background. These stair-steps are never in good perspective; they are seen from different angles, and always tilted in different ways. The top of the steps is covered with a wash of pale green; I believe the top is always pale green and the back brown. There is always a little triangular patch of blue over against the top of the steps. The end of the steps is uncolored; it always has in it an unusual sort of a design, sometimes outlined in black; the design is about like the irregular petals of a flower. The background of the stair-steps is of circular formation; it is sometimes almost smooth and entirely circular except for an irregular inset at the right lower periphery and sometimes its outline is very irregular around the top and even the sides. Sometimes the background entirely encloses the pair of steps, and sometimes these latter extend very far out over the edge of the background. The backgrounds are sometimes uncolored, and sometimes they are entirely filled in with very pretty colors."* Introspection: "That recall was almost entirely a description of visual imagery. The images were slow in coming; the first to appear was a visual image of the background of the Tefoq, drawn in pencil, along with which came vague situation-imagery,—dim visual imagery of the apparatus and experimental situation. I found myself turning my eyes down, as if to see the image more closely. Then suddenly the pair of steps appeared. I am not sure about their size. There was present some sort of a background which meant for consciousness 'these characteristics are common to every figure of that set.' This background was made up of situation-imagery, and the occasional flitting through my consciousness of variations in form and perspective of the figure, in visual imagery. The focal thing was the visual Tefoq image, nevertheless I was aware non-focally of the apparatus here, and of imagery which I believe was motor, of myself in position before the apparatus; I do not think there was any awareness of the experimenter, but there was some sort of imagery which had to do with the exposure of the series,—very dim visual imagery of grayish leaves falling, one after another, and some motor imagery in my eyes, as if I were following them down. The color, the triangle and the design added themselves afterwards; and my description of them was preceded by auditory verbal imagery. I had auditory imagery of my own voice saying 'wash of green', also an auditory verbal image of 'brown' which came in so persistently that I had to make place for the brown, and decided that it belonged on the stair-step. The visual imagery of the triangle appeared; I saw two or three of them, in blue, the first small and bright. Next came the design in the end of the 'steps', little and black. When I spoke of the color of the background, that again was an auditory verbal recall. No background colorings came in, and I definitely tried to call them up, but without much success. Twice during the recall, once before and once during my description, a visual image of the most extreme Tefoq which you showed me in the identification series,—the one where the stair-

steps are so exceedingly long,—came into my consciousness, the form only, and not the color, being present.”

Tefoq (eleventh recall, Apr. 28, 1913). *“A Tefoq is a peculiar pair of steps, which appear in different perspectives, tipping at different angles, and are set against an irregular, more or less circular background. These stair-steps are colored brown and green. On the top of the steps there is a wash of green, and the perpendicular part is brown, There is a little triangle of blue which extends out from the top of the upper step. The end of the pair of steps, which is turned toward the observer, is uncolored, and has in it a queer little design, more like some rather misshapen petalled flower than anything else. The background sometimes entirely includes these ‘steps’, while sometimes the steps extend well out over its right side. The feature that is constantly present in the background is a very irregular inset in its lower periphery. The rest of the periphery varies from smoothness to great irregularity, and from pure white to various brilliant colors.”* Introspection: “I gave that definition in an exceedingly unsystematic fashion! I was constantly tempted to bring in particular features because they came up so vividly in my visual imagery. My description was preceded by visual imagery, excepting at the very outset. When you said ‘Tefoq’ at the beginning, I was immediately aware of visual imagery of a grayish pair of steps as they are formed in the Tefoqs. Then for several sentences my description proceeded in a more or less automatic vocal-motor fashion; I simply seemed to find myself going through this description. The words seemed to have a certain familiarity for me, which was present apparently as the mechanical way in which they followed one after the other,—the ease with which they came to consciousness and then disappeared from attention; the familiarity was present, also, in very ill-defined situation-imagery, which formed a background to the words. As I began to describe details, my visual imagery cleared up and became very definite. I think the word ‘color’ occurred in auditory imagery of my own voice, before any visual imagery of color appeared. Then I am certain that the words ‘green’ and ‘brown’ occurred in auditory and vocal-motor verbal imagery. I tried to project visual imagery of those colors out into the uncolored visual imagery of my figure; this constituted a consciousness that I was not sure where the green and brown belonged. The green could not be localized at any part save the upper surface of the step. The brown would not become localized, and I placed it on the front of the step; my imagery of brown was so clear that I could not discard it from consciousness. My visual images contained in clear form the blue triangle as well as the uncolored end of the steps, with the figure on it, which I plainly saw had four projections. I was aware of actual innervation in my hand, of drawing in those things. At four or five different times I was conscious of visual imagery of that remarkable Tefoq of the identification series, the ‘step’ of which extends out two-thirds of its length beyond the background; this was uncolored the form only being present. My imagery of the color which occurred in the backgrounds was rather clear, but very disordered; I get bright yellowish browns, pinks, blues, and lavender. Some Tefoqs were uncolored, but with different shading lines.”

Deral (second definition, Mar. 3, 1913). *"I will add to my definition this statement: the periphery of the right-hand part of the Deral always has an indentation in it, somewhere. I am not yet willing to add the statement that each Deral has a point at the base of its left-hand part, because I am not sure that this was the case with the first of the series."* Introspection: "When I made that statement, I had two visual images of Deral figures in each of which this feature was clearly present, being smaller and higher in one. I also had auditory and vocal-motor verbal imagery of describing it as general. During the preceding exposure, I had watched for this little hump in the periphery, and had found it each time. When I made this last statement, the background of my consciousness was a vague awareness that I had attended to this feature in every exposure of the preceding presentation of the series; this was not clear; the important thing about it seemed to be the way my attention rested on the two images. When I first thought of adding the sharp corner at the base of the left left-hand part, I found myself going back to the situation of the previous presentation of the series; I had flashy images; but at first, only flashes of the card falling. This seemed to mean that I was not sure what the first figures were. When my attention turned to the humps, I had no tendency to go back to the exposure of the series."

Deral (third recall, April 1, 1913). *"The Deral is a figure composed of two apparently separate bodies, the right-hand one of which lies over the left-hand one and seems to stand a little closer to the observer. The right-hand one is drawn in black and is never colored. Its general shape is something between a fish and a harp. It stands on a perfectly horizontal foot; and its left side extends out to make a rather sharp angle, then sweeps upward in a curve to form a semicircular sort of top. The right-hand outline is like a Cupid's bow, and always has some sort of cilia-like processes around its periphery. The right-hand body usually has some sort of shading,—this looks like fish scales in one case; in another, like little acute angles in black. The left-hand portion is always colored, and rather brilliantly. It has no cilia around the sides, but stands on an acute angle instead of a horizontal foot. Its left outline is very much like the left side of the right-hand figure, except that the top portion is taller."* Introspection: "I was aware of clear visual imagery from start to finish; my recall was simply a description of this imagery. At first there was a sort of blank, excepting that the word 'Deral' was ringing in consciousness in auditory terms of your voice. Very soon, however, an utterly uncolored Deral appeared, which was almost identical in form with the first one in the series. The form was very clearly present all in black. The cilia were particularly clear, also the little scale-like triangles. While talking about cilia I saw some which appeared in later members of the series; some were like little 'w's', some like hooks and sharp angles. I was not absolutely sure of the statement that every right-hand figure has cilia. That uncertainty appeared as rather distinct visual imagery of Derals which seemed to be the last four of the series. I had flashy visual images of the four last leaves falling over, and a recollection of having told you about noting cilia in these. Then I was aware of an attempt to see other figures of the series; but I could not distinguish cilia in the intermediate ones. I

seemed to see a white sheet on which I could not project any image. Then came auditory imagery of my own voice saying 'all have cilia'. I became aware that all my images were colored,—some were bright green, some orange, some pink, some bright blue, some brown, but I do not localize these colors with any particular Deral. I can not tell whether I directed my attention consciously or whether my attention was claimed by one feature after another, yet I think there was a little ordering of my recall; I certainly set out to describe the right-hand figure first. There was a definite *Aufgabe* to make my description so clear that you would know what I had in mind. I think the structure of that was a rather vivid visual image of Mr. X." (naming a student who was reputed to lack the capacity for clear verbal expression).

OBSERVER C

Zalof (first recall, Dec. 6, 1912). "*A Zalof is a cell-like body, with fibroid or axis-cylinder processes. I recall that it is red at the center. The main branches proceed in a more or less triangular formation; sometimes there is a fourth branch. The cell-body is usually in the center,—always in the center.*" Introspection: "Most of my recall came first in visual terms. The visual imagery was especially clear at the time when I made the exception that there might be four branches; one particularly vivid image had this character. Other images came, which varied: One was larger, and sprawly, of a figure with red color and fimbriated ends, and another was small. The larger image was more distinct, the clearest part being the color and fibroid processes; the smallest image tended to vary,—to be replaced by others,—and it was vague and hazy." (Describe the small image.) "It was one-third the size of the larger one. The large one almost filled one of these cards, while the small one was not more than two inches across at the widest part. The red color in the little figure was in thin lines; while in the larger one it was splotched on with the brush, and occupied one-half of the cell-body." (Describe the varying of the smallest image.) "The form and size of the cell-body (outline) came and went in an indefinite way. The off-shoots were sometimes much fringed, sometimes only slightly fringed. The upper portion was clearer, the lower part being filmed over by something." (Describe the four-branched image.) "The color was blocked densely in the center. It followed the outline of the cell-body, but did not cover the entire part. The right-hand off-shoots were not very clear; they were of medium size and colored an indefinite gray. The clearest parts were the upper and the lower off-shoots on the left side, and they were in clear, black, distinct lines. The upper branch was almost vertical. In every case, the under line was blacker, the upper grayer. The background is not white, but light grayish."

Zalof (third recall, Jan. 31, 1913). "A mood appeared first; a feeling of dissatisfaction and a vocal-motor 'I have gotten to the bottom of the alphabets (another method employed) better.' Then came a visual image of the word 'Zalof' in your printing. *Zalof is a figure, composed of a cell-like body, with things extending to the periphery, and ending in fimbriated processes. The center of the Zalof is a smaller reduplication of the main direction of the peripheral figures, and is colored red,—not always a solid red, but sometimes*

red lines with spaces between. The Zalof figure is all done in tones of black and gray and red." Introspection: After the word 'Zalof' appeared in visual imagery there came a visual image of a very large figure, covering the entire space at the top of a card, and done in strong, black India ink. The color was the most prominent feature, although my attention was focused upon a large branch which passed out from the center; I had a feeling of localization of my eye-movement toward that branch. The centers and two other arms of the figure were present in indirect vision, as well as a threefold leaf-like inside structure; the thick bodies of the leaves being in the center, and the leaves extending out to a thinner end. These 'leaves' were brilliantly colored red. Then came a vocal-motor process, with some auditory imagery of your voice, saying, 'Don't attempt associations.' (In explaining the instructions, the experimenter had told the observer to regard the series simply as drawn figures, and not to attempt to associate them with familiar objects; if, however, such associations should appear, they were not to be inhibited.) Visual images appeared of the words 'cell-body', 'dendrite' and 'arborization' on a printed page; and then a slight kinaesthesia of turning away, which was localized in my shoulders. Next came a visual image of a smaller Zalof, so small that a reading glass would be needed to see its central part. I was aware that my mood of dissatisfaction at my inability to get a comprehensive definition persisted; this awareness came with a straining of my eyes as if to look at the very tiny figure. This mood persisted until the close of my recall, the rest of which seemed to come largely in vocal-motor verbal terms. Before I uttered each phrase, I was aware of a sort of a vocal-motor process, and of a consciousness of proceeding carefully,—of tensions of suspense in my throat, not strain, but rather a muscular set to proceed slowly." (How many branches were present in your visual images?) "Three, in the large image,—one being focal, the others there, but not seen focally. I don't know how many branches the smaller image has; it is more like a spider, and has a good many."

Zalof (Fourth recall, Feb. 18, 1913). "*A Zalof is a conventional figure, which has a cell-like body colored black and red, and dendritic processes; in the center there is a reduplication of the design formed by the processes, That is all. . . . The ends (of the processes) are fimbriated.*" Introspection: "First, a very vague, scrappy schematic visual image, of no special color. In its center was a splotch of red. The visual outlines of the figure were extremely indefinite, but a certain motor element was present, and very definite: This consisted in a localization of the main directions of the figure, which was present in kinaesthesia of eye-movement, without innervation. Then the words 'conventional' and 'cell-body' came in vocal-motor terms. After the definition, I added a statement regarding the fimbriated processes: Just before this addition I was aware of a small concrete visual image which was definite in outline, and the ends of whose processes were clear, black marks on a white background." (Give an account of the variations which you can remember.) "*First, as to size: Some Zalofs are such smaller than others. Then as to the form of the arms or dendritic processes; some are thick, others thin. Sometimes the fimbriated end of the arm is close, near the body, while sometimes it branches out at a distance from the body. There*

is a distinction as regards the color: The color of some of the figures is deep red and continuous, in others it is light red, and appears in veins or dots. Variations occur also in the center; sometimes this is thicker and stubby, while in other cases it is fine-lined. Possibly there may be a variation in the number of dendritic processes; usually there are three of these, but there may be four in one case." Introspection: "When I mentioned size, there came a clear visual image of a tiny, almost microscopic sort of thing which was localized in the lower left-hand part of the same card. It was as if I were looking at a microscopic slide. Then came a definite visual image of a large grayish leaf-shaped thing, bulky, tied at three corners, and going off in a symmetrical way. Then came a definite visual image of a slim, finely-drawn line which was localized not on the same card, but on the extreme upper part of another card. This line was part of a fimbriated end. The color came very faintly, in visual terms, but mostly in vocal-motor terms, with some auditory imagery of my own voice, saying 'red,' 'partly reddish.' The visual image was of an indefinite blot of reddish, my attention being on the center. I saw clearly the fine lines and veins and dots. My final statement regarding the dendritic processes came as a visual image of something,—not a figure,—which lay off toward the left. I was conscious of eye-movement in its direction, and of a sort of inhibition of my whole vocal-motor process,—as if my descriptions were halted at this point. I then made the statement." (Did any of these variations occur before I asked you to describe particular features?) "Not in any definite organized fashion. Yet during my first recall, I had a diffuse consciousness of many other things,—a diffused awareness of complexity, a sort of a general *Aufgabe*, or set, to the apparatus, with muscular co-ordinations of attention. In the background, I was aware of a general organic and muscular set of being in the middle of the figures,—of centering my attention on the processes I was giving, which involved a diffuse awareness of the other part of the figure." (Was there any consciousness of organizing your last description?) "Yes, a consciousness of selecting certain features; yet I am not aware that any others came up. The features came up in a series. I was aware of your instructions; then I imaged your instructions in auditory fashion again; and then came a faint, vocal-motor process of repeating them; the word 'variation' was prominent in my vocal-motor imagery. Next came rather narrowly concentrated voluntary attention; a feeling of effort; beyond that I can not go, because the images came up about as I reported them. Yet I was conscious of doing something in an orderly fashion; this was a general sort of counting,—a one, two, three, etc., which was perhaps vocal-motor, and perhaps diffuse manual motor, of checking off, or perhaps a general thump,—I can not now describe it clearly. A sort of a beat,—motor,—came with each feature I mentioned."

Zalof (sixth recall, Mar. 7, 1913). "*A Zalof is a figure which resembles a cell-body, done in black and white; it has three dendritic processes which are divided into several fimbriated ends. In the center is a little geometrical figure, which carries out the main lines of direction of the dendritic processes.*" Introspection: "My recall came to consciousness first in vocal-motor strains which were followed by the statements. When I came to the statement

regarding dendritic processes, I had a visual image like a drawing of a tree with two forking branches; it was not a memory image. My attention was focused on the forking process. My statement regarding the fimbriated ends came in a series of three fluctuating little detached visual images, with fine black lines, such as might have been present in a memory image of a Zalof. When I mentioned the center, I had a definite memory image of a particular Zalof, with a small, dull-red, leaf-like arrangement in its center; it was clear, but not definitely localized. Throughout the recall there was much kinaesthetic familiarity of a vague and diffuse nature; this was my general attitude or bodily adjustment to the experiment, and the ease and smoothness of my vocal-motor utterances. It never came to the focus of my attention; but nevertheless it was present throughout the whole recall." (Describe your vocal motor strains.) "A strain for saying 'cell-body' appeared first, and stood out clearest. When I came to my statement about the dendritic processes a definite innervation preceded the word 'dendritic.' Between the phrases, in addition, there was a feeling of strain and inhibition which consisted in holding my tongue against my lower teeth, my mouth being slightly open and tense."

Zalof (ninth recall, Apr. 2, 1913). "*Zalof is a cell-body, with a nucleus and three dendritic processes which extend out, each (process being) divided into fimbriated ends. Zalof is drawn in tones of black and red. In the center, there is a small structure which extends in the main directions of the dendritic processes.*" Introspection: "A vocal-motor image of 'cell-body' came first, with a visual image of the printed word 'nucleus.' The first part of the definition followed. Very soon a vocal-motor verbal image of 'dendritic' appeared with a visual image of the word, printed in small italics. The definition proceeded automatically until I came to the word 'color.' No definite imagery or idea occurred before the words were pronounced; but afterward, I was aware of a feeling of familiarity, a consciousness of having made many repetitions of the same vocal-motor process. This feeling of familiarity seemed to be partly a memory image, after a word is pronounced, of a former vocal-motor process just like this, with a kinaesthesia of my former set before the apparatus. With the description of the coloring there came a very hazy, vague visual image of a long-armed dendritic process, fimbriated at its end, done in fine black India ink and having one stroke of red ink up its center. It extended to the right, and was clouded,—obscured. Toward the end there was an affective toning of unpleasantness, and a vocal-motor 'forgotten' which constituted a consciousness that a good deal had dropped out of my remembrance." (Describe your kinaesthesia of your former set before the apparatus.) "I had been leaning backwards, my focus was lowered; no tension had been present in my shoulders and arms. When the kinaesthesia in question appeared, the reverse was true. I had a faint kinaesthetic process of focusing my eyes, and of starting up and facing the apparatus, involving tension and balance; the central point was that of my visual focus."

Kareg (first recall, Mar. 11, 1913). ("*A Kareg is composed of two figures, joined by a thin, neck-like structure. These figures are unequal. Sometimes the large one occurs on the left, but it is generally on the right. There is a*

crystal-like formation present in the large parts of some figures. The figures are sometimes colored in pale, pastel shades of blue and yellow. One looks like a pestle, or an acorn in a cup; another looks like a large piece of India rubber, inflated and grasped in the middle." Introspection: "First I had a definite visual memory image of a large Kareg figure localized at the left, colored in light blue, and having a crystal formation; off at its side was a smaller, unsymmetrical figure. Then came a kinaesthetic and tactual process in my right hand, of holding something rather yielding, like an inflated rubber pillow. Then I put myself in the bodily position of observing the exposures, as you gave them; this consisted in a kinaesthetic adjustment to the apparatus, present in my eye fixation and in the poise of my head, with attention and strain. Then the situation began to reconstruct; I had auditory imagery of the flapping of the cards, and a succession of visual images which were not always complete; of them the most complete was the tiny Kareg, with which came the vocal-motor process 'acorn.' I was also aware of fairly complete visual images of two colored figures, pale blue and pale yellow; their cards seemed to stay up longer than the others. An association with turtles occurred, present first as a visual image of a real turtle, than as a blackboard sketch of a turtle, and then as a vocal-motor image of the word 'turtle.' The visual image of the real turtle was followed by a kinaesthesia of turning away; that of the blackboard sketch of the turtle, by a voluntary inhibition and accompanying verbal proceses 'not too many associations,' and 'extraneous.'"

Kareg (third recall, Apr. 2, 1913). "*A Kareg is a lumpy, turtle-like or bag-like figure composed of two unsymmetrical, unequal masses. The larger mass is usually to the left and is conected to the smaller mass by a thinnish neck-like structure. That is all I'd say of the Karegs as a whole; I am, however, conscious of the existence of many variations. The left-hand parts of the larger Karegs are sometimes equipped with crystal-like or geometrical formations; and these large Karegs are colored in pale blue or pale yellow. Sometimes a Kareg is very small,—three millimeters long; it may look like a small black acorn.*" Introspection: "First I had a concrete visual image of a large blue Kareg with crystal-like formation, and also a kinaesthetic process in my right hand of squeezing a half-empty balloon, which I saw in visual imagery as two-dimensional, yet which went with my kinaesthesia of grasping. I also had a visual image of my hand around this bag, lumping it into a large space on the left and a smaller one on the right. Then came a quick succession of concrete visual memory images,—a drawing of a turtle in wavy lines, a small, yellowish one, and a very tiny one. Then I had a vocal-motor image of 'bent down' and I recalled that in a former definition I had said that the smaller ends of the Karegs were joined to the larger at right angles: This recall consisted in a sketchy visual image of a Kareg bent way over, and localized on the other apparatus. I was then aware of a vocal-motor strain of hesitation,—a sort of suspense between 'yes' and 'no,' which might have meant either. Then I had a quick kinaesthetic memory image of that experience: an adjustment of my own body to the other apparatus, and a different kinaestheses of eye focusing, as if my regard were directed somewhat higher.

Then came an inhibition of this feature,—the joining at right angles of the two bodies: this was a vocal-motor strain of inhibiting any utterance of that feature in my definition.” (What was the antecedent in your consciousness to your saying that you were conscious of many variations?) “All of those concrete images. There was an attitude of picking out separate points which perhaps occurred in all the Karegs; yet I was aware of no deliberation,—no necessity of choosing. The only concrete thing about this picking out common features was a strain of rapid focusing, as if I might have been running over the series quickly and focusing only on certain points, *i.e.*, outline, mass, color. The consciousness that certain points were common and others must be excluded was this vague kinaesthesia of rapid focusing and selection; moreover the inhibition of my tendency to include a statement that Karegs were bent at right angles had a radiation about it,—an inclusive element, very vague and fleeting. There was an obscure consciousness of irradiation, as if one inhibition included a great many more.”

Deral (first recall, Apr. 15, 1913). “*Oh,—a Deral? (several seconds' hesitation.) Oh! yes! . . . A Deral is a lumpy, unsymmetrical two-sided figure, and it is colored; the left-hand figure is triangular, and larger than the right-hand one, and it has a point upon the extreme left. The other (right-hand) figure is also more or less triangular, and it is localized a little higher; it is placed in an interlaced position on the right,—or rather, it overlaps the left side. The color is applied more densely on the left than on the right. On the right-hand figure there is a smooth, rather full curve, which describes perhaps a quarter of an inch.*” Introspection: “First my mind was an utter blank; then I had a vocal-motor verbal image of ‘an entirely new name.’ The sound of the word ‘Deral’ in auditory imagery of your voice, recurred three or four times. I had expected to recall ‘Kareg,’—I had had a definite auditory image of the word and even a very faint visual image of a Kareg. After this period of blankness there came a violent kinaesthetic effort of attending,—a pulling up, involving many muscular strains and an intense contraction, almost a cramp, in the right hand, as of rapidly turning pages; also an intense kinaesthesia of groping. Then appeared a clear, definite visual image, localized to the left, of a right angle drawn in a sagging position on a card, and of a patch of washed-out blue color. Then a lumpy area formed itself, visually, on the card; it contained no lines, but was rather a lumpy, palest gray shadow of something indefinite and diffused; simultaneously came a kinaesthetic adjustment of eye-movement, as if following out the boundary line of this area: this was a violent contraction of my eye-muscles, involving actual innervation, and a systematic following out of the periphery of this shadow. As my fixation moved up the left side, an angle stood out in visual terms, faintly traced in India ink; and presently the whole of the left-hand figure appeared in this way, before the right-hand part appeared at all. Then came a vocal-motor verbal image,—‘right-hand figure.’ Next appeared the curved line which I described in my recall; it was localized above the middle. It appeared gradually; at first, numerous lines like the outlines of billowy cloud-formations came up, and kept pushing out toward the edge of the card; and simultaneously I experienced a kinaesthesia of eye-movement, and a kinaesthesia in

the right hand, as if to pull these down toward the lower right, and to prevent them from soaring upwards on the upper right. Then unclear outlines appeared, but with the angles blunted; I was also aware of unpleasantness. Finally the filmy, cloudy appearance receded visually; and these outlines were left, standing out as the curved line which I described in the recall."

Deral (fourth recall, May 13, 1913). "*Deral is a two-sided figure, which is to be distinguished chiefly by its angles. The figure on the left is larger and placed lower down,—nearer the base; it is also colored. The figure on the right is smaller, and its upper right side is curved. Its lower part rests on a foot, or a small structure, which joins the base line of the left-hand figure at right angles. The point of union of the two figures is marked by an angle which is usually acute; and when it is acute, I think it comes near the bottom of the figure. This angle may, however, be obtuse, in which case possibly its location is higher.*" Introspection: "First I was aware of an image of the word 'Deral' printed; this was immediately followed by the word 'Kareg' and the word 'Testout' (the name of a French anthropologist) appeared beside it, in parentheses. (It later appeared that C had associated the name 'Testout' with 'Tefoq.') These contents,—'Kareg' and 'Testout',—constituted disturbing factors: I was aware of affective toning and of a desire to get rid of this 'Testout' image and to inhibit the vocal-motor 'Kareg.' I then tried to reconstruct my past experiences with this problem and particularly the temporal order of the different series which had been given. I had a kinaesthetic image of a sweeping movement of my right hand, similar to the stroke of a pendulum, followed by imagery of a slight vocal-motor verbal strain. This meant that Zalof had been first presented. Then I attempted to reconstruct my experiences of the rest of the series which I had seen in the same way. The word 'Deral' appeared on a card, together with kinaesthesia of myself sitting at the apparatus; my attention was narrowly focused on the card, and a kinaesthesia of effort was present. Then the Deral figure began to loom up visually, its upper part clouded as if covered with a mass of some filmy substance, and its lower part coming up in masses, and possessing three dimensions. A heavy basal effect came out, and I had vocal-motor verbal processes,—'heavy, supporting.' I was conscious that this heavy masonry-like structure was the distinguishing mark, the thing I remembered about the figure; this was my decided pleasure, and interest. This was first time I can recall that I saw the Deral as three-dimensional. From this time on my definition was automatic up to my description of the foot. Hereupon I was aware of effort, then of a blank space, appearing visually on a card, upon which it was localized down toward the lower right. This constituted a consciousness that here,—in this region,—was a blank, where something ought to be. I was aware of a strong kinaesthesia in my eyes; this was an actually present strain. Then came a vocal-motor 'foot.' Next came a clear visual image of the outline of this little structure, the foot and adjoining sides being clear." (Describe the effort connected with the appearance of the 'foot.')

"This was a diffuse, vague, unpleasant kinaesthesia of searching or groping."

Tefoq (first recall, May 13, 1913). "*I had it last time. I don't remember much about it . . . queerish! . . . Oh, yes! A Tefoq is a figure, which is*

something like an oyster. It is spheroid body, containing an internal geometrical structure, on which is a little design having three or more parts, which is like a scroll. The bottom side has a little indentation in it, which has some real or fancied resemblance to this scroll. When the figure is colored, it has, on the whole, dark colors; though at times the colors may be light." Introspection: "First my consciousness was absolutely blank; no content appeared, other than kinaesthesia of hurried search and vague, vocal-motor strains. 'Tefoq' tended to recur, in auditory imagery of your voice. Then I had a visual verbal image of the name of the French anthropologist 'Testout', and I recognized then that this word had really been associated with the Tefoq. Vocal-motor verbal image 'that was Tefoq.' Then visual image of a large, blank card upon the upper part of which was an outline, a fluctuating line, approximating a semi-circle. Then came a kinaesthesia in my head and neck of assent, nodding and the vocal-motor verbal 'clue.' I tried, in terms of violent kinaesthesia of my eyes moving around and around the semi-circle, to bring up something else. Many lines and dots came in, appearing, however, in no special position. Then I started in to give a recall,—to tell about these experiences; vocal-motor verbal images of describing these experiences began to appear. After about the third word, a vocal-motor verbal image of 'oyster' with a visual image of the first figure flashed in, very distinctly. The visual image was pale gray with a little bluish cast; it had an oyster-like form and included the little scroll-like figure. With it came much affective toning of pleasure, excitement, and interest. Then I described this image,—the scroll, with its general formation in three parts, which was present in clear, definite visual imagery, located in the center of the figure. Then appeared a vocal-motor verbal image 'indentation,' and at the same time a kinaesthesia of my right hand, as if the hand were clenched, but with the thumb projecting straight outward instead of being in the position it usually occupies when the hand is clenched; and also a kinaesthesia of myself as placed in the attitude of the figure, as if I were lying on my face, my body curved backwards, duplicating the outline of the figure, and my arm cramped out, in somewhat the same position as the indentation, the curled-up fingers representing the indentation. Then came a vocal motor verbal image of 'color' followed by the question: Is there any color? present in terms of repeating the word 'color' with vocal-motor kinaesthesia and auditory imagery of a questioning inflection. Then I was aware of a visual image of a blackish orange Tefoq,—one containing patches of black and blackish orange splotched together."

OBSERVER D

Zalof (second recall, Dec. 11, 1912). "*A Zalof is an animal, low in the evolutionary scale, whose bodily form is triangular. Its general make-up may be either compact, or characterized by the presence of three more or less long extensions, each of which ends in three groups of terminal processes.*" Introspection: "Immediately after you asked me to recall, I had a definite visual image of one of the original figures,—namely the one with long elongations,—together with a fleeting succession of images of other figures, including a compact one with short tentacles. But this first-mentioned image was much more conspicuous and persistent. It was attended by vocal-motor verbal

imagery of 'triangularity.' In addition, I was aware of a more intensive attention upon certain features,—the triangular form of the body, the tri-partite arrangement of the extensions, and the tri-partite arrangement of the processes at the ends of these extensions. Upon my attending to these features the vocal-motor images appeared. I did not see the word Zalof at all,—only a picture without the name."

Zalof (third recall, Feb. 5, 1913). "*A Zalof is an organism far down in the scale, made up of a body which has three processes irregularly distributed about its periphery, each process terminating in a number of arborizations. In some instances the body is relatively large and the processes short; in another instance, the processes constitute the major portion of the mass.*" Introspection: "Immediately after the question was asked, a visual image of a picture of the original series appeared; this image was clear-cut and well-defined, and represented a Zalof with a small body and long processes. During the course of my description this image gave place to another, in which the body was relatively large." Here *D* stopped to draw this image. He then continued: "During my act of drawing the right corner of this figure, it occurred to me, in visual imagery, that *these terminal processes are arranged in groups*. My attention had not been previously directed to that feature of the image. Just now I became aware that I forgot to say that *the arrangement of the whole animal is tri-partite, the processes are three in number, and the body is more or less regularly triangular.*" ("Except for the later clearing up of the terminal processes, was your imagery uniformly clear?") "The part to which attention was directed at any instant was clearer than the rest. The rest of the figure tended to become indistinct. At times, colored internal parts appeared. I should not have mentioned them, because they are not common. . . . [That statement betokens the definite existence of an *Einstellung*, a tendency to emphasize common characteristics, and to ignore incidental ones!] The word 'Zalof' did not appear. My images were localized out in space; I was not aware of the card." (Does anything attach to the perception of red, that makes this feature particular for you?) "As soon as I became conscious of red coloring, I was aware of the fact that that was not a common characteristic. I presume that is the sort of consciousness to which the name *Bewusstheit* has been given. I can not now analyze it; I do not remember how it was mediated,—whether or not an ultimate component." (Was your procedure voluntary or involuntary) "I was aware of no experience of searching; those things simply came, in an involuntary fashion."

Zalof (seventh recall, Mar. 5, 1913. The instructions were followed by a description of the Derals; *D* had a visual image of a white card with the word 'Zalof' printed on it, upon which the 'Deral' figures then appeared. He did not become aware of his mistake until asked to define Deral, when he realized that he had just done so. He was then asked to 'tell what he remembered about the Zalofs.') "*A Zalof is a triangular-shaped creature,—a creature with a triangular body, from each of whose angles there runs out a more or less long process terminating in arborizations, which are arranged in groups of two.*" Introspection: "When you said 'Define Zalof,' I had a faint visual image of a particular Zalof, which had a small body and relatively long arms. This

gradually changed into a devil-fish which I saw floating in water; after an instant it gave way to a Zalof form. This form became very definite in outline but it was wholly uncolored. During my process of defining, visual images of two other particular figures appeared, both of which had relatively larger bodies and shorter arms; the vocal-motor image 'triangular' was also present; and later on, when I was describing the terminal arborizations, a vocal-motor image of 'paired arrangement' appeared. My act of defining was for the most part wholly automatic in nature; the words flowed along; and except for the two vocal-motor images and the antecedent visual images, I was aware only of pronouncing the words in their sequence." (When you described the visual images, was your use of the word 'particular' indicative of a consciousness of 'particularity' which existed with these images, or was this word used afterward, for descriptive purposes?) "The words were used reflectively; it did not occur to me at the time when my images were present that the figure was particular."

Zalof (ninth recall, May 14, 1913). "*A Zalof is a triangular—a creature of triangular form, having an arm extending from each of the three corners. In certain instances the body constitutes the whole of the creature, and in other cases, the arms are relatively long. The arm, in every instance, terminates in an arborization.*" Introspection: "My act of defining consisted in observing a series of visual images of particular members of the Zalof series. My attention was attracted successively to certain features of these images, the other features being ignored. As my attention went to a feature, verbal images would appear; thus there was present a succession of vocal-motor images,—'triangularity,' 'arborization,' groups of two.' This successive passing of my attention to different features was not of my own initiation. In addition to the features which I mentioned, I was aware in my images of particular features: I was vaguely aware of certain details of the internal structure that I did not mention or even dwell upon during the act of observation." (What were those internal details?) "They were a blotch of red, in one instance, with certain details marked within; again, a blue patch. I also saw a figure, the whole of which was colored; one of the images in which the body was relatively larger and arms relatively short, was colored throughout a sort of an olive green." (How many visual images appeared?) "Three or four. I attended chiefly to one with relatively small body and long arms; this was the most persistent one. I have forgotten about its orientation. There was also a very large image, of a figure which had come relatively late in the series. Another figure was very small, this image being unstable and fleeting. I remember only those three images; but there were others, I believe."

Deral (excerpts from introspection on second definition, Feb. 12, 1913). "During the process of defining, a series of concrete visual images of particular Deral pictures passed through my consciousness and my attention was attracted in turn to the various common features. . . ." (How is "common" present to your consciousness?) "When an image appears, my attention turns to the straight line, or the notch, etc." (Were you aware of these features as common?) "Yes." (How?) "They are the things to be described; they dominate my consciousness for the time being. I approached

the problem with a definite awareness of an *Aufgabe*; as soon as the imagery of such a feature came, it was attended by an awareness of my *Aufgabe* being solved; it was the thing I was looking for; the appearance of the image was attended by a feeling 'that's the thing.'

Deral (second recall, Feb. 19, 1913). "*A Deral is a creature of irregular form, one part of its external surface being rectilinear. It is composed of two halves, the right half,—no, I'll speak first of the dividing line,—the dividing line between the two halves always having a notch,—being bent so that one-half of the creature contains a notch. The right-hand side is uncolored, and is sparsely covered with hairs; the left half is colored and extends farther in a posterior direction than the other half.*" Introspection: "My act of defining here was largely passive. At the outset, I waited for a considerable time before anything came to consciousness. Then I had a visual image which began with a very blurred and confused shape, entirely uncolored. A bright blue gradually developed in the left-hand side of the figure. The blueness appeared first as a patch of blue off to the left, and then moved into its proper place in the image. I am not aware of having seen any color except blue, yet I was not tempted at any time to say that Deral is invariably blue; I cannot state how the general characteristic of color came. It was there; probably I've forgotten details. Very soon the word 'rectilinear' came to consciousness, in vocal-motor terms, and simultaneously with this I noticed that the lower right side of the figure—still blue,—assumed a rectilinear form. I remember I told you once that the other half of the figure is gray; it is white, with hairs. This feature cleared up in the visual image. The word 'notch' occurred in vocal-motor terms, at this point; I immediately saw a notch in the dividing line of the figure. Then hairs added themselves. Then the words 'farther back' occurred, in vocal-motor terms, with a definite meaning,— which I can not analyze,—that one-half of the figure extends farther back than does the other half. I knew this referred to the later figures of the series, but no corresponding visual image appeared; and I do not yet know whether the colored or the white half extends farther back." (During the previous presentation of the series; this observer had noticed, in one of the later figures, that one-half extended farther back than the other. The observer wondered, in vocal-motor terms, whether this was a common characteristic and watched for it in later members of the series.) "The only visual image which I saw during the course of the whole act was the single developing one which I have described. I think this was an image of the first figure of the group,—the one that is bright blue."⁷ The definition was not given in chronological order of the changes in the image. When I look back, I realize that I don't regard hair as being of equal essentialness with color, for instance." (Why do you attach greater importance to color?) "I have simply fallen into that attitude; I mentioned hair last, as if it were less important. Why, I can not say." (In what terms do you remember that the vocal-motor image 'farther back' refers to the later figures in the series?)

⁷ The first figure was not bright blue, nor were any of the series. Two were bluish-green. None of the classification series which the observer had seen were blue.

"I remember that I wondered just after the last presentation of the series, 'is that present in the whole series?' I searched for vocal-motor, visual, and other contents, but I could not find them. I was aware of a diffuse, vague,—or rather of the remembrance of a diffuse, vague attitude of wondering if this character is present in early members. I can not analyze this wondering." (Do you remember this attitude by re-living it?) "Yes; but it was referred back to a former attitude." (How soon was the meaning of this attitude present?) "It came with the vocal-motor image of 'farther back.'"

Deral (fifth recall, Apr. 16, 1913). "*A Deral is a creature made up of two parts separated by a median line, which takes a jog. The left-hand side of the figure is colored, the right side uncolored and containing a number of tiny spots that look almost like hairs emerging from the surface. One part of the external form of the left-hand side of the creature is rectilinear,—a fairly straight line,—perhaps an inch or so. There is also a rectilinear side on the right-hand half, but this is shorter and more anterior.*" Introspection: "Immediately after you said 'Deral' there appeared a visual image of one of the cards containing a figure whose left-hand side was colored, first reddish, then orangish,—this being a fluctuation in the color of a continuously present image. The right-hand side of this image was uncolored, but had a number of tiny dots or spots in it. While I still attended, the left-hand side assumed a bluish color; the form of the figure was exceedingly vague and indefinite throughout. It lay in an oblique position, the median line extending upward to the right. Several features which I included in my description were not observed in the visual image: namely, the rectilinear side and the notch in the median line. Shortly after I began my description, these features came to consciousness in vocal-motor terms,—'rectilinear side,' 'notch in median line.' But immediately after they had come to consciousness, the corresponding part of the visual image cleared up and I actually saw the rectilinear parts of the outline and the notch in the median line, in appropriate spatial position. I was aware of keenly concentrated attention, not only in an attentive observation of my visual imagery, but also in an act of searching or groping for other images. This whole experience was unpleasant; toward the last of my description, and especially during my introspection, I was keenly aware of a *Bewusstseinslage* of uncertainty and doubt and incapacity,—I feel that I have omitted a good deal and am powerless to supply it." (Describe that *Bewusstseinslage*.) "It was dominantly an affective consciousness,—characterized chiefly by tenseness and unpleasantness."

Deral (sixth recall, Apr. 23, 1913). "*A Deral is a creature of very irregular outline, which is divided by a median line. The left-hand half is colored. The median line has a notch. There are two points of note in the outline; they are two rectilinear sides, a long one on the left, and a short one on the anterior part of the right half. The right side is uncolored and has on it a number of things that look like hairs. I am in doubt, but I think the right,—how shall I put it?—the periphery of the figure at the right has, in certain instances at least, a sort of a scalloped effect; but I am not sure that this is universal.*" Introspection: "During the recital of this description, I had before my mind a series of visual images; these usually appeared at first in

vague and indefinite fashion. My attention usually turned to some specific region or characteristic of each visual image, whereupon that region or characteristic cleared up, definitized, and the words were pronounced directly, apparently automatically. Twice a verbal image preceded the clearing up of a corresponding part of the visual image. 'Rectilinear side' came in vocal-motor terms; when it came my attention turned to the left-hand side of the figure, where I saw a relatively long, straight side. As soon as I described this, my attention, apparently of itself, swept to the right side, where I saw the shorter rectilinear side, which I then proceeded to mention. While I was describing those earlier details, the word 'color' appeared in vocal-motor imagery. An appreciable interval intervened before I saw color; for a moment I was in doubt as to which half had color. This was unpleasant. During that period of doubt my attention swept over to the left-hand side,—I seemed to expect color on the left, and was aware of a feeling of uncertainty when I did not find it. I searched diligently for a trace of color; then my attention swept to the right, and very soon after, a brownish color developed in the left-hand side. My attention swept back immediately to the left-hand side, and I examined the color very attentively. My doubt and unpleasantness vanished, and I proceeded to describe the color characteristics of the Deral. Within a very brief time after the appearance of this brownish color, it vanished and a blue color took its place. Toward the close, I spoke of being in doubt as to scallops. When I mentioned this, there had appeared two clear visual images of the right-hand periphery of Deral figures,—the left side and the division line being very vague or wholly lacking,—and I saw the scalloped tracing in black ink strokes: on one, a distinct series of scallops was present; on the other, the scallops were more like the letter 'x', with two horns from the apex of each scallop. These two images alternated. I am not certain as to whether this was a universal characteristic or not. (When did the uncertainty as to whether the scallops were a universal characteristic first occur, and how?) "Simultaneously with the images. I was aware of a *Bewusstseinslage* of hesitancy; I examined the two images and then I seemed to be saying, 'shall I mention this?'" (Describe the hesitancy.) "It was an affective thing, unpleasantness, hesitation. The experience is best described as follows: The first of the two sensory images (of scallops) was suffused with unpleasantness, but the unpleasantness connected with this was not so intense as that attending the hesitancy. Then the second image appeared, in exactly the same context of hesitancy, doubt, unpleasantness. In both cases, the image was very clear and definite; and in both cases, I was conscious of examining it attentively. Finally came a vocal-motor verbal image 'shall I mention this?'" (Describe the setting of your first visual images.) "These were detached; they had no background. I was conscious of nothing by way of setting."

Deral (seventh recall, May 14, 1913). "*A Deral is a figure of irregular form; whose outline is bounded at two regions by straight lines,—at the left anterior region by a relative long straight side, and at the right anterior region by a relatively short one. Its median line is interrupted at one part by a jog, which extends upward, but later returns to its original direction. The left-hand side of the figure is colored.*" Introspection: "When you said

'Deral' I had immediately a visual image of a figure, or part figure, very vague and indistinct excepting for the median line, where I recognized an angle that jutted upward. For some little time, this image failed to clear up and become definite. Suddenly, the outline cleared up at two regions, showing a long straight line on the left, and a short straight line to the right. Those stood out; but I could not see their continuations. The rest of the figure was so misty that I could not make it out. Next to clear up was the part adjacent to the short straight line at the right; at this time, I had a vocal-motor image of 'proboscis.' I rather think the verbal image came in before the visual cleared up. I was conscious of a searching for other characteristics. At first this was unanalyzable, but ultimately I detected vocal-motor verbal imagery, much abbreviated,—'there must be others.' Suddenly, a vocal-motor image of 'color' appeared, and immediately my eyes turned to the left-hand side of the figure where they were held in relatively steady fixation. At that point, I said that the color was on the left. At no time did I have a visual image of any particular color. Later on, I found myself examining the posterior region which had not cleared up. Now it became a little clearer, but never very distinct. I remembered I had been in doubt as to whether the right or left-hand half projected farther in a posterior direction, in every member of the series; I had a *Bewusstseinslage* of doubt, uncertainty, hesitation, with a vocal-motor 'farther' spoken with rising inflection as if in questioning, together with the sensory content I have described. Throughout my recall, I had the same visual image. It was a particular image, not generalized,—an image containing a number of features. The consciousness of search was superadded; it was my attitude toward the image. I was aware of seeking for something,—a feeling of mental activity."

Kareg (third recall, May 14, 1913). "The instructions were followed immediately by a visual image of a dumb-bell-like figure, very small. *A Kareg is a figure which roughly approximates the form of a dumb-bell. One protuberance,—the one to the left,—is larger than the one to the right. Now I'm stuck! I'm in doubt about whether to add another item, for I don't know whether it is an invariable character; this item is the shading.*" Introspection: "While I was making that last remark, I was observing a visual image, which had just appeared, of a figure in which there were lines roughly parallel to the edges, diminishing regularly in length as they approached the center. Suddenly the words 'regular polygon' came in vocal-motor terms, and my attention turned to the general form of the figure in my visual image. I had a distinct impression of regularity, but I could not specify the number of sides. It seemed to me that the form was unmistakably a pentagon or a hexagon. Both of these words were weakly present in vocal-motor terms, but I could not be certain which was right, though I am inclined to believe that it is pentagonal. I was aware that the polygon was regular, but could not say how many sides,—whether five or six." (What was in your consciousness when you said you did not know whether the shading was invariable.) "I can not say, more than to state that I could clearly distinguish this in one visual image, but could not see if it were present in the other,—the first very small figure. In that whole process, I had two visual images, first the tiny one, then the one in which the lines were present. Later the tiny one came

back. The larger one with lines was very stable and persistent. I do not remember having seen any part of it excepting the left-hand part, with lines on it. The first image lasted until the point where I said 'now I'm stuck!' The small figure was dark, heavily inked, on a white ground."

OBSERVER E

Zalof (first recall, Nov. 25, 1912). "*A Zalof is an object having a triangular central portion and three arms. It may vary in its total size and with respect to the relation of the arms to the body. These arms end in a splitting up. The figure contains a body, red in color, which is composed of three separate bodies shaped like apple-seeds with their flat ends toward the center. A Zalof has three dimensions in space.*" Introspection: "These statements followed upon a combination of visual images and verbal images, the latter present both in auditory and vocal-motor terms. The visual images played the most important part; they were definite, and two in number; one had long arms, and the other had very short, thick arms. These visual images formed the basis of my spoken recall; but the verbal imagery assisted me to some extent; when I came to the mention of the splitting up of the arms, a verbal image of 'splitting up' occurred, and my statement followed directly upon this image."

Zalof (second recall, Dec. 9, 1912). "*A Zalof is a body of three dimensions, composed of a single triangular body with pseudopodia which split up at their peripheral ends. It contains a red nucleus, in the form of apple-seeds arranged about a central round body. The Zalof may vary in size, in the relation of the pseudopodia to the central body, and the length and size of the pseudopodia.*" Introspection: "Immediately after your instructions, I had a visual image of a Zalof with its pseudopodia, together with visual imagery of the other room (in which the first experiment had been made). The spoken statements of the recall followed; they were preceded in almost every case by vocal-motor verbal imagery. When I described the ends of the pseudopodia, however, no verbal imagery appeared; and I described them from a visual image in which the ends of the pseudopodia were prominent."

Zalof (third recall, Jan. 11, 1913). "*A Zalof is a body having a triangular shape and three projections which may or may not end in pseudopodia. It has a nucleus containing a circular body about which are distributed three other bodies like apple-seeds. The nucleus is always red and the body is uncolored. The Zalof may vary in size but the body is always triangular.*" Introspection: "The statements of my recall were preceded in almost every instance by vocal-motor verbal imagery. Occasionally the verbal images were accompanied by a flash of visual imagery. The verbal images consisted in single words or phrases, which were immediately followed by the spoken statements. For instance, the verbal image 'three' was followed, in the recall, by the statement 'Zalof has three projections' and the words 'which may or may not end in pseudopodia,' added themselves. Similarly, the verbal image 'nucleus' preceded the statement 'it has a nucleus containing a circular body and three bodies like apple-seeds.'"

Zalof (seventh recall, Jan. 25, 1913). "*A Zalof is a body having a central body of triangular shape and three pseudopodia which usually end in fibrils.*

The size of the body and the relation of the pseudopodia to the body may vary. The Zalof has a central nucleus, composed of a central round body and three apple-seed-like bodies. Striations may be present, and also small detached pseudopodia." Introspection: "The recall was preceded entirely by verbal imagery, vocal-motor and auditory. As soon as I heard your directions, the vocal-motor verbal images 'triangular-shaped body' and 'three pseudopodia' occurred, followed by the spoken words '*a Zalof is a body having a central body of triangular shape and three pseudopodia.*' Subsequent statements were introduced in a similar manner; a single word brought up a phrase of the recall. Thus, the word 'nucleus' brought up the statement '*has a central nucleus, composed of . . .*' and 'striations' brought up the statement '*striations may be present.*'" (How does the word 'nucleus' bring up the statement concerning the center?) "The spoken description follows the verbal image without any effort on my part. I was not aware of systematizing in any way."

Zalof (tenth recall, Feb. 8, 1913). "*A Zalof is a body having a simple triangular shape with three arms or pseudopodia which end in small fibrils, of which there are always two bundles. The size of the body and of the arms may vary, also their relation to each other. A Zalof contains a nucleus which is usually red, composed of a round central body surrounded by three pear-seed-shaped bodies. It also has small pseudopodia from its main body.*" Introspection: "The statements of the recall were preceded by verbal imagery, vocal-motor and auditory. A single verbal image was followed immediately by a long statement. The instructions were immediately followed by the verbal images 'central body'; immediately the statement followed '*a Zalof is a body having a simple triangular shape and three arms.*' In the meantime a verbal image of 'nucleus' had appeared, and also the word 'pseudopodia,' before I had a chance to use them in the definition. They occurred near the end of the first statement. When I had finished the account of the triangular shape and the three pseudopodia with their endings, the rest of the definition followed readily, with no antecedent which I can remember other than the two verbal images of 'nucleus' and 'pseudopodia.'"

Zalof (eleventh recall, Feb. 12, 1913). "*A Zalof is a body having a central triangular shaped body and three pseudopodia ending in bifurcations. The size of the arms and of the central body may vary. The Zalof has a central nucleus, usually red, composed of a round central body surrounded by three bodies the shape of pear-seeds. The Zalof may have some smaller pseudopodia around its edge.*" Introspection: "The statements of the recall were invariably introduced by verbal imagery, auditory and vocal-motor. The vocal-motor images occurred comparatively early in the recall; all had appeared before I spoke of the central nucleus. They were 'three pseudopodia, 'triangular,' 'size,' 'fibrils,' 'size,' 'nucleus,' 'periphery.'" (Did these verbal images persist until you made the statement which they introduced, or did they disappear before you began the statement?) "They disappeared and recurred immediately before the statement which they introduced."

Zalof (fourteenth recall, Mar. 5, 1913). "*A Zalof is a body having a triangular-shaped body with three pseudopodia, fibrilated at their peripheral ends. The fibrilations are divided into two groups. The size of the central*

body and the relation of the body to the pseudopodia may vary. The Zalof has a nucleus composed of a circular body around which are three pear-seed-shaped bodies. The nucleus is usually red but may be black. The central body may or may not be surrounded by pseudopodia." Introspection: "The statements of the recall were invariably introduced by vocal-motor and auditory verbal imagery. With one exception, the verbal images appeared without innervation almost immediately before I began to speak. At the outset, the images 'central body,' 'three arms,' 'fibrils,' 'two groups,' 'size varies' occurred; and the first part of the recall, up to the mention of the nucleus, followed. Then after a slight hesitation a verbal image of 'nucleus' appeared, followed immediately by the rest of the recall."

Zalof (eighteenth recall, Mar. 26, 1913). "*A Zalof is a triangular-shaped body with three pseudopodia ending in fibrifications which divide into two pairs. The size may vary, and the relation of the size of the central body and pseudopodia may vary. A Zalof has a central nucleus, usually red, composed of a central circular body surrounded by three pear-seed-shaped bodies.*" Introspection: "The recall started absolutely mechanically; it was as if the instructions set it off automatically. Just before I said that the size of the central body and the pseudopodia may vary, I started to say 'fibrils' instead of 'pseudopodia'; immediately a vocal-motor verbal image appeared 'that is wrong; pseudopodia'; and the statement regarding size was finished. Then a slight hesitation, followed by the auditory and vocal-motor verbal image of 'nucleus' and the rest of the spoken recall occurred mechanically."

Deral (first recall, Dec. 16, 1912). "*A Deral is an object having three dimensions in space, composed of two parts. On one side is an uncolored part with a central edge which extends in the form of a point; the other side is colored and has a corresponding notch. The object may vary in size, in the relation of the two parts, and in the color of the colored part. The uncolored part may or may not be covered with pseudopodia.*" Introspection: "The statements of the recall were preceded in almost every instance by vocal-motor verbal imagery. Visual images appeared, along with the verbal images just before I described the central regions of the two halves of the figure. The verbal images came singly or in groups immediately before the phrases to which they related; sometimes a single vocal-motor verbal image would contain the meaning of an entire phrase, which followed. The vocal-motor verbal image 'size,' for instance, carried the meaning that the size might vary." (What do you mean by 'containing the meaning' or 'carrying the meaning' of an entire phrase?). "I mean that the verbal image brought up the vocal-motor expression of the entire phrase." (Did the complete meaning appear before the vocal expression occurred?) "The complete meaning was not present before I started the vocal expression; it occurred, however, before I finished the phrase."

Deral (sixth recall, Jan. 27, 1913). "*A Deral is an object having two bodies, the one to the right uncolored, and the one to the left colored. The size of the Deral may vary, as may also the relation of the size of the two parts. The lower periphery of the left-hand body includes a straight edge; the median line has a notch which fits into a point in the median line of the right-hand body. The Deral may have small pseudopodia, also small detached*

bodies." Introspection: The recall was instigated by vocal-motor verbal imagery which preceded each statement. When I referred any characteristic to the right or to the left-hand part of the figure, I was aware of motor imagery of lifting my right or my left hand, respectively."

Deral (seventh recall Feb. 3, 1913). "*A Deral is an object having two bodies, the one to the left colored and the one to the right uncolored. The left-hand body has a notch in its median line into which fits a point in the median line of the right-hand body. The color of the right-hand,—no, the left-hand body,—may vary. So, also, may the size of the entire body. The outer edge of the right-hand body has a curve corresponding to the point in its inner edge of the left-hand body. The lower edge of the left-hand body is square. The Deral may have small detached bodies around the outer edge.*" Introspection: "All of the statements of the recall were preceded by verbal,—vocal-motor and auditory,—images, most of which, however, occurred some time before the statement which they introduced, in the midst of preceding statements. Your instructions were followed by verbal images of 'two bodies' when the recall started. Very soon, the verbal image 'colored' occurred, and after I had finished the statement regarding the two bodies, I made the statements regarding color. In the meantime, the images 'notch' and 'point' had occurred; interspersed with later statements occurred verbal images of 'color varies,' 'size varies,' 'outer edge,' 'lower edge,' 'detached bodies. At the time when I started to say that the color of the right-hand body may vary, there occurred immediately a visual image of a Deral, attended by a kinaesthetic image of lifting first the right and then the left hand. Immediately I changed my statement, saying that the color of the left-hand body may vary.

Deral (tenth recall, Feb. 15, 1913). "*A Deral is a body having two bodies, the one to the left colored and the one to the right uncolored. The color of the right-hand body may vary, but it is always solid. The left-hand body has a notch in its median edge into which fits a point in the median edge of the right-hand body. On the outer edge of the right-hand body is a notch which extends to the point in the middle edge of the right-hand body. The lower edge of the left-hand body is square. Deral may vary in size and it may have small detached bodies.*" Introspection: "The recall was given upon the instigation of vocal-motor and auditory verbal imagery. The verbal images appeared before I had a chance to use them, *i.e.*, before I had come to the phrase which they introduced. I can not remember all of them. Your instructions were followed by verbal imagery of 'right and left-hand bodies' and 'color,' the last immediately followed by verbal imagery of 'don't forget that Northern Lights affair.'" [In the course of the Classification Series (footnote 23, p. 50). *E* had seen a Deral on the left-hand side of which a number of different colors were mingled in patches; this had strongly attracted his attention and he had remarked that he would like to change his definition.] "The recall immediately started. Other verbal images, which occurred later, were 'notch,' 'point,' 'outer edge,' 'lower line,' 'detached bodies,' 'size.'"

Deral (thirteenth recall, Mar. 7, 1913). "*A Deral is a body having two bodies, the one to the right uncolored, and the one to the left colored. The color of the left-hand body may vary but is always uniform. The size of the*

Deral may vary. The median line of the left-hand body has a notch into which fits a point in the right-hand body. The notch in the median line corresponds to a point in the left periphery. The lower part of the left-hand body is square. Around the peripheral edge of the right-hand body there may be small detached bodies." Introspection: "Immediately upon hearing the instructions and before the recall was started, the following vocal-motor and auditory verbal images occurred: 'two bodies,' 'colored and uncolored,' 'color varies,' 'flat,' 'size varies.' Then the recall was started. Faint inner-ventions for saying words appeared later on, just before their proper places in the recall. The words were 'notch,' 'point,' 'notch on other side,' 'square edge,' 'detached bodies.'"

Deral (fifteenth recall, Mar. 21, 1913). "*A Deral is a body having two bodies, the one to the right uncolored, and the one to the left colored. The color of the left-hand body may vary, but it is always flat. The size of the Deral may vary, but the relation of the size of the two bodies is constant. On the median line of the left-hand body there is a notch into which fits a point in the median line of the right-hand body. There may or may not be small detached bodies on the right-hand periphery. The lower line of the left-hand body is square.*" Introspection: "Your instructions were followed by vocal-motor and auditory imagery of 'two bodies,' upon which the recall was spoken in a mechanical fashion until I reached the point where color was mentioned. When speaking of the right-hand body I was aware of motor imagery of slightly lifting the right hand. Then the vocal-motor verbal image 'color flat' appeared, and the spoken statements regarding color followed. Then came verbal image of 'size,' followed by a period of hesitation during which there appeared verbal imagery of 'is relation of two bodies same? . . . Yes.' Then the statements regarding size-relations followed. Then came a vocal-motor verbal image of 'now, where is point?' followed by a description of the notch and the point. Then came a verbal image of 'detached bodies,' followed by verbal imagery of 'keep that until later; always last.' Then came a verbal image of 'square edge' with motor imagery of lifting my left-hand slightly. After the statement regarding the square edge, came vocal-motor verbal imagery of 'now, detached bodies.'"

Deral (sixteenth recall, Apr. 2, 1913). "*A Deral is a body, having two bodies, the one to the left colored and the one to the right uncolored. The color of the left-hand body may vary, but it is always flat. The size of the figure may vary, but the relation of the size of the two parts is always approximately the same. In the median line of the left-hand body there is a notch into which fits a point in the median line of the right-hand body. On the peripheral side of the right-hand body there is a notch opposite the point on its median line. The lower edge of the left-hand body is square. There may be small detached bodies around the peripheral edge of the right-hand body.*" Introspection: "The statements of the recall were made from vocal-motor verbal images which in all but one case occurred just before the statements or phrases which they introduced. Following your instructions came the verbal image 'two bodies' followed immediately by the first statement. Then came, interspersed with the recall and occurring just before their respective statements, the following verbal images 'color flat,' 'size,' 'two

about the same,' 'now shape,' 'notch and point,' 'other notch.' While describing the other notch (the indentation in the right periphery) the verbal image 'edge square' occurred, some time before the statement to which it related; I finished the description of the notch before I made the statement that the lower edge of the left-hand body is square. Then came verbal images of 'pseudopodia,—no! little bodies,' followed by the statement regarding the small detached bodies."

Deral (seventeenth recall, Apr. 16, 1913). "*A Deral is an object having two bodies, the one to the left colored and the one to the right uncolored. The color of the left-hand body may vary but it is always flat. In the median line of the left-hand body there is a notch into which fits a point in the median line of the right-hand body. The lower edge of the left-hand body is square. Around the edge of the right-hand body there may be small detached bodies.*" Introspection: "The recall was given in rather a mechanical fashion, at the instigation of a few vocal-motor, auditory and verbal images. The verbal images were 'colored and uncolored,' accompanied by kinaesthetic imagery of moving my eyes to the left with 'colored' and to the right with 'uncolored.' The other images were 'notch,' 'detached bodies,' 'square edge,' 'detached bodies.' The statements of the recall followed these images in a mechanical fashion."

Tefoq (second recall, Feb. 12, 1914). "*A Tefoq is a body, three-dimensional, composed of three bodies. One of these is approximately circular and has a notch in its lower edge. From this circular body there sticks out at right angles a second body which is like a cross-section of a picture-frame. On the upper edge of this second body is a small triangular-shaped third body, which is usually blue. The sides of the picture-frame body are colored, and the end has a small crow's foot figure in black. The sides of the picture-frame body are pale green. The lower circular body is usually colored and may have small pseudopodia.*" Introspection: "The recall was given entirely upon the instigation of vocal-motor imagery which occurred hesitatingly immediately before the statement which it introduced, excepting at the very first, when some of the imagery occurred before I was ready to use it. My periods of hesitation contained consciousness of effort: straining of the brows and at times a converging of the eyes without definite fixation. A number of verbal images appeared in the course of the effort and strain and hesitation; and at one time verbal imagery of 'anything else?' occurred. The verbal images were numerous; among them I can remember the following: 'three-dimensional,' 'three bodies,' 'round,—almost,' 'groove,—picture-frame,' 'smaller body blue,' 'top uncolored,' 'crow's foot,' 'side colored,' 'green,—pale green,' 'bottom colored, color varies,' 'periphery.'

Tefoq (fourth recall, Feb. 26, 1913). "I have a complete amnesia! . . . This amnesia was just now broken by vocal-motor imagery of 'circular body'; I was unable to call up visual imagery. I am certain now that I can give you a reasonably good definition. *A Tefoq is an object which has two bodies, the lower one approximately circular and flat with a notch in its lower edge. The other body is the shape of a cross-section of a picture-frame; the sides are green, the color being flat. Above the upper edge of the green body is another smaller body in the shape of a triangle, usually blue. The lower*

body may or may not be colored, but if colored, the color is flat. The top of the picture-frame body may be uncolored or black; on it is a crow's-foot which is either black or uncolored. The Tefoq may vary in size and it may have pseudopodia around the outer edge of the circular body." Introspection: "The recall was given entirely at the instigation of vocal-motor and auditory verbal imagery. The imagery occurred between each phrase of the statement and had to do with the phrase which succeeded it. The initial amnesia was attended by much strain and unpleasantness and by an increased mental activity, during which appeared a flood of non-significant imagery, auditory and vocal-motor verbal. After the amnesia was broken, and during the recall, I can remember that the following verbal images occurred: 'central body,—circular, almost circular,' 'notch,' 'picture-frame body,' 'green,' 'colored or uncolored.' Then 'crow's foot,' 'colored,—may be colored,' 'flat,' 'small blue body,' 'pseudopodia.'" (When the vocal-motor verbal image 'circular' appeared was there absolutely nothing in your consciousness excepting the word and the tension and unpleasantness you mentioned?) "I do not believe there was, until I began the description. The word 'circular' is followed immediately by the other verbal imagery and by the spoken phrase."

Tefoq (sixth recall, Mar. 7, 1913). "*A Tefoq is a body composed of two parts, one part flat and approximately circular and having a notch in its lower edge, the other part being the shape of the cross-section of a picture-frame. The sides of the picture-frame body are always green. The top may be black or uncolored. If uncolored it has a black crow's foot; if black, it has an uncolored crow's foot. In the upper edge is a triangular-shaped body which is usually blue. The circular body is colored. The color may vary but it is always flat. The size of the Tefoq may vary, but the relation of the size of the circular body and of the picture-frame body is approximately the same.*" Introspection: "The recall was based upon vocal-motor verbal imagery. The images were numerous and came in groups before the statements to which they referred. Before the recall began, and immediately after your instructions, appeared the following verbal images: 'Gee, do you remember the time I forgot that?'; then 'two bodies, one circular,' 'colored,—green,' 'crow's foot,—black and white,' 'small blue body,—almost forgot it.' Then, later, 'circular body can be colored, too!' and 'changes, always flat.' Again 'size is different, but do you remember that long one?'" (*E had seen, in the Classification Series, a Tefoq figure with a central body of greatly exaggerated length and extending to the right.*) "This last verbal image was attended, I think, by a kinaesthesia of eye-movement,—whether actually innervated, I can not say,—from the primary position of the eyes to the right. No visual imagery was present, however. The image was followed by much strain in the head and brows,—a searching for suitable words,—and finally by the spoken statement. Later came a verbal image of 'periphery.'" (Can you find any definite content other than the verbal images or the spoken definition?) "No. On the other hand, I believe that if I were forced to inhibit the definition, that the verbal images would be followed by more complete statements in vocal-motor and auditory verbal imagery." (When you make statements such as: 'the sides are *always* green' or 'the size *may* vary,' do you have any conscious content other than the words?) "No; just the statements."

Kareg (first recall, Mar. 5, 1913). "*A Kareg is a body having two parts, each rather spherical, connected by a neck. The part to the right is smaller than the one to the left. The entire body may vary in size. The two bodies may or may not be geometrically pyramidal in shape. The figure is usually colored a solid color, showing shading but the color may vary.*" Introspection: "At the outset I was aware of a visual image of a Kareg figure, in which the two parts were pyramidal and the color was pale blue. With this image came vocal-motor and auditory verbal imagery of 'this was the thing I had last time.' I noted the main features of the image. Between this noting and the spoken recall, I was aware of vocal-motor verbal innervations which occurred just before the statement which they introduced. The verbal innervation (silent) was quite complete; the words were 'two bodies, one to the left larger,' 'small neck,' 'may vary in size,' 'color,—color solid,' 'shows shading,' 'pyramids; may or may not have them.'"

Kareg (fifth recall, Mar. 21, 1913). "*A Kareg is a body composed of two bodies, three-dimensional, joined by a thinner neck. The left-hand body is larger than the right-hand body but the size relation of the two may vary within wide limits. The bodies may or may not be geometrically pyramidal in shape. If so, the left-hand body has five sides and the right-hand body three sides. The figure may or may not be colored; if colored, the color is flat. Whether the figure is colored or uncolored it always shows shading.*" Introspection: "The recall was practically nothing more than the pronouncing of verbal and vocal-motor auditory images which were preceded and accompanied by much strain and tension in my brow, eyes, neck, arms and chest. The images occurred hesitatingly and their appearance and the strain was attended by an increasing unpleasantness which did not disappear until just before the close of the recall. The verbal imagery was often more complete than the spoken recall; when I was considering color, I had verbal imagery of referring to one of the figures,—an uncolored one, as complete as this: 'that uncolored one, with lines of shading.' With this verbal imagery came an increased strain in my brow, eyes and neck. When considering size, I had verbal imagery of 'size varies,—remember that confounded little one,' and 'left one big; right, pimple.' When I was giving one part of the recall, I was frequently aware of an effort to look ahead; my attention would turn away from the statement I was giving. The consciousness that I was looking ahead was itself never focal; and I never succeeded in finding anything until I had finished the statement I was on. The failure was accompanied by increased strain and silent vocal-motor verbal exclamations of dissatisfaction. The end of a statement was usually followed by hesitation before the verbal imagery relating to the next statement appeared; and during this hesitation the strain and unpleasantness was the greatest."

Kareg (sixth recall, Apr. 2, 1913). "*A Kareg is a body, having two bodies, the one at the left larger than the one at the right. The size may vary within relatively wide limits, and the size of the left and right-hand bodies may vary. These bodies are connected by a small neck. The figure is tri-dimensional; the right and left-hand bodies may or may not be pyramidal in shape. If pyramidal the left-hand body usually has five sides and the right-hand body three sides. This is not necessarily true, however. The Kareg may*

or may not be colored; if it is colored the color is flat. The figure invariably shows shading, however." Introspection: "This recall was given at the instigation of verbal imagery,—vocal-motor and auditory; parts of the recall were simply statements of the verbal imagery, so complete was the latter. They appeared, however, in a fairly mechanical fashion. When I described the two bodies, or referred to one or the other of them, I was aware of motor imagery of the left hand, verbal imagery of 'right' and 'left' seldom if ever appearing."

b. **The Nature of the Four Concepts.** In the case of every observer, the form in which the concepts entered consciousness in response to the recurrent task of recalling revealed striking differences, both of a structural and of a functional nature, as the number of observations of the original series increased, *i.e.*, as the observers' experiments progressed. Structurally, the several concepts invariably showed a tendency to pass through a remarkable and for the most part a uniform series of progressive changes which ranged from an initial form, characterized by an abundance of relatively concrete imagery, through intermediate forms of increasingly schematic and non-particular concrete imagery plus more or less verbal imagery, to a final form in which the imagery was overwhelmingly or exclusively verbal. Functionally viewed (*i.e.*, regarded from the point of view of the difficulty and effortfulness, or the ease and mechanizedness with which the concept-meanings entered consciousness), the recalls ranged from an initial form in which more or less hesitation and effort was present, to a final form which was marked by a high degree of mechanization and where the spoken statements followed in uneventful fashion, either immediately upon the instructions themselves, or upon a brief and transitory visual or verbal image which served to "set off" the train. Moreover, stages which in different observers were structurally similar manifested wide individual differences as regards degree of mechanization. Accordingly, we shall present the structural and the functional aspects separately. We shall first select out of the total introspective material all of the structurally distinguishable stages and arrange them in what appears to be their natural structural sequence; *i.e.*, our arrangement will be such that if in the case of any one observer the stages which his introspections failed to reveal were crossed off the list, those which remained would still preserve their proper

order. We shall next endeavor to indicate which of the stages resemble one another from a functional point of view, *i.e.*, which stages show approximately parallel degrees of mechanization.

1. *Progressive Structural Variations in the Conscious Form of the Concepts:*⁷⁸ I. The earliest recalls and definitions always represented a stage at which the concepts came to consciousness in the form of definite, relatively particular concrete visual images, sometimes concrete kinaesthetic images as well. The number of these images varied with different observers. In many cases the visual images presented the extremes in form and size of the original series of figures. The concrete kinaesthetic contents consisted in internal imitations of the grosser essential features; the observer here felt as if he were constricted, or extended, or expanded, in a manner which was obviously suggested by the main lines and directions of the figure,—the extended arms represented the two upper limbs of the Zalof figure, or a squeezing kinaesthesia in the hand represented the constricted neck of the Kareg figure. The degree of clearness or definiteness of the images depended upon the nature of the observer's previous examinations of the series; those general or particular features which had received little or no attention in the figures were indistinct or absent in the images. The observers' procedure in verbalizing their recalls consisted in

⁷⁸ In any attempt to give a general description of the successive changes in the growth of the concepts, it cannot, of course, be too strongly urged that the nature of the development indicated is a general trend only, and that it does not hold for any one observer. Every observer failed to reveal one or more of the several stages; and the different observers showed striking variations in the number of their recalls which belonged to any one stage. Moreover, these progressive alterations in the conscious form of the four concepts, as they appeared when the observer was confronted with the task of recalling the series, came about in a gradual fashion; the differences which existed between one recall and the next were sometimes so slight that it is difficult to demarcate definite stages of development. Again, the series of stages was not invariably uniform; the introspections of all the observers show more or less frequent returnings to an earlier stage,—this was especially true in the case of *D*, owing largely to two long interruptions in his series of sittings. Nevertheless, for the sake of envisaging the stages through which the concepts passed, and of comparing the four concepts, we shall endeavor to select recalls which represent well-marked levels of development, and to classify the succeeding recalls according to the closeness of their resemblance to one or another of these forms.

attending to those features which were present in all the images, and in mentioning these as essential to the group. The features which were present only in one or in a few of the images were sometimes mentioned as particular, and sometimes ignored.

It occasionally happened that the concrete images of this first stage were attended or followed by contents of another sort: *a.* These contents sometimes consisted in images of words which had been employed during the observation of the series to describe the features which were being investigated (*E, B, C, and D*). Such verbal images, however, did not participate directly in initiating the spoken recall; they appeared as associations, or as parts of the imaginal reconstructions of past situations. *b.* Again, an image of Stage I was accompanied in many instances by imagery of one or more previous situations, when the figure or a prominent feature had first been noticed. This situation-imagery was sometimes visual—the experimental surroundings, the experimenter in various attitudes, the falling of cards, in terms of which the visual images of the figures were localized in the series (*B*). Sometimes it was kinaesthetic—definite bodily adjustment to the apparatus; and sometimes it was auditory or vocal-motor verbal, of the experienting (*B*). Appearing as it did when attention was attracted to the particular image in question, it frequently contributed to a recognition of the image, or served to identify the past occasions upon which certain discoveries had been made (*cf.* p. 167, 169). Again, it apparently existed only as a vague associative setting for the images. In general, the situation-imagery showed a tendency to become less profuse as the experiments progressed.⁷⁹

The concrete images of Stage I represented many degrees of particularity. Most particular of all were those in which definite specific features were present—features which had belonged to no other figure of the series—and with which came a remembrance of

⁷⁹ For introspective accounts of Stage I, *cf.* the following: *A*, Zalof, first and fifth recalls, pp. 112, 114; third recall, first part, p. 113. *B*, Zalof, third recall, p. 122; Tefoq, first recall, pp. 124 f.; Deral, third recall, p. 129. *C*, Zalof, first recall, p. 130; Kareg, first and third recalls, pp. 134 f.; Deral and Tefoq, first recalls, p. 135, 137. *D*, Zalof, second, third, and ninth recalls, pp. 137 f., 139.

place in the series. This remembrance sometimes consisted in imagery of falling cards—a certain number appearing to have fallen—and sometimes in vaguely visual spatial schemata of one sort or another, the image being localized in its proper place. Extremely particular images of this sort were rare with most observers; it usually happened that a feature which had been noticed only once failed to persist into the recall.⁸⁰ Images of a slightly less particular sort were sometimes present, which although indistinct in themselves were nevertheless localized definitely in the series. Such images were often members of rapidly succeeding trains of images, and they apparently functioned in consciousness as an assurance that such-and-such a particular figure had possessed certain features which the observer had found to be essential.⁸¹

Most of the images of Stage I, however, were semi-particular; they were the products of the fusion of several figures which had possessed a certain feature absent in the others. For example, the observers sometimes mentioned imagery of a slim Zalof figure, or of a Zalof of moderate compactness, both of which had several counterparts in the series. The location of one of the original counterparts was sometimes remembered with the image.⁸²

II. A second stage (*A* only) included recalls in which a varying number of concrete visual images was present, together with a concrete visual schematic image. The latter succeeded the particular images. It was never localized in the series, nor was it associated with situation-imagery, which latter, however, appeared frequently with the more particular images. It was usually characterized only by the fact that it possessed the features which the observer had found to be common to the group. In verbalizing his recall, the observer mentioned the features in this image as essential to the group; the features which were prominent in the par-

⁸⁰ *A*, Zalof, fifth recall, p. 114; probably also such images were among those of the first recall p. 112, and of the third recall, p. 113. *B*, Tefoq, first recall, image of the first figure, p. 124.

⁸¹ *B*, Deral, second definition, p. 129; third recall, images of the last four figures, p. 129.

⁸² *A*, Zalof, first recall, 'thick-bodied Zalof,' p. 112; *B*, Zalof, third recall, p. 122. *C*, recalls of Stage I. *D*, recalls of Stage I. *E*, recalls of Stage IV.

ticular images he either mentioned as non-essential, or else he ignored.⁸³

Schematic images were usually definite in the possession of general features; they were usually of medium size and form; and they were for the most part indefinite or shifting with respect to the non-essential characteristics. In many instances, the regions or the existence of particular features was not attended to in any degree whatsoever, and so these do not deserve even so positive a characterization as indefinite. Schematic images ranged in definiteness from fairly distinct images of specific size and form (*A*, Zalof, last of third recall, p. 113; *cf.* also Kareg, 3rd recall, reappearance of image, p. 121, etc.) to vague, splotchy visual suggestions of line and direction of parts (*A*, Zalof, seventh recall, p. 115). In its more distinct forms the imagery which we have called schematic did not differ in point of actual content from relatively particular imagery; in fact an image which structurally was relatively particular might function as a schematic image. Thus the essential difference between the two sorts of imagery was a functional one, a difference of situation and of behavior of the image in attention. In the case of particular imagery the observer was aware of the non-general features—size, slenderness, and the like, and upon the basis of this imagery he often described features which were common only to a part of the series. In the schematic image, on the other hand, the size and particular shape received little attention; the image appeared when the observer was in a situation of describing common features and it furnished the basis for his mention of them; on such occasions he showed no inclination to seek corroborative imagery.

III. The third stage (*A* only) was one in which the concepts appeared first in schematic visual imagery, after which particular or semi-particular images came.⁸⁴ The initial schematic images were for the most part exceedingly vague and indefinite at the outset; they then embraced only the most conspicuous general features, and they were of medium size and proportions. After a

⁸³ *Cf.* *A*, Zalof, third, fourth, and seventh recalls, pp. 113, 114, 115.

⁸⁴ The following introspections illustrate this stage: *A*, Zalof twelfth recall, p. 115; Deral, fifth, sixth, ninth, and tenth recalls, pp. 116-119; Tefoq, second, and fourth recalls, p. 119 ff; Kareg, third recall, p. 121.

time they became clearer and richer in detail, and more vivid images of particular features occurred.⁸⁵

IV. The fourth stage was one in which the concepts appeared both in concrete and in verbal imagery. The concrete imagery was sometimes schematic, and sometimes particular or semi-particular. The schematic concrete imagery was visual, or visual and kinaesthetic; it sometimes preceded the particular imagery in consciousness (*A, B,*) and sometimes it came only after a group of particular images (*B, Tefoq, fourth recall, pp. 125 f.*). The verbal imagery consisted of words which designated the features; and while it usually succeeded the concrete imagery, it nevertheless constituted the form in which more or less extensive parts of the recall entered consciousness. It often happened that a verbal image was followed by a corresponding visual image, or by the clearing-up of a corresponding region of a schematic visual image, or at least by the momentary turning of attention to such a region (*cf. especially D*).⁸⁶

⁸⁵ *Cf. especially A, Deral, fifth recall, initial image, p. 116; Tefoq, second recall, initial developing visual image, p. 119; fourth recall, pp. 119 ff; Kareg, third recall, p. 121.*

⁸⁶ The following introspections illustrate Stage IV: *A, Zalof, fourteenth recall, p. 116. B, Zalof, fifth recall, pp. 122 f.; Tefoq, fourth, seventh, tenth and eleventh recalls, pp. 125-128.* The above four of *B's* Tefoq recalls illustrate admirably a series of changes in the character and relative importance of concrete and verbal imagery. The earlier recalls of the second stage were characterized by profuse and varied visual images of numerous particular figures, which flooded in at the very outset; and by verbal images which played a relatively insignificant rôle. These latter images initiated the description of only a few features, or functioned merely in the arranging of the definition. As the experiments progressed, the visual imagery very slowly lost its completeness and profuseness, while the verbal images became more numerous, until a final form of recall was reached where the visual content appeared at first as a slowly-developing image which embodied only the barest essentials, in colorless, shadowy, washed-out fashion, and where considerable parts of the recall came in verbal imagery. Visual images always played an important part, however; and their initial vague forms were succeeded by relatively distinct, profuse, and detailed visual images which embodied many particular features, as well as certain essential features which were objectively minute and inconspicuous, and which had most recently been discovered, *e.g.,* the design in the end of the central figure, the blue triangle, etc. *C, Zalof, third and fourth recalls, pp. 130 ff;* these two Zalof recalls illustrate a progressive diminution in the vividness and importance of the visual

In Stage IV, as in the preceding ones, the visual schematic imagery embraced all degrees of definiteness and obscurity. It was sometimes structurally definite and highly colored, or even closely similar to a member of the series, and is to be regarded as schematic only because it functioned as a basis for the describing of general features;⁸⁷ again, the schematic imagery was somewhat more obscure and washed-out.⁸⁸ As in Stage III, it often happened that a schematic image appeared in exceedingly vague and indefinite form, and subsequently became more distinct and detailed.⁸⁹ Schematic imagery was usually indefinite with respect to the regions of particular features, but sometimes it was fluctuating. A series of fluctuations presented the manner in which the region varied in the different figures (*D*, Deral, fifth recall, fluctuations of color in initial image, p. 141).

The kinaesthetic or organic schematic contents consisted sometimes in kinaesthesia of eye-movements of following out the essential lines or directions (*C*, Zalof, fourth recall, p. 131), and sometimes in kinaesthesia of fixating upon the region of an essential feature which latter occurred in verbal terms (*C*, Deral, fourth recall, p. 136). Kinaesthetic content of this sort is obviously appropriate in an especial degree for the schematization of a large number of figures, owing to its essentially indefinite nature.

The particular images were sometimes clear and definite and manifold;⁹⁰ at other times they were very indefinite and fragmentary, and structurally very similar to the schematic images of the vaguer sort.⁹¹ In the latter case the only difference between the

imagery; Deral, fourth recall, p. 136. *D*, Deral, second, fifth, sixth and seventh recalls, pp. 140-143; Kareg, third recall p. 143, *E*, first recall p. 144; Kareg, first recall p. 151.

⁸⁷ *B* Zalof, fifth recall, image of first Zalof, p. 122. *C*, Zalof, third recall, initial image, p. 130.

⁸⁸ *B*, Tefoq, tenth and eleventh recalls, pp. 127 f. *C*, Zalof, fourth recall, pp. 131 f.

⁸⁹ *A*, Zalof, fourteenth recall, p. 116. *C*, Deral, fourth recall, p. 136. *D*, Deral second, fifth, and seventh recalls, pp. 140 f, 143.

⁹⁰ *C*, Zalof, fourth recall, last part, definite visual image of a large grayish figure, p. 132; sixth recall, mention of center, with definite memory image, p. 133. *D*, Deral, sixth recall, image of scallops, p. 142.

⁹¹ *C*, Zalof, fourth recall, imagery of color and final imagery of dendritic processes, pp. 131 f.

imagery of general and that of particular features was a functional difference; it consisted in the fact that the latter appeared in response to a situation of describing particular features; or that such words as "usually has" or "may have" were spoken in spontaneous fashion when the observer set out to describe them; or even that particular features were actually ignored by the attention. With most observers, the non-general features tended to cease to appear as the recalls progressed.

In the second, third, and fourth stages observers sometimes reported the presence as a vague background of situation-imagery of past experimental sittings. This imagery was visual and kinaesthetic, images of the research room on past occasions, or of past adjustments to the apparatus; and verbal-auditory or kinaesthetic images or both, of the voices of observer or experimenter. In certain situations, imagery of this sort became prominent, and functioned as a familiarity, or as a recognition of certain figures or features, or as an awareness of generality (*cf.* pp. 167 ff.).

V. The fifth stage (*B, C, D, and E*) represents a shift in the relative importance of the verbal and the concrete imagery of Stage IV. Here the concepts came to consciousness, for the most part, in the form of verbal images of words which designated the essential features. Certain of the features, especially the more conspicuous essentials and the particulars, appeared first in visual form; the visual imagery was often fragmentary and vague, but sometimes relatively clear and detailed. It was usually fluctuating in nature. Visual imagery, moreover, was apt to trail along after the images or spoken words, as tag-ends of association. As in Stage IV, so here too a verbal image was sometimes followed by a corresponding concrete image, or by a shift of attention to the proper place. Parts of the spoken recall were often given in highly mechanized fashion, upon the appearance of antecedent verbal or visual imagery.⁹²

It occasionally happened that an observer at this stage experienced, in addition to the imaginal contents, an attitude of familiarity with the imaged figures or with the verbal images,—the words he employed seemed familiar. He analyzed this familiarity into kinaesthetic bodily attitudes or into a peculiar behavior of the 'familiar' contents in consciousness, *i.e.*, the smoothness and fluency with which the words, when once started, were spoken. For illustrative introspections, *cf. C, Zalof, sixth recall, p. 133.*

⁹² For illustrations of Stage V, *cf. B, Zalof, ninth recall, p. 123. C, Zalof, sixth recall, pp. 132 f. E, Zalof, second recall, p. 144; Deral, first recall, p. 146.*

VI. At this stage (*B*, *C*, and *E*) the concepts came to consciousness exclusively in verbal form, as words which had been used upon past occasions to designate the essential features. The spoken recall was instigated by one or more verbal images of the grosser general features; other verbal images appeared later, introducing each phrase. Some of the observers reported that flashes of vague and colorless visual imagery accompanied or followed their spoken statements. In certain instances they employed movements of hand or eye to indicate the location of a feature which was present verbally. The number of verbal images present, and the degree of automatization, varied widely from individual to individual. When in the case of any observer this sixth stage occurred relatively late, it was highly automatized from the outset; the verbal images were now few, and they served to "set off" lengthy statements (*B*, *C*,). In the case of *E*, however, Stage VI occurred early, especially in the Tefoq and Kareg groups; verbal images were numerous in this stage, and they made their appearance hesitatingly, with much tension and unpleasantness which functioned as effort to recall.⁹³

As in Stage V, it occasionally happened that after the statements were verbalized, an observer experienced a consciousness of familiarity,—of having verbalized them before. This consciousness was largely a kinaesthetic remembrance of a former attitude and adjustment to the apparatus, and of a former process of saying the same words (*cf.* *C*, ninth recall, p. 133)

VII. At this stage (*E* only) the concepts appeared exclusively in verbal form; the verbal images and the spoken statements, however, were telescoped in a peculiar fashion, so that the verbal imagery which introduced any of the later statements of the recall appeared during the time that the observer was giving the previous statement, instead of during the period immediately preceding the statement to which they related.⁹⁴

⁹³ For illustrations of this stage, *cf.* *B*, Zalof, sixteenth and eighteenth recalls, pp. 123 f.; *C*, Zalof, ninth recall, p. 133. *E*, Zalof, third and seventh recalls, pp. 144 f.; Deral, sixth and sixteenth recalls, pp. 147, 138 f.; Tefoq second, fourth, and sixth recalls, pp. 149 f.; Kareg, fifth and sixth recalls pp. 151 f.

⁹⁴ The following introspections illustrate Stage VII; *E*, Zalof, tenth recall, p. 145; Deral, seventh recall, p. 147. The progression of *E*'s concepts after Stage VI appears far more clearly in the Zalof than in any other group.

VIII. The eighth Stage (*E* only) represented a further telescoping of the verbal imagery and of the spoken recall. The verbal images—which again constituted exclusively the conscious form of the concept—occurred immediately before the recall began, or during the first few statements. Most of the verbal images thus appeared long before the statement which they served to introduce; at times, such an image occurred immediately before its statement.⁹⁵

IX. At this Stage (*E* only) a few images of words which designated the grosser general features occurred at the outset and “set off” the recall, which thence proceeded in automatic fashion, except for the occasional non-focal reappearance of a verbal image immediately before its related statement, after which the recall proceeded automatically as before (*cf. E*, Zalof, fourteenth recall, pp. 145 f.; Deral, thirteenth recall, pp. 147 f.).

X. The recalls of this stage (*D* and *E*) were either “set off” directly by the request for a recall (*E*) or else they were instigated by a single verbal (*E*) or by one or more visual images (*D*). Once started, the statements proceeded in an automatic fashion, save for an occasional scrappy verbal image. The recall, when initiated visually, was in no sense a description of visual imagery; it was rather an automatic repetition of a well-learned material.⁹⁶

The above-described ten stages, then, represent all the different conscious forms of the several concepts which we have been able to find in our introspective records. It was usually the case that the course of development of a concept began *ab initio* with its presentation, and advanced in a relatively indeed, it is not unlikely that in the case of the Deral group, the course of the mechanization proceeded directly from Stage VI to Stage X. We have seriated the successive Deral recalls according to their resemblance to one stage or another of the Zalof recalls; but it was very difficult in several instances to determine whether a Deral recall belonged properly to Stage VI or to a later Stage (*cf. especially* the ninth, tenth, thirteenth, and fifteenth recalls, pp. 147 ff.). Accordingly we do not insist upon details of our seriation in the case of the Deral recalls (*cf. Table II*, p. 111).

⁹⁵ *Cf. E*, Zalof, eleventh recall, p. 145; Deral, tenth recall, p. 147.

⁹⁶ *D*, Zalof, seventh recall, pp. 138 f. *E*, Zalof, eighteenth recall, p. 146; Deral, fifteenth and seventeenth recalls, pp. 148, 149. In *E*'s case, Stage X possessed a superficial resemblance to Stage VI; it differed, however, in that the verbal imagery was infrequent and scrappy, and in that it revealed a high degree of mechanization. Moreover, *E* reported at this stage no tension and uneasiness whatever.

uniform fashion. Sometimes, however, an observer's imagery showed a progressive course of development not only within single concepts, but from concept to concept, a fact which is probably to be interpreted as correlative with the extent of his experience with the problem, and with the most efficient means of solving it (*A*, Table II, p. 111). Instances of divergencies in the progress of the concepts occasionally occurred with three observers. In the case of these observers, each of the four concepts showed certain peculiarities of development which were undoubtedly dependent either upon the conditions under which the different groups were presented—whether early or late in the experiments, and consequently whether the observer was obliged to distinguish them from a number of other groups,—or upon the nature of the figures themselves—their complexity and their characterizability in verbal terms. The peculiarities consisted *a*. in a tendency to revert from a higher to a lower stage, or in modifications of certain stages; and *b*, in the omission of certain stages which were present in other concepts of the same observer. *a*. *C*'s eleventh Zalof recall, which occurred shortly after the introduction of a new series, constituted a distinct modification of the preceding highly automatic form of the Zalof recalls. It was characterized by the presence, before the verbalization began, of a large, clear visual image of a Zalof, in addition to the customary verbal imagery. The verbalization, once started, proceeded in an automatic fashion; so that strictly speaking this recall does not represent a retrogression. In fact, it is probably to be regarded as a modification of the preceding stage in consequence of the difficulty which she experienced, after a new series had been introduced, in recalling the series which corresponded to the series-name. Again, in a number of instances among the later sittings observers experienced difficulty in recalling the proper group of figures; these recalls were characterized by unusual amounts of effort and hesitation and strain, endeavors to reconstruct the situations of past experiments, etc., and they are probably to be interpreted as modifications of certain stages incidental to the necessity of distinguishing between a number of different groups.⁹⁷ Cf. also *E*, the course of the Deral concept and the strains and hesitations which characterized the appearance in consciousness of the Tefoq group. The lack of uniformity and the reversions to earlier stages in the growth of the Deral concept stand in sharp contrast with the uniform development of the Zalof concept; and this fact is probably due in large measure to the more ready describability, in words, of the triangular Zalof figures, and the relative complexity and indescribability of the Deral and Tefoq figures.

An illustration of the absence, in the growth of a certain concept, of stages which were present in other concepts formed by the same observer is seen in the development of the Zalof concept, in the case of *D*. Here the absence of intermediate stages between *I* and *X* is remarkable. A surprisingly abrupt transition occurred between the recalls, on the one hand, which were direct descriptions of visual images, and those, on

⁹⁷ *A*, Tefoq, second recall, p. 119; Kareg, third recall, p. 121. *C*, Deral, first recall, p. 135; Tefoq, first recall, pp. 136 f. *C*'s third Deral and fourth Kareg recalls were of this nature, as well as *D*'s fifth Deral recall.

the other hand, which came automatically, and which, although preceded or set off and sometimes accompanied by visual imagery, did not consist in the description of this latter. A possible explanation of this abrupt transition is the somewhat readier appearance of descriptive words in the case of the Zalof group; the form was more easily expressible in a single word, 'triangularity'; the appendages were more readily nameable. In the case of the Deral series, the description was more difficult; such words as could be employed for designating a part of the figure ('straight line,' 'snout,' etc.) were more equivocal, and consequently required a greater amount of concrete reinforcement.

2. *Progressive Functional Variations in the Conscious Form of the Concepts:* Excepting in the cases of *A*, who scarcely reached Stage IV, and of *E*, who passed with remarkable rapidity from Stage I to Stage VI, the first four stages were marked by uniformly decreasing amounts of strain and hesitation, and by an increasing facility with which the remembrances made their appearance in consciousness. The Sixth Stage was marked by a high degree of mechanization in the cases of *B* and *C*, with whom it appeared relatively late. In the case of *E*, however, Stage VI was reached with great rapidity, and it possessed a degree of mechanization which was comparable with that of Stages I and II, for the other observers. In *E*'s case the verbal form of recall became substituted for the concrete long before this change occurred with the other observers; yet the actual mechanization did not proceed in a markedly more rapid fashion. Consequently we find in his case that at functionally parallel stages, verbal imagery behaved in much the same fashion as did concrete imagery in the cases of the other observers. When *E* had made only a few examinations of a series (*e.g.*, the Deral and Tefoq series), the images of words, in terms of which his findings were remembered, entered his consciousness in hesitating fashion, and their appearance was preceded by tension and unpleasantness; thus contents which other observers experienced as mental groping and effort were present also in *E*'s case. Moreover, *E* reported that his spoken statements were given with effort; they followed upon the verbal images in much the same fashion that the statements of the other observers followed upon visual images, when the latter were described in the recall.

For *E*, Stages VI to X were marked by uniformly increasing

automatization. For *D*, Stage X followed immediately upon Stage IV in the matter of degree of mechanization.

c. **The Experience of Generality.** So much for the nature of the concept as a whole. The specific behavior in consciousness of the individual elements of the concepts which constituted the essence of the experience that a feature was general likewise evolved as the experiments progressed. In its initial form, this experience was an explicit awareness that the features were essential. The contents in virtue of which the experience was explicit consisted in a succession of concrete images or percepts which informed the observer that the feature occurred in every member of the series. Its subsequent progress consisted in the dropping-out of these explicitly informational contents, rapidly at first, more slowly later on, so that the observer's imaginal information that the feature appeared in every member of the group became less complete and adequate in itself; his awareness of the essential features actually involved fewer and fewer visual images, until it finally involved but a single image. Bound up with this structural evolution, however, was a certain immediately-experienced behavior of the general features themselves, which became increasingly obvious as the other components disappeared. This behavior consisted in the fact that the common features became focal in fluent and uncontested fashion whenever the observer set out to recall, and that they dominated consciousness, in whatever form of imagery they appeared, and were unhesitatingly described as "what a Zalof (or Deral, etc.) is." This behavior of the general features in consciousness rapidly became the important factor in the experience of generality; and during the last recalls of the Zalof series it was present without any vestiges of qualitative content which the observers ever referred to as an awareness that the features were essential.

In order to indicate clearly the nature of the experience, at its different levels, we shall proceed to describe in more detail its successive stages, of which at least four can be distinguished in the observers' introspections.

I. In its initial form, the experience that a feature was general occurred during the actual examinations of the series; this ex-

perience consisted in noting that the feature was present in every member of the group of figures, which latter involved the conscious experience of similarity; in other words, it consisted in the process of generalizing abstraction which was not terminated by the observed absence of the feature (*cf.* Results, A, pp. 73 ff.). The observers sometimes merely described the process; at other times they reported in addition a definite awareness of generalizing,—of ascribing the feature, tentatively or otherwise, to each member of the group. When this sort of “conscious attitude” of generalizing occurred early in the process of generalizing abstraction, or in connection with the intention which sometimes occurred at the initiation of the process, it was for the most part present to consciousness as a tentative generalizing, or a wondering if a certain feature might be essential. It consisted *a.* in efforts to visualize coming cards, or in the fact that the initial observation of a feature was attended by a fragment of formulated definition, present in verbal terms, and that it was succeeded by an investigation of the generality of the feature (*cf.* footnotes 36 and 37, pp. 80 f.). *b.* Or the tentative generalizing occurred after the feature had been observed to recur in several exposures, as a “wondering” if it might be essential. This “wondering” consisted in the fact that attention lingered more or less focally upon the feature in question, sometimes with a marked additional pleasure, and sometimes with an increment of verbal imagery, *e.g.*, “I wonder if it’s always a right angle” (*cf.* footnote 62, p. 96).

When the awareness of generalizing took place at or near the termination of a process of generalizing abstraction, it consisted in an intention to include in the definition the feature which had thus been repeatedly noted. The structure of this intention was usually verbal,—such words as “include” or “definition” being present (*C*, Zalof, fifth presentation, seventh figure, p. 61. *A*, Zalof, fourth presentation, p. 43).

In its earliest form, then, the conscious experience of generality may be regarded as the finding that a feature was present in every member of a series, or at least as the fact that in no case was the absence of the feature observed. This experience was often supplemented by an awareness (or “conscious attitude”) of generalizing, as such.

II. Whenever a feature which had become the object of a process of generalizing abstraction was noted in most or all of the figures in a group, it reappeared as a prominent part of one or more concrete visual or kinaesthetic images when the observer next set out to define or recall that group; this occurred whether or not the feature had been generalized in any of the ways described in Stage I. The second stage in the progress of the experience of generality consisted in this becoming prominent of the general features in each member of a series of relatively particular images, together with the additional fact that the observers unhesitatingly mentioned the feature as a characteristic which was essential to the group. The series of images often included the extremes in the group. Whatever the number of images in which the feature appeared, the latter possessed a compelling claim upon attention. It is doubtful if any of the observers ever reviewed images of all the figures; nevertheless they never attempted to evoke confirmatory imagery, *i.e.*, they never attempted to recall the whole series of figures, and to examine each member to determine whether the feature were present. Hence at this level the experience of generality was, in part, an explicit knowing that a feature was common, and in part a behavior of the general features in consciousness—their clearness and durational aspects, the fact that they stood out when the observer was placed in a situation of stating “what a Zalof (or Deral) is,” that they stood out with fluency and readiness, and were unhesitatingly specified as common to the group without any tendency on the observer’s part to examine their credentials for the position of essentiality. This behavior of the general features in consciousness was sometimes accompanied by pleasantness or other contents (*cf.* p. 167).

In many instances, the observers merely described or mentioned this standing-out of the essential features in a more or less extended series of relatively particular images of the group figures. They did not reflect upon the experience as such either at the moment of its occurrence or afterward, and characterize or label it in any such terms as an awareness that the features to which they were attending were common.⁹⁸

⁹⁸ A, Zalof, third recall, p. 113, Deral, fifth recall, description of lobes, p. 117. B, Zalof, first definition, p. 121; Tefoq, first recall, p. 124, fourth recall,

At times—as we have remarked—the observers reported that their awareness of a feature in a series of visual images was accompanied by contents which constituted an awareness that this feature had been seen in all of the members of the group. They specified the persistence of the visual imagery of the feature, and reported in addition a pleasantness and satisfaction, together with vague imagery of falling leaves, or of past experimental situations, and the like.⁹⁹ It rarely happened that the ready standing-out of the common features in a series of concrete visual images was accompanied by obscure kinaestheses of passing the eyes over the series and focussing only upon certain points, which was labelled as a consciousness that these points were general features, but that other, non-general ones existed. Such kinaestheses were doubtless vestiges of the kinaesthesia of the initial process of generalizing abstraction, in the course of which the features had been established as general during the examination of the series. (Cf. *C*, Kareg, third recall, pp. 134 f.).

At the level represented by Stage II, then, the experience of generality was in part a more or less explicit awareness that certain

imagery of all essential features excepting “step”, pp. 125 f. *C*, Zalof, first recall, p. 130; Kareg, first recall, pp. 136 f. *D*, Zalof, second recall, treatment of triangularity and ends of tentacles, pp. 137 f.; ninth recall, p. 139; *D*'s introspection upon the ninth recall of the Zalof series contains a contrasting illustration of the fate of a feature which had been found to be absent in one of the figures; his vague awareness of the non-general red internal details and his disregarding of them stand in a striking contrast to his clear awareness and immediate description of such a feature as that of triangularity. *E*, Zalof, first recall, p. 144.

⁹⁹ Cf. *B*, Deral second definition, awareness of having attended to curve of right periphery in every member of the series, p. 129: In this last instance, much light is thrown upon the nature of the awareness in question when we contrast it with the accompanying consciousness that another feature (the angular base) had not been observed in all of the figures. This latter consciousness evidently consisted in a turning back to the series—an awareness in visual terms that she was uncertain as to the presence of the feature in the first members of the group. Her behavior toward her images of this latter feature was thus markedly different from her behavior toward the images of the right periphery; in the latter case she proceeded immediately to describe the feature as a part of her definition of the group, without any interrupting tendency to turn back to the series. It appears that in this instance, at least, *B*'s experience of generality was far more rapid and transitional than her experience of uncertainty regarding generality.

features, momentarily prominent in consciousness, were general—a knowledge-content, of imaginal nature, that they had occurred in all the members of the group—and it was in part the conscious behavior—clearness relations and temporal relations—of the imaged general features themselves, with the response to these features.

III. At a third stage the experience of generality consisted almost entirely in the above-described behavior of the general features in consciousness, *i.e.*, in the fact that the general features appeared and were mentioned readily and unhesitatingly at times when the observer was in a situation, momentarily at least, of recalling essentials. The general features now appeared to consciousness in a single schematic image, which the observer sometimes described as a vague presentation definite only in the possession of certain features—the general ones. These latter he attended to and mentioned as essential without more ado. This image appeared in a situation of naming essential features, *i.e.*, at the outset of the spoken recall, or when the observer set out to state “what a Zalof (or Deral) is”; the observers reported no effort, or tendency to turn to other images for verification. It occasionally happened, however, that particular images in which the feature was prominent appeared later in spontaneous fashion.

This behavior in consciousness of the imagery of the essential features was sometimes merely described, without being labelled as an awareness of generality.¹⁰⁰ At times the observer explicitly stated that no effort was present, and no tendency to turn to other features for verification. It was simply a case in which the typical image prevailed, with certainty or with greater prominence or both.¹⁰¹ Again, an observer not only described the image and mentioned its prevalence and the absence of a tendency to turn to other images for verification, but also labelled the experience as a

¹⁰⁰ *A*, Zalof, twelfth and fourteenth recalls, pp. 115 f.; Deral, tenth recall, pp. 118 f.; Tefoq, second recall, p. 119; Kareg, third recall, p. 121. *B*, Zalof, fifth recall, describing of visual image of first Zalof, p. 122. *C*, Zalof, third and fourth recalls, pp. 130 ff.; Deral, first recall, p. 135, fourth recall, all features save “heavy structure,” p. 136. *D*, Deral, fifth, sixth, and seventh recalls, pp. 141 ff.

¹⁰¹ *A*, Zalof, seventh recall, p. 115; Deral, sixth recall, p. 117.

“seeming to stand for the others,” or as “seeming to contain the essentials,” or as “being seen as a thing common to the group,” etc.¹⁰² Again, an observer sometimes reported that an experience of generality of the above-described sort became definite and explicit when a series of images which contained the feature appeared (*A*, Tefoq, fourth recall, “Chesapeake Bay indentation,” p. 120).

At times, however, the conscious experience of generality was less simple than the above-described behavior of the imaged general feature in consciousness. It was sometimes complicated by the addition of pleasantness.¹⁰³ Again, the observers reported vague remembrances—verbal and concrete—of past definitions and situations in which the feature had been described as common; or vague and fleeting imagery of the falling leaves or variations in the form of the feature occurred and functioned as “knowing” that the feature had been observed in all the figures.¹⁰⁴

In rare instances, an observer reported that the attending to the general features in the single image involved obscure contents as of the attention being centered upon the part of the figure in question. The implied attending away from other parts was interpreted as a consciousness of complexity of the figures (*C*, Zalof, fourth recall, p. 132). The same observer upon a later occasion labelled a similar experience as a consciousness of generality (*Kareg*, third recall, p. 135).

Again, the observers reported the additional presence of verbal images of “all,” “every,” “always,” and the like (*B*, Tefoq, fourth recall, imagery of green wash, p. 125 f.).

A remarkable instance of the development of the experience of generality regarding a certain essential feature occurred in three of *D*'s successive Deral recalls,—the fifth, sixth, and seventh, pp. 141 ff. The general characteristic of the existence of color on the left-hand side was present, in the fifth recall, as a series of different colors, localized on the left-hand side; the statement that “the left-hand side is colored” followed upon this. In the

¹⁰² *A*, Zalof, fourth recall, p. 114; Deral, fifth, and ninth recalls, pp. 117 f.; Tefoq, fourth recall pp. 119 f.

¹⁰³ *B* Tefoq, seventh recall, description of design and triangle. *C*, Deral, fourth recall, consciousness that the heavy structure was a distinguishing mark, p. 136.

¹⁰⁴ *A*, Deral, ninth recall, pp. 117 f. *B*, Tefoq, tenth recall, p. 127.

sixth recall, color appeared first in verbal form—the word “color”—and *D* was aware of a series of shifts of attention, which he interpreted as an effort to determine which side of the figure was colored. No effort of any sort was made to recall what the color was. As soon as a trace of color appeared on one side (the left) he made the statement that ‘the left-hand side is colored.’ In the seventh recall, the word “color” was followed by a turning of attention to the left of the image, and by the statement that the left-hand side was colored—no actual color appearing. Here is evidently a growing tendency for attention to turn away from the varying color-quality toward the essential color-location; and it is a striking confirmation of the thesis of the present section, that under the conditions of our experiment the experience of the generality of a feature soon becomes reduced to a brief experience of the behavior of the general feature in consciousness, and the fact that its mention as general immediately follows; additional “cognitive” contents which were at first present became stripped off, as time passed.

Thus at Stage III it appears that the experience of generality consisted essentially and for the most part exclusively in the behavior of the general features in consciousness—the way in which they were present, their clearness and temporal aspects—and in the fact that they were immediately and readily described as general. It was obviously and strikingly an experience which cannot be described alone in terms of structural contents—qualities, intensities, extensities—but which essentially included functional factors. The latter were, of course, inseparably bound up with the former.

IV. At this stage the experience of generality was nothing more than the unhesitating, ready, and even mechanical mentioning of the general features as “what a Zalof (or Deral) is”; and the fact that these features appeared, as single verbal or schematic concrete images, in ready and easy and uncontested fashion as soon as the observer was placed in a situation of recalling the essentials. Sometimes verbal images of “always” or “all” occurred with the imagery of the features themselves; but usually these words were uttered in spontaneous fashion with the spoken recall. The generality experience was based essentially upon nothing more than a highly mechanized association between the words “Zalofs (or Derals, etc.) are objects having,”—or “Zalofs *always* have,”—and the enumeration of the essentials. The recalls were often given in a very automatic fashion.¹⁰⁵

¹⁰⁵ Cf. recalls of Stages V and VI with *B* and *C*, and of Stage X with *D*, and of Stages V to X with *E*. Cf. also *B*, Tefoq, eleventh recall, description

d. **The Experience of Non-generality.** Under the conditions of our experiment, it almost invariably happened that after a process of generalizing abstraction had been terminated by the noting of the absence or of a critical alteration in any figure of an essential feature, this feature subsequently occurred in one or more images, and failed to occur in other images, when next the observer set out to recall. Features which were noted only in a single figure failed very frequently to appear at all in the next recall. The experience that a feature was not essential usually consisted in this fact, that the feature appeared in some images of the original series, and failed to appear in others.

Nevertheless the introspections contain indications that the experience of non-generality, like that of generality, underwent a progressive evolution as the experiments proceeded.

I. At the outset, the experience of non-generality consisted in the noting that a feature was absent in certain figures of the series. When a process of generalizing abstraction was terminated by an observer's failure in some figure to discover the feature under investigation, he abandoned the search; occasionally the abandoning was marked by kinaesthetic and organic tensions and by unpleasantness. These contents were often exceedingly obscure, and they were sometimes labelled by the observers as states of doubt, hesitation, and the like (*D*). Sometimes the observers reported, in addition, the presence of imagery of words which expressed either the absence of the feature or its non-generality (*cf.* p. 180).

II. If a feature had thus been found to be absent in some members of the series, one of two things happened when next the observer set out to recall. Either the feature failed to appear at all, or else—as was more frequently the case—the feature came to consciousness in the recall imagery, sometimes as a series of changes in a single concrete visual image (*D*, Deral, fifth recall, color fluctuations in initial visual image, p. 141, *et al.*), and sometimes as a characteristic which was present in some but absent in other members of a series of visual images.¹⁰⁰ The appearance of the non-general features was sometimes accompanied by imagery of words of past recalls, in which the non-generality of these features was expressed (*A*, Zalof, twelfth recall, p. 115). When the non-essential feature was present in the recall imagery, the observers either mentioned it as 'what a Zalof (or Deral) may have',¹⁰⁷ or else they turned away from it or even inhibited its mention, in of the pronunciation of the auditory verbal imagery, with ease and additional situation-imagery which was labelled 'familiarity'; p. 128. In no instances did the observers ever refer to their experience as a consciousness or awareness that the features named were common.

¹⁰⁰ *Cf.* recalls of Stage I, especially those of *A* and the following: *B*, Zalof, fifth and ninth recalls, pp. 122 f.; Tefoq and Deral recalls, pp. 124 f., 129 *D*, Zalof, third recall, p. 138. *E*, Zalof, first recall, p. 144.

¹⁰⁷ *Cf.* *B*'s and *A*'s recalls of Stage I, pp. 112, 122, 129; *D*, Zalof, second, third, and ninth recalls, pp. 137 f., 139; *et. al.*

kinaesthetic and vocal-motor fashion.¹⁰⁸ Sometimes, again, they entirely ignored the feature in their spoken statements, and were for the most part only occasionally and vaguely aware of it.¹⁰⁹

Thus it is evident that here the observers had explicit imaginal information that a feature was non-general. In most cases, moreover, the non-general features were present in secondary fashion, often subsequent to the general ones, and almost always less focally and compellingly. Such features were either described or mentioned as 'what a Zalof may be', or else they were actively inhibited or ignored.

III. In certain cases it is possible to differentiate a third stage of the experience of non-generality, when the non-general features were present in a single visual image, and when the observer possessed no image in which it was lacking. The observers thus possessed no imaginal information that the feature was non-general. The experience of non-generality now consisted at times wholly in the behavior of the non-general feature in consciousness, and the observers' subsequent treatment of it, *i.e.*, in the fact that the feature did not become definite or focal in consciousness, and that it was ignored, omitted in the statement of the recall.¹¹⁰ This experience was sometimes complicated by verbal imagery of words which expressed the non-generality of the feature, or by a vague memory of a past situation in which the observer had been uncertain as to whether the feature had been present in a part of the series.¹¹¹

IV. A fourth level in the development of the experience of non-generality was that which was present in the highly mechanized recalls in which non-general features were mentioned; it consisted in the appearance of the words "may have" or "sometimes has" in conjunction with the description of the feature, which latter followed in easy and unhesitating fashion.¹¹²

e. The Experimental Task. From the foregoing account it appears that the experiences of generality and of non-generality cannot be adequately described in terms of sensory qualities and intensities alone. At the outset, to be sure—when the material was relatively novel to the observer—either experience involved

¹⁰⁸ C, Kareg, third recall, treatment of feature of angle of joining of two sides, pp. 134 f.

¹⁰⁹ D, Zalof, third recall, p. 138, and ninth recall, treatment of red internal parts, pp. 139 f.

¹¹⁰ Cf. D, Deral, second recall, blueness, p. 140; sixth recall, brown color on the left, p. 142.

¹¹¹ Cf. D, Deral, second recall, treatment of relative backward extension of the two parts of the figure, p. 140. D was unable to give a complete description of this experience, excepting to call it a reinstatement of a former vague, diffuse kinaesthesia of wondering, which occurred with the verbal image. This is the only experience of the sort which he reported, and in view of our absence of data, we are scarcely justified in attempting its interpretation.

¹¹² B, Zalof, sixteenth and eighteenth recalls, pp. 123 ff. E, any of the recalls of Stages V to X.

such contents as constituted more or less complete imaginal information that the feature was general or that it was non-general. But as soon as the material had been examined frequently by the observers, these experiences came in many instances to consist exclusively in the behavior of the general or non-general features in consciousness—their clearness and persistence, and the fact that certain definite sorts of processes or conscious situations preceded and followed them. The explanation of the nature of the experiences of generality and of non-generality is obviously to be sought in the experimental task, and in the situation and context in which these experiences appeared. If under our experimental conditions non-general features had been stressed—if the task had been one which necessitated the selecting and retaining of variable features—there is no reason to believe that the behavior in consciousness of these features would not be identical with that now exhibited by the essential features. Our instruction gave rise from the outset to a succession of processes of examining and stressing the common features; and it therefore increased the survival-value of these features and led to a strong association between them and the group-name, which latter revealed itself to consciousness in the peculiar manner of appearing of the common features in response to the conscious situation of stating “what a Zalof (or Deral, etc.) is.”

For the most part, the characteristic processes which normally followed upon the experimental task of defining did not actually show themselves in operation during the course of the recalls. The general features were not now being selected, but instead they came to consciousness with the stamp of priority and attention-compelling power already upon them; they had previously been selected out and their more vivid revival was merely a specific case of the validity of the law that stimuli which have repeatedly been attended to possess a proportionally greater survival value. Under certain conditions, however, the processes of selecting were operative during the recalls. This was most markedly the case when the observations of the figures had not been characterized by the presence of the process of generalizing abstraction, but when instead the figures had been treated as wholes (*cf.* pp. 90 f., 107 f.). Under these conditions, this process was post-

poned into the recall, and the observer now attempted to select out of his wealth of imagery the features which were common to all; he reviewed images of the figures, and the common features came to stand out in them successively, with more or less effort.¹¹³ These repeated reviews of visual imagery, with the operation of the process of generalizing abstraction, had the same effect for subsequent recalls that the perceptual abstraction-process did, *i.e.*, the essential features later came to appear already emphasized, and to be described unhesitatingly as essential (*cf.* *A*, recalls of stage III).

It occasionally happened that the processes which normally operated upon the basis of the percepts of the figures appeared in the recalls in a far more mechanized and less effortful form than that described in the preceding paragraph. The observer now experienced the priority and greater clearness of the imagery of the features which had been the objects of generalizing abstraction; and he also experienced contents which apparently were vestiges of the kinaesthesia and attention-play which had been involved in the process of abstraction. One group of these less effortful processes appeared in those recalls in which the observer reported that he more or less voluntarily turned away from non-general features.¹¹⁴ A still more mechanized form appeared in *a.* those recalls in which an observer turned away from the non-general features in spontaneous fashion (*D*, Zalof, third and ninth recalls, treatment of color, pp. 138 and 139; Deral, second recall, treatment of cilia, p. 140); and *b.* in those recalls in which the naming of a feature as "what a Zalof is" was accompanied by motor and kinaesthetic contents of fixing the attention on a certain region, or of rapid focussing upon a certain region in successive figures, with its inherent implication of something focussed away from. No actual selection was made, however, for no particular features had appeared to consciousness (*C*, Kareg, third recall, p. 135; Zalof, fourth recall, p. 132).

¹¹³ *A*, Zalof, first recall, p. 112; third recall, p. 113; fourth recall, pp. 113 f., fifth recall, p. 114.

¹¹⁴ *A*, Zalof, fourteenth recall, treatment of size, p. 116; Deral, tenth recall, treatment of colors, pp. 118 f. *C*, Kareg, third recall, treatment of angle of juncture of two sides, pp. 134 f.

The task of defining, then, whether or not it realized its influence in processes which operated in connection with the percepts of the figures during the exposures of the series, or upon the images of the figures during the recall, was directly responsible for the nature of the experience of generality in our experiments. This influence consisted in a stressing by attention of similar features, in a situation of determining what a Zalof, or Deral, etc., was; and hence, when the situation of telling "what a Zalof is" recurred at a later time, the similarities thus emphasized would tend to recur in a fluent fashion. This is what they actually did: and their fluency—apparent to consciousness in the way in which the general features were present, their clearness and duration aspects—functioned, alone or with additional contents, as the experience of the generality of the features.

The influence of yet another task occasionally realized itself in the recalls. The instructions to confine the concept-meanings to the pictures shown,—to refrain from seeking for associations, but not to inhibit such associations as should spontaneously appear—evidently revealed itself in instances when such associations occurred and were inhibited by the observers in deliberate fashion (*C*, Zalof, third recall, p. 131; Kareg, first recall, p. 134). The inhibiting of the associations consisted in the fact that their appearance in consciousness was followed immediately by verbal imagery, and by kinaesthesia of pushing them aside, or of rejecting them, or of turning away from them.

f. **The Interpretation or Labelling by the Observers of their Experiences of Generality and of Non-generality.** As we have already pointed out, the observers sometimes merely described or indicated the manner in which their imagery of general features appeared in consciousness, *i.e.*, its clearness and temporal aspects, and its being unhesitatingly mentioned as general, while at other times they not only described this factor, but labelled it as an awareness that the feature in question had appeared in all the members of the series. When this experience was complicated by the addition of pleasantness, imagery of the falling leaves of the booklet, and other components, the observers often affixed some label of generality to the complex. A similar state of affairs obtained with the experience of non-

generality; the observers sometimes merely described or indicated this experience, while at other times they not only described it, but labelled it as an awareness that the features were not essential, or that certain features must be excluded. Hence it appears that in a number of instances, experiences which were described in practically identical fashion were sometimes not labelled at all, and at other times were labelled as an awareness that the feature was essential or non-essential.¹¹⁵ Again, an observer occasionally labelled very similar attention-experiences in different ways, at different times.¹¹⁶ Attention-experiences which resembled one another closely were described by one observer, and described and later labelled by another.¹¹⁷

When we examine the instances in which observers labelled an experience as an awareness that an image stood for the others, or an awareness that a feature was common, a number of facts stand out: *a.* Such instances were relatively infrequent. Out of a total of 164 recalls, they were reported in only 19 cases. Out of a total of 86 well-marked experiences of non-generality, only four were labelled. *b.* Of the 16 labelled experiences of generality, 8 were reported by *A*, 4 by *B*, and 2 each by *C* and *D*. In no case did *E* interpret or label an experience of generality or non-generality. *c.* Of the 20 labelled experiences of generality or of non-generality, 7 were complicated by the presence of more or less intensive experiences such as pleasantness, verbal images of "all," etc., imagery of falling leaves, and situation-imagery (pp. 167, 169), or by auditory-verbal imagery of introspecting or de-

¹¹⁵ Cf. *A*, Zalof, seventh recall, p. 115; Deral, sixth and tenth recalls, pp. 117, 118 f. *D*, Zalof, second recall, pp. 137 f.: In all of these, a typical image prevailed with certainty and greater prominence. In the following recalls, the same phenomenon was labelled as a "seeming to stand for the others," or as a "seeming to contain the essentials"; *A*, Zalof, fourth recall, p. 114; Deral fifth and ninth recalls, pp. 117, 117 f. *D*, Deral, second definition, nature of attention to various "common" features, pp. 139 f. Cf. also *D*, Zalof, third and ninth recalls, awareness of red as a particular characteristic, pp. 138, 139, and Deral, fifth recall, series of (particular) colors, p. 141.

¹¹⁶ *C*, Zalof, fourth recall, attention-kinaesthesia of focussing labelled "awareness of complexity", p. 132, and Kareg, third recall, attention-kinaesthesia labelled as awareness that certain features were general ones, p. 135.

¹¹⁷ Cf. *A*, Zalof, fourteenth recall, treatment of size, p. 116, and *D*, Zalof third and ninth recalls, treatment of red, pp. 138, 139.

fining; while two were characterized by unusually intensive attention-kinaesthesia. These 7 experiences included those reported by *B* and *C*, and one of those of *A*. The remaining 11 experiences were reported by *A* and *D*; they consisted essentially in the manner of appearance of the features, and in the events which followed them. *d*. In a few instances, the interpretation or labelling was obviously given upon the attracting of the observer's attention to the process, either directly in the course of his introspecting, or in response to a question of the experimenter's.¹¹⁸ *e*. Up to the time when the highly-mechanized form of Stage IV was reached, in which no experience of generality was labelled, the greater number of mentions of generality or of non-generality occurred during the later experiments, with the second or third series to be presented. Thus, *A* labelled two experiences of generality or of non-generality in his 14 Zalof recalls, four in his 12 Deral recalls, and 2 in his 6 Kareg recalls. *B* labelled 2 such experiences in the Tefoq, and 1 with the Deral, series; *C*, 3 with the Kareg and 1 with the Deral, and *D*, 1 with the Zalof and 3 with the Deral recalls.

It appears then from the above indications that the labelling of an experience as an awareness that a feature is general or non-general was to some extent an individual matter. One of the observers never affixed such a label, another did so relatively frequently. Other conditions which marked the labelling of the experiences of generality or of non-generality were such as obviously served to emphasize these experiences in consciousness. Often the condition was the presence of additional attention-compelling components; sometimes it was the directing of attention upon the experience by a question of the experimenter's, or by a comment made by the observer himself during the introspection. Again, as the experiments progressed, the observers undoubtedly became more familiar with the object of the experiment, and it is highly probable that the more frequent references

¹¹⁸ Cf. *D*, Zalof, third recall, "that statement betokens the existence of an *Einstellung*", p. 138; Deral, second definition, pp. 139 f.; second recall, "I was not tempted to say that Deral is invariably blue", and "when I look back, I realize that I don't regard hair as being of equal essentialness with color," pp. 140 f. *C*, Kareg, third recall, p. 135.

to an awareness of the generality or non-generality of a feature were due to the growing interest in, or apperceptive habit of pointing out anything that might be interpreted as an experience of generality or of non-generality within certain limits of mechanization. Further evidence for this view is furnished by C's two interpretations of a similar attention-experience. The first interpretation, given early in the experiments, was one of a consciousness of complexity; the later one was that of an awareness that certain features were general (Zalof, fourth recall, p. 132, and K̄areg, third recall, p. 135). It is not unlikely that the observer who most frequently labelled his experience was more interested in the problem of abstraction and the general concept; in a number of instances he had commented to the writer upon differences between abstraction and generalization which he had found in his reading. So, while our data are far too meagre for definite conclusions, they indicate that any sort of factor or content which draws the attention to the experience of generality more markedly than to other experiences favors the subsequent application to it of a label.

It is obvious that under the conditions of our experiment, the dominant and ready standing-out of a feature in the situation of describing "what a Zalof is" would normally be followed directly by the description of the feature, and not by an additional interpretative response. In other words, the immediate significance of the easy advent of an image would be that of the answer to the question, "what do you recall about a Zalof?" The meaning or response "this is a general feature" would be slightly more remote. That is to say, the experimental situation gave to the easy and ready advent of the general feature a "this-is-a-Zalof" connotation, rather than a "this-is-a-general-feature" connotation. Hence it is not surprising that as a rule, the observers simply described the feature which came up, and did not stop to represent its generality to themselves in any specific fashion. Nevertheless, when certain conditions brought the phenomenon of this facile standing-out of the feature to unusually vivid attention, or when attention-compelling components occurred, the observers usually interpreted this experience as an awareness that

the feature was the thing to be described, the distinguishing mark; that it stood for the others, that it was common or general. These were obviously the interpretations which were most immediately in harmony with the situation.

g. The Experience of Doubt Regarding the Generality of a Feature. It sometimes happened that an observer did not begin the investigation of a given feature until about the middle of a series, and hence was not certain as to whether the feature had invariably occurred in the earlier members. At the time of the presentation in question, this uncertainty was present in terms of a peculiar behavior in consciousness of the feature, which was frequently complicated by additional affective and organic and kinaesthetic contents of an obscure nature which the observers sometimes labelled as doubt, or as a wondering whether the feature now being attended to had previously been present. The behavior of the attention here consisted in the fact that the investigating of the feature, or the immediately present figure, did not occupy so exclusive a position in consciousness as usual, but that instead the attention harked back to earlier members, *i.e.*, that images of such figures appeared and reappeared, or the observers even deliberately attempted to evoke imagery of the first members of the series, and to determine whether the feature was present in them. When next the observer set out to recall, he found that certain images were present in which the region of the feature was indefinite (*D*, Kareg, third recall, p. 143), or else he imaged falling cards bearing visual images in some of which the feature in question was present, while in others it was absent or the card was blank (*B*, Deral, second definition, recall of basal acute angle, p. 129; third recall, cilia, p. 129). Sometimes he questioned himself in verbal fashion—"every"? or "exception"? these words being imaged or innervated silently with rising inflection (*B*, Zalof, ninth recall, "horn" characteristic, p. 123). Again, an observer reported that his doubt regarding the generality of a feature consisted essentially in obscure organic and kinaesthetic contents ("*Bewusstseinslagen*"), with a prolonged attending to the feature (*D*, Deral, sixth recall, p. 142). The imagery of the uncertain feature usually persisted or recur-

red, and served, when next the series was presented, to initiate an investigation of the feature.

h. Imagery of General and Non-general Features. Such data as our experiments have yielded concerning the imagery of general and that of non-general features point to the conclusion that there exists no essential structural difference between the two sorts of imagery, provided they are compared at analogous levels. Both may be detailed and definite, both may be vague and fleeting. Both tend to evolve from a distinct and complete form to an indistinct and fleeting form. Both tend ultimately to give way to verbal imagery.

These statements are illustrated in eight of *B*'s successive recalls of the Zalof series,—the ninth to the sixteenth inclusive—in which she introduced detailed descriptions of particular features; and a study of her introspective records reveals the fact that the imagery which represented particular features tended to pass through the same series of progressive changes as did the imagery which represented general features, *i.e.*, it embraced, at the outset, numerous and detailed images of different Zalof figures, while later it tended toward a verbal form, the features now coming up in images of words which designated them, prefixed by such expressions as 'Zalofs may have' or 'some have'. Table II (p. 111) shows the stage of development represented by the recalls both of the general and of the particular features in the eight recalls; the stages attained by the remembrance of the particular features are introduced in italicised numerals: *B*, Zalof ninth and sixteenth recalls, pp. 123 f. *C*, Zalof, fourth recall, presence of particular features, pp. 131 f., as compared with first recall, presence of general features, p. 130.

Since, then, the imagery of particular features, like that of general ones, began to occur fleetingly, indistinctly, and in isolation as the number of the observers' examinations and recalls of the non-general features increased,—or in other words, since both followed the same course of mechanization, under similar conditions—it appears that the difference between the imagery of general and that of particular features is not one of structure. We cannot say that general features inherently tend to be present in vague, colorless, and attenuated form, while particular features are clear, vivid, and detailed. The distinction between the two sorts of imagery is rather one of function—of their conscious situations, of their behavior in consciousness, and of the fact and nature of the processes which succeed them.

Nevertheless, our experimental task gave rise, in many cases, to an apparent structural difference between the imagery of general and that of non-general features. The general features were more closely attended to and more often recalled and described than were the non-general features; and hence they merged more rapidly into a mechanized form than did the latter. Consequently it frequently happened that during the same recall, the general features appeared in vague, schematic form, while the non-general ones appeared in distinct and detailed fashion, often with accompanying situation-imagery or localization in the series. Indeed, with three of our observers, the non-general features never attained any marked degree of mechanization. Still, we are convinced that this apparent difference was due not to any inherent difference in the distinctness and completeness of the imagery of general and of non-general features, but rather to our experimental conditions themselves, under which the imagery of general features became mechanized more rapidly than did that of non-general features.

i. Individual Differences. The procedures of our five observers showed remarkable similarities as regard the fundamental nature of the conscious processes which were involved in the course of the recalls. Nevertheless, numerous individual differences occurred both in the details of these processes, and in the nature of the material in terms of which they operated. The important functional differences had to do, on the one hand, with the rate and the manner of the mechanization of the four concepts, and, on the other hand, with the prevalence of the influence of the experimental task of defining in the recalls,—the extent to which the observers reported individual or non-general variations of the figures. The structural differences had to do with the image modality which was favored by the various observers at different levels, and with the nature of the imaginal substitutions which occurred.

1. *Functional Differences.* *a.* The rate of mechanization of the four concepts. The difficulty of comparing the recalls of different observers from the point of view of degree of automatization is of necessity very great. We have chosen as a criterion of automatization the serial number of the recall at which the obser-

ver began to report consistently that a part at least of his spoken recall was repeated automatically, after it had been "set off" by some content, visual or verbal. No high degree of quantitative accuracy can be claimed for such a method; but it seems to be the only one open to us, and we present the results for their indicative value only. Table III contains, for each observer, the number of recalls which had been given before the observer began to report consistently that more or less extensive parts of his recall were given in automatic fashion. A dash indicates that no true automatization was attained; the number which follows in parentheses indicates the total number of recalls.

TABLE III

This table indicates the number of recalls given by each observer before a stage was reached at which the concepts had attained an automatic level. The dash indicates that no such level was reached; and the number which follows the dash, in parentheses, indicates the total number of recalls given by each observer. In this table, the observers are arranged in descending order on the basis of rapidity of automatization.

Observer	Zalof	Deral	Tefoq	Kareg
A	—(14)	—(12)	—(5)	—(3)
E	13	12	9	—(7)
B	11	—(5)	10	
C	8	—(4)	—(2)	—(5)
D	5	—(7)	—(3)	

Table III reveals the presence of wide individual differences in the rate of automatization of the concepts. These differences are, in great measure, correlative with the number of features which the observer noted and reported. Table IV shows the percentage of features which each observer noted,—the total number of different features reported by all five observers being given a value of 100 per cent. The three columns arranged under each of the four concept headings contain respectively the percentages of notings of the total number of features, the percentages of notings of the general features, and the percentages of notings of the variable features.

In Tables III and IV the observers are arranged in descending order as regards respectively the relative slowness of mechanization, and the relative number of features reported. A comparison of the two tables reveals the fact that the two observers whose

recalls mechanized most rapidly (*C* and *D*) not only reported the fewest features, but also reported a smaller number of variable features. Moreover the one observer (*A*) whose recalls failed to mechanize was the only individual who reported the finer details of the figures, such as the nature of the minute structure of the terminal branchings of the Zalof figures, and the form of the indentation in the lower periphery of the Tefoqs. Even so, however, there is not a perfect parallelism between the rate of mechanization and the number of features reported, as is shown by the fact that in the cases of *A*, *B*, and *C* the respective serial orders are not identical in the two tables. The explanation for this lack of complete parallelism is to be sought either in the inadequacy of our method of computations, or in the individual differences in the dispositions of our observers, or in the differences among the observers in the interpretations which they placed upon analogous sorts of processes.

TABLE IV

The data included in this table show the percentage of all the observed features which were noted by each observer,—the observers being arranged in descending order of percentage. Of the three columns under each concept heading, the first shows the per cent of the total number of features observed, both common features and non-common features; the second column shows the per cent of common (general) features observed by each observer; and the third column shows the per cent of non-general (variable) features observed by each observer.

Observer	Zalof			Deral		
	Total	General	Variable	Total	General	Variable
<i>B</i>	80	77	84	87	94	79
<i>A</i>	77	92	61	74	65	82
<i>E</i>	69	69	69	48	65	28
<i>C</i>	38	54	23	35	59	09
<i>D</i>	34	30	38	35	41	29
Observer	Tefoq			Kareg		
	Total	General	Variable	Total	General	Variable
<i>B</i>	95	83	92			
<i>A</i>	58	78	38	58	100	38
<i>E</i>	58	78	38	84	100	77
<i>C</i>				68	100	54
<i>D</i>				26	66	07

b. The extent to which the experimental task of defining dominated the recalls. While all of the observers stressed the essential features in their recalls, and while in every case non-general features tended more and more to drop out in progressive

recalls, still it is true that certain of the observers reported a greater number of individual variations than others, and that some observers even ignored variable features, or inhibited in kinaesthetic fashion, the mention of these features. Table IV reveals the fact that *B* and *A* usually reported the greatest percentage of all variable features noted, and *D* and *C* the smallest. *D* frequently reported or indicated that he omitted to mention variable features which appeared in his recall imagery, while *C* at times inhibited the mention of such features, rejecting them in kinaesthetic fashion (*cf.* imagery of particular features, pp. 171 f.), a behavior in which the influence of the experimental task clearly realized itself.

2. *Structural Differences*: The structural differences among our observers were concerned with *a.* the modality of imagery which was preferred, and *b.* with the nature and rate of the substitution of one sort of imagery for another in the course of the recalls,—the extent to which different observers failed to reveal certain stages, and revealed others in a prolonged form.

a. Imaginal preferences among the observers. As regards the sort of imagery which was preferred in our experiments, our observers represent widely diverse types. All of the observers employed concrete visual, auditory verbal and vocal-motor verbal imagery. The concrete visual imagery of every observer varied, for the most part, within wide limits as regards completeness or fragmentariness, definiteness or vagueness, and the extent to which it was schematic. The amount of this variation, nevertheless, differed.

Two of our observers were characterized by an overwhelming preference, in our experiments, for a single sort of imagery. These observers were *A* and *E*; the former reported a surprising number and preponderance of concrete visual images, and the latter, of vocal-motor (and probably auditory) verbal images. *A*'s visual images included both particular and schematic forms. His particular images were sometimes so numerous and so uniformly clear and distinct and detailed that they actually impeded his spoken recalls, while at other times they were very vague and fleeting. His schematic visual images varied from a high degree of vividness, where they differed from particular images only in their lack of localization in the series and in the function which they subserved, to the vaguest outlines or splotches of grayish imagery, definite only in the possession of the most conspicuous general features. His images were sometimes relatively stable

and sometimes shifting. Again, his schematic visual images sometimes appeared in relatively sudden fashion, while at other times they developed slowly, from an initial exceedingly vague mass to which the general features added themselves one by one. Excepting for the remembrance of a single feature of the Zalof group in two recalls (the thirteenth, and the fourteenth, p. 116), *A's* recalls came entirely in visual imagery. Verbal imagery however made its appearance occasionally as part of the situation-imagery; it was usually auditory, but sometimes motor or visual. Definite verbal images of distinct words were rare; his auditory imagery usually presented the sounds of his voice in recalling or in introspecting.

E's dominant imagery was vocal-motor verbal, and probably auditory as well. His verbal imagery included words which designated general and particular features which he had noted, and also words of self-instruction. Concrete visual imagery was very infrequent; it was usually non-detailed, but definite in the possession of the features which the observer had noted. Very rarely, *E* reported the presence of kinaesthetic imagery of a concrete sort—imagery of tracing the outline of a figure, or imagery of indicating, by a nod of the head or a turn of the eyes, the position of a feature which was otherwise present in verbal terms.

Upon certain occasions, *E* was asked to draw what he remembered of a group of figures. His efforts at drawing, and the conscious contents which accompanied them, furnish striking confirmation of the dominance of the verbal in his imagery; moreover, they show that the functioning of his verbal imagery was similar to the functioning of the visual imagery of the other observers. When confronted by the task of drawing one of the groups, *E's* attempts to draw invariably followed upon the appearances of verbal images such as were present in his recalls,—a verbal image appeared, and was followed by a corresponding movement of his drawing hand. The inadequacies of *E's* drawings consisted *a.* in a failure to include, or to draw with any degree of correctness, those features which he had not succeeded in naming (details of the tentacle-ends of the Zalofs, of the outline of the Derals). *b.* While no feature which was included in *E's* stock of images was ever omitted from his drawings (he drew several figures in representing the nature of the variations which he mentioned) his drawings of such features were incorrect in a rather peculiar fashion; his errors in drawing were clearly correlative with inadequacies in his verbal descriptions. He frequently failed to find appropriate words to designate certain features which proved to be difficult to describe in verbal terms; in such cases he contented himself with inadequate terms, and he frequently expressed dissatisfaction at the time of adopting them. Apparently, however, they subsequently sufficed as presentations in consciousness of the essential features which he observed. But when he was obliged to use these verbal presentations in drawing, he reproduced the features in a form which was more true to the verbal description than to the actual figures. For instance, he described the central body of the Tefoq as a 'cross section of a picture-frame', and he drew it as such a section,—*i.e.*, as two thickened planes at approximately right angles, rather than as the irregular figure which is actually present in the Tefoqs. The "crow's foot" figure was drawn by *E* much as a crow's foot-print would ap-

pear, instead of as it existed in the Tefoq figure itself (this was corrected, however, in a later drawing). The parts of the Deral which *E* called "notches" he drew as sharp (acute-angled) cuts, instead of as the curved indentations which were actually present in the figures. The observer himself was not satisfied with his drawings; in an effort to improve them, he attempted in a number of cases to evoke visual images but without success. When a visual image did appear, it usually came after the drawing had been begun, and it sometimes served to correct a wrong start, or to assist the observer in continuing. At times when visual imagery failed, a number of mistakes were made which could hardly have been possible, if even an indefinite visual image had been present. For instance, the observer began to draw the "triangular body" of the Zalof; he finished one side and one "pseudopod," coming around to the proper place to start the second side, which should thence extend downward at an angle of sixty degrees from the first. Instead of drawing the second side in this direction, however, *E* started to draw a line in a direction which was practically a continuation of that of the first line. He presently discovered that he could not construct a triangle in that way; thereupon he erased a part of his sketch, and now drew the second side at an angle of approximately one hundred and twenty degrees with the first. This did not satisfy the requirements, and was in turn erased, to be followed by a line which served the purpose. It is difficult to understand how such errors as these could have been made if the observer had possessed even the vaguest concrete visual or kinaesthetic image of a triangle. *c. E* was wholly at sea when he attempted to draw those parts of the figure which were not present in verbal imagery. Here the features which were included in his imagery served as points of orientation; and his procedure consisted simply in drawing lines at haphazard to fill the spaces between.

The evidence presented in a former paragraph led us to conclude that the concepts which *E* formed under the conditions of this experiment were essentially verbal in their structural character; and this conclusion is corroborated by evidence derived from his efforts to draw the figures. Additional confirmation is furnished by certain experiments upon the process of classifying which will be published in a forthcoming number of the *American Journal of Psychology*. In these experiments, it turned out that *E* promptly refused to identify (*i.e.* to include under the given concept) every figure which failed to conform with the features represented in his verbal imagery of that figure, but he failed to detect omissions in essentials of outline, etc., no matter how conspicuous to the visual observer, if they were not included in his list of verbal representatives.

C stands in striking contrast both to *A* and *E* as regards variety of imagery. Her concrete presentations of the series were visual, and kinaesthetic and organic, the visual being most frequent. Her visual imagery was particular and schematic; and the schematic imagery varied in definiteness from the vaguest visual suggestions of line and direction to definite, distinct presentations. *C*'s concrete visual imagery was sometimes detailed and sometimes fragmentary or shifting. It occasionally varied widely in size from the original figures (Zalof, third recall, p. 131). *C* reported a slightly greater proportion of fragmentary imagery than any of the other observers; another peculiarity of her visual imagery was its occasional

merging into a form of eye-movement kinaesthesia, and its being accompanied extensively by motor and kinaesthetic contents (Zalof, fourth recall, p. 131). Other forms of concrete kinaesthetic contents in *C*'s case consisted in imagery of tracing the outlines of figures. But most remarkable of all were her peculiar kinaesthetic and organic components which constituted an internal imitation of the main lines and directions of the figures.¹¹⁹ In addition to her concrete imagery *C* employed much verbal imagery; this was usually vocal-motor, but sometimes it was visual and occasionally it was auditory. It was present in all degrees of completeness and definiteness, from mere vocal-motor fragments or strains to complete words.

As regards the extent to which they employed various kinds of imagery, *B* and *D* stand between *A* and *E*, on the one hand, and *C*, on the other. *B* was obviously nearer to *C*; the former made extensive use both of concrete visual, and of auditory verbal and vocal-motor verbal imagery, with occasional recourse to kinaesthesia of tracing outlines. Her concrete visual imagery included both particular and schematic, clear and vague, definite and indefinite forms. Her visual imagery was characteristically more definite and complete than *C*'s. *D* employed both visual and vocal-motor imagery, but no other kinds. His visual imagery included widely different degrees of definiteness, completeness, and rapidity of development in consciousness.

A, *B*, and *C* frequently reported that vague imagery of past experimental situations—visual, auditory, and kinaesthetic—constituted in many cases a kind of dim background for their recalls. The functions of this situation-imagery have been discussed (pp. 154, 160, 167, 169). For all of the observers, kinaesthetic and organic and affective contents appeared and functioned in certain situations as doubt, hesitation, or certainty. Two of the observers, *D* and *A*, occasionally reported awareness of mental effort, which they sometimes were unable to analyze into simpler components.

b. The Nature of Imaginal Substitutions during the Growth of the Concept. The imaginal substitutions which appeared as the recalls progressed invariably consisted in the replacing of rather numerous particular images by more schematic varieties of concrete imagery, and finally by verbal imagery. We have already indicated certain of the individual variations which were concerned with the omission or extension of certain of the stages which we have differentiated in the course of development of the concepts with increasing experience with the figures. Table V indicates those of the nine stages which appeared in the introspections of each observer, together with the number of recalls belonging to each stage. From the table, it appears that *A* and *E* represent extremes among the observers, *A*'s recalls being practically confined to the first three stages and *E*'s to the last six. *B* and *D* in the Zalof series remained relatively longer upon

¹¹⁹ Cf. Kareg, first and third recalls, pp. 134 f; Tefoq, first recall, p. 137.

TABLE V

Table showing the stages which occurred in the development of each concept of every observer, together with the number of recalls of each stage. The numerals from 1 to 10 which head the columns refer to the ten successive stages; the numerals opposite the observers' names indicate the number of recalls of the stage whose number heads the column. Thus *A* had three recalls of stage 1, etc.

Obs.	Zalof										Deral									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
<i>A</i>	3	8	2	.	.	.	.	.	.	.	2	2	8	.	.	.	.	.	.	.
<i>B</i>	4	.	.	4	3	7	.	.	.	.	2	.	.	2	1	.	.	.	.	.
<i>D</i>	6	.	.	.	.	.	.	.	1	3	1	.	.	4	2	.	.	.	.	.
<i>C</i>	1	.	.	3	2	6	.	.	.	.	2	.	.	1	.	.	.	.	.	.
<i>E</i>	.	.	.	1	1	6	2	3	2	4	.	.	.	.	2	4	3	2	1	2
Obs.	Tefoq										Kareg									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
<i>A</i>	.	.	6	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.
<i>B</i>	3	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D</i>	.	.	.	.	.	.	.	.	.	.	1	.	2	2	.	.	.	.	.	.
<i>C</i>	.	.	.	.	.	.	.	.	.	.	3	.	7	7	.	.	.	.	.	.
<i>E</i>	.	.	.	.	1	8	.	.	.	.	.	.	.	.	1	6	.	.	.	.

earlier stages than *C*, but they made a more sudden transition to verbal forms. *C*'s progress, on the other hand, was more uniform; her remembrances tended to pass more evenly from particular forms, through more and more schematic visual-kinaesthetic forms, to an entirely verbal stage. In the Deral and later series, *B* and *D* reported more schematic, and less particular, imagery than in the Zalof series; and here, their transitions were much more uniform.

The fact that *A* remained upon the first three stages is one of many indications that he belonged almost entirely to a concrete type. A partial explanation for *A*'s remaining upon these stages is probably to be found in the nature of the features which he remembered; these were in some cases the finest details, for whose retention verbal imagery would be less readily adaptable, and hence the transition to a verbal form would be postponed. If such an explanation be accepted, however, it merely throws the burden upon individual differences in the sort of features observed; and we still have left the fact of wide individual variations among our observers.

j. Summary. In the foregoing sections we have described the evolution, both structural and functional, which the four concepts underwent in the course of our experiments. The experiences of generality and of non-generality we found to consist fundamentally in a specific behavior in consciousness, or manner of being present, of the general or non-general features; and we

traced the evolution of these experiences (for brief descriptions, *cf.* pp. 164, 171, 200 f.), as well as the conditions under which they were or were not labelled as such by the observers (*cf.* pp. 202 f.). We found the explanation of the nature of the experiences of generality and of non-generality to lie in the experimental task. We discovered no ubiquitous structural differences between the imagery of general and that of non-general features, but instead it appeared that the difference was a functional one. We finally pointed out certain individual variations which occurred among our observers.

V. SUMMARY

A. THE PROCESS OF GENERALIZING ABSTRACTION AND THE EXPERIENCES OF SIMILARITY AND OF NON-SIMILARITY. Our experimental arrangement proved to be successful in inducing the process of generalizing abstraction in a large per cent. of the observations of our five observers; and the introspective descriptions furnished in the various experimental sittings throw a flood of light upon the nature and peculiar characteristics of the process of generalizing abstraction, and of the experience of similarity.

a. **The Grosser Aspects of the Process.** 1. *Nature of the Process.* An analysis of our introspective records shows that the process of generalizing abstraction consisted in a peculiar series of conscious events which culminated in the standing-out of certain features that were common to the group of observed figures. This series of events may be described as follows: The visual attention was confined, in the successively-appearing percepts of the figures, to certain definite features which had attracted notice. The chance noting of a feature,—its momentary standing-out in consciousness,—did not mark the termination of an observer's experience with that feature, but instead it marked the beginning of a series of experiences in which attention returned in each later figure to the region of that feature. Or in other words, the observer usually ceased at an early date to perceive the figures as wholes; after the first two of three exposures, his perception of the figures came to be composed of contents the most prominent of which were the common or repeated features, and the least prominent were the features which were not repeated. If the repeating feature were a conspicuous one, the "returning of attention" to it consisted simply in the fact that this feature flashed out in consciousness immediately upon the exposure of the figure, without any effort on the observer's part, *i.e.*, without eye-kinaesthesia, strain, or the like. If the repeating feature were relatively obscure, sometimes even when it was prominent, the "returnings of attention" were marked by experiences of searching—eye-movement and other kinaesthesia—

or the "returning" followed upon intentions or determinations to focus upon the region in question.

2. *The Initiation of the Process.* The consciousness which intervened between the hearing of the instructions and the perceiving of the first figure of the series contained for the most part nothing more than kinaesthetic and visual processes which functioned in their setting as an adjustment to the apparatus, and to the instructions. This adjustment was frequently labelled as an intention or *Aufgabe* to make a careful observation of the figures; it tended to become less prominent in consciousness and less complex in its conscious constituents as the experiments progressed. Otherwise the processes of generalizing abstraction which occurred under the conditions of our experiment were for the most part initiated upon the standing-out for the first time of the abstracted feature, without any previous self-instruction or intention which related specifically to some pre-conceived plan of observing, or of obtaining a definition. This initial standing-out of the feature was followed immediately by persisting focality of that feature, usually with additional components of tensions about the eyes, throat, and elsewhere, by marked kinaestheses of visual fixation, by visual images of past figures in which the region now under consideration was prominent, by verbal characterization of the feature in question, by imaginal or sensory contents which functioned as tentative generalizings or as definings of the feature, and the like. In certain cases, any or all of these contents were merely described; in other cases they were not only described, but also labelled as intentions, *Aufgaben*, and the like, to investigate the focal characteristic. Upon the appearance of the next stimulus, the feature in question (if repeated) stood out, as described in the preceding paragraph, and the process of its generalizing continued.

3. *Concomitants of the Process.* In many instances the process of generalizing abstraction was marked by such components as tensions, strains, organic and affective contents, which were similar to those characterizing the initial discovery of the feature (*cf.* preceding paragraph), and which in their present setting functioned as an awareness of something to be done, of hurry,

of unusually close attention, and the like. The appearance and nature of such components depended upon four conditions:

1. The resistance which the figures offered to the operation of the process of generalizing abstraction. When conspicuous repeating features were present, and when the progress of the investigation was not interrupted, the observers reported diffuseness of attention, alternating with intensive kinaesthetic and organic and unpleasant-affective processes which they labelled as discouragement.
2. The earliness or lateness of the sitting in the series of experiments; with a number of observers, kinaesthesia and organaesthesia were more numerous during the earlier experiments.
3. The extent to which new features had been discovered and generalized during the immediately-preceding presentations of the series; when the observer had ceased for a time to find novel features, the discovery and investigation of such a feature was more frequently marked by kinaesthesia and organaesthesia.
4. When a previously generalized feature regarding whose generality the observer had become doubtful was being re-investigated, kinaesthetic and organic and affective contents were particularly likely to be present.

4. *Structural Basis of the Process.* The structural contents of the process of generalizing abstraction usually consisted in the visual qualities in their spatial arrangements and intensities incidental to the visual percepts of the figures. The process consisted in the nature of these succeeding percepts—their shifting clearness-relations, the particular regions of them that were successively emphasized—with or without additional kinaesthetic and organic and affective contents. Not infrequently, however, the observers reported that visual images of past figures persisted, or that visual images of oncoming figures occurred, and were compared with the present perception. The comparing consisted in the fact that the similar or different feature or features stood out in more or less rapid alternation both in image and percept. These images clearly did not change the essential nature of the process of generalizing abstraction itself; they merely constituted additional contents in terms of which it revealed itself.

5. *Persistence of the Process.* The various processes of generalizing abstraction varied widely in persistence, in a fashion

dependent upon the nature of the process and the individual observer. The more focal and dominant processes persisted, in most cases, from their initiation until the close of the series, or until the discovery that the feature under investigation was absent. In a few instances a process of generalizing abstraction persisted even into the next presentation or presentations of the series. The less dominant processes, and those that occurred concomitantly with several others, were more frequently interrupted, or lowered in degree of energy.

6. *Number of Parallel Processes.* The possible number of processes of generalizing abstraction which ran their course during any one presentation of a series varied with the individual observer and with the nature of the process, being smaller, the more focal and energetic the process.

7. *Behavior in Consciousness of Non-general Features.* Features which the observer had found to be non-general were never deliberately turned away from; usually attention simply ignored them, or shifted away from them without returning for reinvestigation.

8. *Predominance of the Processes.* The extent to which processes of generalizing abstraction dominated the observations varied with the individual observer and with the nature of the process. At times an observation was dominated almost exclusively by the investigation of one or more repeating features, and individual features were either not noticed or not remembered; at other times, striking peculiarities stood out more or less focally. Again, generalizing abstraction was almost or quite absent; the figures were treated largely as wholes, and the similar features did not undergo accentuation with oncoming stimuli, but instead the observer attended focally to individual features. With this latter sort of observation, the observer, when immediately confronted with the task of defining, hurriedly reviewed a series of visual images of the figures in which the common features became focal; this review of imagery constituted the process of generalizing abstraction. Such observations involved an extreme lengthening of the very initial stage of the first type of observation, in which the process of generalizing abstraction prevailed in the percepts of the succeeding figures themselves.

b. The Finer Aspects of the Process: The Experiences of Similarity and Non-similarity. 1 *The Experience of Similarity.*

1. The persistence of the process of generalizing abstraction was primarily conditioned at each successive exposure by the observer's experience that a certain region of the stimulus under inspection was similar to a region which he had noted in the preceding stimulus or stimuli. This experience was intimately bound up with the generalizing process under which it invariably occurred, and with the experimental task; its nature depended also upon the extent to which the figures resembled one another. When a feature which was being investigated was definitely present, objectively, in the succeeding figures, it stood out focally for a longer or shorter time when attention and fixation turned to its region, and immediately the attention shifted in rapid and uneventful fashion to other parts of the figure. This specific behavior of the feature in perception,—the fact that it was experienced in the way in which it was, *i.e.*, the conscious nature of its temporal course and of the changes which it underwent,—constituted the simplest form of the experience of similarity of the feature, of recognition of or assent to its presence.

2. In many cases, especially if the process of generalizing were an energetic (prominent and dominating) one, the experience of similarity was complicated by the appearance of additional components. *a.* It often happened that relaxations and pleasantness appeared when focality or clearness shifted away from the feature under investigation. *b.* Again, kinaesthesia of nodding or of another form of assent occurred as the feature stood out. *c.* Verbal imagery of assent was sometimes present. *d.* The standing-out of the feature was occasionally followed by concrete imagery, kinaesthetic or visual, of a past figure. *e.* Sometimes the standing-out of the repeating feature was followed by an image of a word which served to designate it, and which was identical with a word formerly employed to signify the corresponding feature in a former figure.

3. Recognitions of non-general features. The experience of recognizing particular features occurred apart from the presence of a specific investigation, and usually at a time considerably after the previous noting of the feature, *i.e.*, in a subsequent

sitting. This experience itself consisted in a peculiar behavior of the recognized particular in perception, which was very similar to that of the repeating feature whose presence was affirmed,—that is, the feature stood out for a moment, more or less suddenly and compellingly, but did not in itself block the progress of attention, *i.e.*, the observer did not occupy himself with a close examination of its details in themselves. Instead, his attention passed immediately and readily to other contents,—the pursuance of an investigation of another feature, or concrete imagery of the previous seeing of the feature itself. The feature “fitted in,” *i.e.*, it was readily followed by imagery which functioned in its context as explicit awareness of previous dealings with the feature, or else by a continuation of the main tendencies of consciousness.

4. The peculiar behavior of the similar feature which constituted the essence of the experience of similarity was sometimes merely described by the observer, and sometimes described and labelled with such designations as recognition, or familiarity, or affirmation, acceptance, or verification, of the feature. When this fundamental experience was complicated by the addition of kinaesthetic and organic and affective and concrete or verbal imaginal components, the experience was in most cases labelled in one of the above-mentioned ways. These additional components functioned as a more explicit and distinct awareness or a genuine “conscious attitude” that the feature under observation was similar or identical with one seen in the past; and they apparently invited interpretation, or labelling. Our data also suggest that the calling of attention to the experience by means of a question lead at times to the application, retrospectively at least, of an interpretative label.

The nature of the additional components which developed, and the particular label which was applied to the experience of similarity, were functions of the conscious situation in which the experience occurred. When the experience was bound up with a process of generalizing abstraction, *i.e.*, when the object of the experience was a feature which was under investigation at the time, the additional contents consisted for the most part in kinaesthetic relaxations, in pleasantnesses, in kinaestheses and verbal images

of assent; and the experience was in almost every case labelled as a "verification" or an "affirmation" of the presence of the feature. When the object of the experience was not bound up with any process of generalizing abstraction, but was a variable feature, the additional contents were more likely to include visual imagery of past notings of the feature; and the experience, when labelled, was usually called a "recognition" or a "familiarity" or a "seeming known" of the feature. Thus it appears that the development or non-development of more or less elaborate "conscious attitudes," as well as the content of these "attitudes," was in accordance with the main direction of consciousness; and if these experiences were subsequently labelled by the observers, the label which was applied likewise harmonized with the total current.

2. *The Experience of Non-similarity.* 1. The experience that a feature which was being investigated was absent or altered in any figure was in most respects exactly the reverse of the experience of similarity. When such a feature was objectively absent or obscured in any figure, its region stood out focally when attention turned to it, and the course of attention and regard was halted abruptly. The altered region became unusually and persistently focal in perception.

2. This fundamental experience of absence or change of a feature under investigation was usually complicated by the addition of one or another of the following contents: *a.* Kinaesthetic and affective components which functioned in this setting as surprise. *b.* Kinaestheses of holding back the card, or of starting toward the apparatus. *c.* Verbal imagery of exclamations, or of naming the absent feature. *d.* Concrete visual or verbal imagery of the feature as it had previously occurred. *e.* Internal imitations of the altered region. The kinaesthetic-affective reaction varied with the circumstances under which the experience of the absence of the feature occurred; it consisted in pleasantness and relief when the noting of the absence occurred at a time when numerous general characteristics had been established, and when the discovery of a novel one would have aroused doubt as to the thoroughness of preceding observations. It consisted in unpleasantness and doubt when the observer had previously found it difficult to discover general features, or when a number of at-

tempts had met with failure. The kinaesthetic-affective reaction depended in large measure upon the individual observer. The diverse and often opposed character of these additional components appear to support the view that the specific behavior of the altered region in consciousness constitutes an important determining component of the experience of difference, and one which is relatively little subject to individual variation.

3. The experience of absence or alteration of a supposed essential feature was similar to the experience of absence of a feature under investigation, excepting that it was more focal, that the interference with the coursing of attention over the figure was more prolonged, and that the additional components were more numerous and intensive.

4. The experience of noting a novel feature invariably occurred apart from any process of generalizing abstraction. It consisted essentially in the fact that the feature claimed attention and stood out focally and persistently, and in this far it resembled the experience of absence or change in a feature under investigation. The events which followed immediately upon the experience, and which contributed largely to its conscious significance, were now different; and they depended on the conditions under which the novel feature stood out: If it were early in the experiments, or if the novel feature were in a region regarding which the observer was uncertain, its standing-out initiated a process of generalizing abstraction, with or without a previous tentative generalizing or defining of the feature: *i.e.*, it "meant," "Will it prove to be essential?" If the feature were obviously absent in images of past members of the series, or if it were in a region which the observer had previously found to be variable (*e.g.*, a particularly brilliant color, when color varied), no investigation ensued, and marked kinaesthetic and organic and other imaginal contents developed, which functioned as an "attitude" or explicit awareness of novelty.

5. The conscious situation—the presence or absence of a process of generalizing abstraction—was the essential factor in determining both the nature of any "attitudinal" components of the experience of non-similarity, and the label which was subsequently applied to the experience, whether the label were one of

“difference” or “novelty,” on the one hand, or of “intention” or “*Aufgabe*” or “wondering if the feature were essential,” on the other. When the experience had to do with the absence of a feature under investigation, the observer almost never labelled it as an awareness of novelty, or of difference. When the experience marked the initial standing-out of a feature, it was frequently followed by a process of generalizing abstraction, with or without a tentative generalizing or defining, and it was now labelled for the most part—when labelled at all—as an “*Aufgabe*” or “intention” or “wondering if the feature had been” or “would be present.” Rarely, however, it was labelled an awareness that the feature was new. When an experience of non-similarity had to do with a feature in a region which had been found to vary, or with a feature which proved to be absent in visual images of other figures of the series, the observers frequently referred to the experience as an awareness of unfamiliarity, or an awareness that the feature was new. Thus it appears that the process of generalizing abstraction, when present, lent the peculiar significance accruing to any experience of non-similarity which occurred under its jurisdiction; it was only when the novel percept failed to initiate such a process that an explicit experience of non-recognition was free to develop, or that the observer labelled the attention-experience as an awareness of novelty.

c. Individual Differences. 1. Our observers differed widely in the extent to which their observations were marked by processes of generalizing abstraction, on the one hand, or on the other hand by such components as the noting of striking variable features, associations, subjective reactions to the figures, etc. With four of the observers, generalizing abstraction constituted the main part of the procedure in dealing with the figures. In the case of one observer, however, the common features did not undergo emphasis in the percepts of the figures to any considerable extent, but instead the figures were treated largely as wholes. Toward the close of the sitting, when the task of defining was imminent, or when he endeavored to remember whether a feature which now attracted his attention had occurred previously, this observer turned to a series of concrete images of the figures, in which he looked for the common features, or the feature which

had attracted his attention. Thus the process of generalizing abstraction asserted itself tardily, and operated in imaginal instead of in perceptual terms.

2. The observers differed also in the number of processes of generalizing abstraction which ran their course during a single presentation of the series, and in the persistence and freedom from interruption of these processes. The number of concomitant processes varied from one to six. Moreover, the nature of the features which were habitually investigated by different observers varied; some observers concerned themselves chiefly with the noting of extensive parts of the contour, or with larger aspects of the figure, while others noted relatively circumscribed and easily nameable parts of the figure. Our observers ranged between two extremes, one extreme representing a type whose observation—number of investigations and magnitude of parts noted—was relatively extensive and non-circumscribed, but whose investigations were less persistent and more frequently interrupted; and the other representing a type whose observation was circumscribed, but whose investigations were relatively persistent, and whose information regarding the generality of the investigated features was more accurate and valid.

3. The observers differed in the extent to which their processes of generalizing abstraction were marked by the presence of kinaesthetic and organic and affective contents which functioned as sense of effort, as intention to investigate, and the like.

4. The contents in which the process of generalizing abstraction revealed itself always consisted partly in the visual percepts of the figures. Sometimes, however, they consisted largely in visual images of the figures; and occasionally they included concrete kinaesthetic imagery, internal imitations of the figures, and the like.

5. The observers differed in the manner and degree in which they supplemented their observations of the figures by verbal imagery (of naming the feature), or by kinaesthetic and organic imagery (of internal imitation of the figure, tracing its outline, etc.).

B. THE GENERAL CONCEPT AND THE EXPERIENCES OF GENERALITY AND OF NON-GENERALITY. a. Evolution of the Con-

cepts. The four concepts which evolved under the conditions of our experiment invariably passed through a series of progressive changes, both structural and functional. These changes were correlative with the increasing number of the observers' examinations of the figures. At the outset, the concepts appeared to consciousness in the form of numerous concrete and particular visual and kinaesthetic images. As the experiments progressed, these particular concrete images ceased to appear, and their place was taken by visual or kinaesthetic imagery of a more and more schematic form. Meanwhile verbal imagery was assuming a progressively more important rôle, until a stage was reached at which the concept appeared almost exclusively in verbal terms. The verbal images themselves became fewer and more telescoped and fragmentary, until finally the instructions to recall were followed immediately by a few statements descriptive of the prominent general features. At least ten fairly well-marked stages can be differentiated from the introspective records, although not more than six of these stages can be distinguished in the record of any one observer. Inseparably bound up with these structural stages was a series of functional changes in the course of which the concepts ranged from an initial form, where more or less effort and hesitation were present, to a final form which was marked by a high degree of ease and readiness of appearance of the concepts to consciousness. Stages which in different observers were structurally similar often manifested wide differences as regards the fluency and readiness with which the contents entered consciousness.

b. The Experience of Generality. The experience that certain features were general consisted fundamentally in a specific behavior, or manner of being present, of the features which the observer had noted in every member of the series. This experience likewise evolved in a fashion which was correlative with the number of the observer's past dealings with the figures. In its initial form this experience consisted in the fact that the general feature stood out in a series of concrete images or percepts and was straightway mentioned as essential. The observer now possessed imaginal information that the feature had been present in many or all members of the series, and he treated it as essential. The

subsequent progress of the experience of generality consisted in the dropping-out of these explicitly informational contents, rapidly at first, more slowly later on, so that the observer's imaginal information that the feature appeared in every member of the group became less and less complete and adequate in itself; his awareness of the essential features actually involved fewer and fewer visual images, until at length it involved but a single image. Throughout this progression, the behavior of the general features in consciousness was becoming increasingly obvious: This behavior consisted essentially in the fact that the common features appeared rapidly and uncontestedly whenever the observer set out to recall, that they dominated consciousness, in whatever form of imagery they appeared, and they were unhesitatingly described as "what a Zalof (or Deral) is." This specific conscious manner of being present of the general features, and their treatment as essential, rapidly became the important factor in the conscious experience of generality.

c. **The Experience of Non-Generality.** The experience that certain features were non-general usually consisted in the fact that a feature which the observer had been unable to note in one or in a number of the figures appeared in one or more images, and failed to occur in other images, when next the observer set out to recall; and also in the fact that such a feature was either ignored, or voluntarily turned away from, or described as "what a Zalof (or Deral) may have" or "sometimes has." The experience of non-generality likewise evolved; after a time, the non-general feature appeared in a single image, so that the observer possessed no explicit imaginal information that the feature was non-general. The experience of non-generality now consisted essentially in the specific manner in which the non-general feature appeared in consciousness, and in the events which followed its occurrence—its ready mention as non-essential.

d. **Additional Contents.** The experiences both of generality and of non-generality were sometimes complicated by the additional presence of verbal imagery, visual imagery of falling cards, imagery of past experimental situations, kinaesthetic and affective components, etc., which were frequently labelled as an awareness that the feature was essential or non-essential.

e. The task. The explanation of the manner in which the general features entered consciousness—their clearness and dominance and persistence—is undoubtedly to be found in the nature of the experimental task, whose solution involved processes in the course of which the repeating features received more and more attention. Such stressing by attention of the common features naturally increased their survival value, and lead to their fluent and uncontested appearance in consciousness, when the observer later set out to recall.

It occasionally happened that the influence of the experimental task of defining actually realized itself during the recalls, in processes of selecting essential features in imagery of the figures; these were typical processes of generalizing abstraction, operating upon the images of the recall. This realization occurred when the common features had not been emphasized during the presentations of the figures, in which case their imagery did not enter the recall-consciousness with the stamp of generality already on it. A lesser degree of such task-realization occurred in those cases in which the focal and dominant appearance of the imaged general features was attended by vague vestiges of the kinaesthesia which originally marked their investigation.

f. The Becoming Explicit and the Labelling of the Experiences of Generality and of Non-generality. Sometimes the observers merely described or indicated the manner in which their imagery of general or of non-general features appeared in consciousness, *i.e.*, its specific clearness and temporal aspects, while at other times they not only described this experience but labelled it as an awareness that the feature in question stood for the others, or must be excluded, as the case might be. Such labelling of the experiences was relatively infrequent, however. When it did occur, it was dependent in part upon the individual,—his “interest”— and in part upon the presence of other conditions, any of which favored the attracting of attention to the experience as such. These conditions were *a.* the concomitant presence of other attention-compelling contents; *b.* the subsequent attracting of the observer’s attention to the experience either by a remark of his own, during the introspecting, or by a question of the experimenter’s; *c.* the stage of advancement of

the experiment,—after the observers became more familiar with the purpose of the experiment they tended somewhat to note and label the experience of generality, in retrospect. We have no evidence that either of the last two conditions, or condition *a*, actually changed the nature of the recall-continuum itself. They merely increased the likelihood of a reflective judgment concerning the experience. This opinion we base upon a comparison of the labelled and the non-labelled experiences, as they were described by the observers. Our data upon this question, however, are too few to warrant definite conclusions.

The infrequency of the instances in which the observers applied a label to their experience of generality is undoubtedly to be explained on the basis of the nature of the conscious situation evoked by our experimental conditions. When the general feature made its characteristically fluent and ready appearance in consciousness, the observer was in a "What-is-a-Zalof?" situation; the appearance of the feature constituted the answer or response of mind to this situation, and the natural thing to do was simply to describe the feature as "What a Zalof is," without stopping either to represent its generality in any specific fashion, or to reflect upon the significance of the behavior of the feature in consciousness. When, however, certain conditions led to the observer's reflecting upon the process, the label of generality was the most natural response.

g. The Experience of Doubt regarding Generality. The experience of doubt regarding the generality of a feature again consisted largely in the behavior in consciousness of the feature, and the conscious response to it. This specific behavior may be described as follows: When the investigation of a feature did not extend over a whole series of presentations, so that the observer was uncertain as to its presence in every member, its appearance in the imagery of the recall was persistent in character, and was followed by imagery of figures in which its presence was indefinite, or by verbal imagery of questioning, or by experiences of doubt, which latter were rich in kinaesthetic and affective components. The imagery of such a feature usually persisted or recurred, and served to initiate an investigation of the feature when the next series was presented.

h. The Imagery of General and of Non-general Features.

Our data reveal no ubiquitous structural differences between the imagery of general and that of particular or non-general features, provided the two sorts of imagery are compared at analogous levels. The difference between them was essentially a difference in the conscious situation in which they appeared, in their behavior in consciousness, and in the events which followed them, *i.e.*, their treatment by consciousness.

i. Individual Differences. Our observers revealed many individual differences, both structural and functional. Functionally, the observers differed *a.* in the rate of mechanization of the recalls, this rate being roughly parallel to the number and fineness of the features observed and reported; and *b.* in the extent to which non-common features entered into the recalls. The structural differences were concerned with *a.* the modality of imagery which the observer favored. All of the observers employed at times concrete visual imagery of various degrees of particularity, stability, and completeness, and auditory and vocal-motor verbal imagery. Two of them were characterized by an overwhelming preference for a specific mode of imagery (visual, vocal-motor verbal). Three of the observers, on the other hand, had more or less frequent recourse to a number of modalities, one observer in particular including in her repertoire remarkable kinaesthetic-organic internal imitations of the figures. *b.* Again, the structural differences had to do with the nature of the imaginal substitutions which occurred during the growth of the concept. Certain of the observers remained relatively long upon the concrete imaginal level, while others passed rapidly to the verbal level. All of the observers failed to reveal various of the ten distinguishable stages. The observer whose imagery was most concrete was the one whose observation was most refined and most detailed, a fact which suggests a possible correlation between habits of attention and imaginal type.

VI. CONCLUSIONS AND INTERPRETATIONS

Our investigation of the process of generalizing abstraction has furnished results which are in harmony with those theories which place emphasis upon the subjective factors in the process (pp. 3 f.). We have found that the essence of the process of generalizing abstraction consists in a specific and characteristic mode of behavior in consciousness of a succession of imaginal or sensory contents, *i.e.*, in their changing relative focality, and in their temporal aspects, such as their rate of rise, their degree of persistence, and their rate of disappearance. This behavior of the contents of consciousness is immediately experienced as such; and it is characteristic of the process of generalizing abstraction that, during the course of the process, those contents which prove to be common to a group of perceptions or images obtain an ascendancy over the other contents and hence come to prevail in consciousness.¹²⁰

Our findings are not at variance with the motor theories (pp. 4 f.), but our view differs from the latter in that it is descriptive while they aim to be explanatory. The fact that a certain part of the stimulus-figure becomes especially clear,—and this clarification has been found to be of paramount significance for the process of generalizing abstraction,—is undoubtedly to be correlated with motor phenomena, *i.e.*, with movements of the eyes, of the head, or of other members of the body. Moreover it has turned out that certain motor habits and certain motor “attitudes” developed during the progress of the experiments, in consequence of which the observers’ regard came to be directed especially or chiefly upon certain portions or regions of the figures. The conscious counterpart of these movements,—and therefore the descriptively important aspect of the phenomenon,—consisted chiefly or exclusively in a definite behavior in conscious-

¹²⁰ We believe that the immediately experienced behavior aspect of the contents of consciousness constitutes the essence of the experience of mental activity.

ness of the various parts of the perceived (or remembered, or imagined) figure. The movement may or may not come to consciousness in the form of kinaesthesia. When it does make its appearance in kinaesthetic form one cannot assert that the kinaesthesia determines the nature of the percept; one can only say that both the kinaesthesia and the character of the percept are due to the movement.

Our findings support those of Külpe, Grünbaum and others as to the significance of the task or *Aufgabe*. Yet we found no evidence for asserting that the *Aufgabe* as a conscious experience determines the subsequent content or the subsequent course of consciousness by any deliberate selective process of including certain contents and excluding others. If we attempt to envisage the *Aufgabe* descriptively, we can only say that it constitutes the initial member of a succession of mental processes which in virtue of their immediately experienced aspects of focality (clearness), of duration and of change, constitute a specific direction of consciousness. No observer was able to isolate in it an active principle. They failed to discover a selective agent which operated by debarring certain contents and admitting others; nor were they aware of any *Zielstrebung* apart from the function of kinaesthesia and certain images, in their setting, as adjustment to task, or as waiting, or as intent to observe carefully, or as "feeling" that they must hurry, that something was to be done, or the like.¹²¹

The essence of the concept, as it occurred to consciousness under the conditions of our experiment, consisted in the fact that certain essential features, in varying structural form, entered consciousness in a specific manner when the situation demanded them. This "specific manner" of entrance, or this "behavior" in consciousness of the concretely or verbally imaged essential features constituted fundamentally the experience of generality. The modality and definiteness and completeness of the imagery varied

¹²¹ If we use the expression *Aufgabe* as an explanatory category, we mean cerebral or neuro-muscular phenomena. We are inclined to regard the view of the cerebral reflex, possibly in some such form as that of Kostyleff (47, 48) as the most plausible one.

widely with the age and degree of fixedness of the concept; and the experience of generality became at times more definite and explicit in consciousness in virtue of the additional presence of concrete or verbal imagery and kinaesthesia of various sorts. This finding harmonizes most closely with the "response" view of the concept, when it is recognized that the response need not necessarily be an overt motor response, but may occur as imagery, present in a certain manner. Under the conditions of our experiment, the essence of the conscious response does not consist in any specific imagery; it consists rather in the fact that imagery of some sort *does* occur, imagery which is adequate at the time, and is more or less fluent and rapid in its appearance, the fluency and rapidity depending upon the degree of mechanization of the concept. It is conceivable, and indeed highly probable that under other conditions than those of our experiment, the concept-response would be different. The "attitude of response," or the "system of tendencies," or the "organized union of positive and negative tendencies" all constitute convenient explanations of the fact and manner of the response; and the most successful attempt as yet to envisage the situation neurologically we believe to be that of Kostyleff (47, 48).

We found no evidence for the existence of Moore's imageless "mental categories" to which incoming sense-data are alleged to be assimilated, unless the attention-habits of ready response to certain oft-repeated (geometrical) forms be regarded as categories. And if they be so regarded, Moore's categories are not structural elements of consciousness, but rather they are functional categories,—ways of being present of certain contents, or modes in which these are perceived. It would appear that as a matter of fact both Moore and Aveling are dealing with functional experiences, and that they have erred in making them structural contents. Aveling's omnipresent "overknowledge of generality" seems to be largely a product of his experimental instructions, in which the observers were asked to look for particular or general reference; and we are inclined to believe that this "overknowledge" would reduce to functional, rather than to structural or content categories. We found no ubiquitous "con-

cept-feeling," in the Wundtian sense; apparently the nearest approach to such a feeling was constituted by those experiences of generality which were characterized by the presence of a certain amount of imagery and kinaesthesia (pp. 167 ff.).

Our experiments, we believe, also reveal the importance of the contribution made by the general conscious situation to the identity of certain conscious experiences (pp. 97 ff., 106, 175 ff., 195 f., 197 f.). The experience of similarity (pp. 92 ff.) and that of generality (pp. 164 ff.) were in themselves strikingly akin. The conscious situation however was different for the two experiences; and the response, whether it were one of verbal interpretation of the experience or whether it were some other conscious treatment of it as "similar" or "general," was in accord with the conscious situation or context, and was not determined by any details of content which may have been present.

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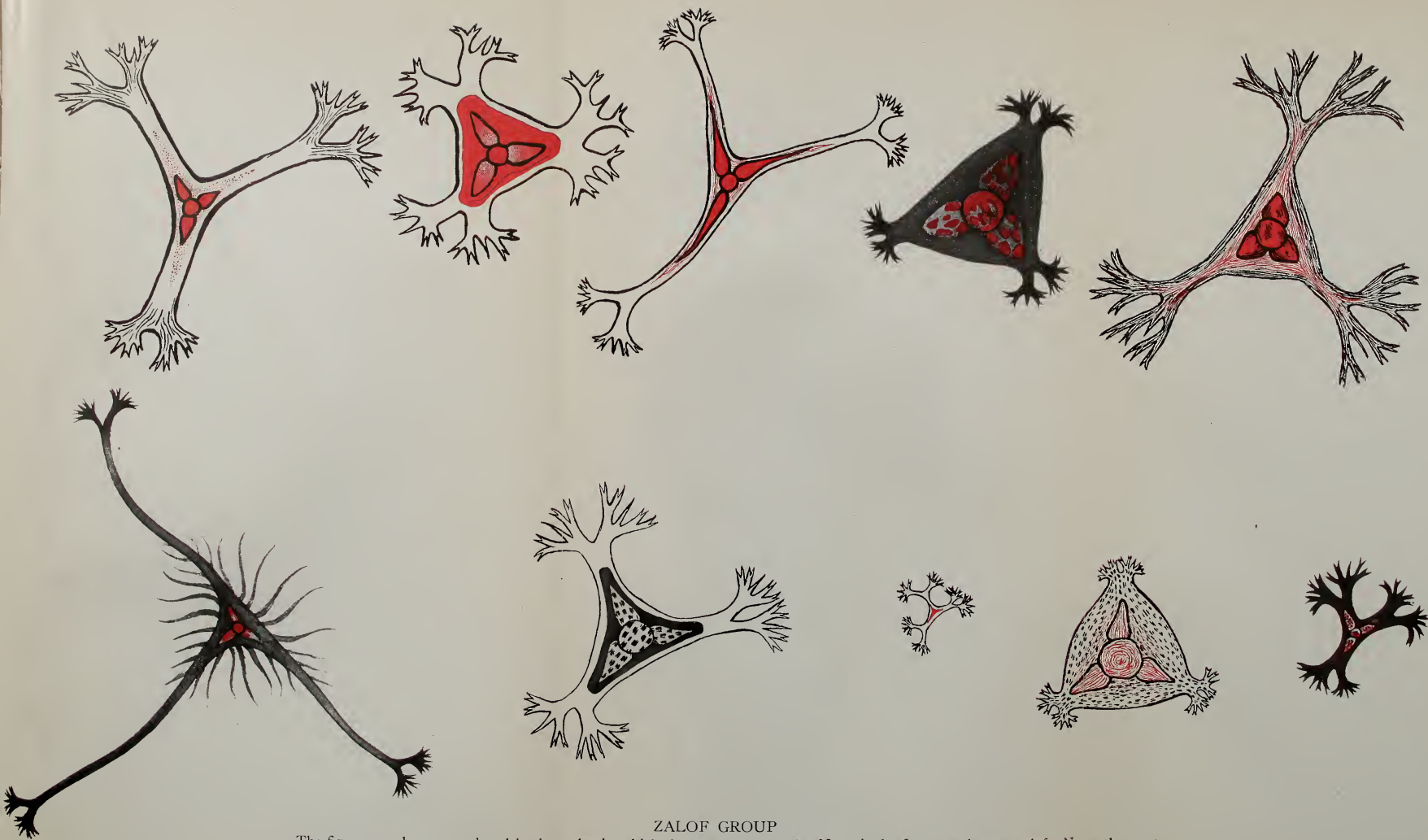
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APPENDIX
COLORED REPRODUCTIONS OF THE FOUR GROUPS OF FIGURES.



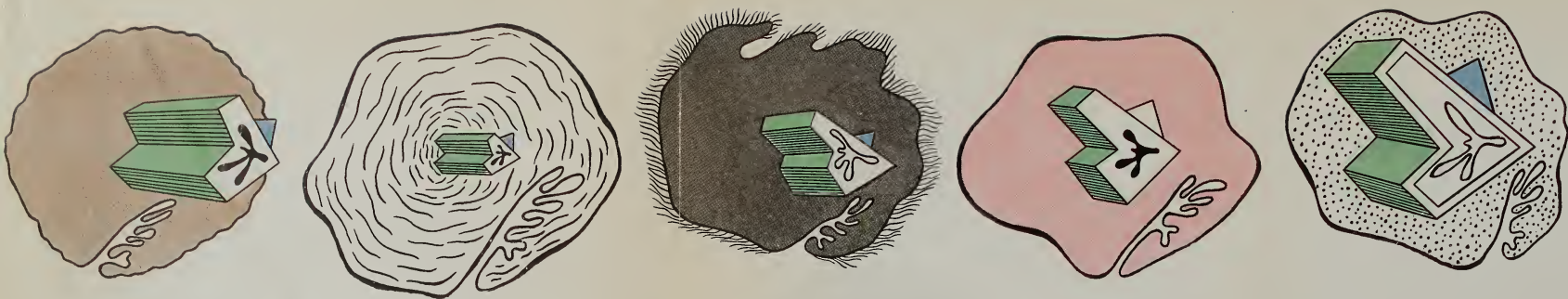
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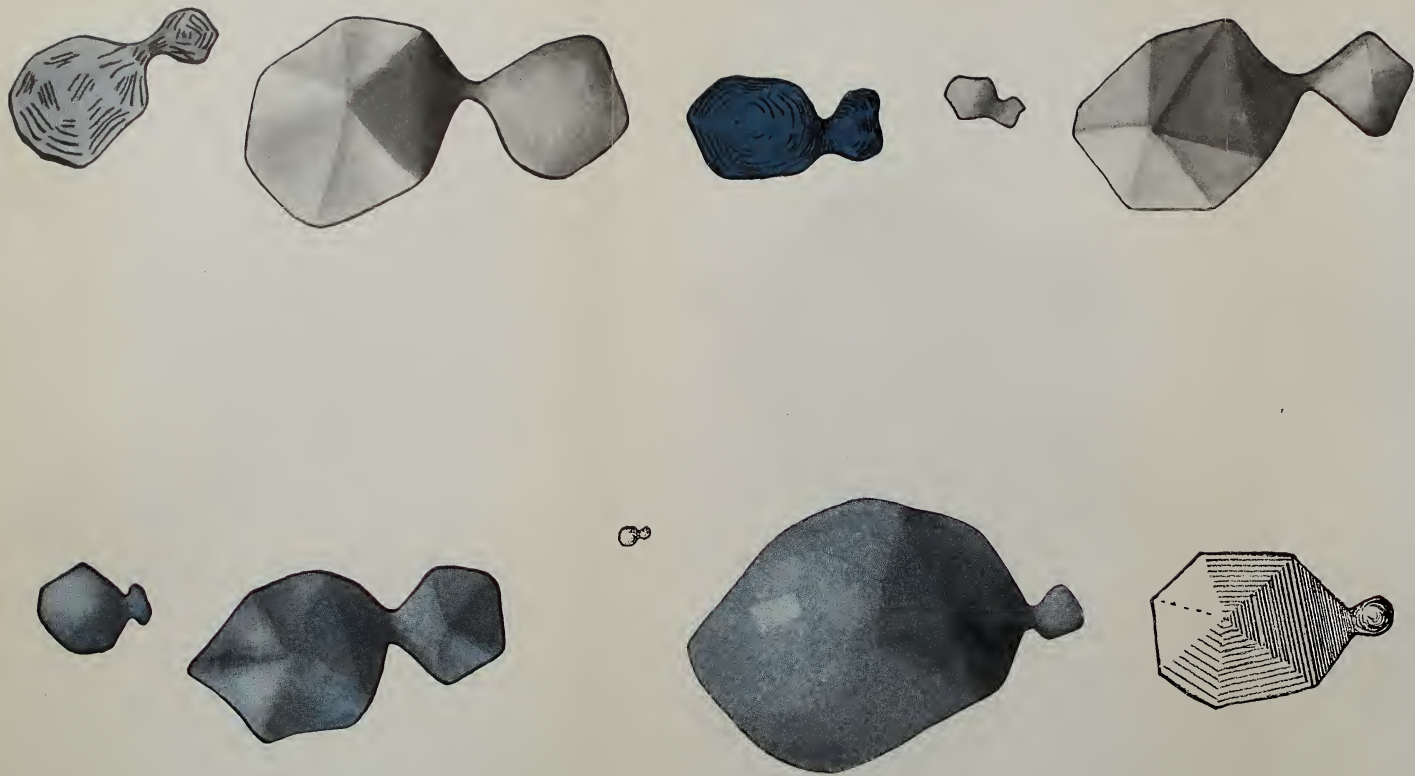
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Acquisition of Skill

By

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INTRODUCTION

REVIEW OF LITERATURE

The acquisition of skill in any line of endeavor presents many interesting and important problems. In recent years several studies have been made to determine the factors that influence learning in various fields.

One of the first experiments carefully worked out upon this subject was the study of learning of telegraphy by Bryan and Harter.¹ Their work was based upon the information gained by questioning about two hundred operators, upon reports from schools of telegraphy, and upon the records of individuals that were studying the subject. Two of these individuals were tested weekly from the time they began to practice until they had attained a fair degree of ability as operators. With a third person, the tests commenced about six weeks after he had begun the practice. He was tested weekly on his ability to receive, first, letters not making words; second, letters making words but the words not making sentences; third, letters making words and the words making sentences.

The curves for the first two subjects were plotted by letting the divisions on the y-axis represent the number of letters per minute sent or received and the divisions on the x-axis represent the periods between the tests. The curves for the last subject were three in number. The divisions on the y-axis for each of these represented the number of letters received per minute and the divisions on the x-axis represented the practice periods. The first of these was the letter curve, the second the word curve, and the third the connected discourse curve.

As a result of the information gained from those acquainted with the work and the tests made by the experimenters, they concluded that the curves which represent the sending and re-

¹ Bryan, W. L. and Harter, N. "Studies in the Physiology and Psychology of the Telegraphic Language." *Psy. Rev.*, vol. 4, pp. 27-53 and vol. 6, pp. 345-375.

ceiving ability take different forms. The sending curves rise rapidly for some time and then gradually approach parallelism with the x-axis. The ordinary receiving curve takes a more irregular form and shows at least two extended flat places where there appears to be little or no progress. This was not true, however, in the letter and word receiving curves. Each of these had the same general form as the sending curve.

The reasons given for the difference in the two kinds of curves are the seeming complexity of the language, the difference of opportunity for practice, the pleasure involved, and the intensity of the effort. Bryan and Harter believe that the receiving of the message constitutes a very much more complex act than the sending of a message. The learner is able to make progress more rapidly in controlling a series of quick movements which constitute the sending than in distinguishing the sounds that represent the dots and dashes and the back click of the instrument in receiving.

Besides this, the opportunity for practice in receiving at a slow rate is much less than that for sending at a slow rate. There is no reason given as to why it should be more pleasant to send than to receive. The intensity of the effort is considered to be very important. In this connection, they make the following statement: "One conclusion seems to stand out from all these facts more clearly than any thing else, namely, that in learning to interpret the telegraphic language it is intense effort that educates."²

They take the sending curve to be the typical practice curve, and their principal task is to explain the form of the receiving curve. The first ascent appears because the learning of the letters is comparatively easy. The periods of arrest or plateaus in the curve are explained on the basis of different order of 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."³ By the lower-order habits are meant those con-

² Bryan and Harter. *Psy. Rev.* vol. 4, p. 50.

³ *Ibid.*, vol. 6, p. 357.

cerned with the interpretation of letters, syllables, and words. The higher-order habits constitute a system of habits associated with groups of words as they are found in connected discourse. The plateau is a period when no progress is being made in the letter and word habits. They are simply becoming automatic. As soon as they are sufficiently brought under control so that attention is free, the higher connected discourse habits begin to grow and this marks the rise from the plateau.

The attention at first is confined almost entirely to the letters, then to words, and finally to larger sense groups or to the message as a whole. However, the writers do not hold that there is complete isolation of the lower and higher habits. "The synchronous curves of Fig. 30 and the experience of operators agree in showing that from an early period letter, word, and higher habits make gains (a) simultaneously, but (b) not equally."⁴ The chief gains, however, are in the lower-order habits. In the sending curve the various order habits are formed simultaneously and so no plateaus appear. Objective and subjective factors have a great influence on the beginner but do not disturb the expert.

Swift studied types of learning of different degrees of complexity and reached conclusions somewhat at variance with those given above.⁵ For the purpose of studying the improvement in what he took to be the simplest type of learning, he had six subjects toss balls. Five of these subjects practiced with two balls, receiving and throwing one while the other was in the air. The other subject practiced with three balls, using both hands and keeping one ball always in the air. The balls that he used were of solid rubber, weighing 122.6 and 130.2 grams and being 42 and 44 mm. in diameter respectively. The practice consisted of ten trials daily. The number of throws the subject could make without missing one of the balls constituted a trial. The score for the day was the sum of the catches that were made in the ten trials.

⁴ Bryan and Harter. *Psy. Rev.* vol. 6, p. 350.

⁵ Swift, E. J. "Studies in the Psychology and Physiology of Learning." *Amer. Jour. of Psy.* vol. 14, pp. 201-251.

He found that various objective and subjective factors had a very marked effect upon the learning. The physical efficiency was very important but the subject could not always tell in advance how well he would succeed. He agrees with Bryan and Harter that all advance requires effort but further states that excessive effort may cause the subject to lose rather than gain ability.

The curves for this work were plotted by taking the divisions on the y-axis to represent the number of catches for each daily practice and the divisions on the x-axis to represent the practice periods. All of the curves for this work have the same general form and are concave to the y-axis. All of the curves show great irregularity of advance. In these curves there are no long period fluctuations, as was noted above. There were, however, several short periods during which there was little or no advance.

No immediate rapid rise appears in these curves as appeared in those for telegraphy obtained by Bryan and Harter. Swift thinks that this first rapid rise will appear only in those cases where symbols or other devices are used for handling and presenting ideas. He seems to imply that the curve that is concave to the y-axis is the normal practice curve.⁶

Swift seems to think that the shorter plateaus that he found in this work may be caused by a combination of different factors or by a number of factors that act separately. He is not clear as to whether there is no progress or whether the progress is such that it can not be measured. He says: "This lack of energy, due to waning interest, probably has more to do with delaying the learner's progress and making plateaus than any thing else. One cannot escape a dead level in uninteresting work and after the enthusiasm that novelty stirs has spent itself the interest is dulled and effort slackens. Yet the slow progress is often only an apparent one and due to our inability to measure the advance."⁷ In support of this last view, he points out that during the slow period the subjects occasionally made high scores and that at the end of the plateau there was a rise much above the

⁶ Swift. *Amer. Jour. of Psy.* v. 14, p. 228.

⁷ Swift. *Amer. Jour. of Psy.* vol. 14, p. 213.

level immediately preceding the plateau. In another place, he points out that the delay may be the result of having reached the limit of a certain method.⁸

In order to get a curve for a more mental type of work and one that would serve as a comparison curve with those obtained by Bryan and Harter for telegraphy, Swift studied the learning of shorthand.⁹ He acted as subject himself and was the only one tested. In this work, an hour and a half a day was given to study for a period of something over ten weeks. During the early part of this time the practice was confined to writing the material in shorthand, but later the daily periods were divided between writing and reading what had been written. He was given a ten minute test daily by an assistant. In both the reading and writing tests the number of words read or written formed the basis for the score. The material for the reading tests was the matter that he had written ten days before.

The curve was plotted by letting the divisions on the y-axis represent the number of words and the divisions on the x-axis represent the practice periods. Swift decided in this work that there was no evidence of higher-order habits being separated from the lower-order habits. There were no long period plateaus. Whatever arrests there were, could be accounted for on the ground of emotional factors.

In explaining the short period plateaus, he uses the following language: "In learning shorthand and presumably also in learning to receive or send telegraphy, a large number of associations are formed that do not affect the speed of the work, because there is no opportunity to use them, and the learner seems to make little or no progress, not because this is the particular time for the formation of a 'hierarchy of habits', for this is going on all the time, but because the range of associated knowledge in the subject is too limited to meet the demand."¹⁰ Swift seems to place his explanation more on a quantitative than a qualitative basis. A certain amount of material must be accumulated and properly associated before it becomes effective, and the accumulation of

⁸ *Ibid.*, p. 214.

⁹ *Ibid.*, p. 224.

¹⁰ Swift Amer. Jour. of Psy. vol. 14, p. 224.

this definite quantity of material explains what takes place during the arrest period.

In his study of typewriting,¹¹ he practiced one hour per day with the sight method for forty-four practice days. The score was kept by noting the number of words written per hour. The curves for the work were plotted by letting the divisions on the y-axis represent the number of words per hour and the divisions on the x-axis represent the number of practice periods.

Swift and Schuyler¹² later carried on another experiment on typewriting. In this experiment, Schuyler was the subject and practiced thirty minutes daily by the touch system. The work extended over sixty-six practice days. The material copied was at first taken from Grant's typewriting manual, and later lectures and essays were copied. In this work the number of strokes were used as a basis for keeping the score. For a few practice periods the same sentence was repeated for the whole half hour.

In both of these curves the progress was irregular. The change of copy, physical condition, subjective state, and perhaps other factors contributed to this irregularity. There were no long period plateaus as in the curve for telegraphy. Both simple and complex factors reveal themselves to introspection from the beginning of the work. However, the simpler elements are more active in the early period. The shorter plateaus such as are found here have two causes. "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 slump in enthusiasm."¹³ The steps of improvement here as in the ball tossing were made unconsciously and then adopted. Swift holds that this unconscious advance is an argument for the idea that the associations are being made automatic during the apparent rest periods. The lapse of attention which accompanies these plateau periods is a result of the accumulation of loosely connected associations.

¹¹ Swift. "The Acquisition of Skill in Typewriting." *Psy. Bul.* vol. 1, pp. 295-305.

¹² Swift and Schuyler. "The Learning Process." *Psy. Bul.* vol. 4, pp. 307-310.

¹³ Swift. *Psy. Bul.* vol. 1, p. 305.

In the study of telegraphy, a Morse instrument was used and James' "Talks to Teachers" furnished the material. The practice consisted of four hours on four successive days given to the study of the alphabet and following this were thirty-nine practice days. Each of these practice periods consisted of a half hour of practice and five minutes test. The curve for this work was of the same general form as for ball-tossing and for typewriting. He holds that the delays are the result of the time it takes the associations to become automatic.¹⁴

Swift also studied the learning of a language and secured a curve for the improvement. The Russian language was used as the basis for this work because the subject would be least assisted by his past experience. The practice continued from March 30 until June 14, 1905, and consisted of thirty minutes study and fifteen minutes reading each day. The number of words read was made the basis for the score. The curve obtained from this work showed three periods of advance and four plateaus. He holds here that the plateaus do not represent places of no progress but that the progress cannot be measured. The lower-order and the higher-order habits go along together.¹⁵

Swift has also studied the problem of relearning in ball-tossing and typewriting. In both cases, he finds that during a long rest period there is little, if any, loss of skill and that the subject in a very short time is able to go beyond his best previous record.¹⁶

Book has made a more elaborate study of learning to type-write. His aim was to obtain learning curves that might be explained in detail by the aid of introspections *of* the subjects. Eleven subjects took part in the work. Both the sight and touch methods were used. The score was kept in terms of strokes. The curves were plotted by having the divisions on the y-axis represent the number of strokes and the divisions on the x-axis represent the practice periods.

¹⁴ Swift. "Learning to Telegraph." *Psy. Bul.* vol. 7, pp. 147-153.

¹⁵ Swift. "Beginning a Language; A Contribution to the Psychology of Learning." *Studies of Philosophy and Psychology by Former Students of Charles Edward Garman.* Pp. 297-313.

¹⁶ Swift. "Memory of a Complex Skillful Act." *Amer. Jour. of Psy.*, vol. 16, pp. 131-133. "Memory of Skillful Movements." *Psy. Bul.*, vol. 3, pp. 185-187. "Relearning a Skillful Act." *Psy. Bul.*, vol. 7, 147-153.

He found that the curves obtained showed three types of fluctuations: the first was the short fluctuation from day to day; then there were slightly longer periods of arrest which he called "breathing places"; lastly, there were long periods during which there was practically no progress at all, which he called plateaus.

The daily fluctuations he explained on the basis of objective and subjective factors. The principal objective factor was the difference in the material to be copied. On the subjective side the amount of re-learning and warming up, fluctuations in attention, and changes in emotional attitude were very important factors in determining the daily fluctuations. Fatigue from general causes was another important element.

The breathing places were largely the result of lapses in spontaneous attention. In some cases strong application of voluntary effort caused them. Sometimes the subject on good days made an unusually high score and for several days it took all his attention to maintain this level. In this case Book's statement that "It takes some time for the new way of writing to become sufficiently automatic to allow part of the attention to forge ahead in quest of more economic methods,"¹⁷ seems almost to agree with the interpretation of Swift who speaks of giving the associations time to become automatized.

Besides these short period arrests, some long period arrests were noted. The curves of two of the subjects, one that had used the sight method and the other the touch method, showed pronounced long period plateaus. Both of these curves extended over long periods of time. Book thinks that these plateaus belong to rather definite levels of attainment. There is no regular order for the development of special habits in typewriting. These long period plateaus "do not represent periods of incubation, where certain elementary habits make substantial gains, preparatory to their organization into higher-order habits, they are: (a) Resting places in the learner's interest and effort; or (b) 'breakdown' stages caused by excessive effort wrongly ap-

¹⁷ Book, W. F. "The Psychology of Skill: with Special Reference to Its Acquisition in Typewriting." University of Montana Publications in Psychology: Bul. No. 53, p. 155.

plied.”¹⁸ Here Book disagrees with both Swift, and Bryan and Harter.

The rise from the plateau, instead of being the result of old associations which have become automatic, is the result of renewed effort by means of which new short cuts have been discovered. He holds that in simple forms of work where only one or a few simple associations are to be formed no plateau will appear. Even in cases of complex work, it is possible so to direct and control effort that they will not appear. Some of his subjects were able to do this complicated work in typewriting without the occurrence of any plateau.

In regard to the warming up and re-learning, the evidence is quite conclusive. The records showed that the last half of the practice period in almost every case gave better results than the first half. Besides the daily revival of the associations already learned, there is a process of getting into a certain “set” which he terms a “typewriting psychosis,” and as this “set” comes many of the former difficulties disappear.

Book also gave a number of memory tests in this work. He found that after a period of six months from the time of the last regular practice, ten daily tests showed an average slightly lower than the last ten tests of the regular practice. One year later a second series of ten tests showed a gain over the last ten regular practice tests in the number of strokes, but a slightly higher percent of errors. Book feels that the increase in the number of errors for the memory tests shows that more effort was put forth than had been in the regular practice. This, however, does not account for the increase of skill in the second memory test over the first one nor does it fully explain the gain made over the regular practice. The author attributes that gain, “to the disappearance, with the lapse of time, of numerous associations, bad habits of attention, incidentally acquired in the course of learning, interfering habits and tendencies, which, as they faded, left the more firmly established typewriting associations free to act.”¹⁹

¹⁸ Book. “The Psychology of Skill,” p. 157.

¹⁹ Book. “The Psychology of Skill,” p. 80.

Several less extensive studies have been made touching upon the subject of the acquisition of skill. Among these may be mentioned the work of Scripture, Smith and Brown; Johnson; Partridge; Bair; Wells; Starch; and Whitley.

Scripture, Smith and Brown studied the effect of practice upon one's ability to insert a needle into a small hole. They reached the conclusion that the improvement was due to the training of attention and that it was psychical rather than physical. Any distraction or mental or physical fatigue lowered the result. The best results were obtained when the attention was fixed upon the hole rather than upon the needle.²⁰

Johnson had his subjects practice at tapping at the corners of an equilateral triangle. In this work, he found that all of the curves of improvement follow the same form. He reached the conclusion that transition from a state requiring constant attention to a state of automatic control follows a law as exact as any physical law. But because the subjects are never mentally and physically equal at two different tests and because we do not have scientific results from allied subjects, it is difficult to determine the law. The closer the personal factors are to the normal and the more accurate the measurements, the nearer the curve will show the law of habit. The daily variations in the curve can be explained by the variations in the subjects.²¹

Partridge studied the reflex wink. The work consisted of having a little hammer hit a glass plate immediately before the eye. The two adult subjects used were able to improve greatly their ability to inhibit the wink and their curve of improvement shows a steady rise from the beginning with the usual daily fluctuations in the successive tests.²²

Bair studied the acquisition of control over a voluntary muscle and found that the power was gained by associating the given muscle in a group with others. After the power was gained to

²⁰ Scripture, E. W., Smith, T. L., and Brown, E. M. "On the Education of Muscular Control and Power." *Studies from the Yale Psy. Lab.*, vol. 2, pp. 114-119.

²¹ Johnson, W. S. "Researches in Practice and Habit." *Studies from the Yale Psy. Lab.*, vol. 6, pp. 51-103.

²² Partridge, G. E. "Experiments upon the Control of the Reflex Wink." *Amer. Jour. of Psy.*, vol. 11, pp. 244-250.

move it with others, the ability to move it separately was obtained by concentrating the attention upon the particular act. He also studied the nature of the improvement of subjects practicing on throwing shot into a tumbler and manipulating a modified form of typewriter. These tests were continued only for a few days and do not give much idea of the curve of improvement.²³

Wells did some work with special reference to fatigue phenomena but also touching upon the problem of improvement. The unit of measurement used was the taps upon a telegraph key. The subject selected his own method of tapping but did not change it during the experiment. The subject commenced at a given signal and continued at maximum speed for thirty seconds. After a rest of two and one half minutes this was repeated. Five trials of thirty seconds each were given each day. Two of the subjects practiced for thirty days. The work of these two subjects is the only part that is important here.

The curves show a constant improvement until near the end, when progress gradually diminishes. There is no rapid rise at the beginning of the curve. In a later test on one of the subjects there was an improvement over the best score at the end of the practice.

There was evidence of warming up for both subjects, and as the practice continued this warming up process increased. After an intermission there was a loss in the right hand in all cases and a loss in the left hand in the first case but a gain in the second and third for Subject I. Subject II in all three cases with each hand showed a gain. With both subjects, the first interval of five seconds showed a gain but fatigue came in and made the total score lower in the cases stated above. The only explanation he offers for the initial increase is that it is the result of a renewed "Neuigkeitsantrieb" but he seems to think that the practiced co-ordination parts become more firmly set during a period of rest. He further points out that the daily fluctuations in this work vary more after a week than at the beginning.²⁴

²³ Bair, J. H. "Development of Voluntary Control." *Psy. Rev.*, vol. 8, pp. 474-510. "The Practice Curve." *Mon. Sup. to Psy. Rev.* No. 19.

²⁴ Wells, F. L. "Normal Performance in the Tapping Tests." *Amer. Jour. of Psy.*, vol. 19, pp. 437-483.

Starch studied the trial and error method by having a subject trace a six pointed star as it is seen in a mirror. He finds that the advantages of using a figure in the form of a star rather than some other form are, that it gives frequent changes in direction, the divisions are of equal length, and they are sufficiently long to be difficult and yet not cause undue fatigue. The curves were obtained by taking one hundred records made at the rate of one a day on consecutive days. Both an error and a time curve were plotted.

The error curve falls rapidly at first and then gradually until near the end of the practice where it seems to have reached a dead level. The time curve shows a rapid fall at first but after about fifty practices it remains nearly parallel to the horizontal axis until the error curve ceases to fall then it takes another drop. Near the end of the practice it again approaches parallelism with the x-axis.²⁵

Whitley gave a number of tests to determine individual differences. She emphasizes the importance of a number of tests in order to get a true estimate of a person along any line. She also points out the danger of mis-interpreting measurements. She believes that in the same field, improvement follows the same law for different individuals. The higher mental functions are more susceptible to practice than the sensory functions.²⁶

A large number of other improvement tests have been made, but, since very little of the motor element was involved, they have little connection with this problem and are not discussed. In all the tests mentioned except the first three the period of practice was rather short and very little can be said about the longer period plateaus. In every case the short fluctuations appeared.

²⁵ Starch, D. "A Demonstration of the Trial and Error Method of Learning." *Psy. Bul.*, vol. 7, pp. 20-23.

²⁶ Whitley, M. T. "An Empirical Study of Certain Tests for Individual Differences." *Archives of Psychology*, No. 19.

PROBLEM STATED

From this work have grown a number of interesting problems and not a few conflicting opinions are held in regard to the questions raised. The influence of the objective and subjective factors on different types of learning and on the same type of learning at different stages of development, the daily fluctuations in the curve, the warming up process, the general form of the curve, the effect of short and long rest periods—all present fields for further study. One of the most troublesome problems is that of the plateaus. Are they the result of different habit levels, are they due to the automatization of associations, are they dependent upon attention, or may there be some other explanation? Are they necessary for all or any types of learning?

The purpose of this study is: first, to get more information in answer to the questions stated above; second, to gain such information on the other points pertaining to the curve of learning as the data will afford.

The plan of the work has been so to devise experiments that the elements determining the curve of learning can be analysed. In the first set of experiments, the factors affect the process of the learning simultaneously. In the second set, the work is reduced to its simplest form and only a relatively simple sensori-motor reaction is required. In the third set, several factors influence the same learning process but they act in succession. On the basis of this work, the curves are plotted and the explanation of their form is given. The study ends with a general discussion of these results in their relation to the results that have been obtained in other experimental work in this field.

THE EFFECT OF A NUMBER OF FACTORS WORKING SIMULTANEOUSLY

METHOD OF PROCEDURE AND RESULTS

This part of the work is a continuation of Swift's ball-tossing experiments. The only apparatus used was two hollow rubber balls and two pieces of hard rubber. The balls weighed 16.7 and 17.1 grams and were 1.6 inches in diameter. The pieces of hard rubber were cylindrical in form, weighing 8.91 and 8.94 grams and being .5 inches in diameter and 2.1 inches long. Neither the difference in weight of the pieces of hard rubber nor of the balls could be noticed.

Five subjects took part in the work. Subjects D(Decamp), B(Batson), W(Wang), and F(Foulk) were all graduate students taking research work in Psychology. Subject H(Hayes) was a junior in college taking Psychology.

EXPERIMENT I. SUBJECT D.

Subject D. was instructed simply to toss and catch the ball so that one ball would be always in the air. He had had no previous experience. The right hand was used. The practice consisted of ten trials daily at 10 A. M. The work was commenced on October 8, 1912 and continued until November 23, 1912. After the first three days the same room was used for practice. The subject knew his score daily as well as that of each of the other subjects doing the work at that time. There was no limit put upon the time between trials. At first scarcely any time was taken but as the success became greater and the work was more fatiguing a minute or two was taken for rest between successive trials. Table I shows the result of this practice in detail.

TABLE I

Subject—D.

Experiment—Tossing and catching two rubber balls with right hand.

Trials	1	2	3	4	5	6	7	8	9	10	Sum
Oct. 9	1	2	2	2	3	3	3	1	2	2	21
10	2	2	4	7	3	3	7	1	3	6	38
11	3	1	8	3	3	3	1	2	3	2	29
12	2	3	2	3	2	2	5	2	2	3	26
13	2	3	3	11	4	1	3	2	2	5	36
14	7	1	2	9	3	1	2	1	1	4	31
15	5	4	3	4	2	2	2	1	3	3	29
16	3	6	3	3	2	2	3	3	2	2	29
17	24	2	2	4	10	2	5	3	5	3	60
18	6	12	4	4	5	8	3	8	3	3	56
19	10	7	4	10	2	5	1	2	4	1	46
20	18	4	2	3	4	0	3	4	0	8	46
21	2	9	5	1	4	3	3	2	4	11	44
22	5	5	4	3	6	17	3	0	9	2	54
23	13	4	9	5	4	1	2	4	9	3	54
24	4	0	14	7	8	33	0	2	3	14	85
25	22	3	6	0	2	5	3	7	4	5	57
26	6	12	4	5	9	13	11	11	5	6	82
27	9	9	16	22	0	3	7	2	11	3	82
28	10	20	9	7	24	29	22	2	35	26	184
29	10	1	16	35	7	3	1	27	1	4	105
30	23	23	4	31	21	2	28	17	15	5	169
31	17	3	35	40	4	17	18	7	18	37	196
Nov. 1	19	1	1	9	1	8	2	8	32	18	99
2	21	10	40	19	35	40	1	6	12	14	198
3	37	11	34	6	12	32	62	5	56	45	300
4	52	4	20	11	32	58	9	28	2	61	277
5	52	25	47	49	45	5	59	3	45	65	395
6	17	4	67	43	6	6	4	10	29	114	300
7	14	13	32	29	5	34	34	9	1	0	171
8	18	23	22	16	18	10	39	48	96	54	344
9	84	23	4	60	80	22	16	21	7	33	350
10	24	30	6	27	9	33	48	37	5	5	224
11	2	51	25	24	27	67	13	72	16	24	321
12	8	22	38	9	81	27	24	57	28	66	360
13	37	42	64	51	88	8	64	18	60	31	471
14	42	15	21	26	37	64	102	77	30	24	438
15	57	5	39	29	27	23	16	62	76	12	346
16	100	2	32	35	46	3	43	42	17	60	380
17	48	55	27	0	48	10	3	9	30	5	235
18	22	25	101	33	35	65	37	123	17	53	511
19	8	26	88	205	16	95	82	19	32	78	709
20	36	151	20	29	74	79	58	30	48	63	588
21	3	151	259	0	170	58	70	247	181	265	1404
22	116	88	72	94	80	53	179	222	47	124	1075
23	113	30	137	178	65	0	74	352	96	24	1069
Total	1134	943	1357	1261	1169	958	1175	1616	1115	1396	12124

When these trials are divided on the basis of those that fall below twenty, those between twenty and ninety, and those that are ninety or above, the following results are obtained:

	Below 20	20 to 90	90 or more
First third of table.....	149	1	0
Second third of table.....	98	52	0
Third third of table.....	37	99	24

The horizontal columns opposite the dates show how many catches were made each trial. The vertical column to the right marked "Sum" shows the number of catches that were made during the ten trials of each day's practice. The last set of figures at the bottom of each vertical column shows the sum of the columns. This gives the sum of all the first trials, second trials, etc. The number at the base of the column marked Sum shows the total number of catches that the subject made in all the practice that was taken.

The subject was tested again under the same conditions on August 15 and 17, 1913, and the following figures were obtained:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
Aug. 15	85	90	84	108	89	32	97	108	82	107	882
Aug. 17	113	107	243	18	88	78	148	8	148	54	1005

He was tested again July 10, 1914, and made:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
July 10	95	166	297	268	131	253	351	432	75	482	2550

The balls for this test were similar to those used above but weighed 20.3 and 18.1 grams respectively. The test was made in a smaller room but it is not likely that this had any effect upon the throwing. The subject had not practiced from the time the regular practice had ended up to the time of the test of August 15, 1913. Between that time and the test in July 1914, he had occasionally tossed different objects but was sure that all this practice would not amount to a half hour.

EXPERIMENT II. SUBJECT B.

In this experiment the work was the same as in the preceding one, that is to toss and catch two balls. The method was to center the attention on some one phase of the work. The subject aimed to fix his attention on the manner of pitching the balls. The balls were pitched in a circle from right to left. Only a very little incidental practice in this work had taken place

before the experiment. The right hand was used. The practice was in the forenoon and consisted of ten trials daily. The work commenced on October 15, 1912 and continued until November 11, 1912. All the practice was in the same room. The daily score was known. As much time was taken between the separate trials as the subject desired. Table IIa shows the result of this work. Table IIa is arranged the same as Table I and the explanation of the first table may be used for this one.

TABLE IIa

Subject—B.		Experiment—Tossing and catching two rubber balls with right hand.										
Trials		1	2	3	4	5	6	7	8	9	10	Sum
Oct.	15	7	8	6	6	1	6	4	11	9	17	75
	16	1	10	13	2	2	7	4	4	5	6	54
	17	3	13	7	20	10	23	12	10	10	17	125
	18	12	2	3	1	5	22	22	0	5	3	75
	19	10	27	2	35	1	15	16	8	8	10	132
	20	12	8	9	30	4	11	24	13	31	35	177
	21	6	1	0	32	3	47	24	25	10	28	176
	22	37	7	1	41	35	34	4	23	31	8	221
	23	13	19	23	6	49	18	14	36	28	23	229
	24	1	23	2	41	12	4	38	31	22	29	203
	25	11	7	12	28	6	37	23	35	46	14	219
26	4	6	28	70	45	16	19	52	17	18	275	
27	11	9	25	35	45	24	53	46	24	40	312	
28	34	77	38	7	0	20	11	79	28	70	364	
29	20	40	24	42	64	15	79	69	90	67	510	
30	98	58	52	142	31	52	33	16	6	8	496	
31	7	72	3	15	31	35	38	35	54	41	331	
Nov.	1	29	75	69	21	109	48	112	33	77	66	639
	2	44	105	148	92	19	56	108	40	34	59	765
	3	1	63	110	41	13	11	27	34	31	167	498
	4	3	114	24	11	63	22	117	79	60	13	506
	5	25	20	47	23	29	59	75	100	15	184	577
	6	23	19	104	63	123	118	92	42	73	137	793
	7	183	90	31	110	163	153	111	142	64	74	1120
	8	159	107	112	33	26	58	53	95	18	42	703
	9	31	46	124	131	42	39	65	84	74	245	881
	10	114	67	43	46	262	134	149	96	84	197	1192
	11	29	206	184	65	179	332	14	7	121	134	1271
Total		927	1359	1244	1189	1372	1416	1340	1245	1075	1752	12919

When the trials of Table IIa are divided on the basis of those that fall below twenty, those between twenty and ninety, and those ninety or above, the following results are obtained:

	Below 20	20 to 90	90 or more
First third of table.....	64	26	0
Second third of table	27	58	5
Third third of table	12	47	41

After the subject had been able to make an average of one hundred catches per trial on successive days with the right hand, the practice was changed to the left hand. The method was to give attention to all the particulars,—the force of the throws, the direction, the manner of catching the ball, the position of the body, etc. There had been no previous practice with the left hand. The practice consisted of ten trials daily in the forenoon. The work commenced November 12, 1912 and continued until January 15, 1913, with an intermission from December 20 to January 8 and one practice period on November 28. A part of the practice was in a smaller room than that in which the work commenced, but the walls were the same in color and the lighting was about the same. The daily score was known. No time limit was set between trials. The result of this practice is shown in Table IIb.

TABLE IIb

Subject—B.

Experiment—Tossing and catching two rubber balls with left hand.

Trials	1	2	3	4	5	6	7	8	9	10	Sum
Nov. 12	2	4	2	4	0	4	2	6	2	5	31
13	3	2	2	3	7	5	6	3	1	8	40
14	6	6	7	9	8	8	9	6	8	2	69
15	21	2	20	3	2	2	2	0	4	10	66
16	13	13	1	7	10	17	0	1	9	7	78
17	3	7	6	2	6	2	8	10	6	0	50
18	6	3	8	21	3	7	4	6	9	4	71
19	5	17	4	4	7	8	7	9	2	10	73
20	1	11	17	7	3	4	8	11	9	13	84
21	9	4	2	12	11	9	0	10	25	10	92
22	28	12	4	18	7	14	6	14	22	19	144
23	2	17	14	20	3	19	12	8	11	15	121
24	3	7	11	4	12	11	6	4	9	11	78
25	16	8	11	10	16	5	3	11	8	5	93
26	7	11	7	7	0	2	21	10	19	14	98
27	3	5	14	28	13	6	1	0	15	0	85
28											
29	2	10	6	5	14	21	15	6	23	4	106
30	6	6	2	21	12	13	20	42	13	14	149
Dec. 1	9	15	28	12	20	22	2	20	8	27	163
2	22	14	8	12	13	15	1	7	8	13	113
3	10	23	4	13	16	15	21	20	11	5	138
4	28	16	6	9	19	20	27	2	26	3	156
5	15	11	14	12	25	22	10	29	12	24	174
6	9	31	19	12	23	16	29	5	7	39	190
7	10	35	10	40	20	20	17	32	6	23	213
8	22	17	17	28	40	27	17	29	3	14	214
9	21	50	8	49	5	21	26	41	13	7	241
10	31	40	35	34	5	24	37	11	26	5	248

TABLE IIb

Subject—B.

Experiment—Tossing and catching two rubber balls with left hand.

Trial	1	2	3	4	5	6	7	8	9	10	Sum
Dec. 11	5	6	35	39	17	30	46	21	11	45	255
12	26	56	11	4	8	27	24	9	24	52	241
13	19	71	3	53	63	23	7	21	36	41	337
14	74	90	34	30	5	7	60	7	1	39	347
15	60	18	8	32	140	83	29	39	59	83	551
16	3	5	63	178	80	38	3	104	45	96	615
17	110	56	69	79	35	64	88	48	45	29	623
18	38	5	25	50	204	0	43	20	32	42	459
19	31	34	12	28	75	11	23	101	46	74	435
20	35	91	0	1	21	22	27	14	35	6	252
Jan. 8	14	153	40	66	85	5	91	45	42	67	608
9	101	61	16	46	127	108	9	19	23	6	516
10	58	103	62	31	44	41	10	95	51	16	511
11	83	37	57	24	9	149	85	31	45	76	596
12	45	44	118	30	48	12	17	94	11	108	527
13	118	65	73	30	8	133	60	123	117	119	846
14	35	130	289	48	166	119	133	162	153	115	1350
15	42	73	268	241	156	10	161	26	52	141	1170
Total	1210	1495	1470	1416	1611	1241	1233	1332	1143	1466	13617

When these trials of Table IIb are divided on the basis of those that fall below twenty, those between twenty and ninety, and those that are ninety or more, the following results are obtained:

	Below 20	20 to 90	90 or more
First third of table	143	7	0
Second third of table	87	63	0
Third third of table	34	88	38

The subject was tested again on July 17, 1914. The conditions were the same except that the balls were slightly heavier, weighing 20.3 and 18.1 grams respectively. The difference in weight, however, could not be noticed.

With the right hand, the following score was made:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
July 17	329	4	7	142	0	86	100	1	227	228	1124
July 18	63	82	55	201	130	257	169	60	36	384	1437

The left hand was tested on July 17, 1914, and again two days later. The score was:

Trials	1	2	3	4	5	6	7	8	9	10	Sum
July 17	10	17	57	73	14	78	41	98	52	49	492
July 19	23	70	59	52	88	46	68	130	114	52	702

The subject had tossed tennis balls a few times after the regular practice had stopped but not over fifteen minutes had been spent in such work. There had been no practice with the left hand. A rest of two minutes was made between each trial of this last practice.

EXPERIMENT III. SUBJECT W.

The subject was instructed to toss and catch the two balls after the same manner as the other subjects. The practice consisted of ten trials daily at eight A. M. The work was commenced Oct. 30, 1912, and continued until Feb. 12, 1913. During this time, the following daily practices were missed: Nov. 3, 5, 6, 21; Dec. 7, 8, 12, and the period from Dec. 20 to Jan. 8. After a few practices, the subject rested one minute between trials. He had had no previous practice in the work. The results of his work are shown in Table III.

TABLE III

Subject—W.
Experiment—Tossing and catching two rubber balls with right hand.

Trials	1	2	3	4	5	6	7	8	9	10	Sum
Oct. 30	1	1	1	4	1	2	3	1	3	3	20
31	2	2	3	3	2	2	3	4	2	3	25
Nov. 1	2	2	2	2	2	3	2	1	1	3	20
2	4	1	3	4	3	1	2	1	3	2	24
3											
4	2	1	2	3	1	2	3	4	1	1	20
5											
6											
7	1	0	2	2	3	3	5	5	4	3	28
8	2	2	3	1	4	5	6	2	7	5	37
9	4	5	2	5	3	6	7	5	5	3	45
10	5	0	5	4	8	3	5	3	6	6	45
11	0	5	7	0	3	3	5	3	2	6	34
12	4	14	2	8	2	2	4	2	5	3	46
13	5	4	3	6	4	3	7	2	1	5	40
14	6	4	7	3	11	2	6	6	2	4	51
15	4	3	4	5	2	4	6	3	6	6	43
16	5	7	18	8	9	3	4	1	8	1	64
17	5	3	7	0	5	8	2	0	5	1	36
Nov. 18	2	4	4	0	8	3	3	1	2	7	34
19	11	0	6	7	2	14	2	9	16	9	76
20	10	6	1	3	2	11	2	9	4	8	56
21											
22	2	3	4	13	1	0	2	7	2	11	45

TABLE III—(Continued)

Subject—W.											
Experiment—Tossing and catching two rubber balls with right hand.											
Trial	1	2	3	4	5	6	7	8	9	10	Sum
Feb. 3	43	51	62	14	8	37	36	25	48	88	412
4	3	29	89	22	64	105	36	79	90	41	558
5	19	51	9	32	101	50	29	41	126	27	485
6	50	9	53	97	54	58	91	133	127	26	698
7	4	41	43	3	83	11	52	84	79	127	537
8	26	24	105	37	33	79	81	133	16	48	582
9	72	136	106	27	186	61	12	52	73	16	741
10	67	9	106	100	44	71	114	111	70	152	844
11	19	77	118	160	159	172	88	66	23	117	999
12	181	110	132	59	72	103	178	116	36	118	1105
Total	1485	1997	2090	2120	2381	2093	1842	2211	1923	2038	20180

When the trials of Table III are divided on the basis of those that fall below twenty, those between twenty and ninety and those ninety or above, the following results are obtained:

	Below 20	20 to 90	90 or more
First third of table	265	5	0
Second third of table	158	110	2
Third third of table	68	176	36

Subject W. was tested again under the same conditions on June 26 and 27, 1913. He had had no practice in the meantime. The results were:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
June 26	2	62	27	68	73	37	167	92	66	116	712
June 27	53	51	173	230	36	170	67	130	181	215	1306

On July 3, 1914, the subject was tested again in the same room and under the same conditions except that the balls weighed 20.3 and 18.1 grams respectively. The scores were:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
July 3	146	55	116	115	105	118	201	205	156	145	1362

The subject had thrown a few times three or four months before with tennis balls but with no intention of making a high score. He had also tested himself once before with these same balls but did not think that over twenty minutes had been spent in such practice.

EXPERIMENT IV. SUBJECT F.

PART I

In the first part of this experiment, the subject was to toss and catch the two pieces of hard rubber described above in the same manner as the other subjects caught the balls. No specific directions in regard to the manner of attending the work were

given. The subject had had some little experience in tossing and catching balls. The right hand was used. The practice consisted of ten trials. The work was commenced on Oct. 9, 1912 and continued until Jan. 12, 1913. The practice was on alternate days from Oct. 9 to Nov. 19 and after that it was daily. The following practices were missed: Nov. 24 and from Dec. 20 to Jan. 8. The same room was used for all the work except a few practice periods near the end. The last room was not very different from the former one and no change was noted as a result of this. The subject knew his score. He took as much rest between trials as he desired but it was never over two or three minutes. The results of his work are shown in Table IV which is arranged on the same plan as those for the ball tossing.

TABLE IV

Subject—F.												
Experiment—Tossing and catching two pieces of hard rubber.												
Trials	1	2	3	4	5	6	7	8	9	10	Sum	
Oct.	9	2	7	9	8	12	2	6	9	7	6	68
	11	1	4	6	5	2	8	11	10	9	9	65
	13	3	3	9	19	5	9	7	13	7	3	78
	15	2	2	3	6	10	13	6	4	15	5	66
	17	1	5	8	3	7	26	4	12	13	18	97
	19	17	3	14	14	9	11	7	6	3	32	116
	21	17	2	10	9	4	18	7	6	12	5	90
	23	11	14	0	6	3	8	15	12	11	9	89
	25	33	10	2	13	3	6	4	6	4	10	91
	27	20	3	9	4	22	8	30	9	12	9	126
	29	13	3	0	6	47	12	11	22	2	11	127
	31	25	17	9	10	2	9	3	5	11	11	102
Nov.	2	7	3	9	10	14	2	26	5	3	7	86
	4	3	12	13	35	12	19	6	11	8	3	122
	6	13	11	7	5	21	39	40	12	18	17	183
	8	6	2	11	29	7	5	13	22	0	6	101
	10	17	8	4	16	3	2	15	14	0	9	88
	12	7	24	11	7	10	5	15	20	7	52	158
	14	5	6	9	17	12	57	7	64	6	6	189
	16	24	9	25	15	37	12	1	47	32	56	258
	18	9	13	3	18	14	4	7	39	41	4	152
	19	18	28	21	17	16	53	28	17	12	14	224
	20	5	21	10	7	9	26	39	12	8	4	141
	21	7	15	0	32	5	31	21	20	13	22	166
	22	20	8	53	22	40	11	21	3	35	3	216
	23	14	16	0	12	31	20	19	3	28	11	154
	24											
	25	17	44	5	7	22	12	10	35	2	20	174
	26	7	30	14	25	2	12	37	41	29	9	206
	27	34	7	11	32	18	46	26	9	7	25	215
	28	8	16	30	47	4	19	4	13	8	9	158
	29	41	4	26	22	4	14	2	42	26	7	188
	30	3	0	10	24	5	13	14	0	1	0	70

.. TABLE IV

Subject—F.		Experiment—Tossing and catching two pieces of hard rubber.										
Trial	1	2	3	4	5	6	7	8	9	10	Sum	
Dec.	1	34	2	13	22	75	32	15	4	8	18	223
	2	24	45	5	11	13	8	12	1	36	78	233
	3	13	3	12	34	14	7	9	13	13	53	171
	4	11	20	0	1	16	12	5	6	3	22	96
	5	19	18	3	28	39	36	3	49	44	9	248
	6	20	34	9	37	52	54	44	46	13	26	335
	7	14	15	5	31	11	30	56	95	3	36	296
	8	10	69	35	40	108	59	121	10	8	104	564
	9	15	103	53	67	85	28	110	25	24	22	532
	10	7	194	193	66	157	128	115	46	53	6	965
	11	121	119	13	133	72	44	103	71	108	57	841
	12	68	34	53	23	141	130	88	146	41	84	808
	13	76	91	91	113	113	122	44	66	32	61	799
	14	36	145	115	12	96	2	38	98	18	64	624
	15	44	165	83	30	110	52	77	24	112	78	775
	16	54	45	19	121	208	71	69	4	179	71	841
	17	66	265	294	195	111	59	30	15	54	197	1286
	18	1	71	102	120	180	11	285	60	77	29	836
	19	91	12	136	16	31	25	159	88	128	33	719
	20	10	115	117	137	76	98	57	5	95	36	746
Jan.	8	20	37	89	60	1	54	24	19	102	80	486
	9	14	60	41	24	99	35	59	117	77	37	563
	10	6	113	72	9	159	23	82	67	35	57	623
	11	4	191	318	187	9	110	19	25	39	165	1067
12	221	484	20	391	78	123	254	109	159	116	1955	
Total	1409	2800	2232	2410	2466	1885	2340	1752	1851	1951	21096	

When the trials in Table IV are divided on the basis of those that fall below twenty, those between twenty and ninety, and those ninety or more, the following results are obtained:

	Below 20	20 to 90	90 or more
First third of table	169	21	0
Second third of table	114	76	0
Third third of table	31	90	69

The subject was tested again on June 1, 1913, and made the following score:

Trial	1	2	3	4	5	6	7	8	9	10	Sum
June 1	29	157	158	69	154	110	10	0	54	21	762
June 2	4	97	27	31	19	106	75	67	14	184	624

No practice had been taken between the end of the regular practice and this date.

EXPERIMENT IV. SUBJECT F.

PART II

In this part of the experiment the subject was requested to toss and catch two balls, keeping one in the air all the time. The same balls were used that had been used by the other sub-

jects. The practice was with the left hand. The subject had had no previous practice with that hand. In this work, the subject continued each day until he had made one thousand catches. There was a rest of one minute between each hundred catches. The work was commenced on Jan. 13, 1913 and continued daily until Feb. 4, 1913.

The number of misses before a hundred catches were made in each trial and the total number of misses in each day's practice are shown in Table V. Where zero appears in the table, the subject was able to make a score of one hundred without missing. It should be noted that the number of misses counted is always one less than the number of trials for each one hundred catches.

When the columns are added vertically so as to show how many misses were made in catching the first hundreds, second hundreds, etc., the following figures were obtained:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Sum
44	27	32	37	38	52	36	26	23	35	350

The total number of catches was 23000. This represents the amount of practice the subject had. Table Va shows this work in detail. This table, with the exception of the first day's practice, shows where each miss was made for each one hundred catches.

TABLE V

		1st 100	2nd 100	3rd 100	4th 100	5th 100	6th 100	7th 100	8th 100	9th 100	10th 100	Sum	
Jan.	13	4	4	5	8	4	12	8	3	4	4	56	
	14	5	5	4	8	9	6	2	2	1	3	45	
	15	3	2	1	5	5	7	5	4	1	2	35	
	16	2	2	3	3	4	2	4	1	3	4	28	
	17	3	3	2	2	5	2	2	1	2	2	24	
	18	3	0	3	0	2	1	2	1	0	5	17	
	19	2	1	1	0	0	1	1	0	3	3	12	
	20	4	0	1	0	1	0	1	1	1	0	9	
	21	1	0	2	1	1	1	1	1	0	3	11	
	22	2	0	0	1	0	3	2	0	1	1	10	
	23	2	3	2	0	2	4	1	3	0	2	19	
	24	2	1	2	4	1	4	0	1	2	1	18	
	25	2	0	1	0	0	0	0	2	3	1	9	
	26	2	1	1	1	0	1	2	0	0	1	9	
	27	1	1	1	1	0	3	1	2	1	1	12	
	28	0	2	0	1	1	1	1	0	0	0	6	
	29	0	0	0	1	0	0	0	0	0	1	2	
	30	0	2	1	1	0	2	0	2	1	1	10	
	31	1	0	1	0	2	1	0	0	0	0	5	
	Feb.	1	1	0	0	0	0	0	0	0	0	3	
		2	0	0	0	0	0	0	1	1	0	2	
		3	4	0	1	0	1	1	0	1	0	8	
		4	0	0	0	0	0	0	0	0	0	0	
	Total		44	27	32	37	38	52	36	26	23	35	350

EXPERIMENT V. SUBJECT H.

This work was the tossing and catching two balls. No further instructions were given than that the subject should toss and catch one ball while the other was in the air. The practice consisted of five hundred catches, or as near as the score under the conditions could be kept to that number, daily. In the last trial that commenced below the five hundred, the subject was permitted to continue until he missed. This sometimes ran slightly over the five hundred. The practice was taken in the evening between seven and eight o'clock by electric light. The work commenced Feb. 3, 1914 and continued until March 1, 1914. The following days of practice were missed: Feb. 10, 18 and 28. The subject had had no previous experience in tossing balls. A rest period of five minutes was given as near the two hundred and fiftieth catch as it was convenient to make it without stopping the subject in the midst of a trial. The results of this practice are shown in Table VI.

TABLE VI

Subject—H.

Experiment—Tossing and catching two rubber balls with right hand. Each practice was five hundred catches with five minutes rest near the 250th catch. The numbers at which the misses were made are given below.

Feb. 3—1, 2, 3, 5, 7, 9, 10, 13, 15, 18, ——— 22, 26, 29, 30, 32, 34, 37, 40, 44, 46 ——— 49, 51, 55, 56, 57, 57, 61, 62, 63, 64 ——— 67, 70, 73, 75, 78, 79, 80, 84, 85, 88 ——— 93, 95, 100, 102, 102, 103, 105, 111, 112, 116 ——— 123, 125, 129, 133, 135, 139, 140, 148, 149, 153 ——— 160, 163, 166, 171, 173, 176, 179, 182, 184, 186 ——— 188, 193, 195, 198, 201, 203, 205, 208, 212, 215 ——— 219, 221, 223, 224, 227, 231, rest period, 232, 233, 238, 240, 241, 251, 265, 276, 277, 281, 293, 296, 299, 301 ——— 303, 304, 308, 317, 325, 330, 334, 336, 341, 343 ——— 349, 351, 358, 365, 368, 384, 386, 396, 404, 410 ——— 414, 418, 428, 431, 434, 435, 437, 442, 445, 446 ——— 449, 454, 455, 460, 465, 468, 474, 477, 483, 488 ——— 491, 492, 494, 497, 500. Total 145.

Feb. 4—4, 7, 12, 14, 16 ——— 19, 21, 23, 25, 28, 31, 34, 38, 43, 46 ——— 47, 49, 49, 58, 64, 64, 65, 71, 75, 77 ——— 81, 85, 92, 96, 100, 105, 109, 109, 120, 120 ——— 123, 128, 131, 137, 141, 143, 146, 149, 150, 155 ——— 163, 177, 181, 189, 193, 200, 208, 218, 222, 226 ——— 226, 229, 231, 237, 247, rest period, 252, 253, 258, 263, 268 ——— 280, 284, 289, 292, 293, 294, 297, 319, 326, 329 ——— 335, 336, 347, 356, 357, 357, 360, 369, 374, 377 ——— 381, 383, 394, 400, 409, 412, 426, 432, 437, 442 ——— 445, 446, 448, 452, 458, 461, 463, 469, 475, 481 ——— 493, 496, 498, 502. Total 110.

Feb. 5—1, 3, 8, 10, 12 ——— 13, 18, 22, 22, 25, 28, 28, 28, 34, 36 ——— 37, 37, 41, 45, 46, 48, 52, 55, 57 ——— 59, 60, 60, 60, 60, 61, 64, 72, 76, 83 ——— 83, 84, 87, 88, 94, 96, 101, 103, 106, 109 ——— 110, 119, 126, 131, 135, 140, 141, 141, 148, 151 ——— 151, 152, 152, 158, 161, 164, 168, 174, 175, 188 ——— 200, 207, 207, 212, 220 229, 237, 244, rest period, 245, 245, 251, 252, 254, 255, 256, 259, 268, 281, 283, 301 ——— 321, 333, 338, 343, 377, 377, 379, 384, 388, 410 ——— 425, 425, 439, 461, 481, 482, 494, 496, 508. Total 104.

TABLE VI
(Continued)

Subject—H.

Experiment—Tossing and catching two rubber balls with right hand. Each practice was five hundred catches with five minutes rest near the 250th catch. The numbers at which the misses were made are given below.

Feb. 6—11 ——— 14, 15, 21, 24, 32, 38, 44, 45, 47, 67 ——— 72, 77, 82, 86, 90, 91, 92, 97, 99, 103 ——— 107, 111, 130, 143, 151, 168, 174, 182, 190, 205 ——— 219, 228, 255, rest period, 261, 280, 285, 311, 326, 333, 336 ——— 385, 391, 428, 430, 431, 433, 461, 475, 485, 501. Total 51.

Feb. 7— ——— 7, 17, 19, 21, 41, 60, 78, 96, 114, 132 ——— 135, 150, 166, 167, 175, 179, 181, 190, 195, 201 ——— 215, 223, 225, 225, 227, 240, 258, rest period, 263, 265, 268 ——— 273, 276, 290, 334, 356, 364, 377, 381, 400, 414 ——— 423, 444, 453, 455, 479, 486, 504. Total 47.

Feb. 8—2, 3, 11 ——— 13, 17, 27, 27, 30, 36, 41, 48, 60, 70 ——— 90, 94, 105, 107, 110, 121, 133, 141, 143, 150 ——— 150, 172, 203, 235, 267, rest period, 279, 286, 290, 300, 310 ——— 318, 322, 326, 334, 345, 375, 388, 400, 403, 407 ——— 435, 438, 441, 455, 489, 518. Total 49.

Feb. 10—16, 17, 20, 21 ——— 21, 28, 47, 110, 152, 160, 173, 196, 201, 202, ——— 209, 231, 235, 238, 246, rest period, 253, 260, 264, 267, 268 ——— 300, 330, 343, 346, 376, 401, 416, 432, 449, 452 ——— 510. Total 35.

Feb. 11—1, 98, 129, 130, 153, 165, 193, 213, 272 ——— rest period, 280, 287, 324, 339, 381, 421, 430, 442, 504. Total 18.

Feb. 12—39 ——— 60, 81, 100, 122, 176, 194, 221, 281, rest period, 290, 318 ——— 450, 489, 499, 560. Total 16.

Feb. 13—49, 93, 111, 116, 121 ——— 143, 182, 249, rest period, 274, 315, 368, 410, 431, 509. Total 15.

Feb. 14—0, 42, 69, 131, 190, 203, 238, rest period, 214, 264, 284 ——— 301, 338, 364, 367, 373, 389, 409, 418, 450, 453 ——— 460, 471, 535. Total 23.

Feb. 15—6, 21, 31, 59, 78, 88, 89 ——— 116, 135, 150, 169, 174, 185, 193, 199, 204, 205 ——— 244, 246, 247, 255, rest period, 257, 272, 285, 288, 289, 323 ——— 327, 344, 362, 369, 379, 383, 409, 427, 428, 438 ——— 472, 488, 494, 505. Total 41.

Feb. 16—56, 84, 124, 152, 158, 200 ——— 219, 223, 234, 242, 296, rest period, 299, 311, 350, 359, 386 ——— 391, 395, 402, 446, 497, 506. Total 22.

Feb. 17—15, 21, 44, 83, 130, 138, 163, 216, 261, rest period, 287, 309, 407, 428, 432 ——— 492, 524. Total 16.

Feb. 19—99, 130, 178, 208, 235, 252, rest period, 290, 328 ——— 352, 416, 428, 454, 518. Total 13.

Feb. 20—97, 159, 200, 240, 268, rest period, ——— 322, 352, 413, 459, 537. Total 11.

Feb. 21—31, 47, 61, 99 ——— 126, 131, 149, 150, 162, 180, 185, 216, 217, 233 ——— 243, rest period, 263, 267, 278, 337, 362, 373, 413, 415, ——— 434, 455, 460, 461, 523. Total 29.

Feb. 22—24, 54, 91, 91, 109 ——— 134, 145, 171, 220, 247, rest period, 261, 335, 377, 428, 436 ——— 456, 463, 474, 476, 477, 489, 494, 517. Total 23.

Feb. 23—15, 116 ——— 149, 186, 208, 237, 298, rest period, 340, 369, 434, 500. Total 11.

Feb. 24—32 ——— 61, 200, 205, 231, 322, rest period, 335, 449, 537. Total 9.

Feb. 25—86, 114 ——— 189, 234, rest period, 516. Total 5.

Feb. 26—53, 87, 187, 266, rest period, 348, 415, 435 ——— 551. Total 8.

Feb. 27—227, rest period, 435, 509. Total 3.

March 1—332, rest period, 550. Total 2.

The table shows the number at which the misses were made, that is in the first practice the subject caught one ball and missed the second one. The next trial he caught one more and then missed. This makes two catches as represented by the two. By

taking the difference between any two successive numbers, the number of catches made during that trial may be found. The breaks, marked "-----" in the columns divide the work into periods of ten trials each. This was done for convenience in plotting one of the curves. The last figures marked "total" show how many misses were made in that particular practice period.

THE PLOTTING OF THE CURVES

In order that the significance of these figures may be better understood, the curves which they represent have been plotted. Curves I, II, III, IV and V (Plate I) are plotted by letting the divisions on the x-axis represent the practice periods and the divisions on the y-axis, the number of catches. In Curves VI and VII (Plate II), the divisions on the x-axis represent the number of practice periods and the divisions on the y-axis represent the number of misses in the practice period. Curve VIII (Plate III), also, has practice period divisions on the x-axis and the number of catches on the y-axis. Curve VIII is obtained by taking the work of Subject H. and finding how many catches were made in each ten trials. Since he was not stopped at the end of any trial, the only difference between this and the first five curves is that the practice was differently distributed. Each practice period for Subject H. continued until he had caught five hundred or a few more than five hundred balls. In Curve VIII, each ten trials is called a practice period and given a space on the x-axis.

Curves IX and X (Plate III) are obtained by taking the second part of the work of Subject F. and the work of Subject H. and using the reciprocals of the number of trials for the divisions on the y-axis and the number of practice periods for the divisions on the x-axis. The number of trials and the number of misses are the same for Subject H. But for Subject F. one trial must be added in each hundred as the last one was not counted a miss. This places him at a disadvantage as he was not allowed to finish out his last trial. Under the given conditions these reciprocal curves have the same form as the curves that would be obtained by taking the average number of throws per

trial in the given practice period, which in these cases includes one thousand or five hundred catches for the divisions on the y-axis.

Curves XI, XII, XIII, XIV (Plate II) and XV (Plate III) are plotted by taking groups of one thousand tosses for the divisions on the x-axis and the average number of catches per trial for the divisions on the y-axis. Tables I, IIa, IIb, III and IV are used as a basis for the data. Each table is divided into as many groups as there are thousands of catches. Where a thousand catches ended in the midst of a trial the number that was used out of that trial was used as a fractional part of a trial. For instance, if the first one thousand included the sum of the number of catches made in the first fifty trials and a half of the number of catches made in the fifty-first trial, then the whole number of trials for the first one thousand would be fifty and one half. This divided into the one thousand would give the average number of catches per trial in the first one thousand. In each of these tables there was a fractional part of a thousand left over. The curves do not show this.

Another way of handling the data was to divide the catches in each table into groups of one thousand each and then to find what per cent each thousand catches was of the total number of tosses for making a thousand catches. For instance, in Table I, it is found that in order to make the first thousand catches 1172 + tosses (1000 catches plus 172 trials) were necessary. This gives 85 per cent of success. In each succeeding thousand as the number of trials per thousand catches becomes less the percent of success becomes greater. Curves were plotted on this basis and Curves IIa and IVa (Plate I) are typical examples.

Curves were also plotted by taking the highest score in each one thousand group for divisions on the y-axis and the thousand groups representing divisions on the x-axis. Curves IIIb and IVb (Plate I) are typical examples obtained in this way.

DISCUSSION OF THE CURVES

Curve I, II, IV, and V have a rather long period during which they rise but little. It took twenty practices for Curve I to rise above the one hundred level. Half of the number of prac-

tices were spent before the two hundred mark was reached. The drop in the curve at the twenty-fourth and the fortieth practices was the result of the room being cold. The drop at the thirtieth and thirty-third practices was caused by those apparently unaccountable bad days for which there was no reason that could be pointed out.

Curve II shows that the practice commenced further along. It is, however, slightly concave to the y-axis. Curve III has a more typical form for this method of plotting the work. There is a period of slow rise extending over more than half of the practice periods. The two hundred mark was not reached until the twenty-fifth practice. The thirty-sixth, thirty-seventh and thirty-eighth practices were on the three days just before the Christmas vacation and this seems partly, at least, to account for the drop here. It will be seen that after a period of eighteen days rest, the score on the thirty-ninth practice is nearly as high as it had ever been before.

Curve IV shows a very slow rise but without any very marked fluctuations. It took thirty-six practices for the subject to reach the two hundred mark, and he did not rise above it permanently until the fiftieth practice. The fluctuations between the forty-fifth and fifty-second practices represent the period just before and after the Christmas vacation. In this case there was a slight fall in the score immediately after the practices were resumed.

Curve V is peculiar in that it shows a very marked decline period. This is, no doubt, the result of too much effort. The subject was very anxious to reach the mark set which was to make an average of a hundred per trial for two consecutive days. After he made the score on the forty-ninth practice, he tried very hard to make a thousand catches in the ten trials on the next day. He said that his attention was so set on making a thousand catches that he forgot how to throw. His failure caused a temporary period of despondency. He thought he never could reach the mark set.

The higher level from the nineteenth to the thirty-fourth practice may be explained by the fact that the practices were daily;

before this time they had been on alternate days. The curve shows a somewhat higher level at first than do the other curves. This is possibly due to the subject's previous practice.

Curves VI and VII show a very rapid drop at first and then a slower fall toward the end. The fluctuation in Curve VI, perhaps, would not have appeared had the subject not had to practice in a cold room and had he been in a good physical condition. Curve VII has two marked rises. The first marked rise at the eleventh practice is the result of subject's being in a bad physical and mental state. At this practice he stated that he had had a disagreeable conversation just before and that he was all "worked up." He had been up late for several nights. He stated that his head and eyes ached and that he had no control of his hand. The next night he said that he was all worn out, that he had a cold and that he did not think he would ever be able to get below the mark that he had already set.

The rise at the seventeenth practice was due to the subject being in a hurry to get to orchestra practice. In these cases where the practice period is long, it appears that the fluctuations under normal conditions would be rather small. Subject H. felt confident after he had finished that if he had not tried to take the practice under adverse conditions, he would have had a nearly smooth curve.

When the work of Subject H. is reduced to a ten trial basis, the form of the curve does not differ greatly from the first five curves. It does not appear that the heaped up practice has any effect on the general form of the curve. In the curve only six trials are represented on the last division of the x-axis and yet the score for these six trials is more than twice as large as that for any other ten trials.

When the reciprocal of the number of trials is used as a measure of the skill, the curves take the form of IX and X. As has been stated, Curve IX is defective because the last trial in each hundred is not complete. The subject was stopped when he reached a hundred.

Curve X has a form similar to the first five curves,—that is it is concave to the y-axis. It has a slow rise at first and a rapid rise at the end.

Curves XI, XIII, XIV, and XV are all to a certain extent concave to the y-axis. By taking groups of a thousand instead of ten trials as a basis for the divisions on the x-axis, the early part of the curves rise more rapidly but even in these cases the latter part of the curves shows a rapid rise.

Curve XII corresponds to Curve II plotted by letting the ten trials represent the divisions on the x-axis. In this case where the groups of one thousand represent the divisions on the x-axis there is a slight convexity to the y-axis. It approaches more nearly a straight line.

Curves IIa and IVa rise rapidly at first and then approach parallelism with the x-axis. Curves obtained by taking the highest score in each one thousand group as a basis for divisions on the y-axis, of which Curves IIIb and IVb are examples, approach a straight line in general form. In none of these curves is there evidence of an arrest period of any considerable length between two periods of rapid rise.

DISCUSSION OF RESULTS

It was the intention in this part of the work, to change the conditions so as to give a chance to analyse the factors involved and thus to get a better idea of how they influence the acquisition of skill.

Experiment—I: The purpose here was to get a curve for comparison where no directions were given and the subject was free to learn as he pleased. The first difficulty he noticed was his inability to throw the balls properly. This was such a bother that it was necessary to move to a larger room on the third day. This did not seem to aid any as he made a lower score on that day than on the day previous. The subject had great confidence throughout the work and was always sure that he was going to do better than on the preceding day. He noticed after the third trial that he fixed his attention on the ball at its highest point. On the twentieth day, when he reached a score more than twice as large as he had ever made before, he could give no other reason for the improvement than that they just seemed to fall

right. A cold room had a very marked effect upon the score as is shown by the result on the twenty-fourth and fortieth practice days.

Experiment—II: After two trials the subject had control of the manner of throwing to a large extent. In the fourth trial, all the attention apparently was centered on the throwing and the trouble came in the balls rolling out of the hand. In the fifth trial there was a greater feeling of confidence. The subject knew that he had reached a higher level of ability. At the ninth trial there was trouble because of the balls hitting together in the air. This difficulty lasted until the end of the practice. If the thought of their hitting together came up, they were almost sure to do so.

When the left hand was used, it was just the same as beginning all over again. The ability to grasp the ball came slower. It was noted at the eighteenth trial that this power had increased. It was also noted at that time that there was increase in ability to place the hand so as to receive the ball.

Experiment—III: The subject's first object was to pitch in a curve from right to left. His eyes seemed to follow the ball in its course and then with a quick jerk he threw the second ball and attempted to catch the first. The tendency was for him to follow the ball around in a circle from right to left. He was encouraged to follow the plan of pitching rather than to aim to make a high score. In the third trial, he thought there was no hope; his trouble was all in catching. He was still urged to give all his attention to throwing and get that under control first. In time, he did succeed in mastering the plan of throwing but an improvement in all the other elements of the work went along with this improvement. The subject was very sensitive to a cold room and the low score on Dec. 14 was the result of this. The missing of a few practices did not seem to effect the score either way to any great extent. After the Holidays, when the practice had been discontinued for seventeen days, his score fell slightly below what it had been the last two days before the vacation but these had been unusually high.

Experiment—IV: The purpose in using hard rubber was to

compel the subject to throw in a certain way. At first there was a tendency to throw the pieces so far away that he could not reach them. At the ninth trial on the first day, he commenced to throw in a circle from right to left. On the sixth day, he changed his plan of throwing because the pieces had whirled end over end. He now tried to pitch them straight up and let them fall flat on his hand. On Nov. 30, the low score was made because the subject was trying out a new plan of throwing. He now let the pieces roll off the ends of his fingers. He continued to use this method but in most cases when the pieces did whirl end over end he was able to get them started properly and would thus recover.

In the practice of all the subjects, a large part of the improvement seemed to be in their ability to get out of tight places. Ordinarily the throwing would go smoothly for some time until a bad pitch or catch would put one in a difficult position to make the next move. Early in the practice, this would mean a miss, but later the subject would be able to recover and get them going correctly. Subject F. thought his ability to get out of bad places was due to his giving attention to the next throw rather than centering all attention on the catch about to be made.

In the second part of this experiment, the object was to see the effect of giving a longer practice period. These results are shown in Curves VI and IX.

Experiment—V: This experiment had the same object as the second part of the experiment above. The subject was not at all given to any form of athletic work and took but little interest in physical exercise. He tried to study every phase of the work. At first he had very little confidence in his ability to do the catching. In the second practice, he noticed that he recovered a number of times from bad places. In the fourth practice, he found that the chief trouble was fatigue. He now felt confident that he could make a good score.

Taken as a whole, the subjects were affected more by subjective and objective factors in the beginning of the work than after they had reached a high degree of efficiency. The subject's feeling that he was going to make a high score was no

guarantee that he would do so. At times both high and low scores were made without the subject being able to account for them. An extra effort had no noticeable effect in increasing the score. In the early practice, there was a great amount of useless effort. The other hand would work in harmony with the one that was being used, the feet would be shifted with every catch, and the whole body seemed to be affected. When the skill, became greater, the unnecessary movements dropped out. They would return, however, when the subject found himself in a tight place but as soon as he got control they ceased.

By a study of the curves, it is seen that an attempt to give attention to different phases of the work does not modify the general form of the curves for this work. There seems to be scarcely any room for doubt that although some one factor may be picked out and emphasized, all the elements improve together. In this work having a method did not help much and nearly all the improvements were made accidentally and then adopted.

The Warming up Process

A good idea of this may be obtained by taking the sums of the trials separately for the different subjects. The following are the figures:

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Subject—D.	1134	943	1357	1261	1169	958	1157	1616	1115	1396
“ B.	927	1359	1244	1189	1372	1416	1340	1245	1075	1752
“ B.	1210	1495	1470	1416	1611	1241	1233	1332	1142	1466
“ W.	1458	1978	2051	2097	2338	2079	1793	2184	1883	2008
“ F.	1409	2800	2232	2410	2466	1885	2340	1752	1852	1951
Total	6138	8575	8354	8373	8956	7379	7881	8129	7066	8573

From the figures in the total, it is seen that the first trial falls almost a thousand below any other trial. In three cases it is below any other of the ten. In the other two cases it is below the average for the ten.

RELEARNING

None of the subjects shows any considerable loss for a long rest period. Subject D., on Aug. 15, after a rest of 265 days, was able to make a score higher than any he had ever made before excepting the first three at the end of the practice where he had made a sudden rise. Two days afterwards without any further

practice he was able to make a score that almost equalled his last practice score. After nearly a year (327 days) more had elapsed, he was able to make the very high score of 2550 which was almost twice as high as he had ever made before. Here the only thing that seemed to bother him was the fatigue.

Subject-B. after more than a year's rest (613 days) made nearly as good score with the right hand as he had ever made before. He was sure he could have exceeded any previous score if he had not fatigued himself so much by the first throw (score 329). After that he could not grasp the balls so well. After the beginning of each trial was made the work went along without much trouble. The next day, he surpassed any previous record with a score of 1437. Here the fatigue element, especially that of the eyes, was very annoying.

The left hand, after a period of 612 days, seemed to have lost more. The process seemed very strange and the subject had no confidence that he could do it. Even in this case the score did not fall much below what it had been before the last two times in the regular practice. Two days later the subject was able to make a score of 702. This exceeded any score he had previously made except the last three of the regular practice.

Subject-W., after a rest of 134 days, was able to reach a score higher than any he had before made except the last four in the regular practice. The next day he exceeded all previous records. After a period of 371 days from this practice he was able to make a score higher than any he had ever made before. The only explanation he gave for this is that he had been out playing tennis and felt especially well that morning.

Subject F., after a period of 143 days seemed to have dropped to a level that preceded his last two practices. The next day he was not able to do so well. The first day he started out confident that he would exceed an average of a hundred catches per trial but after a bad run in the seventh trial he became discouraged as the figures show.

Taken as a whole the results show that there remains for long periods of time after practice ceases an ability about equal to what it was at the end of the practice. In some cases it seems

to increase and in nearly all cases is capable of a very rapid increase when practice is commenced again.

THE TOTAL AMOUNT OF PRACTICE

In the first five experiments, attention has been called to the amount of practice that passed before any great amount of advance was made. This must not be taken to mean that a proportionate part of the practice time had passed. In the trial method, the first ten trials gave but very little practice. The amount of actual practice increased as the ability increased. This, of course, is not the case where a certain number of catches had to be made each day or practice period.

The total number of catches gives an idea of the total amount of practice and may be a truer index of the subject's ability to improve. It is seen from these figures that Subject D. took the least practice (12124 catches) although he took more practice periods than did Subject B. The figures show further that Subject B. improved almost as fast with the left hand as with the right hand, the catches being 13617 and 12919 respectively. However, the practice with the left hand is distributed over a longer period. This might mean that the left hand improves about as fast as the right hand or that the longer distribution has the advantage.

Subject W. took 20180 catches to gain the degree of skill required of the other subjects. Subject F. took 21098 catches but his work was much more difficult.

THE EFFECT OF AN ISOLATED FACTOR

While doing the work just discussed, it was noticed that several factors influenced the subject's progress. At least three of these could be easily picked out. It has already been noticed that the ability to throw the ball so that it could be reached was an important element in the learning. This judgment of direction or the ability to throw properly is one of these elements.

Again, the force with which the balls were thrown was important. If the ball was not thrown high enough, it would return before the other could be thrown. Not all the subjects

used the same force, or in other words pitched the balls the same height, but they soon fell into some habit of pitching and when the work was going smoothly, about an equal amount of force was put into each pitch. The element of force was the second factor to be noticed.

The third element is that of time. It has been stated that the eye saw the ball only at the highest point of its upward motion and a short way down on its course. The absolute eye movement was not measured but by watching the subject's eyes it was seen that they scarcely moved in a vertical line. It was necessary for the subject to learn to catch the ball by timing it from the time it left the field of vision until it reached the hand. That this was the case is shown by the subject's inability to grasp the ball at first when it hit his hand or by his closing the hand too soon and permitting the ball to hit the ends of his fingers. That this grasping is not simply a reflex that takes place after the ball hits the hand is further shown by taking a practiced subject and intercepting the ball after it leaves the field of vision but before it reaches his hand. It was found that the hand closes even though the ball does not touch it.

These three elements, judgment of direction, judgment of force, and judgment of time, have been selected for further study. The aim was to discover the nature of the improvement of these factors when isolated and trained in as simple a form as it was possible to devise.

EXPERIMENT I. ON DIRECTION

Two subjects took part in this experiment: Subject D. (De-Camp) and Subject W. (Wang) had both been subjects in the ball tossing experiments. The apparatus consisted of a smooth board, a steel ball, and a small block of wood. The board was fifteen inches wide and about fifteen feet long. Forty and one half inches from one end of the board a line was drawn across at right angles to the side. On this line, inch spaces were marked off and numbered from zero out on one side to plus seven and on the other side to minus seven. Seven and one half feet from this line another line was drawn across the board. The board

was three and one half inches higher at the first mark than at the second mark.

The steel ball was one inch in diameter and weighed 66.8 g. The block of wood was two and one half inches long and seven eighths of an inch square. This was set up on the zero mark as a target. The subject stood at the lower mark and rolled the ball at the block of wood. His score was kept in figures as +1, -3, etc. accordingly as the steel ball passed through these numbers or spaces.*

Subject W. commenced this work on Apr. 14, 1913 and continued it until May 18, 1913. The practice was daily in the forenoon and consisted of fifty trials. The result of this work is shown in Table VII.

TABLE VII

Subject—W.

Experiment—To obtain a curve of learning for direction. Work consisted in rolling a steel ball at a mark.

April 13. 0, 2, 1, 0, 2, -7, 2, 0, -1, 1, 0, -7, 6, 2, 1, 2, 1, 3, 0, -5, 1, -2, 3, 0, -2, 3, 5, 0, 0, 0, 2, 2, -4, 0, 2, -5, 0, 0, -2, 4, 0, 0, 3, 3, 3, 0, 0, 0, -1 = 90.

Apr. 14. 0, -4, -4, -2, -3, 2, -1, -1, 0, -2, 0, -2, -2, -1, -1, 0, 0, 2, -2, 0, 1, -2, 0, -1, 0, 0, 2, 2, 1, -2, -3, -2, -1, -2, 0, 0, -2, 0, 0, 2, 3, -2, -1, 0, 0, -2, 1, -1, 0, 1 = 63.

Apr. 15. 2, 2, 1, 0, -1, 0, 0, 0, 0, 0, 0, 1, 0, 1, -1, 1, -5, 4, 2, 0, -3, -2, 1, 2, 2, 1, -1, 0, 0, -1, 0, 0, -3, 7, 0, -3, -4, -4, 0, 0, -1, -1, -3, 0, -3, -4, -3, -2, -1 = 73.

Apr. 16. 1, 0, 1, 2, 2, 0, 2, 2, 0, 0, 0, -1, 0, 0, -1, 1, 0, -3, 0, 0, 0, -4, 0, -1, 0, 0, 0, -1, -2, 0, -1, 0, 0, 0, -2, -2, 2, -4, 1, 0, 1, 0, 2, 0, 0, 1, -1, -2, 1, 1 = 44.

Apr. 17. 1, 2, 0, -1, -1, 2, 1, 2, 1, 1, 0, 0, 1, 2, 2, 0, 1, 0, 0, 0, 0, 0, 4, 2, 0, 1, 0, -3, 2, 1, 1, -3, 0, -1, 0, 0, 0, 0, 0, -1, 0, 1, 0, 1, 0, 1, 2, -2, -5 = 49.

Apr. 18. -2, 2, 1, 0, 1, -2, 0, 3, 0, 1, -4, 0, 1, 0, 1, 1, 0, 0, 0, 0, 2, 0, -1, -2, 0, 0, 0, -1, -3, 1, 2, 1, 0, 0, -2, 1, -3, -1, -1, 0, -4, 2, 0, 0, 0, -1, 0, 0, 0 = 47.

Apr. 19. 1, 1, 2, -5, -3, 0, -2, -2, 0, -3, 0, 5, 2, 2, 0, -4, 2, 0, 0, -5, 0, -3, 1, 1, 0, 2, 0, 1, 0, 0, 0, -3, -1, 0, -1, 0, 0, 0, 1, -1, 2, 0, 0, 4, 0, 3, 0, 1, 0, 1 = 65.

Apr. 20. 2, 2, 2, 0, 1, 0, -2, -4, 1, 0, 2, 0, -1, -2, 2, 0, 0, 2, 0, 0, 0, -2, -2, 2, 2, 2, 2, 0, 0, -1, 1, 0, 1, 0, 0, 0, -2, -3, 0, -2, 0, 0, -1, -2, 1, 2, 0, 0, 0, 0, 0 = 51.

Apr. 21. 0, 0, -1, 0, 1, 0, 1, 0, 0, 0, 1, -1, 0, 0, 0, -3, 2, 2, 1, 0, 3, 2, -2, 2, 0, 2, 1, 0, 0, 2, 0, -2, 0, -1, 1, 0, 0, -3, 2, 0, 1, 2, -1, -1, -2, 0, -1, 3, -1, 0 = 48.

Apr. 22. 2, -2, 0, 1, 0, -1, 0, 0, 0, 2, 0, 0, 0, 0, -2, -1, -3, 1, 0, 0, 0, 1, 0, 2, 1, 0, 0, 0, -3, 1, 1, -2, 0, 0, -1, -3, -4, 0, -1, 0, 1, 1, 1, -1, 0, -2, -1, 0, 4 = 46.

*In order for these figures to correspond to the value they represent, the divisions should have been weighed according to the divisions on the base line of the curve of probability. But as there were relatively few high scores the error in the final result was negligible.

TABLE VIII
(Continued)

Subject—D.

Experiment—To obtain a curve of learning for direction. Work consisted in rolling a steel ball at a mark.

2, 0, 2, 0, 3, 0, 0, 2, 1, 3, -1, 0, 0, -1, -3, 0, 1, 0, 2, 1, -1, 3, 3, 0, 2, 0, 5, 3, 1, 0, -1, -1, 0, -1, -1, 0, 0, 2, 0, 1, 1, 1, 1, -1, 0, 0, -1, 0, 0, 0, 0, 4, 1, 4, 0, 0, 0, -2, 0, -3, -3, 0, 1, 2, 2, -1, 0 = 104.

Apr. 30. 3, 2, 0, -3, -1, 2, 1, 0, 0, 1, -2, 5, 0, 2, 3, 0, 0, 1, -4, -1, -1, -2, 0, -2, -1, 2, 0, 1, 2, -1, -1, 0, 1, 0, 1, -1, 2, 2, 0, 0, 0, 1, 0, 0, 2, 0, 1, 2, 0, -1, -1, 5, 2, 0, -3, 2, 0, 0, -1, 0, 0, 0, -1, 0, 0, -2, 0, 0, -1, 0, 0, -2, 1, 0, 3, 5, 2, 1, 0, 0, 0, 0, -2, 0, 0, 1, 0, 0, 0, 0, -1, -1, 0, 0, 1, 1, 2, 2, 3, 0 = 104.

May 1. 2, 0, 2, 0, 0, 1, 2, 1, -2, -2, 1, 0, 1, 2, 0, 3, 0, 0, 3, -3, -3, 2, -2, -3, 0, 1, -1, 2, -3, -1, 1, 0, 0, 1, -3, -1, 1, 0, 1, 1, 0, 2, 1, 4, 0, 0, 1, -3, 0, 1, 4, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 1, 4, -1, -1, 0, 1, 0, 7, 0, 0, -3, 1, 0, 2, -1, 5, 0, 1, 0, 1, 0, 1, 0, 2, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0 = 105.

May 2. 0, 0, -1, 0, 1, 5, 1, 2, 0, 0, 1, 0, 0, 2, 0, 1, 0, -1, 0, 0, -1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 2, 2, 1, 0, 0, -1, 2, 0, 0, 1, 2, -1, 0, 3, 1, 0, 2, -1, -1, -2, 0, 0, 1, -1, 0, -1, 0, 0, 0, 2, 1, -2, 2, 2, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 3, -1, -1, 0, 3, 0, -1, 0, 2, 0, 3, -3, 4, 3, -1, 0, 1, 0, 1 = 82.

May 3. -2, 4, 0, 5, 3, 1, 1, -1, -2, 0, 0, 2, 1, 0, -2, 0, 0, -3, 1, 0, 0, 1, -1, -1, 0, 0, 0, 0, 1, -1, 0, 2, 3, 1, 3, 2, 0, 3, -1, 0, 0, 0, 2, 0, 0, 2, 0, 0, -1, 3, 4, 3, 0, 0, 2, 3, 1, 0, 1, 0, 0, 0, 2, 0, 0, -3, 1, 0, -3, 0, 1, 0, 0, 1, 0, 0, 0, 3, 1, -3, 1, 0, 1, 2, 1, 0, 0, -2, 2, 2, 0, 2, 4, 0, -2 = 107.

May 4. 0, 1, 2, 2, 2, -1, -1, 0, 0, 0, -1, 3, 0, 3, 3, 0, -1, 0, -2, 0, 0, 2, 0, -4, 0, 2, 0, 5, -4, 0, 0, 2, 0, 0, -1, 2, 1, 0, -2, 0, -2, 0, -1, 0, 0, -2, 0, -1, 0, -1, 0, 0, 0, 7, -2, -5, -3, -5, 0, 0, 0, 0, 0, -1, 0, 0, -1, 2, -2, 0, -2, 4, 1, -1, 2, 1, 2, 1, 3, 1, 2, 0, 0, 0, 0, -1, 1, 0, 1, 2, 2, -2, 1, 0 = 116.

May 5. 0, 1, 3, 5, 0, 0, 0, 0, 2, 0, 0, 0, 2, 0, 1, 2, 1, 1, -1, 3, 2, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, -1, 0, 0, 2, 0, 0, 3, 0, 0, 1, 0, 2, 0, 0, 0, -2, 0, 0, 0, 0, -1, 0, 5, 2, -1, 3, 2, 0, 0, 0, 0, -2, 1, 2, 2, 0, 0, 0, 1, 3, 0, 0, 1, -1, 1, 1, 0, 0, 1, 0, 0, 1, 0, -1, 0, 4, -1, 2, 0, 1, 0, 0, -1, 2 = 83.

May 6. 3, 2, -2, 0, 0, 0, -2, 0, 0, 0, -1, 3, 0, 0, -2, 1, 3, 0, 0, 1, 0, 1, 0, 0, 2, 1, -2, 2, 1, 0, 1, 4, 1, 0, 1, 0, 1, 0, 0, 2, 0, 1, 2, 0, 1, 2, 0, 2, 1, 3, -1, -1, 0, 1, 0, 0, 1, -2, -2, 3, 1, 1, 3, -1, 4, 2, 0, 2, 1, -2, 0, 0, 1, 0, -1, 2, -2, 1, 2, 0, 0, -1, 0, 0, 0, 0, 0, 2, 1, -1, 2, -2, 0, 1, 1, 3, 0, 0, 1, -3 = 105.

May 7. 1, 1, 1, 0, 0, -1, -2, 0, 0, 0, -3, 0, 1, 0, 0, 0, 0, -1, 0, -1, -1, 2, 1, -1, -3, 0, -2, 0, 0, 0, 0, 2, 0, 0, 2, 0, 0, -1, 0, -1, 0, 2, 0, 2, 0, 0, -2, 0, 0, 0, -1, 0, -1, -1, 3, 0, -1, 0, 0, 0, -1, 1, 0, 2, -2, 0, 1, 0, 0, 1, 0, -2, 0, -2, -1, 0, 0, 0, -1, 0, 0 = 64.

May 8. 2, 0, 1, 0, 0, 0, -1, -2, 3, 0, 0, 0, -1, 2, -1, 2, 0, 3, 0, 1, 2, 3, -2, 1, 1, 0, 0, -1, 0, -4, 0, 0, 0, -1, -1, -1, -1, 0, 0, -1, -1, 0, 0, -2, 0, -1, 0, -1, 2, 2, 0, 2, -2, 0, -1, 2, 0, 0, 1, 0, 1, 1, 0, 2, 0, 0, 1, 0, -1, 0, 0,

the daily fluctuations are quite large, there is an almost constant downward course to each curve. The large fluctuations from the thirteenth to the twenty-first practice of Curve XVI represent the period when the subject was attempting to curve the ball and to locate a place on the board near his hand through which he could throw the ball. It will be noted that at only one place are there as many as four consecutive points on the same side of the line passed from point seventy on the y-axis to point thirty-six on the x-axis of Curve XVI. With the exception of the period when the subject was attempting to find a new method, the curve follows the general direction of this line. The average deviation of the points from this line is eight. The upper heavy line shows the position where the plus and minus deviations are balanced. The sum of the deviations above this line is equal to the sum of the deviations below the line. The two dotted lines show the average deviation from the line.

The course of Curve XVII is fairly well shown by a line drawn from 135 on the y-axis to a point 37 units above 35 on the x-axis. There is a period from the thirteenth to the twentieth practice when the score was rather high which was the result of the subject trying to spin the ball on its axis. The only explanation for the rise at the thirtieth and thirty-first practices was the bad weather which may have affected the subject. Only in one case here do as many as four consecutive points remain on the same side of the line and three of these are within the average deviation limit, which is twelve in this case and is represented by the two dotted lines.

An examination of Tables VII and VIII shows that the subjects were able to do almost equally well in each half of a practice period. The scores that Subject W. made in the first half of his daily practices were as follows:

50, 33, 31, 20, 24, 24, 44, 31, 22, 19, 27, 19, 22, 37, 31, 19, 17, 25, 28, 30, 13, 9, 12, 24, 12, 16, 20, 6, 11, 1, 4, 4, 12, 8, 9, 5. Total 619.

The scores for the last half of each practice were:

40, 30, 42, 24, 25, 23, 21, 21, 26, 27, 29, 24, 29, 28, 26, 25, 15, 21, 28, 12, 17, 4, 6, 4, 2, 6, 16, 10, 2, 4, 5, 5, 0, 1, 1, 2, 7. Total 608.

in psychology. The apparatus for Subject W. was the same as in the preceding experiment, except the block of wood was not used and instead of the steel ball, two rubber balls that had been used in the ball tossing experiments were used. The board was placed on a table with a point marked zero three and one half inches above the mark from which the ball was thrown. There was a space of seven and one half feet on the board between these two marks. At the zero mark a heavy line was drawn across the board. On either side of this line divisions were laid off three inches wide by other lines drawn across the board parallel to the line running through the zero mark. These divisions ran up to plus thirteen on one side of the zero mark and to minus thirteen on the other side of the zero mark. The mark from which the ball was thrown was drawn across the board parallel to the line drawn through the zero mark and was, as stated above, seven and one half feet from it.

The second board which was used with the other three subjects was covered with a piece of heavy paper during the latter part of the practice. It was laid off in the same way as the one above except the divisions ran up to plus fifteen on one side and to minus fifteen on the other side. The minus numbers in both cases were next to the subject. In this case the steel ball was used instead of the rubber balls.

The subject in both cases stood at the lower mark and attempted to throw the ball so that it would roll to the zero mark. He was instructed not to let his hand pass the lower mark. The subjects that shot the steel ball as one would a marble with the thumb put the fore finger down on the mark and did not move it when the ball was released. If the ball went beyond the zero mark the division in which it stopped was noted as "+8" etc., or if it did not reach the zero mark the division was indicated as "-7" etc.

The results of this experiment are shown in Tables IX, X, XI, and XII. The first horizontal column of figures shows the days on which the practices were taken. The first vertical column represents the divisions on the board. The columns to the right of this show the distribution of each fifty throws. Commencing

at the top of the first practice period (Feb. 1) of Subject W., it is seen that the ball stopped twice in the plus thirteen division, twice in the plus eleven division, etc. The score is found by multiplying the numbers in the first vertical column by the numbers that stand opposite to them in the practice columns and taking the sums of these products.

Subject W. commenced work on Feb. 1, 1913 and continued until Feb. 20, 1913. Subjects D. and Do. commenced on June 29, 1914 and Subject C. on June 30, 1914. All three of these subjects continued practice until July 19, 1914.

In this work, Subject W. and Subject C. used a full swing of the arm to throw the ball. Subject D. and Subject Do. used only the thumb to propel the ball. The curves for these results are plotted by using the number of spaces that the mark is missed for the divisions on the y-axis and the practice periods for the divisions on the x-axis. Curves XVIII, XIX (Plate V), XX, and XXI (Plate VI) show the general trend of this learning. Curves XVIII and XIX show a marked drop at first and then a more gradual fall with wide fluctuations. Curve XX shows a relatively low score during the third and fourth practices and then a rise which lasted for several days. This was caused by putting paper on the board which made the ball roll more easily. It appeared to bother this subject much more than the others. On the twelfth day he found that he could judge the force much better when he let his finger drag along lightly on the paper. After that his score continued to be much lower.

The curves may be compared by passing a line through them so as to leave as nearly as possible the same number of points on either side of the line and at the same time have as few consecutive points on either side of the line as possible. In Curve XVIII, a line drawn from ninety on the y-axis to a point seventy units above the twenty one on the x-axis leaves ten points on either side of it with not more than three consecutive points in one place. The sum of the deviations of the plus units is 115+ and that of the minus units is 102+. The average deviation from this line is 10.9 and is represented by the dotted lines.

In Curve XIX, a line drawn from one hundred and eighteen

TABLE IX

Subject W.
 Experiment—To obtain a curve of learning for force. The first horizontal column shows the days on which the trials were made. The first column to the left represents the divisions on the board. The columns to the right of this show the result of each fifty throws. The number at the foot of each vertical column shows the total score.

Feb.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
13	2	I																		
12	I	I		I	2															
11	2	2	I	I																I
10	2	I	2																	
9	6	I		I						I										
8	3	2	I	I	2	3	I	I	I		2	2	I	I						I
7	5	2	I	I	2	I	I	I	I		3	2	I							I
6	2		I	I	2	I	I	I	I		2	2	3	3	2	2	3	2	I	I
5	4	I	2	3	2	I	2	I	I		2	3	I	2	2	2	3	2	I	I
4	5	3	4	3	2	2	4	3	6	5	5	4	2	I	I	I	4	I	4	2
3	2	3	3	3	2	2	7	3	6	7	2	4	2	5	9	I	3	2	I	2
2	I	2	3	3	I	3	4	4	4	6	2	6	4	3	5	7	3	5	3	3
1	3	4	3	3	2	I	3	I	4	3	4	4	10	3	4	4	I	7	3	2
0	I	2	2	2	4	2	I	3	4	I	3	I	2	3	I	2	2	I	I	I
—1	4	3	7	3	8	2	0	2	4	2	3	2	2	2	5	7	3	5	2	5
—2	2	2	5	5	7	4	2	4	4	5	8	4	5	5	4	3	3	7	5	5
—3	I	3	3	3	3	6	4	4	7	2	4	4	4	3	I	I	3	7	5	5
—4	I	2	5	2	4	7	6	4	5	4	4	4	4	3	4	3	3	2	6	6
—5	I	2	3	4	4	5	3	3	5	3	6	5	6	3	3	3	6	9	7	7
—6	4	5	4	4	2	2	5	2	I	3	2	2	I	2	3	10	4	3	2	4
—7	I	5	2	2	4	2	3	3	I	I	2	4	I	I	4	I	4	I	I	I
—8		3	I	I	2	2	2			I	I		I	I						3
—9		I	I	2	2		I	I	I	I	3		I							
—10		I	I	2			2						I							I
—11										I										I
—12																				I
—13	8	I				I	I				I									
351	266	214	225	228	185	230	202	156	188	204	226	170	162	167	171	223	148	191	194	194

TABLE X

Subject D. Experiment—To obtain a curve of learning for force. The first horizontal column shows the days on which the practice was made. The first vertical column to the left represents the divisions on the board. The columns to the right of this show the result of each fifty throws. The number at the foot of each vertical column shows the total score.

June	July							18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	19	
	29	30	1	2	3	4	5																				
I5	7	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
I4	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
I3	3	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
I2	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
II	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
I0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
9	3	2	3	4	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	I	2	2	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
7	I	2	I	4	4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
6	7	I	2	3	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
5	3	2	3	3	3	5	I	4	I	2	3	2	I	5	I	3	I	3	I	2	I	3	I	5	I	2	2
4	I	2	I	4	4	4	2	3	2	4	I	I	I	I	I	4	4	4	4	4	4	4	4	4	4	4	4
3	3	2	2	5	8	7	7	6	4	2	5	2	2	5	4	2	2	2	2	2	2	2	2	2	2	2	2
2	2	I	4	3	I	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
I	I	3	4	2	5	2	2	2	I	I	5	2	2	3	4	2	3	4	2	3	4	2	3	4	2	3	3
0	2	3	3	5	2	4	2	4	2	4	3	8	6	8	6	8	4	5	4	5	4	5	4	5	4	5	4
-1	2	2	2	7	4	2	4	2	4	5	3	4	2	5	4	2	5	4	2	4	5	3	4	2	5	4	2
-2	2	4	I	I	I	2	4	2	4	5	3	4	2	3	4	2	3	4	2	4	5	3	4	2	3	4	2
-3	4	3	3	2	3	7	3	2	2	3	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
-4	I	3	6	2	I	4	3	2	4	4	2	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4
-5	I	3	I	I	I	I	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
-6	I	3	3	3	I	I	I	2	2	2	4	2	3	4	2	4	2	3	4	2	4	2	3	4	2	3	3
-7	2	2	3	2	I	2	I	I	2	I	2	3	I	I	2	3	I	5	I	I	2	3	I	I	2	3	3
-8	4	3	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-9	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-10	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-11	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-12	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-13	I	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-14	I	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
-15	3	2	I	I	I	I	2	I	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
388	335	303	212	278	219	185	265	249	250	216	192	184	175	206	188	181	198	231	246								

TABLE XI

Subject C. Experiment—To obtain a curve of learning for force. The first horizontal column shows the days on which the trials were made. The first vertical column to the left represents the divisions on the board. The columns to the right of this show the result of each fifty throws.

June	July	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
15	3	8	I	2	I	3	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
14	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
13	4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
12	4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
11	4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
10	4	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
9	2	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
8	3	2	2	I	2	6	3	2	I	I	I	I	I	I	I	I	I	I	I	I	I
7	3	2	2	I	3	2	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I
6	I	I	I	I	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
5	5	2	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	2	5	I	4	I	3	4	3	2	I	I	I	I	I	I	I	I	I	I	I	I
3	3	5	4	2	3	3	3	3	2	3	2	2	2	2	3	4	3	3	3	3	3
2	2	4	3	3	I	2	I	5	4	2	5	4	7	3	2	6	4	2	2	2	4
1	5	2	2	7	3	3	3	3	4	5	3	4	3	4	9	4	4	2	5	5	2
0	0	4	4	5	2	2	0	2	2	7	5	6	7	5	6	10	4	3	5	8	4
—1	I	I	3	5	I	4	3	I	I	3	5	2	2	5	3	6	3	9	6	3	8
—2	2	I	4	4	6	3	2	2	4	2	3	2	4	7	3	4	5	7	4	2	3
—3	2	5	4	2	2	4	2	5	2	2	3	I	2	3	4	2	4	3	2	2	3
—4	I	I	2	2	3	5	2	3	5	4	4	2	2	2	3	5	I	2	4	4	I
—5	2	I	2	4	5	7	5	7	3	I	3	2	2	2	2	2	I	2	2	2	I
—6	I	I	2	4	3	I	2	3	I	I	I	I	3	2	2	2	3	I	3	I	I
—7	I	I	2	I	I	I	I	I	I	I	I	I	2	I	2	2	I	I	I	I	I
—8	I	I	I	I	I	I	I	I	I	I	I	I	3	2	2	2	I	I	I	I	I
—9	I	I	I	I	I	I	I	I	I	I	I	I	2	2	2	2	I	I	I	I	I
—10	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
—11	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
—12	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
—13	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
—14	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
—15	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

on the y-axis to a point sixty eight units above twenty one on the x-axis leaves eleven points above and ten below with not more than four consecutive points on either side. The sum of the plus deviations is 144+ and the sum of the minus deviations is 131+. The average deviation is 13.3.

Curve XX does not yield to this method of treatment very well, partly for the reason mentioned in the preceding page. No line can be drawn through the curve in such a way as not to leave several consecutive points on one side. A line drawn as indicated from one hundred and twenty on the y-axis to forty units above twenty one on the x-axis shows its general direction about as well as any one line will do. This line leaves ten points above and ten below. The sum of the plus deviations is 111+ and the sum of the minus deviations is 109+. The average deviation is 11.

The direction of Curve XXI is indicated by a line drawn from eighty three on the y-axis to a point forty eight units above twenty one on the x-axis. This line leaves ten points above and eleven below. There are not more than three consecutive points on either side. The sum of the plus deviations is 84+ and the sum of the minus deviations is 88+. The average deviation is 8.6.

If the slope of the line is taken to represent the improvement it is seen that Curve XX stands first with a slope of .80. Curves XIX, XXI, and XVIII have respectively .50, .35, and .20.

For the purpose of comparison curves were drawn which represented a range of +1 to -1 on the board. For instance in Table IX on the first trial the ball stopped eight times on +1, 0, and -1. The sum of these three divisions was taken each trial for divisions on the y-axis and the number of trials for divisions on the x-axis. Curves XXa and XXIa show the general form of the curves obtained by this method.

It would seem in this experiment that the person who is able to make a low score would be the one who is able to perceive accurately small amounts of force. It would require the same kind of ability as distinguishing small differences in weights. In order to test this, three subjects (Subjects D., Do., and C.)

were tested for their ability to distinguish small differences in the weights of bodies. Eight weights were used for the test. Hollow hard rubber cylinders were used for this purpose and loaded with shot and felt so that they weighed 75.001, 76.004, 77.002, 78.001, 78.996, 79.998, 85.004, 90.005 grams respectively. The weights were numbered from one to eight. They were presented to the subjects in pairs. The subject was blindfolded and required to lift the cylinders two inches from the table or until they touched a rod running horizontally. The subject reported the last weight as heavier or lighter.

The tables below show the result of the test:

Weights in order	I-8	I-7	I-6	I-5	I-4	I-3	I-2
Subject C. —Right.....	10	9	10	10	10	9	6
—Wrong		1				1	4

Weights in order	8-1	7-1	6-1	5-1	4-1	3-1	2-1
Subject C. —Right.....	10	9	8	5	4	4	5
—Wrong		1	2	5	6	6	5

This shows that the subject gave 109 right judgments and 31 wrong ones or he obtained a percentage of 77.8 correct.

Weights in order	I-8	I-7	I-6	I-5	I-4	I-3	I-2
Subject Do. —Right.....	10	9	5	10	7	8	7
—Wrong		1	5		3	2	3

Weights in order	8-1	7-1	6-1	5-1	4-1	3-1	2-1
Subject Do. —Right.....	8	8	8	8	7	6	6
—Wrong	2	2	2	2	3	4	4

This shows that the subject gave 107 right judgments and 33 wrong ones or he obtained a percentage of 76.4 correct.

Weights in order	I-8	I-7	I-6	I-5	I-4	I-3	I-2
Subject D. —Right.....	10	8	7	9	9	9	6
—Wrong		2	3	1	1	1	4

Weights in order	8-1	7-1	6-1	5-1	4-1	3-1	2-1
Subject D. —Right.....	10	8	7	2	3	5	4
—Wrong		2	3	8	7	5	6

This shows that the subject made 97 right judgments and 43 wrong ones or he obtained a percentage of 69. correct.

If these figures are compared with those representing the slope of the lines on the curves, it is seen that the subject that showed the greatest improvement in the force test has the largest percentage of correct judgments of weight and that the other two follow in order.

EXPERIMENT III. ON TIME

Subjects W., B., C., and D. took part in this experiment. The apparatus consisted of a circular piece of board about twelve inches in diameter and three quarters of an inch thick, placed in a vertical plane on an axis. Beneath the board was a pulley so that a motor could be attached and the board rotated. Two circular bands of cardboard were made by bending strips into the form of a hoop. These two bands were placed on the board, the one inside of the other. The inner band was one and one half inches in height and nine and five eights inches in diameter. The outer band was one and one half inches outside of the inner band and was one half inch high. The space between the two bands of cardboard was divided into twelve parts by tacking pieces of tin on the radii of the circular board. These pieces of tin were the same height as the outside band of cardboard.

A trough about twenty inches long was supported so that the lower end rested one half inch above the little pockets on the circular board. The other end of the trough was six and one half inches higher. The trough was made by nailing two pieces of wood together at right angles and then it was lined with soft tin so that it was perfectly smooth. A mark was made in the trough eighteen inches from the lower end. On this mark the subject held a piece of wood that fit the bottom of the trough and behind this was placed an ordinary B.B. shot. When the subject lifted the piece of wood the shot rolled down the trough and fell into one of the pockets on the circular board.

One of these pockets was marked by placing a piece of green paper in the bottom of it. The circular board was covered with a piece of cardboard from which a sector had been cut so that only a small part of the circular board was visible beneath the end of the trough. As the board rotated, the subject could see the pockets pass under the end of the trough and then disappear under the cardboard. The object was to release the shot so that they would roll down the trough in time to fall into the marked pocket. The circular board was rotated forty six times per

minute or a pocket passed the end of the trough in one ninth of a second. The movement of the board made it impossible to distinguish any of the pockets except the one that had the green paper in it. The subject waited a short time after the marked pocket had passed the end of the trough and then released the shot. The aim was to improve his ability to judge this period of time.

The subject could see the shot hit the pocket if they hit near the middle but if they hit near the side of the pocket he was not able to tell if they hit too early or too late. The pockets were marked zero, one, minus one etc. out in either direction. The score was kept by counting the number of shot in each pocket. These numbers were multiplied by the number of the pocket and then the sum of these products taken for the daily score.

Subject W. commenced this work on May 13, 1913 and continued it until May 24, 1913. The practice consisted of fifty trials daily. The result of his work is shown in Table XIII.

Subjects B., C., and D. commenced work on June 30, 1914 and continued until July 19, 1914. The practice was daily and consisted of fifty trials. The results are shown in Tables XIV, XV, and XVI.

Curves XXII, XXIII (Plate IV), XXIV and XXV (Plate VI) show the form of the improvement. All the curves show rather a large drop during the first two or three practices. After that there is a slow but gradual improvement to the end of the practice. The first large drop in each case is the result of the subject's learning the apparatus. He would have a few very bad results at first which would not occur again after a few trials. Curve XXIII does not show this first early drop to so great an extent because the subject had set up the apparatus and knew by a few trials previous to the first test what to expect.

The direction of these curves after the first two or three practices is shown by the straight lines drawn through them. A line run from forty one on the y-axis to seventeen units above thirteen on the x-axis of Curve XXII shows that with the exception of the first two practices the points alternate on either side of the line. The sum of the plus deviations is 10 and the

sum of the minus deviations is 15. The average deviation is 2.5.

On Curve XXIII, a line run from thirty five on the y-axis to fifteen units above twenty one on the x-axis leaves not more than two consecutive points on either side. Omitting the first practice, the sum of the plus deviations is 35 and the sum of the minus deviations is 36. The average deviation is 3.5.

On Curve XXIV, a line run from forty three on the y-axis to twenty nine units above twenty one on the x-axis leaves no more than two consecutive points on either side of the line. The sum of the plus deviations is 29.4 and the sum of the minus deviations is 33. The average deviation is 3.2.

On Curve XXV, a line run from thirty four on the y-axis to a point eighteen units above twenty one on the x-axis leaves no more than three consecutive points on the same side of the line. The sum of the plus deviations omitting the first one, is 41.8 and the sum of the minus deviations is 41.7. The average deviation is 4.1. The slope of these lines is .40, .20, .14 and .16 for the curves taken in order.

When the actual number of hits, that is the number of shot that went into the marked pocket was taken to represent divisions on the y-axis and the trials to represent divisions on the x-axis, the curves take the form represented by Curves XXIVa and XXVa (Plate VII).

TABLE XIII

Subject W.

Experiment—To obtain a curve for learning to judge time. The first horizontal column represents the number of practice days. The first vertical column to the left shows the number of the pockets. The other vertical columns to the right show the distribution of the fifty shot in each practice. The number at the foot of each vertical column shows the total score.

May	13	14	15	16	17	18	19	20	21	22	23	24
5	1	1										
4	0	1										
3	2											
2	6	7	5	1	5	1		1	3			
1	6	6	13	14	8	15	18	8	13	10	13	8
0	12	17	18	23	27	22	18	25	28	26	33	30
— 1	10	10	13	10	7	12	13	15	6	12	3	12
— 2	4	4	1	1	3		1	1		2	1	
— 3	6	4		1								
— 4	2											
— 5	1											
— 6												
	78	59	38	31	34	29	33	27	19	26	18	20

TABLE XIV

Subject B. Experiment—To obtain a curve for learning to judge time. The first horizontal column represents the number of practice days. The first vertical column to the left shows the number of the pockets. The other vertical columns show the distribution of the fifty shot in each practice. The number at the foot of each vertical column shows the total score.

	June	July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
5																							
4																							
3																							
2																							
1																							
0																							
—	1	9	10	6	13	9	9	6	8	7	9	10	8	6	6	5	7	6	3	9	2	8	
—	2																						
—	3																						
—	4																						
—	5																						
—	6																						
	57	36	31	24	39	38	26	23	24	25	26	26	23	18	23	21	21	28	16	19	10	18	

TABLE XV

Subject C. Experiment—To obtain a curve for learning to judge time. The first horizontal column represents the number of practice days. The first vertical column to the left shows the number of the pockets. The other vertical columns to the right of this show the distribution of the fifty shot in each practice. The number at the foot of each vertical column shows the total score.

	June	July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
5																						
4																						
3																						
2																						
1																						
0																						
—	1	4	1	4	15	16	30	16	24	20	19	22	19	19	20	17	25	26	25	22	24	12
—	2																					
—	3																					
—	4																					
—	5																					
—	6																					
	122	102	51	45	28	42	39	32	37	33	35	36	34	40	26	35	29	30	27			

TABLE XVI

Subject D. Experiment.—To obtain a curve for learning to judge time. The first horizontal column represents the number of practice days. The first vertical column to the left shows the number of the pockets. The other vertical columns to the right of this show the distribution of the fifty shot in each practice. The number at the foot of each vertical column shows the total score.

	June	July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
5	1																						
4	1																						
3	6	1																					
2	9	8				3	1	2															
1	10	12	13	12	17	17	17	13	17	11	9	10	18	2	1	1	1	9	7	8	18	12	
0	9	23	22	24	19	21	23	23	21	28	32	28	21	33	33	31	22	30	30	38	22	28	
—	1	7	4	11	11	12	10	10	12	11	8	12	9	8	9	6	12	10	11	4	10	10	
—	2	3	1				2	2			1		1	1			1	1	2				
—	3	2																					
—	4																						
—	5	1																					
—	6	1																					
85	41	31	30	29	34	31	29	22	19	22	31	22	18	20	20	21	21	22	12	28	22	20	

An examination of all these curves where a single element is involved shows that there is a large degree of similarity in them. All three of the experiments were such that it was hardly possible to reach and maintain the limit of perfection. Except in the cases where the subjects made very high scores during the first two or three practices, the curves show a downward slope with considerable daily fluctuations. These daily fluctuations balance each other in almost every case within four or five days.

It is likely that if the practice had been continued until the subjects had reached a point where they were no longer able to distinguish the selective element as force or time, the curves would have approached parallelism with the x-axis.

In the ball tossing experiments the work was such that a number of elements had to be improved together or the unit of measure did not indicate the advance. In the second set of experiments where the elements of direction, force and time are involved a relatively simple reaction was required. The next set of experiments are such that a number of elements are involved but in such a way that the attention may be focused on any one of them or distributed over the whole of them.

THE EFFECT OF SEVERAL FACTORS WORKING IN SUCCESSION

The ball-tossing experiments showed the nature of the curves of learning when several factors must be attended simultaneously. The experiments on the judgment of direction, force, and time showed the form of the curves of improvement when the attention is centered on a single factor. It is the purpose of the following experiments to show what form the curves of learning take when several factors influence the attention but in such a way that they can be considered separately.

Four subjects—M. (Martin), Fe. (Feemster), S. (Miss Scott), Cd. (Miss Coldwell) took part in the work. They were all undergraduates in college.

The apparatus (See Fig. 1) consisted of a disk ten inches in diameter cut from a pine board three quarters of an inch thick. This disk was placed in a horizontal plane on an axis. The axis ran through and was fastened beneath a table. Beneath the disk was a pulley by which a motor could be attached. On top of the disk, eight holes had been scooped out similar in form to the bottom of a spoon. These holes were three quarters of an inch in length, one half of an inch wide and one fourth of an inch deep. They were located three quarters of an inch from the circumference of the disk and extended across the ends of four diameters that divided the disk into eight equal parts. A piece of cardboard covered three fourths of the disk leaving one fourth in the form of a sector exposed. The top of the disk was three inches from the table.

A frame was set up twenty-three inches from the center of the disk. This frame was perpendicular to the table and was in a plane parallel to the radius that divided the exposed sector of the disk into two equal parts. The frame was sixteen inches square and inclosed a hoop that just touched the sides. A piece of cloth was spread over this hoop and sewed to the hoop all

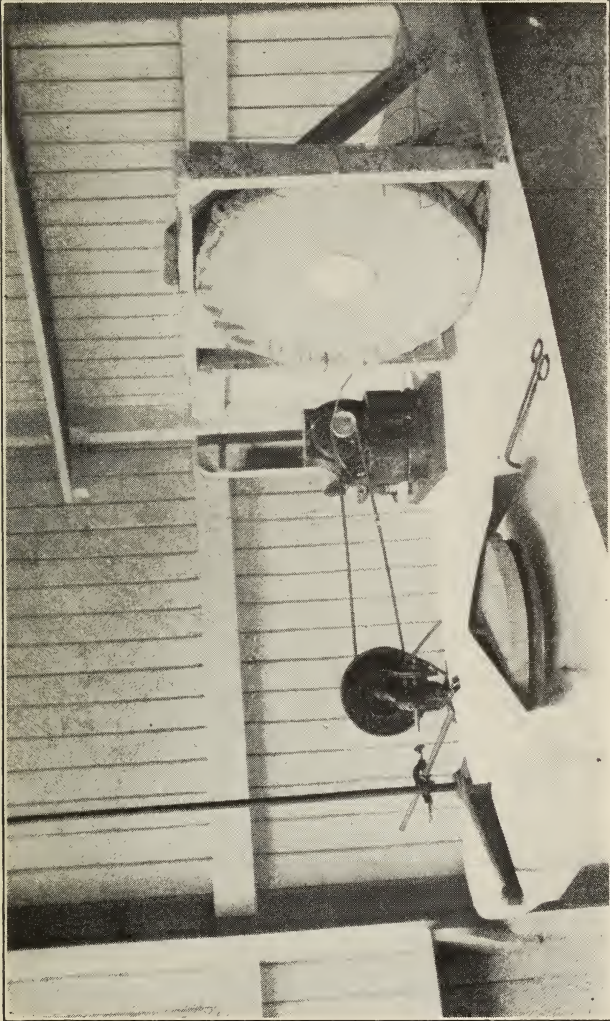


FIG. 1

the way around the border. At the center a circular piece of wire was inserted which was four inches in diameter. A piece of cloth was sewed to this wire ring in such a way as to leave a pocket extending out on the side opposite to the disk. The center of this pocket was eight inches from the table and about five inches above the level of the top of the disk.

The subject held in his right hand a pair of tongs nine inches long which were bent down at right angles one inch from the lower end. The seizing end of the tongs was one eighth of an inch wide and was ground perfectly smooth.

The work of the subjects was to take these tongs and seize shot from the eight holes on the disk and throw them into the four inch pocket in the middle of the circular hoop twenty-four inches to the right. The disk was rotated eleven times per minute by means of a motor. This made the shot pass the point where they were to be seized at the rate of eighty-eight per minute. After the subject had struck at the shot during one revolution of the disk, he rested until it was refilled. The subject was instructed to strike at every shot that appeared and to throw as many of those that he seized into the pocket as possible.

In taking the data, four things were considered: First, the hitting the shot; second, the seizing the shot; third, the hitting the large circle which included all of the area of the hoop which was sixteen inches in diameter; fourth, the hitting the pocket. The practice consisted of eighty strokes at shot, taken daily, except as noted in the tables. The practice of all the subjects was in the afternoon between twelve-thirty and one-thirty o'clock.

Subject M. commenced this work on Jan. 20, 1914 and continued it until June 5, 1914. He was given a certain position in which to stand, that is on a certain side of the table, and was told to strike at every shot as it appeared with the aim of seizing it and throwing it into the pocket. The importance of striking every shot was emphasized and at the end of eight strokes he was required to make a stroke at the hole in which he had struck at the first shot. This was done so that he could not take extra time to throw the last shot.

The result of his work is shown in Table XVII. Curve XXVI

(Plate V) is plotted from these figures. The spaces on the y-axis represent the number of shot. The spaces on the x-axis show the number of practice periods. The part at the top shows the number of shot hit; the next one below it, the number of shot seized; the third one, the number of shot that hit the big circle; and the fourth one, the number of shot that were thrown in the pocket. As nearly all of the shot that were seized were thrown so that they hit the big circle, the second and third parts run along almost together.

The subject's attention during the first two or three practices was almost entirely upon the disk. He was not able to take his eyes off the board long enough to look at the pocket and then return them in time to make a stroke at the next shot. He then tried to remember the general direction of the pocket. About the third practice, he felt that he was getting a better idea of this direction. He soon found that he had trouble handling the tongs. He would hit the shot but they would roll away from the end of the tongs. This trouble represents a period from the third up to about the fifteenth practice. The wide fluctuations on the sixteenth, seventeenth, eighteenth and nineteenth practices are the result of trouble with the motor. The belt slipped at first so that the disk rotated about one revolution per minute slower. After it was tightened the disk was unsteady in its motion so that the subject was not able to get hold of the shot.

It will be noted that very little progress had been made in the second and third parts during the time that the subject was having trouble with the tongs. The fourth part showed some slight improvement which was due to the subject's gaining a better idea of the general direction of the pocket.

The first part shows that the subject had trouble hitting the shot up to the fifty-first practice. About that time he commenced to watch the disk that carried the shot make one full revolution before he started to strike. He noted the exact position of every shot and, as he said, had a mental picture of just how it looked. It may be seen that parts two and three shortly after this, rise to a higher level. They had remained almost on the same level from the nineteenth to the sixtieth practice with

the exception of the marked drop between the thirty-fifth and the forty-second practices. Here the subject developed a habit of bringing the shot back with the return stroke of the tongs. This bothered him so that he was not able to grasp the next shot. He discovered the trouble to be due to having changed very slightly the angle of the tongs when releasing the shot. Instead of having the end that contained the shot point toward the pocket, he had been holding them so that the end pointed down toward the table. When he opened the tongs under this condition the quick back motion did not give the shot time to drop but carried it back.

During the time from the fifteenth to the fifty-seventh practice the fourth part shows practically no improvement. He had been trying to seize and throw all the shot without trying, directly, to improve the manner of locating the pocket. It may be noted that shortly after the first part had been perfected, the second and third also rose to a higher level. His concentrating his attention upon the position of the shot enabled him to seize them oftener.

This may in part account for the rise in the fourth part from the fifty-ninth to the sixty-third practice. But the subject during this time discovered another change. He at first noted that standing with his feet in a certain position gave him a certain balance that he did not have otherwise. He later found that when he stood with his feet in this position and stretched out his arm straight towards the pocket, the end of the tongs rested about one and one half inches from the center of the pocket. This was the position in which he could do the best work and after he had discovered this way of locating it he always stretched out his arm and took the proper position before starting.

There is not much improvement in any of the parts after this. The subject was very desirous of getting a perfect record even up to the end of the practice and thought he could do so if he had had a few more times to practice. He succeeded a few times in making as many as six rounds of the disk or seventy-two strokes without missing. This chance to see any variation in the progress gave an added incentive for greater effort. At the end of the practice, the subject was asked to write out the factors, as he remembered them, that helped him in the work.

He gave the following outline :

"Some factors that were important in this experiment :

1—Concentration of mind on the work before beginning.

a. Must have a clear conception of the apparatus in mind.

b. Must think of the actual work to be done.

c. Must think of the distance, direction, and position of the pocket as related to the revolving disk.

2—Getting the proper position.

a. Stand with the feet separated about two feet.

b. Stretch the hand that holds the tongs toward the pocket until the tips of the tongs are about one and one-half inches from the center of the pocket. Then look down the arm to see that the same relative position is gained each time. After this, move the hand back and forth as if throwing the shot to insure absolute freedom of the arm. Just before beginning, fix the eyes upon the revolving disk, and at the same time look out of the corner of the eye at the pocket. After the body is in a proper position, let the disk make one complete revolution. During this time look steadily at the shot to see that they are in their proper position. Not only the motion of the disk and the position of the pockets must be related but the time rate of the arm movement must be clearly in mind.

3—In order to do the best work, must have a feeling that the arm is absolutely under control.

4—Must have confidence; yet overconfidence sometimes produces a low score.

5—Must have a strong purpose in mind, in order to do best work."

The increase in the subject's power to concentrate his attention upon the work was very noticeable. After he had practiced several times, the work appeared to take hold of him. There was a set to his whole body and a certain rigidity that was entirely absent at first. This grew into a habit so that when the subject watched one of the other subjects perform he was apparently under this strain. A very high degree of accuracy with great speed was required but since each trial lasted but slightly over five seconds, the fatigue element did not enter.

TABLE XVII

Subject M.

Experiment—Throwing shot.

The first column shows the date of practice. The second column shows the number of shot hit; the third, the number of shot seized; the fourth, the number of shot in the big circle; and the fifth, the number of shot in the pocket. This outline is true of each of the three divisions on the page.

Jan. 20.....	56	40	27	12	Mch. 8.....				Apr. 24.....				
21.....	79	58	46	16	9.....	78	60	50	25.....	80	78	77	74
22.....	80	61	51	21	10.....	80	67	56	26.....				
23.....	80	59	52	26	11.....	80	72	68	27.....	80	78	73	69
24.....	79	55	49	19	12.....	80	67	63	28.....	80	73	73	67
25.....					13.....	79	66	60	29.....	80	77	77	70
26.....	80	70	60	31	14.....	79	67	59	30.....	80	78	78	69
27.....	80	59	53	21	15.....				May 1.....	80	73	72	58
28.....	74	55	51	17	16.....	80	72	70	2.....	80	77	75	66
29.....	79	60	52	17	17.....	79	68	60	3.....				
30.....	80	60	57	21	18.....	80	68	66	4.....	80	76	76	70
31.....	80	59	52	24	19.....	80	72	69	5.....	80	74	71	67
Feb. 1.....					20.....	77	65	64	6.....	80	77	74	60
2.....	80	59	53	32	21.....	80	71	68	7.....	80	71	71	60
3.....	77	51	43	24	22.....				8.....	80	73	74	51
4.....	79	61	51	36	23.....	80	66	66	9.....	80	74	74	61
5.....	79	61	50	29	24.....	80	71	69	10.....				
6.....	80	65	59	47	25.....	80	72	66	11.....	80	75	75	67
7.....	80	74	68	49	26.....	80	66	63	12.....	80	78	75	69
8.....					27.....				13.....	80	79	75	73
9.....	79	58	48	18	28.....	80	74	69	14.....	80	73	73	67
10.....	79	66	59	26	29.....				15.....	80	74	74	67
11.....	80	71	63	47	30.....	80	66	65	16.....	80	75	73	68
12.....	80	68	63	31	31.....				17.....				
13.....	75	65	59	44	Apr. 1.....	80	71	67	18.....	80	77	76	74
14.....	79	75	68	56	2.....	80	73	71	19.....	80	77	76	71
15.....					3.....	80	73	71	20.....	80	72	72	67
16.....	79	74	70	28	4.....	80	72	66	21.....	80	80	78	73
17.....	80	74	68	45	5.....				22.....	80	78	77	74
18.....	78	71	67	43	6.....	80	73	68	23.....	80	77	77	72
19.....	79	68	65	42	7.....	80	75	73	24.....				
20.....					8.....	80	78	78	25.....	80	76	76	70
21.....					9.....	80	74	74	26.....	80	78	77	67
22.....					10.....	80	77	75	27.....	80	78	78	75
23.....	80	74	65	54	11.....	80	78	74	28.....	80	80	78	72
24.....	78	65	61	45	12.....				29.....	80	73	73	68
25.....	80	69	61	42	13.....	80	76	72	30.....	80	77	76	70
26.....	80	72	70	62	14.....	80	75	75	31.....				
27.....	80	70	67	58	15.....	80	76	75	June 1.....	80	76	75	67
28.....	79	69	64	50	16.....	80	79	73	2.....	80	75	75	68
Mch. 1.....					17.....	80	80	79	3.....	80	76	75	65
2.....	78	67	60	35	18.....	80	77	77	4.....	80	78	77	75
3.....	80	71	62	54	19.....				5.....	80	78	77	73
4.....	79	65	53	47	20.....	80	75	75					
5.....	79	62	50	36	21.....	80	78	77					
6.....	80	63	40	32	22.....	79	75	75					
7.....	78	62	48	37	23.....	80	78	77					

Subject Fe. commenced work on Jan. 20 and continued until June 4, 1914. The practice was daily except as noted in Table

XVIII. The conditions under which he worked and the instructions were the same as those for Subject M. The result of his work is shown in Table XVIII and the form of his improvement by Curve XXVII (Plate VI).

This Subject did not analyse his manner of procedure as closely as did Subject M. He at first gave his attention to the seizing of the shot but after a few trials he grasped the situation as a whole. By examining the curves, it is seen that there is considerable difference between his work and that of Subject M. His first part was perfected somewhat more quickly. He failed to make a perfect score only four times after the thirty-second practice. Subject M. had trouble with this part of the work up to the fifty-first practice.

The second and third parts rise rapidly at first and then gradually until about the fiftieth practice. After that they remain all on a level fluctuating between seventy-six and eighty. The fourth part makes practically no progress until the sixth practice; after that it rises rapidly until the ninth practice. The large fluctuations between the fourteenth and seventeenth practices were due to the belt slipping on the motor. If this trouble had not occurred, it is likely the rise would have followed a more gradual course up to the thirty-sixth or thirty-ninth practice. After that there is a period of practically no progress up to the sixty-first practice, or during twenty-three or four days. At that point, he found that he could give a longer swing to his arm and thus hit the pocket more often. This brought the fourth part to the final level which lasted to the end of the practice. Except this last case, the subject did not discover any factor that had helped him in the improvement.

TABLE XVIII

Subject Fe.

Experiment—Throwing shot.

The first column shows the date of practice. The second column shows the number of shot hit; the third, the number of shot seized; the fourth, the number of shot in the big circle; and the fifth, the number of shot in the pocket. This outline is true of each of the three divisions on the page.

Jan.	20.....	76	58	30	0	Mch.	7.....	80	72	67	59	Apr.	22.....	80	79	77	58
	21.....	80	69	47	1		8.....						23.....	80	77	73	70
	22.....	79	70	41	2		9.....						24.....	80	78	78	74
	23.....	80	67	40	0		10.....	80	75	75	61		25.....	80	80	80	69
	24.....	80	65	58	3		11.....	80	75	73	64		26.....				
	25.....						12.....	80	75	71	56		27.....				
	26.....						13.....	80	77	74	62		28.....	80	80	80	70
	27.....	78	61	62	12		14.....	80	77	74	61		29.....	80	76	76	72
	28.....	80	61	57	16		15.....						30.....	80	77	77	73
	29.....	79	68	60	28		16.....					May	1.....	80	80	78	73
	30.....	79	59	53	31		17.....	80	77	75	64		2.....				
	31.....	78	68	64	26		18.....	80	78	77	65		3.....				
Feb.	1.....						19.....	79	69	69	58		4.....				
	2.....						20.....	80	79	76	68		5.....	80	79	78	57
	3.....	78	64	58	20		21.....	80	79	76	68		6.....	80	77	76	66
	4.....	79	70	62	29		22.....						7.....	80	77	76	67
	5.....	79	73	70	25		23.....						8.....	80	78	78	67
	6.....	75	70	56	33		24.....	80	78	76	62		9.....	80	79	79	72
	7.....	77	75	64	53		25.....	79	78	77	67		10.....				
	8.....						26.....	80	80	79	66		11.....				
	9.....						27.....	79	72	72	65		12.....	80	80	79	74
	10.....	79	73	68	35		28.....	80	79	76	69		13.....	80	77	73	67
	11.....	80	74	64	56		29.....						14.....	80	80	80	74
	12.....	80	74	71	45		30.....						15.....	80	80	80	72
	13.....	80	73	64	45		31.....	80	75	74	61		16.....	80	80	80	65
	14.....	79	70	62	46	Apr.	1.....	80	77	77	68		17.....				
	15.....						2.....						18.....				
	16.....						3.....						19.....	80	78	78	70
	17.....	80	71	66	46		4.....						20.....	80	79	79	69
	18.....	79	71	69	39		5.....						21.....	80	80	80	77
	19.....	80	75	71	43		6.....						22.....	80	77	77	69
	20.....	78	70	68	36		7.....	80	77	76	70		23.....	80	79	79	69
	21.....	80	71	67	36		8.....						24.....				
	22.....						9.....	80	77	76	83		25.....				
	23.....						10.....	80	79	79	67		26.....	80	79	77	70
	24.....	80	73	69	35		11.....	80	77	77	62		27.....	80	80	79	72
	25.....	79	77	74	50		12.....						28.....	80	80	80	75
	26.....	80	72	71	55		13.....						29.....	80	77	76	72
	27.....	80	77	75	50		14.....	80	76	76	61		30.....	80	78	75	64
	28.....	80	77	76	54		15.....	80	79	77	52		31.....				
Mch.	1.....						16.....	79	78	77	52	June	1.....				
	2.....						17.....	80	78	77	60		2.....	80	77	76	73
	3.....	79	77	74	51		18.....	80	79	79	69		3.....	80	79	78	76
	4.....						19.....						4.....	80	76	76	71
	5.....	80	74	73	56		20.....										
	6.....	80	77	72	54		21.....	80	77	75	65						

Subject S. commenced work on Apr. 2, and continued until May 29, 1914. She worked under the same conditions as the other two subjects and was given the same instructions. The

By comparing these four curves, it may be seen to what extent each of the four factors influenced the work and what the effect is on the form of the curves. It will be seen that in all the curves except XXVIII the problem of hitting the shot was not mastered until several weeks practice. This period was extended longest in the case of Curve XXVI. In Curve XXIX, this element caused trouble until the end of the practice.

The second and third parts of Curve XXVI show three rises and three plateau periods. The first rise from the first to the third practice represents the period when the subject was getting acquainted with the rate of rotation of the disk. From the third to the fifteenth practice, his attention was on the general direction of the pocket and on the tongs. At the sixteenth practice there was a marked improvement in his ability to handle the tongs. From the sixteenth to the fiftieth practice the attention was centered on seizing and throwing the shot while the hitting of the pocket was ignored. At the fifty-first practice, the subject commenced to watch one full rotation of the disk before starting to strike and he continued to attend to this phase of the work until the fifty-seventh practice. Here he improves his seizing on the basis of better striking and also notices a better way of standing.

Curve XXVII shows no such steps in the second and third parts. There is a general rise up to about the fiftieth practice and after that little improvement. The subject's manner of attending gave him no factor for separate consideration. The second and third parts of Curve XXVIII show about the same form as the same parts of Curve XXVII. The first factor having been mastered after about six practices there was no element to cause trouble and no particular improvement in the plan of the work. In Curve XXIX the second and third parts rose rapidly for four or five practices, but did not succeed in reaching so high a level for this part of the work as that reached by the other subjects.

Curve XXVI shows in the fourth part a very pronounced plateau type of curve. At first, there is a slight rise partly due to the subject's getting acquainted with the apparatus and partly

the result of his improving the method then being used. After about sixteen practices, a level was reached in this part of the curve that remains practically constant until the fifty-eighth practice. What was going on at this time may be partly accounted for by noticing the other parts. The rise to the next level involved two factors at least. One was this mastering the first element and the second followed as a consequence from this. The subject being somewhat free discovered the proper way to get the most suitable standing position. He had noted a feeling of ease when in the proper position even before he had analysed a method to make sure of it every trial.

The fourth part of Curve XXVII shows no improvement for four practices. During this time, the subject had given all his attention to the other factors. Then by attending the whole problem he reached a level at about the forty-first practice which seemed to have been the limit for the method he was using. After he had discovered a new method, that of extending his arm farther, he brought this part of the curve to the next level. The fourth part of Curve XXVIII shows a constant rise for the reason that the subject was attending to this part from the first. No especial changes in method were noted. The fourth part of Curve XXIX shows a rapid rise for a few practices which seems to have been the result of adapting an ability already existing to this new situation. After this process had become perfect no further advance was made. No new method was devised and no special effort was put forth. There was a drop from the twenty-first to the thirty-second practice which appeared to be the result of indifference.

GENERAL DISCUSSION

The first aim of this study was to get further information in regard to the long period fluctuations or plateaus in the curve of learning. It is seen from these experiments that only in the last division of the work are there plateaus of long length. Neither in the ball tossing experiments nor in the work done by Swift, although the work extended over a considerable period of time in some cases, does there appear a long arrest between two rapid

progress periods. The middle division of this work where only one element was involved did not in any case extend over a period of time of sufficient length to show a long plateau. In the last division of the work, however, in one case in particular the plateaus were very pronounced if the part representing the shot thrown in the pocket is considered.

No one, so far as the writer is aware, has contended that the long period plateaus are a necessary part of all learning curves regardless of the type of learning. Bryan and Harter, however, in their work were convinced that these long periods of slow progress were necessary in the curves for receiving the telegraphic language. Book found the long period fluctuation in two of the curves he obtained for learning typewriting but he did not think they were a necessary part of the development. The last division of this work shows that there may be or may not be plateaus of long length in the same type of work.

One way of deciding the question of the necessity of plateaus for a particular type of learning would be to try a large number of individuals and see if they uniformly had plateaus in their improvement. Another way and a more satisfactory plan would be to attempt to analyse out the factors and see just what is involved in the formation of the arrest period. It has been seen (see Introduction to this study) that Bryan and Harter attributed the plateaus to the time it takes to form different-order habits: Swift, although he found only short plateaus, believes for the most part that they can be explained on the basis of the associations being made automatic; and Book thought they were the result of lapse of attention or misdirected attention. In none of these publications was an attempt made to so arrange the work that an opportunity would be given to see just how the separate factors acted during a plateau period and what effect the different reactions to them by different subjects had upon the work as a whole.

The last division of the work reported in this study was planned with the intention of having a number of elements involved in such a way that the subject could attend to all of them at once or attend to one or more of them separately from the

rest. It may be objected that the factors that were measured in this work must follow one another in a certain order and that the subject could not modify this or in other words change the order of the factors. This is true,—the subject could not throw or hit the pocket until he had struck or seized the shot—but this did not prevent him from giving practically all his attention to the first factor or distributing it over the work as a whole. What occurred in the subjects tested for this work may be seen by examining the different divisions of the curves obtained for the four subjects used in this experiment.

If the last or fourth part (the part obtained by using the shot that hit the pocket as a unit of measure) of the curves for each of these subjects be observed, it will be seen that one of the subjects (Subject M.) had two rises and two marked plateaus. Subject Fe. showed a short arrest period at first, a rapid rise and then another period of arrest. Subject S. showed no sign of an arrest period in this part of her work but an almost constant rise from one end of the curve to the other. Subject Cd. at first showed a rapid rise and then a long period of delay which was not broken at the end of the practice.

If the hitting of the pocket had been the only goal and the unit of measure had considered nothing else, the explanation of the curve would have had to depend upon introspections. Here, however, the other parts of the curve give an objective basis for explanation. Subject M. who had two pronounced plateaus attacked the work in parts; he attended to the first or basal factor until it was under a high degree of control. After that he took up the other factors. It is true the improvement was due, in part, to improvement in method but this depended upon the fact that his attention was free to attack the other part of the problem. In this case the subject followed a plan parallel to what Bryan and Harter explained when they spoke of the lower order habits being completed or automatized first. There was no evidence in this subject of a lapse and renewal of attention as Book pointed out in his work on typewriting. It may be that the work was such that the subject could see that he was making progress all the time; that is, he could see that he was hitting the shot or

in which curves

seizing them better and this kept up his interest. However, the fact stands that it was not lapse of attention that caused the long arrest in the fourth part of the curve.

Subject Fe. had a short period of arrest in the fourth part of his curve, while there was a relatively large improvement in the other parts. This indicated that he was attending to those first factors. Later all the parts of the curve make gains together. He was able to attend during this time to the process as a whole. When he reached a level near the limit of his ability to improve, all the divisions of the curve sloped off more nearly parallel to the x-axis.

Subject S. had no plateau in the fourth division of her work, because, as can be seen from the other three parts of her curve the first three factors presented her no trouble. As has been explained, the quickness of her hand movement and the accuracy with which she used the tongs enabled her to master these factors in a short time. In her work, it was simply a case of giving her attention to a single factor and the curve of the type of the simple association curve (see discussion on the form of the curves) was the result.

Subject Cd. had much the same form of curve in the fourth part but the rise was more rapid. The reason for that has been explained already. The practice on the piano was a training that only needed special adaptation. This took place rapidly. After that she improved the work in a short time to a point near the limit of her ability.

From this study and from the other experiments done in this field, the writer feels justified in drawing the following conclusions in regard to the plateau. 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 a nature that they must be improved together or if the subject is able to attend them as a whole, there will be no plateau. If, however, the nature of the work is such that the factors must be attended in succession or the subject gives his attention to the separate factors, as such, there will be plateaus.

Ball-tossing may be taken as an illustration of where the factors involved must be improved together. At least three of these factors have been mentioned and studied to some extent in this work. If these factors are taken, it is seen that it is practically impossible for the subject to separate them. One of them counts for nothing unless the others go along with it. It might be conceived that the subject could practice throwing the ball a certain height or in a certain direction, yet in this case, he would either have to watch it or use some other means to get a selective factor, that is, to show when an improvement is made and this would give him a criterion for the time element. Again if he improves his ability to throw in a certain direction and does not improve his ability to shift his hand to the position where the ball will fall, there will be no improvement in the unit of measure.

In the work on throwing the shot, the separate factors could be improved in succession. The subject could practice with his attention fixed on the seizing of the shot until he had acquired the ability to hit and seize practically every one in order, or he could distribute his attention on the separate factors about equally. The aim was to have the subjects learn each factor in order but some of the subjects were more completely able to do this than others. In such cases as this last division of work where the shot throwing is the problem, the attention will be given to a part or the whole of the work according to all the conditions that govern the attention of the individual at the particular time of the practice.

THE DAILY FLUCTUATIONS

The daily fluctuations appeared in all the work that was done. In fact there seem to be no cases of learning where they do not appear. They indicate very clearly the variation in the physical and mental condition of the subject from day to day. At times the subjects were able to tell in advance that they would make a good score but in this work, just as Swift found, their thinking that they would make a good score was no proof that they would. It was noted that Subject F. in his tossing the pieces of hard rubber was set back by his confidence that he would make a high score after the first relatively high score.

Whether these fluctuations were greater at the beginning or at the end of the practice depended upon the nature of the work and the unit of measure. If there was a definite set limit for the unit of measure as in the case of the direction, force, and time curves, or in the shot throwing curves, the later variations were likely to be less. But on the contrary if the unit of measure had no limit other than fatigue or some physical or mental factor as in the case of the ball-tossing, the later fluctuations were relatively large.

This work differs from a large part of the experimental work that has been done in this field in that the material from day to day was kept exactly the same. In work like typewriting, shorthand, and telegraphy where different material is used on succeeding days, the fluctuation may be partly at least accounted for by the fact that the subject matter was more difficult on some days than on others.

The fluctuations are useful for indicating the relative amount of ability shown daily by subjects doing the same kind of work but it must be remembered that the nature of the unit of measure will largely determine the apparent amount of fluctuation each day. It may also be noted that because the fluctuations are larger toward the end of the curve, one should not conclude that the daily ability varies more at that time of the practice.

The time and direction curves may be taken to illustrate the first point. Because the average deviation of the time curves was less than that of the direction curves, it does not follow that the subjects varied less daily from a certain line of improvement in judging time than they did in judging direction. If more pockets had been made on the disk, the variation for the time test would have been greater though the actual daily ability would have been the same.

Again if the ball tossing curves, where the number of catches form the unit of measure, are noticed, it will be seen that the latter part of the curves shows wide daily fluctuations. If it were true that catching ten balls meant the same whether they are the first ten or the ten between ninety and a hundred then these fluctuations near the end of the curve would mean a greater

daily variation in ability, but no one is likely to contend that this is true.

That the fluctuations may be seen to be due to the nature of the unit of measure, attention need only be called to the forms of Curves IIa and IVa. The latter part of these curves shows little variation and gives a directly opposite result from what the first method of plotting the ball tossing curves seems to indicate.

THE GENERAL FORM OF THE CURVES

For the purposes of discussion, the curves of learning may conveniently be divided into four classes. When the number of catches in a given number of trials (Curves I to V), the reciprocals of the number of errors per given group (Curves IX and X) as five hundred or one thousand, or the average number of catches in thousand groups (Curves XI to XV) are used as the basis for the unit of measure the curves all show the same general form. They are all concave to the y-axis. Some of them do not show this peculiarity to so great an extent as others but this can be explained on the ground that the subject had had previous practice or similar practice which modified the form of the early part of the curve.

Another class is where the slope is relatively constant up or down, accordingly as the unit of measure is such that it increases or decreases, until a point is reached near the limit of the subject's skill. This class is illustrated by the experiments on direction, force and time.

A third class is where the curve rises or falls rapidly at first and then gradually approaches parallelism with the x-axis. This class is illustrated by the second and third divisions of some of the shot throwing curves and those for telegraphic sending in the study of Bryan and Harter; also by the ball-tossing experiments when the unit of measure is the number of errors made in catching a definite number, as five hundred or a thousand, or the percent the number of catches is of the number of tosses.

The fourth class is the long level plateau class where there is a relatively rapid rise and then a period of delay and then another period of rapid rise. This is illustrated by the fourth part

of the curve of Subject M. obtained for shot tossing, and also by some of the typewriting curves of Book and the telegraphic receiving curves by Bryan and Harter.

The curves for ball tossing when the unit of measure is the number of catches made in a certain number of trials, show a long period when comparatively little progress is made and then a sudden rise at the end. This is true regardless of whether the subject attempts to use a particular method, or to develop some special part of the work. It is true also regardless of the distribution of practice. When the subject had a practice period of approximately five hundred catches instead of ten trials, the curve obtained when ten trials was made the basis of the score, was the same in form (Curve VIII).

There are a number of factors that must be considered in trying to interpret the significance of this type of curve. The long period of apparent slow progress at the beginning of the ball tossing curves where a number of trials is made the unit for the divisions on the x-axis and the sum of the catches is the basis for the divisions on the y-axis may be explained by the fact that the long period represents relatively little practice. When the subject is able to make less than one hundred catches during the ten trials he gets much less practice than when he can make a thousand or more catches in the same number of trials. This holds true for Curve VIII, when the practice period was five hundred but the divisions on the x-axis were based on groups of ten trials as well as for the first five ball tossing curves.

The rapid rise at the end of all the curves of this type is due to the peculiar nature of the unit of measure; that is, in the ball tossing curves where the number of trials is used as the basis for divisions on the x-axis (Curves I to V and also VIII); the curves where the reciprocals of the number of errors per given group as five hundred or one thousand (Curves IX and X) are used; and the curves where the averages per thousand (Curves XI to XV) are made the basis for the divisions on the y-axis.

In the case of Curves I to V and VIII, ten trial groups are made the basis for divisions on the x-axis but a trial here means the number of catches between two errors or misses. It follows

that the significance of a trial in the earlier and later part of the work in any experiment varies greatly. The implication is that ten catches represent the same amount of skill whether they are made on the first day's practice or on the last day's practice or whether it is the first ten caught or the ten between ninety and one hundred, and that to catch one hundred balls in one trial represents a degree of skill ten times as great as to catch ten balls in one trial.

In all the other experiments of this work, the unit of measure would be comparable to a single toss, that is the toss would constitute a trial. The degree of skill would be represented by the proportion of tosses that are successful. If the subject catches ten balls the first time before he misses, he has ten successes out of eleven trials or ninety-one percent would represent his degree of skill. When he catches one hundred balls without missing, he has ninety-nine percent for his degree of success. Instead of his success or skill being ten times as great in the second case as in the first as it would be by the first method, it is really only eight per cent greater.

In the curves where the reciprocals of the number of errors is made the basis for the divisions on the y-axis the result is the same as where the ten trial basis is used. The assumption is that to catch one hundred balls in one trial represents a degree of skill ten times as great as to catch ten balls in one trial. The effect can be seen readily by noting that the vertical distances (distances above the x-axis) vary as a constant divided by a decreasing variable.

When the data used in plotting these first curves, that is the first five for ball tossing are used so as to make the actual amount of practice the basis upon which to count gain in skill a very different form of curve is obtained (see curve IIa and IVa).

In these cases the basis was one thousand catches which was a definite amount of practice and the success was measured by counting what percent this was of the total number of tosses necessary to make the thousand catches. The implication is that a miss is no practice, at least it gives no increase in skill. This method gives practically the same form of curves as taking the

number of catches made in each one thousand tosses as the basis for divisions on the y-axis. Instead of measuring the absolute gain this method measures the relative gain. With this method of measuring gain, there is no rapid rise at the end of the curves.

Thorndike using Swift's data points out that when the average number of tosses is used as the basis for the divisions on the y-axis and the thousand groups are the basis for the divisions on the x-axis, a curve of the form of type three is the result.²⁷ The data obtained in this work do not give that form of curve when treated in that way.

The second class of curves is where the slope remains up or down depending on whether the unit of measure is such that the values representing the divisions on the y-axis increase or decrease with the increase of skill until a point of development is reached near the limit of its possibilities. This may be determined by the particular function having been perfected as in the case of direction if the subject could have hit the mark every time or by his approaching a place where he could no longer get a selective factor, that is he passes into a realm beyond the threshold of sensory discrimination in that particular field. For instance, if the experiment on force is taken as an example it may be conceived that the subject will be able to hit within a certain minimum distance of the mark every throw but after he reaches a plane where the difference required to put the ball within that space and beyond it falls below a certain fraction of the weight of the ball that he is throwing, he would be able no longer to control the ball so as to reduce the score. At this point the curve would slope off so as to become practically parallel with the x-axis. Sometimes in the case of a single factor acting, the apparatus may at first cause some confusion so that the first few scores may be abnormally high. This makes it appear that the curve rises or falls rapidly at first. The curves obtained for the judgment of time are examples of this.

All the simple association experiments in this work as well as those in other experiments that have been examined show a constant and gradual improvement with the daily fluctuations bal-

²⁷ Thorndike, E. L. "Educational Psychology," Vol. II, p. 122.

ancing each other, as a rule, in such a way as to approach a straight line until near the limit of the development.

The third type may be the result of a number of elements gradually becoming perfected together and as the elements approach their limit the improvement grows less. Where the work is complex, and the unit of measure is such that it shows the full value of the improvement as fast as it is made, and the subject attends the process as a whole, the curve rises or falls rapidly at first and as the chance for improvement in the separate elements becomes less the rise becomes less rapid. The curves for the sending of the telegraphic language illustrate this form as do also some of the curves obtained by Book in the typewriting experiments, and Curves IIa. and IVa. for ball tossing.

The fourth class of curves is that of the long plateau form which has already been discussed under the head of long time fluctuations. In addition to what has already been said, it is interesting to note that Starch's work on tracing a six-pointed star (*op. cit.*, p. 12) shows the effect of two elements working. He plotted a curve for speed and one for error. The error curve was of the third type and the time curve was in a measure like the fourth type. He does not so state but it is probable that the subject was giving his attention largely to the error side of the work while the plateau period lasted in the time or speed curve.

The writer believes there is no typical curve for all types of learning. Where the work is so simple that the attention cannot be distributed as in the case of rolling a steel ball at a mark or the work is of such a nature that the attention must be given in a certain way, the curves are likely to be of similar form for different subjects. Where the work is complex and the attention can be distributed on different parts of the process, then the curve for different individuals will vary, though the work is the same.

THE INFLUENCE OF OBJECTIVE AND SUBJECTIVE FACTORS

This subject has been discussed in detail by Swift and Book. Nothing more was noted in this work than that which emphasizes what they have already said. The objective factors such as

light, temperature, nature of the work, and apparatus, were all very important and any change showed its effect especially in the early part of the practice. The same was true with the subjective factors. However these were not always so easily analysed out. All of these factors showed themselves more influential in the early part of the work when the attention was actively involved than later when the process was more automatic. The experience of expert telegraphers, pianists, and others where there is a large element of motor control involved, demonstrate this beyond doubt. This does not assert, however, that where speed is involved distraction of attention does not affect it.

THE WARMING UP PROCESS

A part of this work showed a warming up and a part did not. The work in ball-tossing shows clearly that after the first trial there were better results. Book also found this warming up tendency to a very marked degree in his work. In the experiments on the judgment of direction there was little evidence of warming up. As the work was such that fatigue would not enter to any great extent, a division of the practice periods into two equal parts ought to show better results for the last half if there was any noticeable warming up. These figures do not show enough advantage to the last half of the work to be of any weight. Wells found in another experiment where a single association had to be formed that there was evidence of warming up to a considerable extent.

In a complex work, the warming up may take the form of renewed associations but in a simple work this is not necessary. It would seem that the difference between the work that Wells had his subject do, that of tapping at maximum speed on a telegraph key, and the work in learning direction consisted in this, that in the first case special preparation was necessary while in the other the ordinary movements of the day would be all that is necessary to keep the arm in proper condition.

THE EFFECT OF SHORT AND LONG REST PERIODS

An examination of the ball-tossing experiments shows that there is no regularity in what happens after a short rest period

of a day or two. Sometimes the score is higher and sometimes lower. This was also true to a large extent in the shot throwing experiments. In the other experiments no opportunity was given to test the effect of short rest periods as the work was continuous from the beginning to the end.

The shot throwing experiments gave an opportunity to test the effect of a short rest period as the work was discontinued on Sunday each week. In the case of Subject Fe. both Sunday and Monday were missed each week. The work of Subjects M. and Fe. extended over nineteen Sundays. Subject M. threw more shot in the pocket on Saturday than on Monday eleven times out of the nineteen. Subject Fe., who had missed two days' practice threw more shot in the pocket on Saturday than on Tuesday nine times out of nineteen. Subject S. threw more shot in the pocket on Saturday than on Monday three times out of eight and Subject Cd., six times out of eight. So far as this part of the comparison goes it is seen that two of the subjects did better after the rest period and two did better before it.

If, instead of counting only the number of shot put in the pocket, the whole work is considered, that is groups of figures in the four columns of the tables for the work immediately before and after the rest periods, it is seen that for Subject M. thirty-one scores were better on Saturday than on Monday, twenty-four were better on Monday than on Saturday and the others are equal. Subject Fe. has twenty-eight better on Saturday and twenty-two better on Tuesday. Subject S. has twelve better on Saturday and eleven better on Monday. Subject Cd. has twenty-one better on Saturday and eight better on Monday. The advantage seems to be slightly in favor of the practice preceding the rest period.

For the long rest period, the results show that where there was not a positive gain, a condition existed that made a rapid gain possible when practice was resumed anew. After a rest of more than six months, subject D. was able to make nearly as high a score the second practice period as he had made the last day in the regular period. Almost a year after this, he was able to make a score nearly twice as high as any he had ever made

before. This was in the first test made. Here was a positive gain with less than a half hour's practice having been taken during the intervening period.

Subject B., after more than a year's rest, made a score on the first day that the practice was resumed with his right hand almost as high as he had ever made before. Two days later he was able to make a higher score than he had ever made before. The left hand had apparently not retained the same amount of skill as the right hand. However, the second retention test showed a marked improvement over the first. The score was as high as any he had ever made in the regular practice except the last three or four where the usual final spurt had occurred.

Subject W., after a rest period of nearly five months, made a score during his second practice higher than he had ever made during his regular practice. A little more than a year after this retention test, he made a score higher than any he had ever made in the regular practice and almost equal to the last score that he made in his first retention test.

Subject F. was the only subject that did not show results in the retention test practically equal to or superior to the best scores in the regular practice. The reasons for this have been explained in the discussion of his work.

Although the work was not carried very far, one interesting point to note is the rapidity with which the improvement takes place in the repeated retention tests. Subject D. in his second retention test which was taken two days after his first shows an improvement of nearly twenty-five per cent over the first one. Subject B., made a gain of almost thirty per cent in the second test over the first with his right hand. With his left hand there was a gain of forty-three per cent in the second test over the first. Subject W., in his second test, showed a gain of nearly ninety per cent over the first. Subject F. was the only subject that did not show a gain in the second retention test over the first. In his case there was a loss of about twenty per cent.

It is interesting to note that this rapid regaining of an acquired ability is closely parallel to the rapid improvement in an instinctive response that has been delayed for a short time. Shepard and

Breed found in their study of chicks²⁸ that if the pecking response of the chicks is delayed for a few days the accuracy of the pecking increased much more rapidly than it did when the instinct took its normal course; in other words the chicks that had been delayed soon gained an ability equal to those that had normally developed.

The only place in this study that a test was made for the effect of a long rest period, except the ball tossing experiments, was for direction with Subject W. His first test showed that he had apparently lost much of his former skill. The reason for that has been already given in the discussion of that experiment. His second test taken immediately afterwards showed that he had regained practically all the skill he had acquired by his previous training.

The data obtained in these tests only confirmed what has been pointed out by Swift, Book, Wells, and others.

SUMMARY

1.—The plateaus of learning depend upon the factors involved in the process to be learned and upon the distribution of attention. They are not found in simple types of learning and may or may not be found in complex types.

2.—The daily fluctuations are common to all types of learning and depend upon the objective and subjective factors involved. They may be deceptive because of the influence of the nature of the unit of measure upon them but they are useful for the purpose of comparing the daily variability of two or more subjects that are at the same point of development in doing the same type of work.

3.—Both the factors involved and the attention of the subject influence the general form of the curves of learning. Where the work is simple, that is requires a simple sensori-motor association, there will be a typical curve common to different subjects. This is also true where the work is more complex and the factors must, from the nature of the work, be attended in a certain order.

²⁸ Shepard, John F. and Breed, F. S., "Maturation and Use in the Development of an Instinct." *Jour. of Animal Behavior*. July-August, 1913, vol. 3, no. 4, pp. 274-285.

4.—Objective and subjective factors have a very great influence on the learning, especially in the early part of the work.

5.—The warming up process is the necessary accompaniment of all work where the ordinary daily activity does not provide the special preparation required for performing the work effectively.

6.—The results do not show that a short rest period has any marked effect on the work one way or the other.

7.—After a long rest period the subject is found to be in a condition to improve very rapidly. In some cases the results show that they have actually gained power during the rest period.

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Plate I.

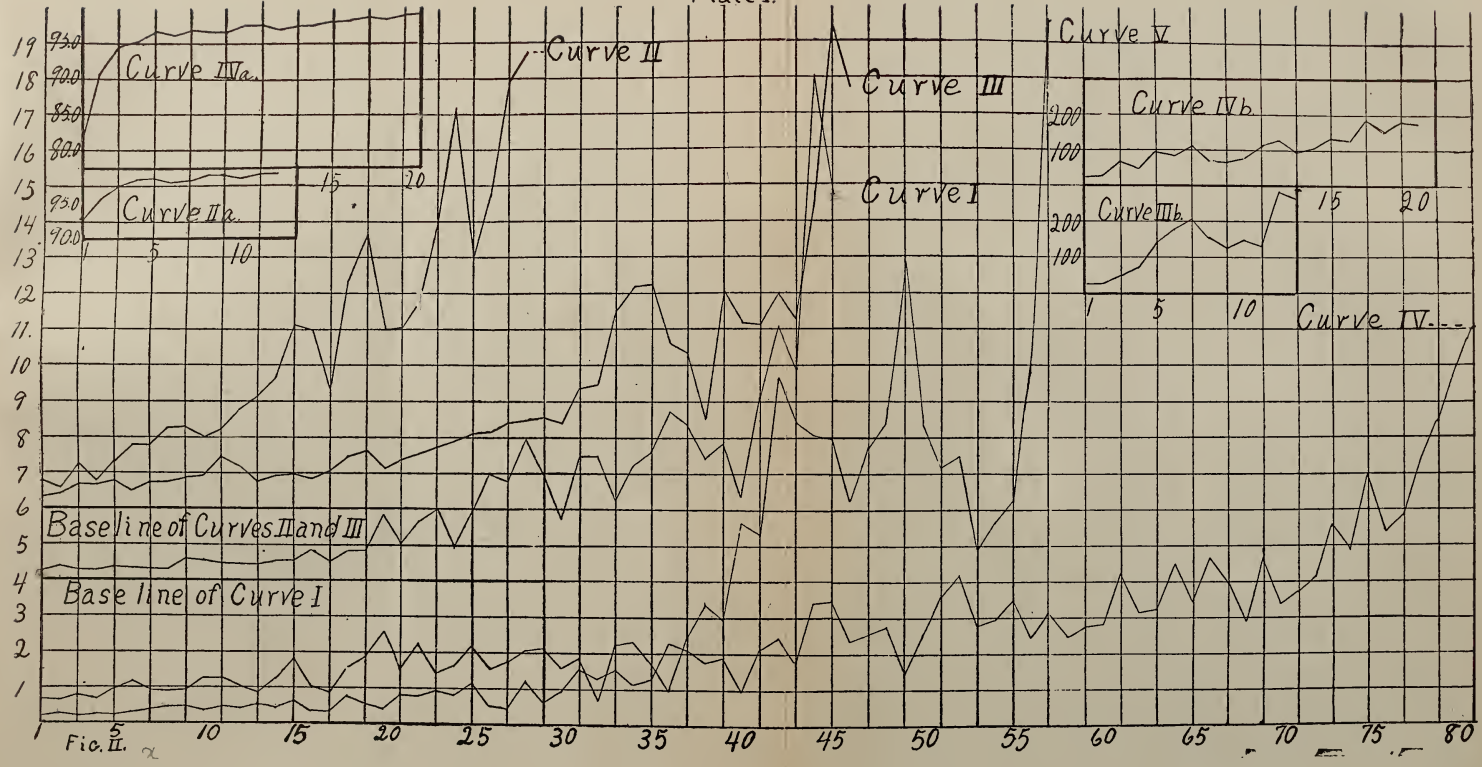
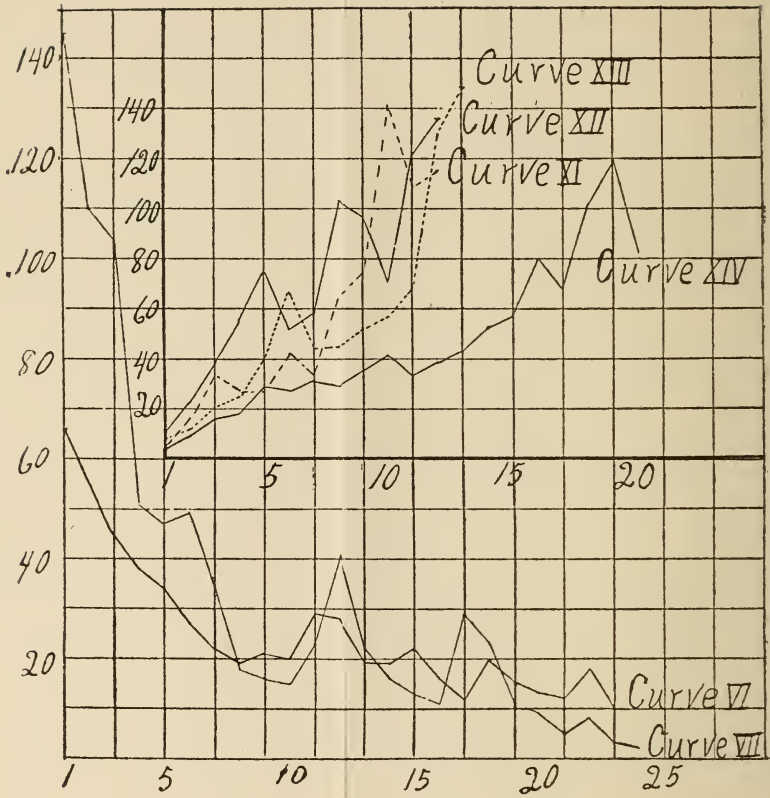


Plate II.



11 21 31 41 51 61 71 81 Plate III.

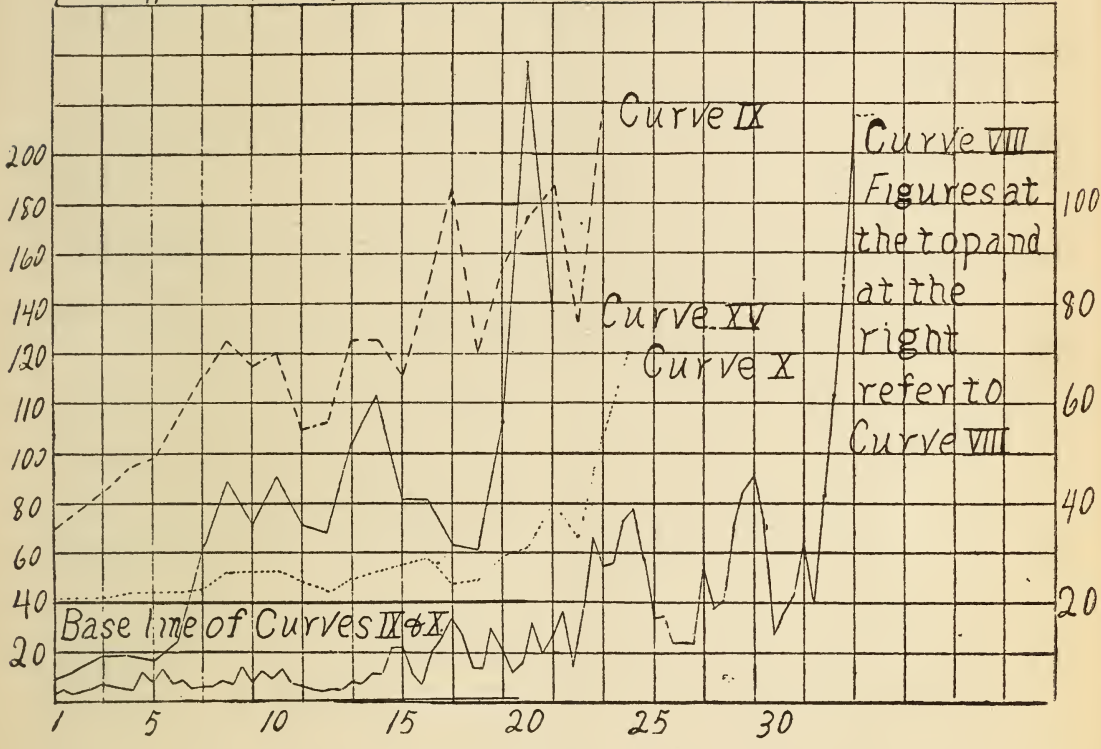


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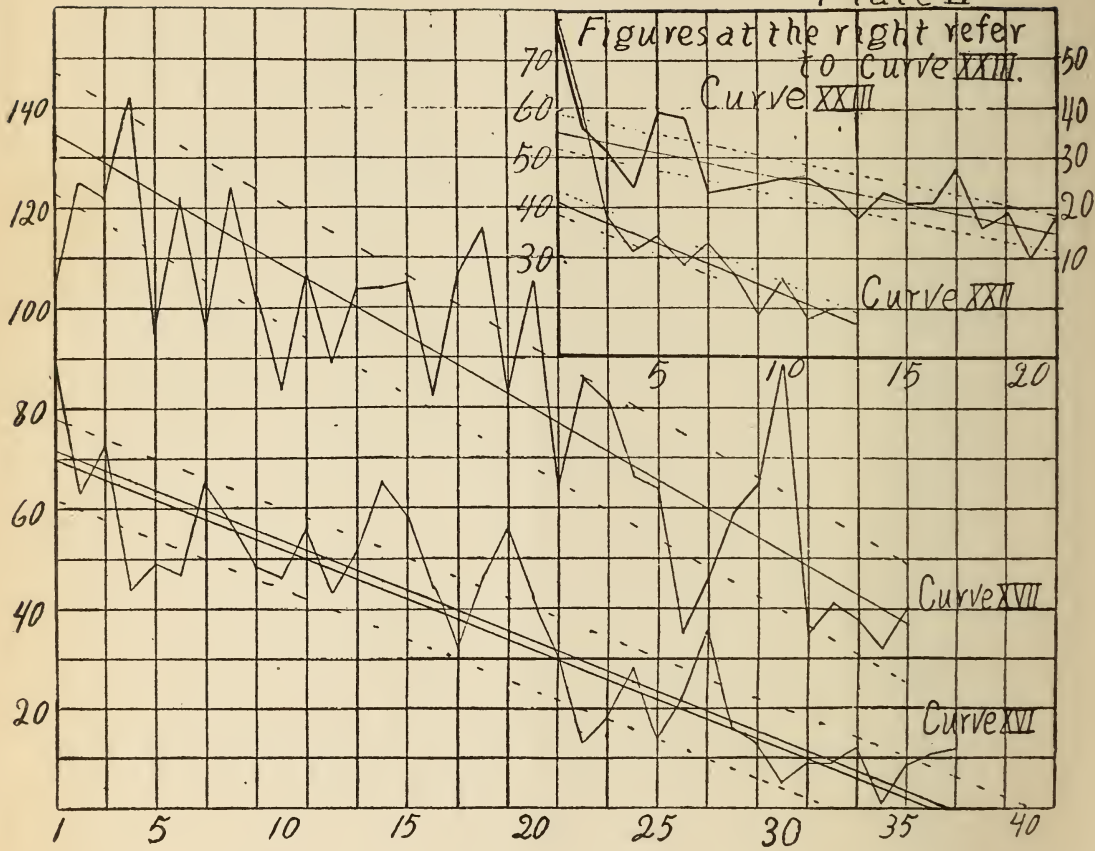


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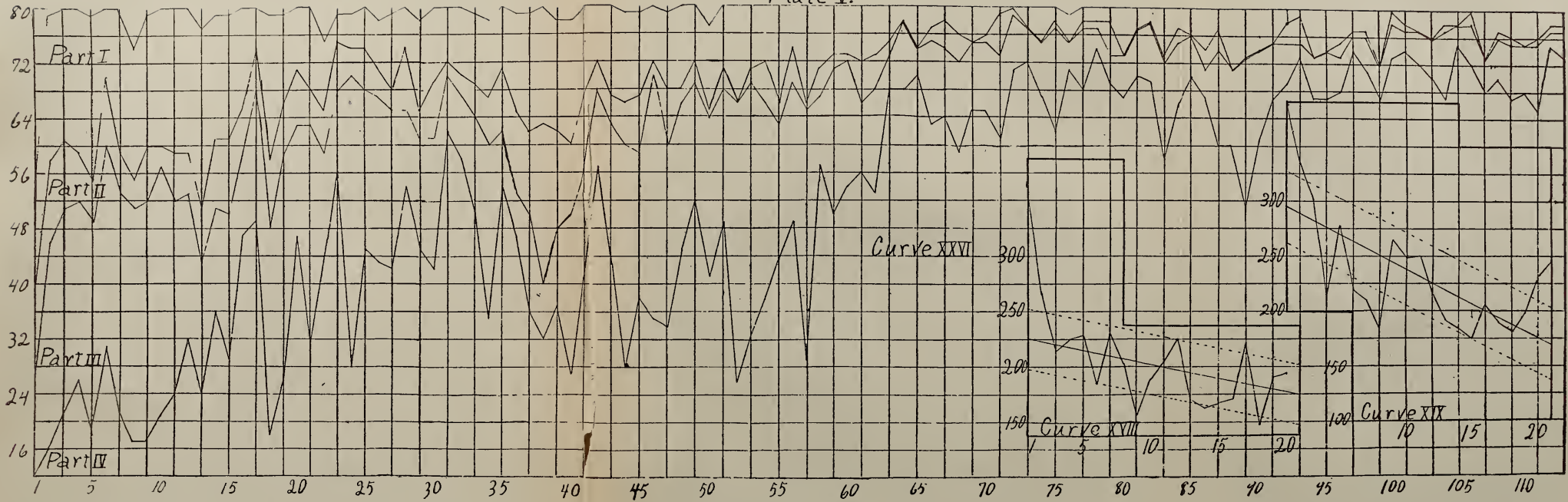


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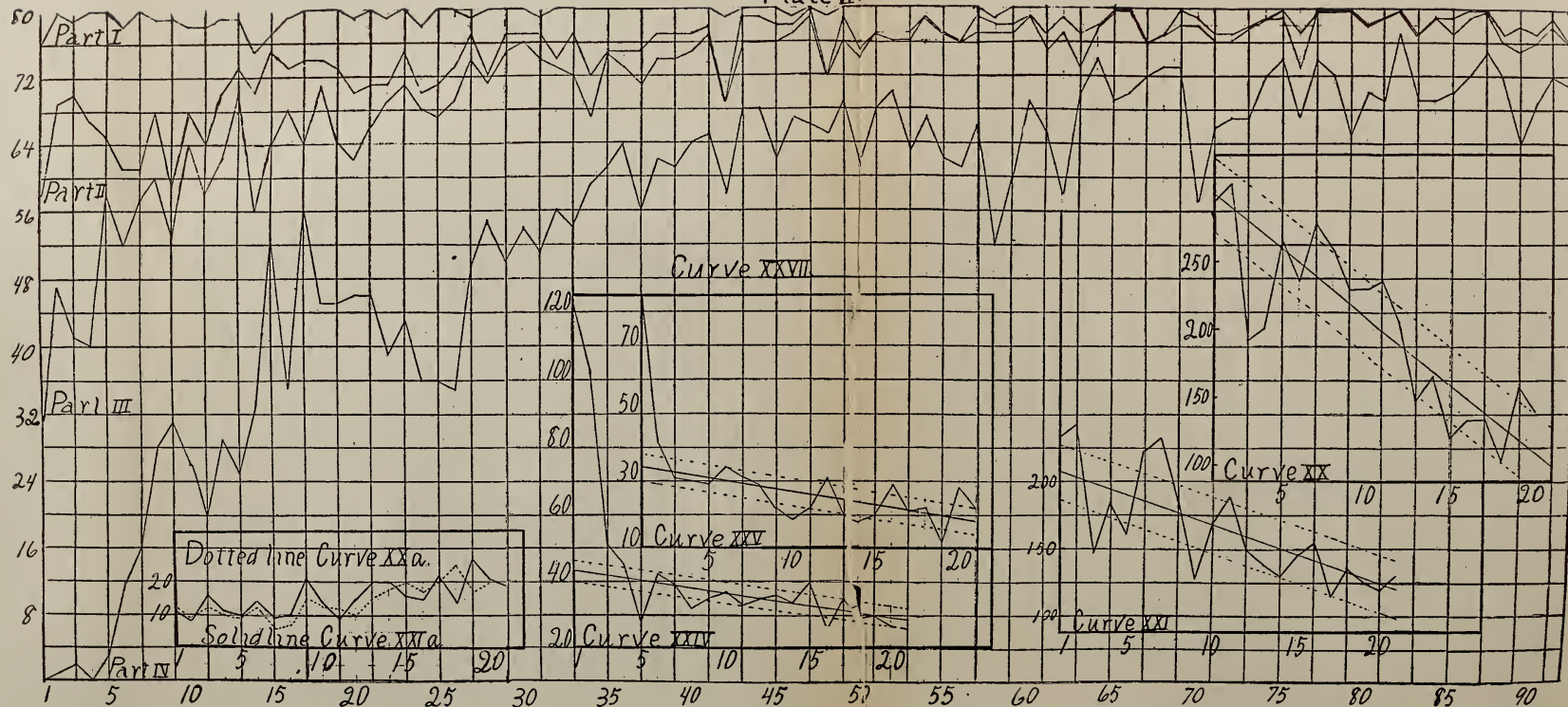


Plate VII

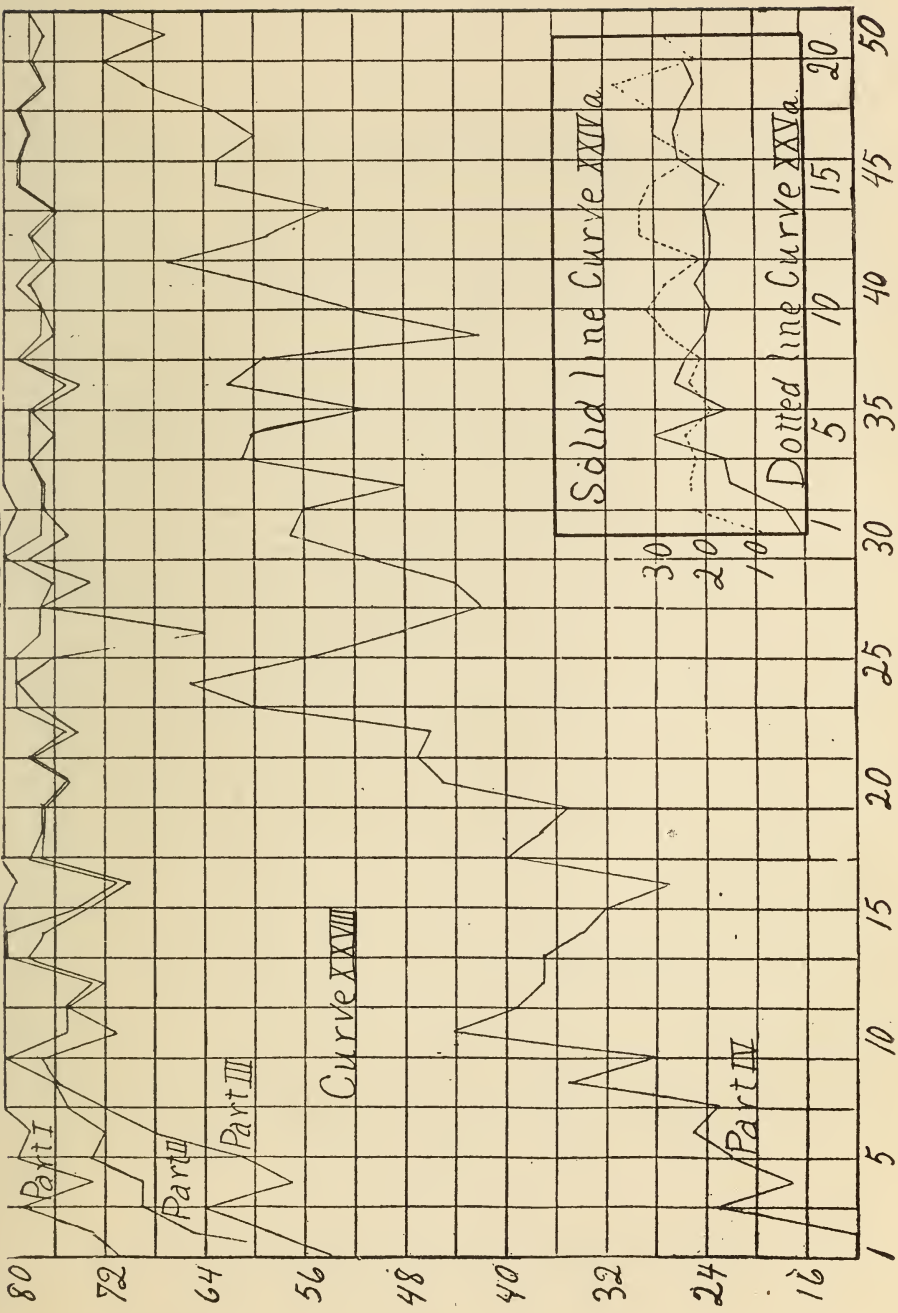
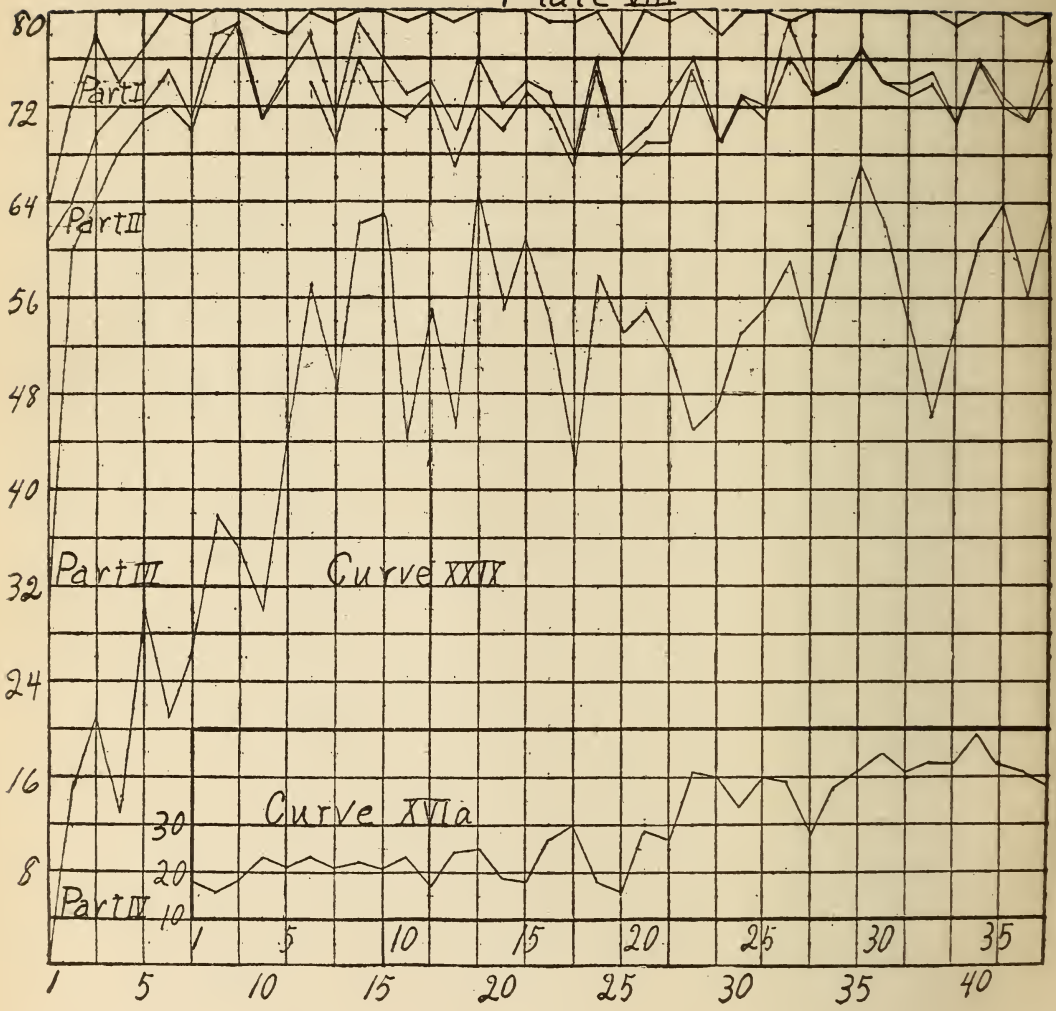


Plate VIII



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Studies in Social and General Psychology

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PREFATORY NOTE

Papers on "The crowd," "Sensation," and "The psychological antecedents of psychology," which were read before the American Psychological Association, December, 1915, have been revised and extended by their authors for the present volume.

The first group of studies attempts to define and to exemplify psychological problems and methods in a territory held in joint tenure by the students of mind and the students of society. Both priority of possession and exigent need have pressed the sociologist to the development of this territory at a time when psychology has been absorbed in other directions. Only in the comparative and genetic branch of his social enquiries,—notably in the *Völkerpsychologie* of Wundt,—has the psychologist done serious and constructive work. It is evident, however, that he is presently to extend his enquiries to all the mental factors which are variously conjoined in human intercourse and in human institutions. It is of the tenor of the present essays to suggest that a social psychology which desires to advance either the fundamental study of mind or the social sciences should be less concerned with the immediate conciliation and confusion of two diverse branches of human knowledge than with the careful and reflective establishment of psychological facts and principles.

The studies in general psychology make use of critical and historical means to sharpen our definition of mental process and of its empirical relation to the organs and the functions of the body.

M. B.

I

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A PREFACE TO SOCIAL PSYCHOLOGY

BY MADISON BENTLEY

- I. Typical problems of social psychology.
- II. The chief factors in social interaction.
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The tasks of social psychology are many and diverse; but they all rest finally upon social interaction,—upon the fact that individuals tend to believe and to think, to feel and to resolve, to speak and to act, to labor and to create, in mutual dependence. This social dependence is exemplified in innumerable ways by the daily intercourse of men. Communication through speech and gesture, every kind of human congregation, imitative performances, the works of art, the organization of the state, and all acts or attitudes of persuasion, acquiescence, and command reveal the social origin or the social tempering of mental function.

It is plain that this fundamental dependence of mind upon mind bears many aspects; and it is to the diversity of these aspects that we may confidently look for the explanation of the variety and multiplicity of tasks and problems which social psychology has undertaken.

I. TYPICAL PROBLEMS OF SOCIAL PSYCHOLOGY

Many of these tasks and problems essayed by the social psychologist arise as soon as we reflect upon the primary facts of interaction. In the first place, the *products* of social interaction are to be found in every human community. It is inconceivable that a man living from early childhood in solitary independence

should create laws, customs, myths, government and language. These institutions are the creations of groups and clusters. They are the precipitates of organization, of communication, and of communal activities. And one of the obvious tasks of the student of such mental dependence as we have presupposed consists just in the examination of these social products for the light which they may shed upon the mental processes concerned in their formation. It is this task which is attempted by Grosse,¹ by Lazarus and Steinthal,² and—more thoroughly and consistently—by Wundt,³ in his “psychology of peoples.” This kind of social psychology seeks to derive mental laws which shall illustrate the reciprocal effects wrought through and upon the human mind by gregarious life.

Again, it is possible to look upon the individual, viewed in all his relations to human and natural surroundings, as the *unit in social interaction*. When so regarded the individual usually becomes the “self,” and society the congregation or the hierarchy of selves. A descriptive account of society then takes either the genetic form, as in Baldwin’s derivation of the social self,⁴ or the analytical form, as exemplified by the late Professor James.⁵

Still another method of considering the facts and the issues of mutual dependence of mind upon mind has given us the beginnings of a *comparative psychology of human societies*;—a psychology which compares racial epochs and cultural levels, seeking to demonstrate the dependence of social organization upon the development of mind and upon the natural and nultural conditions of social growth and change.⁶ Usually this “racial” or

¹Grosse, E., *Die Anfänge der Kunst*, 1894. ..

²Lazarus, M., and Steinthal, H., *Zsch. f. Völkerpsychol. u. Sprachwiss.*, 1860, i, 1.

³Wundt, W., *Völkerpsychologie*, 2 vols., 1900-1909; *Elemente der Völkerpsychologie*, etc., 1912.

⁴Baldwin J. M., *Social and ethical interpretations*, etc., 4th ed., 1906; *Genetic theory of reality*, etc., 1915, 32 ff.

⁵James, W., *The Principles of Psychology*, 1890, i, 292 ff.

⁶Le Bon, G., *The psychology of peoples*, 1898; Lévy-Bruhl, L., *Les fonctions mentales dans les sociétés inférieures*, 1910; Frazer, J. G., *The golden bough*, etc., 1911-15; Boas, F., *The mind of primitive man*, 1913; Rivers, W. H. R., *The Todas*, 1906; Tylor E. B., *Primitive culture*, 1871.

“anthropological” or “ethnic” branch of psychology,—because it goes into such matters as anthropology, history, sociology, and economics,—contains a good deal that is not really psychological; that is not immediately concerned, I mean, with the facts and laws of mind.

A different account of large social groups, made in the name of psychology, is to be found in such depictions as M. Boutmy has skillfully drawn of the English and American peoples. Although here political aspects receive much attention in the authors' *racial delineations*, the studies are generally accredited to social psychology.⁷

We should do an obvious injustice to the present state of the field of social psychology, if we failed to mention, even in this cursory survey of problems and points of view, either the notable attempts of such writers as MacDougall and Wallas to discover the ground of social phenomena in the *innate constitution of the individual*,⁸ or the less subtle reference of social phenomena to the *abstract laws* of imitation, suggestibility, sympathy, consciousness of kind, and invention.⁹

⁷ Boutmy, E., *The English people, a study of their political psychology*, 1904; *Éléments d'une psychologie politique du peuple Américain*, etc., 1902; Bryce, J. B., *The American commonwealth*, rev. ed., 1910; Münsterberg, H., *The Americans*, 1904.

⁸ MacDougall, W., *An introduction to social psychology*, 2nd ed., 1909; Wallas, G., *The great society, a psychological analysis*, 1914, chaps. ii, iii, iv. Upon this basis various recent systems of sociology have built; e.g., Hayes, E. C., *Introduction to the study of sociology*, 1915, 209 ff, and Ellwood, C. A., *Sociology in its psychological aspects*, 1912, chap. ix.

⁹ Tarde, G., *Les lois de l'imitation, étude sociologique*, 1890 (3rd ed., 1900); *Études de psychologie sociale*, 1898; Ross, E. A., *Social psychology*, etc., 1908; Le Bon, G., *The crowd, a study of the popular mind*, 1903; Giddings, F. H., *The principles of sociology*, etc., 3rd ed. 1896. Tarde's object was “de dégager des faits humains leur côté sociologique pur” (*Les lois*, etc., 2nd ed., 1895, pref. x). Accordingly, “imitation” was for him a sociological matter: “partout où il y a un rapport social quelconque entre deux êtres vivants, il y a imitation” (*ibid.*, pref. viii). Nevertheless, when he comes to a stricter definition of the term, it appears to be psychological: “l'impression mentale à distance par laquelle un cerveau reflète en un autre cerveau ses idées, ses volontés, même ses manières de sentir” (*Études de psychologie sociale*, 45). Tarde maintains his consistency only by including all sociology in psychology: it is just collective or “inter-cérébrale” psychology (*ibid.*, 47, 49). This gen-

This empirical and incomplete list of kinds and varieties in the kingdom of social psychology is already long enough to suggest a definite reason for the vague implications of the term brought under our consideration. It is obvious that the words "social psychology" must either be used less variously than at present or else be so defined as to admit in proper perspective all the unlike varieties which now independently claim the same designation.

II. THE CHIEF FACTORS IN SOCIAL INTERACTION

After the omission of those "social" studies which are not primarily psychological, we must, as it seems to the writer, acknowledge that all the remaining problems can show a certain right to the title of "social psychology"; although the treatment of them has included a great deal that is not in strictness psychological. They mainly derive their unlikeness—as I have urged—from the fact that they consider what has been called the fundamental fact of social interaction from different points of view. Now these points of view may reasonably be reduced to three; one regards the individual, another the collective group, and the third the social products and precipitates of interaction. We study "social mind," as the vague term has it, by regarding either the members of the group or the group itself or, finally, those social creations and monuments which survive the process of interaction. The creations and monuments include both uniformities in belief, thought, standpoint, emotion and action (Ross's "psychic planes and currents") and such enduring and detached productions as language, religion, works of art, railways and cities.

We may repeat, therefore, that there underlies all the varieties of psychological enquiry into social phenomena,—whether descriptive, historical, comparative, or explanatory,—the primary fact of mutual dependence of mind upon mind. But if this ulti-

erous extension of the field of psychology is doubtless responsible for a great deal of loose description and interpretation among current American writers on "social psychology." . . . A useful bibliography for this subject may be found in Ellwood, *op. cit.*, 402-4.

mate reduction of the problems of social psychology is acceptable, then it seems to follow that the main entrance to all the connecting avenues of this special province of the mental sciences will be afforded by a study of those modifications of mental process and function which are referable to the presence or to the assumption of other like individuals. If individuals tend "to believe and to think, to feel and to resolve, to speak and to act, to labor and to create, in mutual dependence", then their membership-in-the-group is the primary fact on which social psychology rests.¹⁰

Now membership-in-a-group may be looked at, as I have intimated, from the standpoint of the group, from that of the individual-member, and from that of the group-product. The first two stand logically prior to the third; although such writers as Wundt have contended that it is possible directly to infer from the social products and institutions to those laws of mental development which are exemplified in the history of society, *e.g.*, from language, myth, and custom, to the development of thought, imagination and will. The first two points of view are plainly correlative. The description of the group or collection is obviously involved in the description of the members; and conversely, social "dependence" implies the integration of members-

¹⁰ This conclusion diverges from the standpoint of Ross, which considers groups as objects of *sociological* study and which reserves social psychology for the study of "planes and currents of uniformity." With regard to the difference in point of view it may be remarked (1) that our "groups" are not Ross's structures, institutions, "organizations" of society, but temporary and flowing *mental* collections, (2) that the planes and currents which Ross regards as "psychic" we regard as objects and products of mind and not themselves mental processes, and (3) that Ross's social psychology is explanatory (it explains "how so many planes in feeling, belief or purpose have established themselves"), while our is primarily descriptive.—For the views of sociologists upon the proper functions of social psychology and of sociology, see Ellwood, *op. cit.*, 1912, 1 ff, 60 ff. Practice seems to represent almost all degrees of dependence upon psychology, ranging between the extreme positions of Tarde and Durkheim. Tarde identifies social psychology and sociology (see above, page 3) Durkheim regards the facts of sociology as distinct from, and independent of, psychology. The present essay takes the position that social psychology, on its side, is to be established independently of sociological applications. (For Durkheim, E., see *Les règles de la méthode sociologique*, 1907, 4th ed., 5 ff, 120 ff, 172 ff.)

in-a-group. In our attempt to distinguish the primary forms of grouping, we may expect therefore to find that the modification of the members must also be implicitly recognized. For if we should try to avoid the description of members we should fall into the error of hypostatizing that mythical and abstract being widely known as the "social mind" or the "collective mind"; and if we should omit the group we should atomize out of existence many of the most significant social facts.

III. THE PRIMARY "SOCIAL" FORMATIONS

This apparent dilemma brings us to the real *crux* of our task. We have to ask: What are the primary psychological forms of human integration? What characterizes and distinguishes these? What are the essential modifications of the members entering into each sort of collection? The formulation of these questions is enough to indicate that complete answers can be derived only by compendious researches, not by such a brief survey of the field as the present. This outline attempts no more than a statement of the principles and means to be used in more detailed investigations.

It is obvious that, if human collections are to be described in terms acceptable to psychology, the student must go beyond such general distinctions as the "crowd" and the "public" and such ill-defined qualifications as "suggestibility," "imitation," the "paralysis of reason" and the "loss of conscious personality." In place of such distinctions and qualifications he must seek for empirical characteristics of the group, for distinctive means of formation, for qualitative and quantitative properties, for differential functions, and for diversity of products. If such group-characteristics are not to be found, then it is doubtful whether the psychology of groups can be erected upon a scientific basis.

The principles of descriptive science make it evident, however, that the organization of such units or individuals as are qualitatively diverse invariably produces a totality possessing unique marks and properties. It is only the addition of naked quantities or values which produces a mere sum. The group-properties of

conjoined chemical elements and the morphological and physiological integrity of the living organism alike illustrate the production or "creation" of qualities and properties which characterize the total integration rather than the integrated members when these are regarded in isolation.¹¹

The first distinction to be drawn among human groups separates the *congregate* from the *assemblage*.¹² The *congregate* includes all such groups as the audience, the reception, the jury, the throng, and the mob, where individuals are brought into physical proximity. The *assemblage* denotes individuals placed under common social conditions or "influences" though not physically conjoined.¹³ Such *sympathic* groups are illustrated by the community reading its local news, witnesses receiving common summons to appear before the court, voters setting out for the duties of election day, church members anticipating the service of their organization, or a people considering the disseminated announcement of its battles or of its diplomatic adjustments. The *assemblage* must be socially grouped, though not congregated; and the *congregate* must be an organization as well as a "company." In both kinds of group the essential factor is integration of a psychological kind.

This distinction needs to be justified. We may properly be asked to demonstrate (1) that physical presence or absence is indicative of a true psychological distinction and (2) that the two kinds of grouping possess a "psycho-social" character.

A. *Comparison of the Congregate and the Assemblage*

In reply to the first challenge it should be explained that physical grouping is only a means to, or a symptom of, the social tempering of the individual. In the convention, or the public

¹¹ Bentley, M., *Amer. Jour. Psychol.*, 1902, xiii, 269.

¹² *Grex* and its derivatives, *gregal*, *aggregate*, *congregate*, *congregational*, etc., are convenient terms for this technical usage. Likewise we may employ *assemble*, *assemblage* and *assembled* to describe the non-congregated forms of grouping. The word "sympathic" is useful in the description of the *assemblage*.

¹³ Compare Ross's account of the uncongregated "public" (*Social Psychology*, 63 ff) and Wallas's conception of the "great society" (*op. cit.*).

lecture, or the class room, or in the press of a street accident, social relations are laid upon a perceptual basis. The sight and the sound of the speaker or of the instructor or of the injured man, the sight and the unanalyzed sound of the mass or of the audience, the smell, the contact, the heat, and the effort of the individual to maintain his position, taken together with the organic processes which these perceptions arouse, have a profound *social* significance. The significance is revealed by the fact that—as the phrases run—the crowd ‘forms,’ the audience ‘settles’ and ‘is moved,’ the beholders are ‘impressed.’ In the non-congregated assemblage, on the other hand, the social grouping is conditioned in a very different way. Everyone knows the intimacy and warmth of a printed reference to one’s self and one’s affairs. The reader of the personal note is vividly aware that his neighbor or his county or his city is perusing the paragraph and passing judgment upon him. At such a time the individual is, in a social sense, very much in the “presence” of his fellows. But the total state and temper of his mind are determined, not by perceptual matters (the paper and the print are only symbols, which are represented in the background of consciousness) but by imaginal representations, emotions, and thoughts. And as the consciousness of congregated and assembled members differs on the perceptual or apprehensive side, so also does it differ on the executive side or the side of action. The response to other present members is different from the response to absent persons whom one regards, at the moment, in a social relation. I am tuned for action in one way when I read in my morning’s mail of my appointment to an international committee, and in another way when I actually meet my *confrères* and set to work. The one relation is more passive, the other more active. The temper of the members of the one sort of group, the congregate, is expressed by the phrases “we hear,” “we approve,” “we dissent,” “we will do”; of the other sort, the assemblage, by the phrases “I am considered,” “I am condemned,” “I belong,” “I agree with the proposal.” In the one, the main object of reference is the group and its interests; in the other, the place and relation of the individual, considered as a *member* of the group. In the congre-

gate, the main object of individual attention and interest is the group; in the assemblage, it is the relation of the individual himself to the group.

Two qualifications are called for. First, not every person in the congregate or the assemblage is necessarily a member, *i.e.*, is "groupish" or "crowdsh" or "clannish." Individuals may be "lost" or "absorbed in thought" in the mass, or indifferent to exhortation or to the bonds of nationality, of kinship, and of local affiliation.¹⁴ Secondly, like all distinctions which create adjacent or neighboring classes, the two types are not always to be readily distinguished on the basis of such differences as have been pointed out. There are cases of the border-line. Family bonds may, when the members are for a time separated, be represented by a conscious reference akin to that of the congregate; and on the other hand, the audience which is asked to consider its civic duties may bear the appearance of an assemblage.

Neither qualification really violates the principle of the distinction. The first only goes to show that we cannot answer for every person physically present in the congregate and for every person brought under social pressure in the assemblage. Its positive value lies in the demonstration that mere propinquity and isolation are the inducing conditions, not the essential characters, of the classes in question. The second qualification merely warns us that we must not so rigidly fix the lines separating adjacent territories as to endanger the *status* of localities lying upon or near the common boundary.

Further discrimination among the groups which represent the forms and phases of mental dependence must wait upon an agreement as to the conditions of social "influence" and "dependence." We have spoken of the physical presence of other persons and of the knowledge of common interests as determinants of the minds of members in a social group. Let us inquire now in what sense these circumstances may be regarded as falling among the *essential* conditions of mental integration.

¹⁴ Cf. *The Audience*, p. 48 below.

IV. THE CONDITIONS OF MENTAL PROCESS AND MENTAL FUNCTION IN THE INDIVIDUAL AND IN THE GROUP

All the sciences seek to add to the description and classification of objects brought under their observation a definition of antecedents and causes. In this sense, science is explanatory. If the atomic weight of an elementary substance varies, or the spectrum of a star shows a new line, or if the offspring bears unequal resemblance to its parents, the appropriate science attempts to name the conditions under which the atomic weight varies, the new line appears, or the offspring inherits parental characteristics. In the same way, psychology has discovered in its observation of mental processes that these processes are conditioned by changes within the organism, notably within the nervous system. So invariable has this fact of bodily condition appeared that the psychologist has come to regard the empirical principle of psychophysical dependence as fundamental to his science. The more immediate physical conditions of mind lie within the brain. They are determined in two ways; by stimulus and by disposition or tendency. Stimulus indicates that the functions of the nervous system are determined by an outside agency (either within or without the body); disposition or tendency indicates that neural functions are determined by the residues of earlier function. The commonest forms of the latter are known as impressional, associative, determining and habitual tendencies, and general cortical set. Both kinds of bodily condition are, as we may suppose, in constant operation during normal waking life; though the facts of perception are mainly to be explained by stimulus and associative tendency, passive memory and imagination by associative and impressional tendencies, emotion and action by stimulus and determining tendency, skillful performance by habitual tendency, and thought by dispositions of the determining sort.

If mind morphologically regarded is conditioned in these definite ways, we have to ask how the social psychologist is to conceive those determinations which account for, or underlie, the facts of what has been vaguely called the "social consciousness." As a matter of history, we must note that he has, as a rule, been in-

clined to disregard the terms of general psychology and to invoke instead a very different set of concepts. He says that the mind of man is "influenced" by other minds, that man is "suggestible" or "imitative," that one mind "rules" or "dominates" and that another mind "acquiesces." It is obvious that these terms do not rest upon the same empirical plane as those just discussed. A stimulus is a physical agent acting upon a receptor-organ and initiating there a series of concrete organic processes. The same cannot be said of "suggestion," when suggestion is used to account for the fact that the mob destroys or of "domination" when domination is alleged as the cause of the acts of the laborers' union. "Suggestion," "domination," and the others are,—until they are empirically defined,—sheer abstractions used as agents or forces.¹⁵ They are precisely analagous to the faculties of the eighteenth century.

Now faculties of any sort are unacceptable as a means to scientific explanation.¹⁶ What, then, is social psychology to substitute for them? What may legitimately be given as the conditions underlying the origin, the integration, and the performances of human groups? Put into other words, What do we concretely mean by mental dependence, when we affirm that "individuals tend to believe and to think, to feel and to resolve," in mutual dependence?

It is obvious that the mind of my neighbor is not to be added, as a condition of my mental processes, to the sober and authenticated facts of stimulus and disposition. If my neighbor speaks

¹⁵ Illustrations of this use are to be found in L. F. Ward (*Pure sociology*, etc., 1903, 256 ff, 457 ff, in Ellwood (*op. cit.*, 283 ff, 288), and in Ross ("Suggestions are true forces," *op. cit.*, 13). A large part of the sociological writing which treats of "mind" and of "mental forces" and "mental agencies" is psychological in name only. The writers usually mean by "mind," opinions, beliefs, thought-objects, and the like. A good instance is furnished by a series of current articles on "The mind of the citizen" (*Amer. Jour. of Sociology*, 1915-16, xxi, 145, 383, 501, 634). Lévy-Bruhl's "collective ideas" are pseudo-psychological facts of the same order. Wundt says of "suggestion" and the other abstractions that "sie selbst viel mehr der wissenschaftlichen Klärung bedürfen, als dass sie zu einer solchen beitragen könnten." *Logik* (3rd ed.), 1908, iii, 480.

¹⁶ For a discussion of faculties in general psychology, see below, page III.

with the voice of authority and decision and so convinces me that I should attend the meetings of the Municipal League, my mental processes are set up, after all, just as they would be if I found a blight upon my fruit trees and decided to destroy the orchard. Auditory or visual stimuli and associative tendencies account for the perceptual part of either experience, and determining and habitual tendencies for the performance.

The only thing that is unique about the conditioning factors in social or mental dependence is the fact that the presence of other persons (in the congregate) or the assumption of them (in the assemblage) touches off *certain* dispositions or neural tendencies, giving to our "social" experiences *a certain kind of significance*.¹⁷ The sight of the blighted fruit trees and the sight and sound of my persuasive neighbor are psychophysical events of the same order. There is not, in the one instance, the mere apprehension of an object, in the other, the operation of a subtle and mysterious force through the agency of which my mind is wrought upon by my neighbor's. Because of my constitution and my history the two things are differently apprehended, have different significances, and lead to unlike performances. The one object is the tree-to-be-cut-down-and-burned; the other is neighbor-M-whose-opinion-is-to-be-regarded-and-accepted.

The sociologist may indeed speak of "social forces within the mind" and of the "power of suggestion," provided he has work to be done and sets a value upon the means. But the task of the psychologist is primarily descriptive: he has nothing to say of values, whether social, economic, or political.

Now it is not by accident that the borders of social psychology are left undefined. In no one of the special branches of the science are the dangers of trespass and of transgression so great. And the reason is to be found by an inspection of the *objects* of

¹⁷ The enumeration and the classification of the "social" dispositions and of the "social" significances furnish one of the special problems of social psychology. These things are later touched upon in special articles upon the "crowd" and the "audience."—G. H. Mead contends (*Psychol. Bull.*, 1909, vi, 401) that social conditions are as unique and as general as physiological conditions of consciousness and that therefore general psychology should be supported by parallel treatments of physiological and social facts.

which the social sciences treat. These objects are, for the greater part, *mental* objects,—but not *psychological* objects; mental in the sense that “mathematical” and “imagined” objects are mental.

The psychology of *process* leaves the psychologist no excuse for confusing his materials with the objects of the physical world. But at times he still confuses,—without the sanction of logic, to be sure,—these same process-materials with objects of other sorts. Many writers upon social psychology apparently assume that any object which does not belong to the physical order belongs, *ipso facto*, to the realm of mind. This is a mistake. To be specific we may lay it down as a general rule that one is not treating of mental processes and mental functions whenever one is concerned *either* with the formal organisations of society (the church, the club, the state, the court, the party, and the like) *or* with the products of mind (languages, works of art, opinion, beliefs, traditions, and other thought-objects), when and so far as these things are regarded apart from the fluent processes and functions from which they take their origin or derive their means of continued support. Once these extra-psychological objects are relegated from social psychology to “psycho-sociology” or to some other sociological or economic discipline, the problems and the methods of our own field will be enormously clarified.

V. SOCIAL CONSCIOUSNESS AND SOCIAL OBJECTS

The appeal to the physical concepts of “force” and of “resistance,” to account for the facts of social interaction, is as crude as it is unpsychological. A subtler and a commoner way of approach is through “social consciousness” regarded as the condition primarily and universally involved in human relations. But this term is objectionable. There is no class or group of mental processes or of mental functions which can properly be called “social,” just as there are no “social” conditions of consciousness to be added to stimulus and disposition. It is not consciousness that is social. Objects and events are social.¹⁸

¹⁸ Wallas has distinguished (*op. cit.*, chaps. xi, xii) “thought-objects” and “will-objects.” Contrast W. Fite’s conception of a “mutual consciousness” (*Jour. of Philos., Psychol.*, etc., 1913, x, 367, 373). Mead has built up, in the

They are social when their meaning or significance implies more than one observer. An object or event whose meaning or significance implies no observer, or only one, is *asocial*. When I perceive my inkwell as a part of the furnishings of the desk or as a receptacle which I must fill, it is an asocial object. Regarded as a part of the desk's furnishings, it does not (except logically) involve me or any other observer: as a thing which I must fill, it implies me. But when I regard the inkwell as a cherished gift its meaning at once implies and includes my generous friend as well as myself. It is social. It is social also when its scrolled pattern is apprehended as the artistic achievement of a savage tribe. So too events. The horse-race, the battle, the solar eclipse, and the fall of night are asocial events when they are just happenings, either wanting reference to an observer or making reference to a single observer,—whether myself or some other. But if my horse is contending against B's, if the battle means men-fighting or the contest-of-nations, if the eclipse is an impressive event which human beings silently watch, or the fall of night an hour for the cessation of human labor, then the occurrence is social.

The 'implication of observers' calls for two comments. First, the implication is not a logical implication. It is in the object as perceived. The plurality of observers is a part of the object's meaning. The inkwell is object-scrolled-by-natives-with-a-common-inspiration just as really and directly as it is green-object or ink-containing-object. The socialized eclipse is the eclipse-which-we-are-observing. In the second place, the observer, whether myself or another, is not a logical abstraction. It is a part of the concrete meaning which constitutes the object. When the inkwell is a social object, it is product-of-the-tribe. When the letter which I take from the envelope is a social object it is the thing which speaks for my correspondent to me. The letter is socially constituted by being his-letter-and-my-letter.

spirit of Baldwin, a logically constructed social consciousness which involves "social selves" and the transcendental ego of Kant (*ibid.*, 1912, ix, 401). For the history and use of the terms "social consciousness," "social mind," and the like, compare Davis, M. M., *Psychological interpretations of society* (in *Studies in Hist., Econ. & Public Law*, Columbia University, 1909, xxiii, no. 2): Ellwood, *op. cit.*, 329 ff.

As social meanings grow, the observers of an object or an event assume more and more the character of *partakers*. The social reference gradually migrates backward from the common focus of observation to the relations which emerge between or among the observers. More and more the observers *share* the object. The beginnings of social reference are probably to be found among mammalian forms below man,—and possibly also among certain of the insects. The object is already apprehended as the common junction of observations. Communication is apparently not yet established among the observers for the reason that the *partaking* reference is still wanting. Many of the collections of primitive men seem to rest near this level of socialisation; although language here comes in to strengthen the bonds passing directly from observer to observer and only indirectly through the common object.

Later, we shall see that this distinction between such human collections as are held together by convergent lines of reference meeting in the object and such collections as are chiefly integrated by lines of reference binding together the partakers of a common experience may be used to mark off the typical audience from the crowdish mob.

Having now dwelt upon the meaning of socialised objects, we may proceed with the qualification and description of these. They are apprehended by a great variety of conscious functions: they are objects of perception, of memory, of imagination, of thought and of sentiment. But however the plurality of observers is implied, the implication may be brought under one or another of three different types; presentative, empathic, and inferential.

The implication is *presentative* when the mental functions involved are either perceptual or ideational. In this case, the existence or the behavior of observers is immediately apprehended. The social object is presentatively implied when a colleague M enters my study and scrutinizes with me a new lot of prints. The prints are social. They are works of art which he and I are criticizing and approving. It is not necessary either that I should be "self-conscious" or that I should make my col-

league's mind the object of my attention. My attention to the prints, regarded as *our* object, is sufficient. The case is essentially the same when I merely greet my caller. He is an object which implies me. If he shows anger and threatens injury, his behavior becomes a new part of the social object. When I merely ideate or "think of" M the implication is unchanged. So long as he is an object which implies only himself or only myself the object is asocial: so soon as it sets some relation between us, it becomes social.

But the implication may be immediate in another way,—in the way of *empathy*. Whenever an object implies the valuation or the appreciation (approval or disapproval, sympathy or antipathy) of one observer by another, the object is social. Modern studies of aesthetics, made from the psychological side,¹⁹ have attested the importance in artistic appreciation of this same principle of empathy (*Einfühlung*). The threatening storm, the smiling landscape, the upward-tending pillar, and the balanced cross are all alike physical representations of moods and emotions. The principle of empathic projection seems to be the same in socialised objects. My observation of an heroic act attaches me to the hero because I value his deed. The caryatid maidens under the font were socialized when Sordello came each evening to share in sympathetic silence their enduring labors.²⁰ In social as in aesthetic empathy the object tends to close the discontinuities of perception and idea. The beautiful object feels and thrills with the beholder: the socially valued object unites and unifies, through empathic appreciation, all those who share it.²¹

Finally, the socialized object implies also through *inference* a plurality of observers. I understand the intent of the engraver of cavern walls to express himself in pictures and hieroglyphs when I have inferred from his drawings the type of his mind and the temper of his cultivation, and just as we pass from the

¹⁹ Lipps, Th., *Aesthetik*, etc., 1903, i, 96 ff: Santayana, G., *The Sense of beauty*, 1905, 44 ff.

²⁰ Browning, R. *Works*, 1893. (Riverside ed.), i, 203.

²¹ Professor Calkins regards *all* consciousness as "self" consciousness, and *all* perception as "shared" or social consciousness. W. M. Calkins, *An introduction to psychology*, New York, 1901, 153, 170.

physical or the chemical object to its causes and conditions, so do we proceed by the mediating processes of inference from the "expressive" movement, or from language, law, or custom, to the mental processes and functions which produced it. Now, as in empathy and in presentation, our social implications are bound up with objects; only now, in inference, we pass beyond the primary object to centre our attention upon a derived object which it is proper to call "mental." But it must be carefully kept in mind that an object is not necessarily social because it is mental. The mind which we reach by inference to account for mental productions or expressions is an asocial object when it is observed by itself. It is social only when it implies also another mind. If I read a dead author to discover his ideational type or his knowledge of botany, I regard him asocially; but if I discover in him a revelation of human passions or a means of expressing my own moods and emotions, I regard him socially.

VI. THE PROPERTIES OF THE CONGREGATE

It has seemed to be necessary to interrupt our discussion of social formations for the purpose of making clear what we must mean by the *conditions* of social grouping and by *sociality* itself. Having discovered that we have no right to invent either a mechanics of social forces to mould and to socialize the individual or a special "social consciousness," where we have found empirically given only certain objects and meanings which arise under certain special dispositions, we may now return to discuss the types of formation,—first the congregate and afterward the assemblage.

We begin with the congregate and we seek a psychological principle of classification. All enumerations based upon convenience or common sense or sociological value must be carefully scrutinized before they are admitted under our classificatory rubrics.

Since it is the integration or organization of individuals (p. 10) which we have found to characterize the 'social' facts of psychology, we turn naturally to the phenomena of organization as the appropriate key to the types and kinds of congregate. The

most obvious means of distinction lies in the number of associated individuals. Thus the simplest kind of congregate would seem to imply the conjunction of two individuals; the most complex, the congregation of a multitude. But this appearance is false. The measure is quantitative. It does not rest upon the nature of mental functions. That the organization of two members may be of the closest and the most complex pattern is demonstrated by those private and sentimental alliances which include hundreds of relational bonds and which endure over long periods of time. At the other extreme, we may find in the street throng at mid-day a huge aggregate held loosely together by the simplest and weakest of temporary connections.

A. Grades of Integration among Congregates

Without attempting to supply all the grades and levels of organization in the congregate, we can indicate the gradual rise of integration by beginning with such all-to-all groups as appear in casual and unstudied aggregates of men in the new mining camp, the temporary settlement of pioneers, and the accidental conjunction of many persons seeking separate and unrelated ends (the throng).²² Then we pass to those temporary and spontaneous gatherings whither individuals are drawn by a common object of curiosity;²³ thence to the ordinary heterogeneous audience gathered for an occasional discourse; thence to congregates of individuals rendered homogeneous by a common purpose or common dread or need or request such as a mass of laborers locked out of their shops or fugitives fleeing before fire or earthquake. The next level of integration includes still more closely organized groups. It comprises congregates which are led or governed. There is a spokesman to give expression or a leader to harangue, to initiate, and to command. Such groups are "polarized."

The next stage of social amalgamation includes groups which bear an external resemblance to the heterogeneous audience, but

²² *E.g.*, the railway platform at train-time.

²³ *E.g.*, displays in shop-windows, the street fakir, a fallen horse, a damaged machine.

which really belong at a much higher level. This is the stage of the *selected and primed* audience, the meetings, *e.g.*, of religious, fraternal and social "organizations." These are designated as "primed" congregates because the formal organization (which does not here call for extensive psychological treatment) implies previous association and common interests, sentiments and needs. The gregal attributes of such meetings presuppose a tacit understanding which is expressed in various bodies by creed, constitution, declaration, or platform.²⁴ This kind of congregate, then, reveals very much closer mental organization than is to be found in the heterogeneous and temporary audience. Should we consider minor differences of degree at this general level of integration, we should have especially to regard the gatherings of such organizations as strive to forget individual concerns and to unify themselves by devotion to a common cause. It would appear that this extreme unification in the congregate is commonly produced under the stress of violent emotion and of vigorous priming. Thus religious zealots forget themselves in the common frenzy of the maniacal moment. But we must not confuse extreme unification with extreme organization. The former state arises through the loss of individualizing characteristics in the members; the latter state is one of unity in spite of variety. The mammalian organism stands high in the scale of living beings, not because its organs and functions are homogeneous but because they are, in spite of their diversity, wonderfully correlated and bent to a common end.

Neither does our principle of graded congregates permit us to set at the top such automatized unities as the military formation. Unity of function and harmony of arrangement are indeed attained; but only at the expense of differentiation among the members.

It is, doubtless, the maximal grade of congregation which is

²⁴ The psychological function of such formal organizations as the church, the "society," the club, and the political party is to prepare individuals for membership in the congregate and in the assembly. Parliamentary rules of procedure furnish an effective means of promoting the functions of the mixed congregate with a minimal degree of polarization (cf. Ross, *Social psychology*, 57).

sought in the Anglo-Saxon form of trial by jury. United for a specific end, the jurors are expected to ponder until they "are of one mind," despite the mental differences which mark them as men. Whatever the limitations of this system may be, we must look to organizations of this sort, presenting the greatest unity amid wide inherent diversity, for illustrations of our final grade of "all-to-all" congregations. There we may reasonably expect to find normal and temperate human beings exercising in moderation the general and primary functions of the mind.

B. *The Process of Polarization*

Nothing like specific description of the various all-to-all forms of congregation can be attempted in this place. One mark, however, must be noted before we can advance to the alternative, or one-to-one, forms.

I have spoken of the "polarized" congregates in which a spokesman or a leader appears. Both the temper and the functions of gregal collections are profoundly affected by the unique offices of a single member who serves as leader or speaker or spokesman. The process of polarization implies that the dead-level of a homogeneous congregate is being disturbed. The all-to-all relations are augmented through this process by a new set of one-to-all and all-to-one relations. The thronged aggregate becomes differentiated the moment one of its members calls for help or inveighs against delay in suburban traffic. Attention within the congregate acquires a common object, and thought and emotion receive a common expression. The aggregate is now knitted up into a much closer organization: it acquires new qualities as it reveals the distinction of mass and leader.²⁵

It should be noted that the process of polarization, to which every unpolarized congregate is constantly exposed, is the result of two reciprocal conditions. One is the innate difference among

²⁵ M. Conway (*The crowd in peace and war*, 1915) suggests the apt name "crowd-exponent" for the member who merely expresses the emotions and desires of the congregate. He is "the trumpet of another voice." (Pp. 101, 113). The organizer, the inspirer, the director of the crowdish congregate, Conway calls the "crowd-compeller." (P. 89.)

the members which prompts one man to aggression and others to passive performance, and the other is the universal recognition of this difference by the members themselves. The "natural leader" or spokesman is a member who is perceived as a person to-be-attended-to-and-followed. The first condition serves for the establishment of the one-to-all relations; the second for the establishment of the all-to-one relations. The phenomena of settlement as well as the casual and local congregations of man, continually afford suitable conditions for the process of polarization.

A description of the polarized congregates and a statement of the special conditions under which they are organized are reserved for later treatment. Our general discussion will only call attention to the fact that the process of polarization depends in part upon the appearance and the performance of the leader, and in part upon the matter of his verbal utterance. This difference is, grossly expressed, the difference between oratory and logic. Physical presence, manner, voice and gesture are vehicles which bear a meaning to the mass of the congregate; and the words spoken are symbols of another kind which likewise bear to the rest of the congregate their significance and temper. While no psychological distinction between the audience and other forms of the polarized crowd is everywhere applicable, we may note that in general the audience is a congregate which is *predominantly* organized under the second set of conditions, the other forms *predominantly* organized under the first. Verbal meanings, apprehended in common by a group, coalesce and integrate the members; while the manner, bearing and movements of the leader augment that temper which it is proper to designate as *crowdsh*.²⁶ In the audience, the meaning of the discourse tends to strengthen the individual relations of the mass to the speaker, who represents the topic; in the polarized mob, the significant conditions tend, on the other hand, to increase the inter-relations within the mass, or the secondary pole, of the group.

²⁶ Pierre J. G. Cabanis recalls (*Oeuvres*, Paris, 1824, iv, 346) that Bernard of Clairvaux converted the German peasants by preaching to them in Latin, of which they understood no single word.

Strong interrelations among the members of the mass form the first and primary characteristic of the mob; strong individual relations between the speaker and the other members, the first and primary characteristic of the audience. Most polarized congregates of the one-to-all type partake at once of the nature of the audience and of the mob.

The polarized congregate naturally leads to the one-to-one groups, which make up the second large class of congregates. In fact, the one-to-one type of formation may be regarded as the limit of polarization. Within it the poles are similar: a second individual takes the place of the multitude. There still remain the phenomena of subordination, of unequal give and take, of common objects of perception, and of a reciprocal guidance of thought and conduct,—although the congregated mass has disappeared. Sociology, whose interest lies largely in the performances of extensive groups, tends to overlook this important form of social congregation. But to the psychologist these mental relations are of primary importance even though for him the social and sociological functions of the paired groups are left out of account.²⁷

Extended comment upon the grades of one-to-one congregates may be left for independent treatment. The extreme degrees would seem to be represented by the casual intercourse of strangers and by those "primed" pairs whose rich systems of interrelation rest upon common experiences and frequent conjunctions enduring for years. We have already seen that the upper extreme represents also the highest degree of organization for the whole class of congregates.

VII. THE ASSEMBLAGE

Set over against the congregates we have the major class of assemblages. The psychological distinctions between those collections which are physically grouped and those which are not have already been drawn. There remains the task of deducing

²⁷ Compare Wallas (*op. cit.*, 241 ff) for the functions of "oral dialectic" and of the corresponding one-to-one assemblages which involve writer and reader.

the principal forms of the non-congregated or sympathetic assemblage.

So deeply in man are engraved the effects of communal existence that he lives grouped a large part of the time when he is in physical isolation from his fellows. It was, presumably, not so much the physical absence from his fellows that led Alexander Selkirk to cry out against solitude as the realization that fate had cut off those mental affiliations which exist in the various forms of assemblage. The bare "consciousness of kind," of which Giddings has frequently spoken, represents the lowest order of the assemblage. The conscious meaning which bears it is expressible in the words "I-belong." On the side of numbers, one individual who apprehends himself as a member of a group represents the smallest assemblage. The physical absence of other members does not destroy the sympathetic relation. The fact that one person, relating other observers to himself, is sufficient to form an assemblage will seem less strange when we recall (see p. 8 above) that in this kind of integration, the chief emphasis lies on the side of the member; while in the congregate it rests upon the group.

We have spoken of assemblages as set off from congregates by "distinctive means of formation, qualitative and quantitative properties, differential functions and diversity of products." Our grades of organization ought, then, to be based upon these characteristics. First, compare the lowest degree of organization, represented by a bare "I-belong" attaching to objects, with those highly organized assemblages of scattered individuals glowing with loyalty to a common cause. The first may be formed by any chance reference or incident which draws attention to the social medium in which the individual inheres; while that assemblage which stands at the opposite extreme demands, on the contrary, a specific means of arousing dispositions of great age and tenacity,—dispositions which represent a multitude of relations and which serve to identify the member with his group. The integration of the closer assemblages and of the closer one-to-one congregate is conditioned by seasoned and complex tendencies to neural function which are the precipitates and the residues of a vast number of previous "social" experiences.

As regards the distinction of the properties and functions of the loose and the close assemblage, we may note that the representation of the group-relation is made in the first case by a vague and ill-defined object which stands for "society" and, in the second case, by a clear-cut and individualized object,—one's people, one's land,—which could be confused with, or mistaken for, no other object in existence.

With respect to polarization, the assemblage may be said to present a state analogous to the congregate, save that the primary pole, which was, in the congregate, the individual leader or spokesman, is now the mass; and that the secondary pole, which was there the mass, is here the individual. In the assemblage the individual "belongs to" the mass very much as the crowd "belongs to," and revolves about, its leader or exponent. Moreover, the assemblage reaches its upper limit of polarization in the one-to-one or paired form and its lower limit in those emotional and ecstatic forms, especially those composed of mystical and idealizing natures, in which the individual is consumed by, and identified with, the social totality.

On the side of function, the "I-belong" reference serves at once as a refuge against isolation and as a gentle and mild censor inhibiting overt acts against the state and the community; but the passionate acknowledgment of identity with a race or a cause creates a principle of conduct which sets purposes, commands action, and determines the destiny of the member and of his group. Intermediate grades of the assemblage need only be suggested. Many of them fall under our conception of civic and private duty. They represent a large number of ways in which the individual regards himself as related to his kind. They serve in large measure to maintain parties and states, clubs, churches, and philanthropies. The occasional meeting in the congregate strengthens them and increases their integration; but they exist as unique organizations with properties and functions of their own.

VIII. SUMMARY

“Social psychology” is an ambiguous term which has been applied to a wide variety of facts and problems. The special province which it indicates must be set off from general psychology, on the one hand, and, on the other, from sociology. When traced to their common source all the legitimate problems of social psychology are found to proceed from mental “dependence” or mental “interaction.”

Since social psychology rests upon “interaction,” the meaning of this word must be clearly and empirically determined. The determination begins with recognition of its three fundamental aspects; the human group, with its qualities and its functions, the individual regarded as a member of the group, and finally the products of social integration.

The first two aspects are regarded in the two primary classes of human collections, the *congregate* (resting upon physical conjunction) and the *assemblage* (resting upon the social apprehension of non-congregated groups). In the first, emphasis lies upon the group, which possesses unique properties and presents various degrees of integration; in the second, upon the individual, who is qualified by the apprehension of social relations.

The characterization of human groups depends, in large measure, upon the process and the state of polarization or differentiation. Polarization appears both in the congregate and in the assemblage, and in the one-to-one as well as in the one-to-all forms.

The alleged conditions of congregation and of assemblage and of their marks and functions must be concrete empirical conditions and not such abstract social faculties as suggestibility, mob-spirit, and loss of reason. Consciousness in the group is conditioned just as other consciousness is. Its peculiarity lies first in the unique significance or reference or meaning of its social objects; secondly, in the community of intent, purpose, interest and knowledge; and finally, upon singleness and unity in those functions which the group performs. To speak of a group-mind or of a super-consciousness in any other sense is to countenance either an abstraction or a myth.

THE CROWD

BY HELEN CLARK

- I. The problem.
- II. Methods of observation.
- III. Treatment of results.
 - A. Species of crowd.
 - B. The formation of the crowd.
 - C. Structural characteristics of the crowd.
 - D. Spatial and temporal qualifications of the crowd.

Within recent years there have been many studies of the crowd. Although some of these purport to be mental descriptions, most of them have little, if any, psychological value. As is often the case in popular psychology, discussion has centered about the unusual or the abnormal.¹ We find picturesque descriptions of revolutions and of mobs; but we discover few sober analyses of the sorts of crowd that are of common occurrence. Moreover, many of the writers who discuss the mind of the crowd are not psychologists, and they inevitably resort to gross and popular depiction. And finally, where the description of the crowd forms part of a sociological, ethical, or philosophical study, the character of the work as a whole is apt to flavor those portions which are advanced as psychological.

I. THE PROBLEM

The very conception of the psychological problem of the crowd, as it generally appears in social psychologies, is unsatisfactory to science. An opinion not uncommon among philosophers and

¹Le Bon, G., *The crowd, a study of the popular mind*, New York, 1900; *The psychology of revolution* (Trans. by B. Miall), New York, 1913; Ross, E. A., *Foundation of sociology*, New York, 1905, 109-110; *Social psychology, an outline and source book*, New York, 1913, 69-76; Sighele, S., *La foule criminelle, essai de psychologie collective*, Paris, 1901; Tarde, G., *L'opinion et la foule*, Paris, 1904, 159-226.

sociologists is expressed by Durkheim when he says that the social-psychic phenomena which we call "social mind" have "an existence in themselves independent of their individual manifestations."² Sumner admits that "it appears as if there was a 'mind' in the crowd which was different from the minds of the individuals which compose it, . . . as if the crowd had a mystic power in it greater than the sum of the powers of its members."³ These statements seem to imply that the association of individuals gives birth to a new being, an actual external force, a "collective self,"⁴ or "over-soul,"⁵ a gigantic disembodied consciousness of some sort which constrains individuals to act in various ways.⁶ Such a conception may have a certain amount of poetic or practical truth, but it is of little psychological value.

Certain writers, on the other hand, claim that "no 'social mind' exists apart from individual minds,"⁷ that "all purely psychical reciprocal operation comes to its fulfillment in the individual mind alone,"⁸ and that there is no need of a "spiritualistic hypothesis" or the conception of some "imaginary agent" to explain

² Durkheim, E., *Les règles de la méthode sociologique*, 14ième éd., Paris, 1907, 19.

³ Sumner, W. G., *Folkways, a study of the sociological importance of usages, manners, customs, mores, and morals*, Boston, 1913, 19.

⁴ Durkheim, E., *Le suicide, étude de sociologie*, Paris, 1897, 348, 353, 460; *De la division du travail social*, 2ième éd., Paris, 1902, 100.

⁵ "Before Sociology existed, philosophers conceived of psychic units or Oversouls . . . Hegel's historical method posits for each people a certain immanent Idea formative of its history. Such ideology . . . strains the concept of the 'general mind' beyond the breaking point. The philosophical current which led from Hegel had weighty results for social science. Through its effect upon Karl Marx, the modern 'materialistic conception of history,' or, as we may call it, the Sociology of the Economic Motive, has a genetic relation to the great apostle of the Abstract Idea. Modern Sociology has taken its cues from natural science rather than from philosophy, yet its deductive thinkers have not failed to play shuttlecock with the tempting opportunities offered by the 'general mind.'" Davis, M. M., *Psychological interpretations of society* (in *Studies in History, Economics and Public Law*, Columbia University, 1909, no. 2, p. 27.)

⁶ Durkheim, E., *Les règles de la méthode sociologique*, 14, 15, 18.

⁷ Davis, M. M., *op. cit.*, p. 52.

⁸ Paul, H., *Principles of the history of language*, (Trans. by H. A. Strong), New York, 1889, p. xxxvii.

social coöperation.⁹ It is Wundt's opinion that, since the "Volkskörper" can be nothing but the bodies of the individual members, so the "Volksseele" must consist only of the separate minds of these members.¹⁰ Steinthal regards such a point of view as too individualistic. It ignores the psychological unity of society by considering the social whole as atomized into individuals.¹¹

In fact, neither conception is wholly correct. The psychology of the crowd is not a study either of individual minds or of an hypothetical over-soul. The first conception takes no account of the patterning and integration of the individual members: the second misinterprets the meaning of social organization because it makes of it a special kind of existence. The arrangement and interaction of parts, not alone the nature of those parts, gives a piece of machinery its peculiar characteristics. It is not enough to say that protoplasm is compounded of certain chemical elements. Neither is it necessary to introduce the activity of a "vital force." The characteristics of living matter depend upon its peculiar mode of organization and its manner of functioning. A perception is more than its mental elements; not more in the sense that there is an additional something (*e.g.*, a "quality of form"), but in the sense that the elements are integrated, and that the psychological processes involve, not only changes in the elements, but also changes in their organization. In a similar way, the mind of the crowd consists of a number of individual minds which bear to each other certain definable relations, and which exhibit, in their totality, certain unique group-characteristics. It is a necessary preliminary, then, to study the individual members who are the conscious elements of the crowd; but the final goal is the exposition of the patterning of these elements and the statement of the modes of their organization.

II. METHODS OF OBSERVATION

Students of the psychology of the crowd have not always used

⁹ Lewes, G. H., *Problems of life and mind: The foundations of a creed* (first series), Boston, 1874, i, 146.

¹⁰ Wundt, W., *Völkerpsychologie, die Sprache*, Leipzig, 1900, 8.

¹¹ Steinthal, H., *Begriff der Völkerpsychologie* (in *Zsch. f. Völkerpsychol. u. Sprachwissenschaft*), 1887, xvii, 256-64.

the best methods of selecting their materials. Some investigators have turned to literature, especially to historical reminiscence. Such accounts, however, are prone to treat exclusively of the unusual and the extravagant, and so to neglect the commonplace phenomena which first require description. Something is to be gained from casual observation of crowds or from introspection of one's own crowdish consciousness when with one or more companions. It is also possible to experiment with moderately large crowds under fairly uniform conditions, as in class or lecture. If data from a number of such experiments were compared, **certain characteristics** would undoubtedly stand out as **significant**. **Laboratory experiments** which do not require a large number of subjects are by no means out of the question. Under certain conditions, three, or even two, individuals may—for psychological purposes—constitute a crowd. The difference between the conditions of no-one-else-present and of some-other-person-present may be as significant as, if not more significant than, the difference between the presence of one other or of twenty or two-hundred. Even controlled investigations with a single subject are possible. One may observe introspectively the result of a proposal for action made by a group (*e.g.* of church members, neighbors, or associates in a club), and contrast it with the effect produced by the same proposal when made by a single individual.

III. THE TREATMENT OF RESULTS

Even when valuable material is included in discussions of the psychology of the crowd, the general treatment of results is often superficial. It is not enough to cite a number of alleged characteristics of such groups.¹² A complete psychological description should include (a) the peculiarities of different kinds of crowd as contrasted with other social formations, (b) the conditions under which a crowd forms, continues to exist, and finally dissolves, (c) the distinguishing mental characteristics present at each stage, and (d) the modes of patterning of the crowd regarded in its temporal and spatial aspects.

¹² Ross, E. A., *Foundations of sociology*, 102-103; *Social psychology*, 54-56.

A. *Species of Crowd*

Objects or events apprehended by any conscious function may be called social when their meaning implies more than one observer.¹³ A *social group* is any number of persons who are conscious of the same social object or event. If these individuals are congregated (that is, in physical proximity) the group is called a *crowd* or *congregate*; if they are non-congregated it is called an *assemblage*. Congregates, or crowds, may be divided into three classes. The group is an *aggregate* when there is no initial leader, when the members become congregated through the agency of a common social object or event. The *mob* is a crowd in which there is one initial leader and also a number of subsidiary leaders, members of the group who are so quickly and strongly influenced by the principal leader that they, too, exert a comparatively great influence upon the other individuals. In the *audience*, however, the influence of the leader is by far the most important, and the effect of the other members of the crowd upon each other is relatively slight.

B. *The Formation of the Crowd*

In order that any congregated group of persons may become conscious of the same social object or event, two conditions are necessary. The same stimulus or environmental factor must, at a given time, affect the same disposition or tendency in all individuals. The crowdish consciousness is, like thought and action, a determined consciousness. Crowdiness rests upon racial and individual predispositions toward specific organic functions. The sight of the flag, the announcement of election returns, the charge of injustice against the employer, throw into commission certain prepared functions in the nervous system which are responsible—since these prepared functions are common to the members of the group—for the temper and the activities of the crowd. The organic disposition will, of course, differ considerably in strength from individual to individual. The

¹³ A more detailed discussion of this point is given on page 14 of this monograph.

disposition may be innate, as is the tendency to be terrified under certain circumstances, or acquired, as is the tendency to applaud when the national hymn is heard. In the second place, it is also necessary that all persons regard the object or event as social. A specific example may make this clearer. A number of individuals watching a Fourth-of-July celebration constitute the kind of crowd which we have called an aggregate. A certain part of their environment, the fireworks, influences all members. Although the individuals may differ greatly in other respects, they all possess the disposition to attend to, and to be pleased by, brightly colored lights in rapid movement. To each person the display is a social event, although the attribute of socialness may be manifested in different ways. Some may simply apprehend the presence of others. Some may be conscious of their companions' exclamations of delight. Still others may not only experience pleasure themselves, but may infer that the consciousness of their fellows is like their own. Finally, there may be appreciation and sympathy of one member for another. When others act as we act, and toward the same objects, we usually feel that they sympathize with us and approve of our conduct. If these conditions are fulfilled, the crowd continues to exist for a time, and its crowdish characteristics are intensified. As for the dissolution of such a group, we may allege several possible reasons. If the influence of one environmental factor is intense and of long duration, adaptation and shifts of attention occur, and the crowd breaks up. If an appeal is suddenly made to another common organic disposition of the members, the crowd rapidly disintegrates and another crowd of a different character is formed.¹⁴ This occurs, for example, when a dog runs across the rostrum during an interesting lecture. The organization may also be destroyed when strong appeals are made to tendencies not common to all members. Finally, if the object or event loses its social character for a given individual, that individual ceases

¹⁴ An anecdote of the French Revolution describes the rapid formation and dissolution of four crowds, each of a different nature, due to the effect of different environmental factors acting upon different tendencies common to all members. Tarde, G., *L'opinion et la foule*, 183.

to be a member of the crowd. If a party is being conducted through an art gallery, one of its members may become so absorbed in the contemplation of a picture that he is oblivious to the presence of others and no longer thinks of the object as in any way social.

C. *The Structural Characteristics of the Crowd*

When we examine the crowd from a structural point of view, we find that its consciousness and performance have certain peculiar characteristics. In general, there is an intensification and an exaggeration both of organic movements and of mental functions. In any of the three forms of crowd, consciousness may be predominantly emotional, cognitive, or volitional. Aggregates and mobs, however, are apt to be emotional or volitional in character, while in audiences the cognitive phases are usually more prominent. Some emotions, especially fear and sorrow, are produced or intensified by witnessing in others the expressions of like emotions. The instinctive tendency involved in this phenomenon would obviously have evolutionary value. As regards cognitive consciousness, it is evident that we tend to interpret objects as our fellows interpret them, to consider as real what others, by their behavior, seem to recognize as real, and to accept as true the ideas which our companions appear to accept. The basis of this tendency seems to be innate; but it is notably strengthened by experience. The presence of such a disposition would clearly be of benefit to the species. In speaking of volitional aspects of the crowd, we have tried to avoid the use of such indeterminate concepts as suggestion and imitation. In some cases, the copying of actions of other individuals is purely instinctive. We are apt to yawn when our companions yawn, or to take an attentive attitude when they are attentive. At other times, the individuals in the crowd are cognizant of a general need. If the action of some member indicates a way of satisfying this need, and if no better means occurs to the other persons, the latter are apt to copy the behavior of the first individual. When emotional or hysterical states occur, they usually induce a vague eagerness for action of almost any sort. This

nervous energy is directed into specific channels as a result of observing the behavior of a leader or of subsidiary leaders. Contrary to the opinion of several writers, the action of a crowd may involve a certain amount of reasoning. A jury is often crowdish, but we should hardly say that its members are absolutely incapable of rational thought. The emotional, cognitive, and volitional similarities of the members of a crowd may also result, in part, from the belief that one gains the approval of others if one feels, thinks, and acts as they do. The greater the number or the greater the power and prestige of other persons, the more, as a rule, does one seek their approval.¹⁵ Though partially instinctive, this tendency is also the result of experience, since we learn that others have the power to reward or punish us.

D. *The Spatial and Temporal Qualifications of the Crowd*

Few attempts have been made accurately to determine the spatial and temporal configurations of the crowd. Some data concerning these points were obtained from the results of a class-experiment recently conducted at the University of Illinois.¹⁶ This particular crowd would be classed as a mob, since its members were influenced, not only by the leader, but also, to a large extent, by the behavior of especially susceptible individuals. The students were given the impression that the experiment was upon the diffusion of gas, but the liquid really used was water. Each individual was asked to record his seat-number and the time elapsing before he smelled the new odor. Of the 168 men and

¹⁵ Cooley, C. H., *Human nature and the social order*, New York, Chicago, Boston, 1902, 309; McDougall, W., *An introduction to social psychology*, Boston, 1909, 209-227; Ross, E. A., *Social psychology*, 147-194.

¹⁶ A somewhat similar experiment was performed at the University of Wyoming. The report of results is as follows: "In fifteen seconds most of those in the front row had raised their hands, and in forty seconds the 'odor' had spread to the back of the hall, keeping a pretty regular 'wave front' as it passed on. About three-fourths of the audience claimed to perceive the smell, the obstinate minority including more men than the average of the whole. More would probably have succumbed to the suggestion, but at the end of a minute I was obliged to stop the experiment, for some on the front seats were being unpleasantly affected and were about to leave the room." Slosson, E. E., *Psychol. Rev.*, 1899, vi., 407-8.

women present, 33 (about one-fifth) gave positive reports, while of 9 persons tested individually only one thought that he perceived the gas. When Binet questioned children in groups of 3, 4, or 5, they were more easily influenced by hints as to the answers than were other children tested singly.¹⁷ One peculiarity of the mob, then, is its readiness to be influenced by verbal instructions. The results of the Illinois experiment showed, furthermore, that in each of the first 6 rows, more than 2 persons believed that they perceived the odor. Table I shows the shortest and longest time-intervals elapsing between the exposure of the liquid and the moment when the subject reported the perception of a gas. The number at the left end of each line gives the shortest time-interval in seconds, the number at the right gives the longest interval. For example, the first person in the first row who reported the perception of a gas did so 10 seconds after

TABLE I.

The Mode and Rate of Spread of Susceptibility in a Crowd

Rows		
1st	10	45
2nd	15	130
3rd	30	140
4th	40	180
5th	30	155
6th	85	155

the liquid was exposed, while the last person in the first row to give a positive report recorded the time-interval as forty-five seconds. As a second characteristic we might suggest that, instead of proceeding by regular waves, the influence of the leader first affects a number of especially susceptible persons in the

¹⁷ Binet, A., *La suggestibilité*, Paris, 1900, 330-359.

TABLE IV
Spatial Optimum

Number of persons giv- ing positive reports	Rows (counting from right to left: when facing the experimenter)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
					4		4		4							
			2			3		3				3				
	1	1		1							2		3		2	
										1					1	
																0
																1

It would be interesting to attempt a detailed classification of the varieties of crowd, or to describe a specific crowd in accordance with the plan of procedure already suggested. Such analyses, however, are beyond the scope of the present discussion. We have merely outlined a general method of treatment. If investigators were to employ such a method, we believe that an exposition of the psychology of the crowd might analyze and explain the facts without distorting them, and might, moreover, be scientific without seeming artificial.

THE AUDIENCE

BY CHARLES H. WOOLBERT

- I. Conditions of formation: all-to-all relations.
 - A. General dispositions.
 - i. Receptivity.
 - ii. Homogeneity of interest.
 - B. Special dispositions.
 - i. Sophistication.
 - ii. General cortical set.
 - iii. Preliminary tuning.
 - iv. Associative tendencies.
- II. The integrated audience.
 - A. Polarization: all-to-one relations.
 - i. Presence of the speaker.
 - ii. Effects of polarization; removal of inhibitions.
 - iii. Effects of polarization; positive functions.
 - B. Polarization: one-to-all relations.
 - i. The speaker as an object.
 - ii. Ideational meanings.
 - iii. The speaker's relation to the auditors.
- III. Summary.

While much has been written upon the psychology of the crowd, relatively little has been said of that particular kind of crowd which is commonly called the audience. We propose here to distinguish the audience from other sorts and varieties of human collection and to describe it in terms of its unique qualities and characteristics. The type of social group we have in mind is the company that is gathered together in an orderly frame of mind, at a place usually prearranged, with knowledge of the circumstances which have led to its convocation. The social group which we are to discuss is the audience gathered in church, at the town hall during a political campaign, under the Chautauqua tent, in Labor Union Hall, at a Fourth-of-July celebration, in the college chapel, or at the theater. We ask, then, "What characteristic mental phenomena do men exhibit when they come together under such circumstances?"

As a subject of investigation and experiment the audience is

almost virgin soil. However much the lay observer may have speculated concerning the audience and its actions, little has been done to subject this form of congregate to controlled conditions under the methods of the laboratory. As a consequence, what is said about it here must be chiefly based upon fugitive observation and reflection. Psychologists are at present devising ways and means of subjecting the audience to control and observation, and some day it will be treated experimentally; but for the present the best we can do is to describe what we casually know of it in psychological terms and from a psychological point of view.

An audience does not exist simply because one man is speaking to others. Ten men engaged in a colloquy, each contributing his part to the conversation, interrupting when the spirit moves or a lull in the conversation permits, hardly constitute an audience, even though at times one man may 'secure the floor' and draw all eyes in his direction. A company gathered around a table in oral dialectic may cease all other activities to listen to one person; but this does not necessarily make of them an audience, as we propose to use the term. The essential condition is an attitude on the part of the listener that causes him to set off the speaker as not of his 'situation.' To make an audience, there must be "polarization," the setting opposite of two objects. This it is that makes of a group an audience. Typically the audience and the speaker face in opposite directions: their minds take different bents: they are moving in opposing channels. Even though they may be strongly of "one mind" on some points, the very nature of the conditions is such as to place them at opposite poles.

In the psychological study of the audience we have to consider four kinds of relationship: (1) that of the whole group to itself,—the "all-to-all"; (2) that of the group to the speaker or performer,—the "all-to-one"; (3) that of the speaker or performer to the group before him,—the "one-to-all"; and (4) that of the speaker to each individual in the audience,—the "one-to-one" relations.

I. CONDITIONS OF FORMATION OF THE AUDIENCE: ALL-TO-ALL RELATIONS

In the study of congregated crowds the audience's apprehension of itself is a primary consideration. The set of mind in which people come together to hear a speaker or to witness a play very largely determines their behavior when the process of polarization intervenes. Most audiences gather under circumstances which are definitely determinable. Let us cite the most important. We can include them all under the general name disposition, of which we must recognize two main types; the general set of the persons who make up the audience, and a specific set that pertains to the particular occasion.

A. *General Dispositions*

i. *Receptivity.* The first consideration that affects the character of the audience is what may be called 'mental inertia.' Ordinarily men meet together in a yielding frame of mind. It is the exceptional instance when people gather in a public place with their backs bristling. They come to listen and to enjoy, to learn and to be inspired; and they willingly lay the burden of responsibility on the speaker or the actor. It is considered socially 'proper' to be amiable and yielding. Thus the polarizing power of the speaker is aided by the receptive attitude of the audience. It takes energy to oppose. Men have to be schooled to hesitate and to doubt; and when they do hesitate and doubt, there is always a special reason. The fixed tendency is to receive willingly and without opposition.

This acquiescing tendency, or "primitive credulity,"¹ as it has been called, is one of the surest aids to the speaker in causing the audience to form. A vast majority of the members in a congregate give themselves without reserve to the object of their attention,—that is to say, to the speaker. They are his to take, if he knows how to take them. They have come in an expectant frame of mind; their attitude toward the speaker is, at the least, one of tolerant respect, and they make it easy for

¹ Bain, A., *The Emotions and the Will*, 1876, p. 511.

him to control their mental processes once he gets their attention.

ii. *Homogeneity of Interest.* The second of the factors making for a general predisposition in an audience is similarity of habitual act and thought. Certain groups give allegiance to specific customs, taboos, rituals, ceremonies, traditions, and beliefs. All of these social factors rest on similarity of function and likeness of tradition. Units of the same cult or institution—church, lodge, political party, labor-union, neighborhood—have inclinations toward certain ways of thinking that make them easily consociated. They react to the same ideas, concepts, and beliefs. They do things according to the same ritual and ceremony. Their emotions can be reached by the same objects and in the same sequence. They notice and ignore the same sights and sounds. Their foreground processes wear a common aspect. Any social factor that tends to unite a human group in every-day life makes of it an especially homogeneous audience and also impresses upon its members a fixed disposition toward subsequent union.

B. *Special Dispositions*

i. *Sophistication.* According as we are or are not habituated to congregating we bring to the congregate dispositions that affect materially the experience we undergo. Persons who are accustomed to attend meetings get into habits of behavior that are quite different from the habits of those who congregate but seldom. The city-bred are usually 'audience-trained,' especially those who haunt the theaters and the picture-shows. They applaud more freely and from much more obvious incentives than does the countryman. They have a way of following more slavishly certain traditions of the audience. They are sophisticated. They know just what to do when the flag is flashed upon the screen; how to greet the national anthem; how to react at the mention of a political favorite or a pet fallacy. Aristocrats of one kind and another, especially academic and moneyed, are more reserved in their responses. Members of deliberative bodies feel the necessity of proving that they are deliberate; the voting delegates at a convention can be stampeded much less easily than

the non-voting galleries. Regular attendants upon the services of the church come to meeting with an entirely different set of mind from those who attend only by exception. Repetition of the congregating experience is important, then, in fixing the temper of mind under which the audience gathers; for it sets up habitual tendencies (p. 10, above) which play their part in the social significance of our kind of congregate.

ii. *General Cortical Set.* When an audience comes together with definite intentions and expectations, the pattern of perception and feeling is already determined. When we know that we are to listen to a political speech, our set differs from the set under which we hear a university lecturer discoursing on political science; and the difference is still greater between the tuning for a political meeting and for a religious service, for a gathering of farmers and the convocation of a collegiate faculty. Once we are prepared for a given occasion, we are easily integrated, provided only the occasion yields what we expect.

iii. *Preliminary Tuning.* After the audience is assembled it is influenced in its thinking and behavior by the immediate surroundings. The sights, sounds, smells and temperature of a public hall add to the individual's predisposition to become a part of the audience. The perception of a platform, a pulpit, or a proscenium brings a sense of being-in-a-public-place-in-the-sight-of-others. The pews, the hard chairs or the theater seats add an effect of their own; "storied windows," "dim religious light," music, the bustle of fellow-members moving to their places, the presence of judge and court-officers, the heat of the tent and the smell of crushed grass, the pressure of narrow quarters;—all these things tend to add to the individual's realization that he is 'out among others.'

Again, when the individual perceives that he is among friends, his behavior is appropriately affected; when he is among strangers, it is different. It is, we may suppose, for this reason that urban audiences are more demonstrative than rustic audiences. The former feel no restraint in the presence of a company made up largely of strangers; while the man in the rural audience ordinarily can call everyone present by name, and he is influenced

accordingly. We are chary of displaying our emotions and impulsive acts to those whom we expect to encounter on the morrow.

Once more, the size of the audience plays a part in determining the disposition with which its members listen. The greater the number of persons present, the greater the likelihood that they will represent conflicting customs, inhibitions, and modes of acting. The smaller the group, the more likely are they to represent some common interest growing out of social homogeneity. Men in large groups feel that there must be present a large diversity of opinion and purpose. Men in small groups are likely to infer a basis of unity or actually to apprehend it.

iv. *Associative Tendencies.*² A special agent in affecting an audience actually congregated is found in the trains of association that may at any time, through chance or circumstance, focus the attention of a group upon a given set of objects. During a religious revival the congregation holds in readiness a set of associative tendencies quite different from that possessed by the same group at other times. When the political campaign is at white heat, the crowd at the rally possesses a different set from the same company gathered in the Chautauqua tent when political issues are not in the air. Crises likewise dominate the perceptual attention: they force their way into the foreground of everyone's thinking. A catastrophe, a horrible crime, a political victory, a scandal, a national holiday, or a long-looked-for event brings men together primed in a way quite different from ordinary occasions.

II. THE INTEGRATED AUDIENCE

Thus we have found several factors that prepare the minds of the audience before they are affected by the speaker. Let us note the first effects of these predispositions,—the 'frame of mind'

²"Anything that makes for the impression of two stimuli, during the conscious present, will also serve to establish an associative tendency between them; so that the recurrence of the one, whether as perception or idea, will be likely to arouse the idea of the other." Titchener, E. B., *A text book of psychology*, 1909, 384-5.

that is induced by them. The various sets when brought into contact with the objects perceivable in the congregation create a social significance, chiefly a knowledge of the presence of others. When we sit in our pew or seat, both the foreground and the background of consciousness are occupied by processes that are efficient in providing acceptable social behavior,—conduct that will bear the inspection of others. This means that the processes dominant are those that condition the social factors of custom and taboo. The taboos are especially important. Their principal function in every-day life is to furnish the individual with a body of inhibitions. These inhibitions protect him against behavior that might be looked upon as socially unacceptable. The individual believes that, without these inhibitions, he does not appear to advantage in the presence of his kind. These restraining impulses are the most characteristic manifestation of his psychophysical set when he finds himself to be a part of a congregate. Thus the attention of the individual member of the group is directed outward toward other members. His foreground processes are taken up with perceptions and emotions relating to those around him. The situation can be represented by the following figure (1):

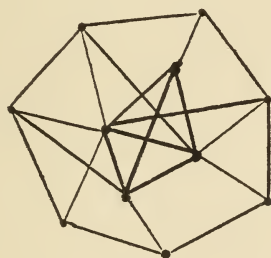


FIG. 1

To appreciate the social temper of the audience, it should be contrasted with the temper of the individual as we find him relatively free from the influence of the congregate. Every-day, unconggregated behavior is chiefly actuated by a few fundamental instincts. It is conditioned by impulses toward self-protection, self-aggrandizement, physical repulsion and attraction, revenge, helpfulness, and tender feeling. We are speaking now of the

individual when he is relatively free from social pressure, when social restraint is at a minimum. Under such circumstances, his characteristic attitude is much the same, no matter what his social position and irrespective of 'social' sets and tendencies. He wants to live on in the world, to be prosperous, to get away from the unpleasant, to take to himself what he likes, to put down his enemies, and to care for dependents. These are among the forms of behavior that most characteristically excite the emotions and dominate the activities of the uncongregated individual man; and it is well to note that actions released by these impulses are, in general, more aggressive, more vigorous, and often more sudden than those which grow from more highly socialized impulses.

A. *Polarization: The All-to-one Relations*

i. *The Presence of the Speaker.* We come now to the next stage in the experience of the audience. The members have gathered; and they are attuned by a wide variety of general and special dispositions. They are ready for something to happen. They await the speaker. They are primed for his coming. He enters: he becomes the object of attention: all eyes are directed toward him as he takes his place. Polarization has begun, though his mere presence is not sufficient to break the social connections that were laid before he appeared. The individual members are therefore still alert to the social significance of their surroundings.

Next, the speaker rises and begins his address. A change comes over the auditors. Polarization proceeds. The new relations may be represented by the following figure (Fig. 2), in which the long lines represent the individuals' apprehension of the speaker. Note that the interconnecting lines are still present, though they are lighter than in Figure 1. This means that the social objects are less vivid and significant than they were before the object on the platform caught the eye.

ii. *Effects of Polarization: The Removal of Inhibitions.* When polarization is complete and the art of the speaker at its highest level of effectiveness, the field of attention is narrowed and the processes in the foreground become very important for

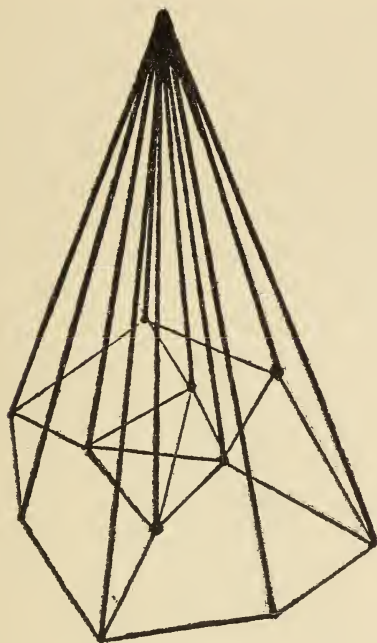


FIG. 2.

the direction of thought and conduct. At the same time, the processes in the background drop out of function. Applied to the audience, then, this means that the speaker's thought, with its attendant motivation, occupies the field. The concentration of the auditor may even approach the state of hypnosis. The sharper and the clearer the concentration, the more is the audience relieved of the inhibiting processes that were represented in the foreground before polarization began. And the first inhibition to go is—as a rule—that of the desire to appear socially 'proper.' When the hearer is lost in the words of the speaker, propriety is a matter of remote concern. Now when the credulous temper, the appropriate surroundings, and the speaker's message are rightly coordinated and harmonized, there is no limit to the distance to which inhibitions may be driven, and no practical bound to the extremities to which the individual can be induced to go in following his more asocial impulses. Mobs can be induced to "seek, burn, fire, kill, slay," although the indi-

viduals in them, when aware of social surveillance (and in this we may include men's belief in an all-seeing eye), would be very unwilling to act a part, however earnestly they might wish to. The impulse hidden within is brought to the surface; the shell of social habit gives way for the expanding tissue of instinctive impulse; the socially-hardened crust is broken by the eruption of inner fires, long ago kindled in the race.

When this loss of 'social' inhibitions occurs, the figure changes to the following (3) :

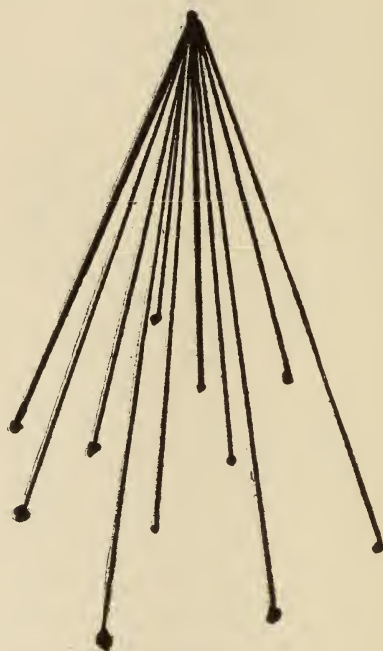


FIG. 3

Here the inhibitions are gone; attention is at high focus on the speaker and on what he is saying. The speaker has entered in reality into a one-to-one relation with the individuals before him. According to his skill in holding them is his power to prevent the inhibitions from coming back. If he loses his grip, the audience reverts to a state indicated in Figure 2. An inapt remark will bring about this result, or monotony of utterance, or a sudden interruption,—anything, in fact, which distracts attention

from the speaker's thought. Where the speaker is effective, he dominates the mental functions, leading his auditors into new paths of thought, stirring in them a variety of feelings, and arousing, at will, emotional and volitional impulses. But where the occasion and the speech are of such a nature as to enable the audience to retain its social armor, social inhibitions will play their part in action. Church meetings, gatherings on academic occasions, lectures before the community's "best people," seldom call for outbursts which shock the sensibilities. On such occasions the crust usually holds. But an appropriate speech delivered to an audience not so effectively armored, causes the shell to give way to the concealed impulses. On such occasions it is that conduct becomes crowdish and that the mob rules. Social conventions are forgotten. The fear of social ostracism or taboo is removed. Men in such a condition are not concerned whether or not they are social conformists. The idea of being a pariah has no fears for them; for social consequences do not enter into their thinking.

Men who are reserved under social inhibitions may be made to reveal an inherent coarseness when these social inhibitions are removed. Women who conceal their emotions when they realize that others are looking on, break into hysterical weeping or rage once they forget that they are the observed of observers. The man who says in his own mind—where no one else can hear him—that the objects of the mob's hatred ought to be 'strung up,' is just the man to take hold of the rope when he is made oblivious to social consequences.

From this point of view, then, crowdishness is in reality based upon isolation, not combination; upon freedom from the presence of others, not subjection to the will of the mass; it is a finding of the self apart from the rest, not a loss of self in a supposed crowd-personality.

iii. *Effect of polarization: positive functions.* Our doctrine of social release may be made to square with the observations of common sense by observing the different functions which an audience may be made to fulfill. We sometimes make the mistake of assuming that all audiences are gathered for one and the same

purpose. But the tasks of the audience are really three; (1) to comprehend, (2) to act, and (3) to think.

Most audiences are concerned with comprehension: most public speaking is of an informative nature. It is thus of a type that permits the background of consciousness to remain in effective operation. The inhibitions, therefore, which custom and social fear impose, remain in commission during an address which simply aims to clarify ideas. The audience that is polarized for this kind of appeal is in little danger of committing those acts which we designate as "displays of mob-spirit." Their crowdishness still allows them to keep pretty close to proper social behavior. (*Cf.* Fig. 2.)

The audience made to act, on the other hand, either emotionally or with selective movement, is further removed from its restraints. Such audiences do those untoward acts that we call unnatural, uncontrolled, reversions to savagery. It is the performances of the executively-functioning audience that are supposed to exhibit that hazy and mythical something we call the "crowd-mind," the "spirit of the mob." This type of audience is merely in the state represented in Fig. 3.

The third type of audience is functioning elaboratively,—thinking its way through a problem. Such an audience—when it really fulfills the conditions—has practically no concern for social restraints. Very few congregates actually get to this point, for the reason that seldom can a group be made to do real and sustained thinking. Only small groups, and those rather homogeneous, can be made to think. Representative types are the jury that really tries to solve its problem, and the class or seminary made up of trained students. This kind of audience, when it is thoroughly absorbed, can be represented by Fig. 4.

In its extreme form, this type of audience has pushed inhibitions so far into the background that in reality there is no audience left. What we have is merely so many individuals pursuing their independent ways. When a student in the class-room becomes really absorbed in the problem in hand, he is likely to slip down on his shoulder blades, spread his feet, ruffle his hair, and do any number of other unconventional deeds. Let the spell



FIG. 4

be broken, and up he sits, rearranges his clothes, and again becomes socially proper. His inhibitions come back into function. It is from this type of congregate that we get our reformers, our dissenters, our bolters. Having worked their way through a problem, they have no concern for what society thinks about them. It is worthy of note, also, that decisions made under such circumstances are more likely to last than those arising from comprehension or execution only.

The instances where social inhibitions are entirely removed are so rare that in most congregated actions we can trace the influence of objects of social significance. Especially are these effective in determining the mind of the audience when clear objects are discernible in the congregate itself. The sound of other persons laughing, the sight of men who look angry, the perception of handkerchiefs dabbing at red eyes, snuffing and sobbing, muttered ejaculations, sounds that represent protest,—all these add to the response which the individual gives to the speaker. When these perceptions are in harmony with the auditor's own thought processes and emotions, as induced by the speaker, they add to the tendency to function as the speaker desires. In this way, visual and auditory stimuli from other members of the congregate are added to those from the speaker. Accordingly, we may say that under such circumstances auditor and speaker are one, for they merge, they cooperate to influence the individual members of the congregation. While this condition prevails, polari-

zation is not complete; though the speaker may be very much the clearest object present.

So we may note, by way of summary, that no matter what the type of audience and no matter what kind of appeal the speaker makes to it, manifestations of crowdishness can be explained in terms of the presence or absence of those inhibitions which serve to protect the individual from being socially noticed and which help him to lose himself in the mass.

B. *Polarization: The One-to-all Relations*

i. *The Speaker as an Object.* When the speaker becomes the object of polarized attention, whatever he does has significance for the beholder and the listener. How he looks, what he does, how he sounds, and what he says, have meaning. Whatever effect he produces upon the auditors is the result of visual and auditory stimuli which are significant to the members. So that a discussion of the speaker's relation to the auditors necessarily touches upon a consideration of the relation of these stimuli to the meanings which the speaker bears.

As a visual object, the speaker begins to carry meaning the moment he appears. First, his personal appearance affects those before him. If he is tall and straight, his influence is different from that of the speaker short and bent; if he is rotund, he impresses men in one way; if slender, in another; the man with a Jovian-brow and an Apollo-like carriage means a thing quite different from the man whose head is small and who stands like a frightened fawn. Then his clothes also mean; the well-groomed man means one thing to an audience; the unkempt, unbrushed man means something quite different. The manner of dressing the hair, even the possession or lack of hair, the way of looking at the audience, the speaker's stride, his manner of taking his seat, of switching his coat-tails, of using his handkerchief—all these visually apprehended details have significance for the observer.

When the speaker raises his voice, the audience's interpretation of his visual appearance is likely to move somewhat into the background; though the way he 'takes the floor' after the intro-

duction or the opening remarks, still keeps the focus upon what is seen. Once his voice disturbs the hearers' ears with sound-waves, the auditors begin to place new estimates upon the object before them. Every sound he makes means; it means either what the speaker intends or something else; in any case, it is significant. The art of the speaker is so to control his voice and his vocal mechanism that what he says means what he intends.

Once the speaker is launched into his address, he mingles visual and auditory objects in about equal proportions. Continually he is giving the listeners sights and sounds to interpret, and the members have no alternative but to make interpretations of one kind or another. Everything the speaker does by way of posture, action, or facial expression is immediately given definite meaning. Every inflection of his voice, the volume and the rate of flow of words, phrases, and sentences affect the auditors' interpretation of what he represents. All these factors lead the auditors to place interpretations upon the object before them, and the object before them is, in large measure, a *social* object.

ii. *Ideational Meanings.* So much for the meanings that depend more or less directly upon visual and auditory stimuli. Let us go on to a consideration of the meanings that arise from the words that the speaker is using.³ When the speaker so uses his vocal organs as to carry what are to him verbal meanings, the hearers attach to his words—rather, to the auditory sensations received—such meanings as their psychophysical set or predispo-

³ The mistake is often made, especially in textbooks on rhetoric, of limiting the speaker's influence to this factor only; on the assumption that it is the speaker's ideas that count, not his manner. But a little reflection will show that there is no such thing as a speaker's ideas dissociated from his voice and physical action. Always the idea behind the voice and manner is conditioned by the physical objects of sight and hearing. One has only to study the effect of a well-staged and properly acted picture-drama to see the power of action to carry meaning and to impart ideas. Again, texts on oral expression and elocution do not pay sufficient attention to the importance of bodily action in carrying meaning to the observer. The only way an idea can get from the speaker to the hearer is by means of visual and auditory stimuli, and there is more meaning carried by what the eye sees than we commonly think.

sition compels them to attach. When the speaker is using words in a way that conforms to custom and to habitual usage, including his way of pronouncing and enunciating them, he may carry to all his hearers 'standard' meanings. If he departs from the normal or fails in his enunciation or if he uses unaccepted pronunciation, he carries only unintended meanings, or even makes it impossible for the auditors to grasp any meaning whatever. In the main, it is the full sentence expressing a judgment by which the speaker holds the attention of his hearers. He gets attention to his judgment by the right choice of ideas, images, and concepts, by the right choice of words, and by the right use of voice and bodily action. Thus by the proper choice of processes in his own mind, by the right choice of symbols in which to express them, and by the right use of stimuli to interpret them, he can be properly meaningful to his auditors.

We say that it is the speaker's mission to carry thought. But there is, in reality, no such thing as "carrying thought." Positively nothing goes from the person on the platform to the man in the seat but sound-waves and light-waves, which are the ultimate vehicles of meaning. Meaning is the only thing in any sense "carried." Not only is it true that every movement and every sound has meaning, but, once the speech is launched, lack of movement and silences also have meaning. So that from any point of view the speaker becomes meaningful once he takes the platform in the eyes of the congregated body.

iii. *The Speaker's Relation to the Auditors.* The speaker standing before his listeners represents purpose. What he contributes to the occasion is the idea of an end which he wishes to see advanced. On no other pretense has a man a right to come before others and to demand their attention. His problem is to convey this idea to his hearers with the accompaniment of the right feeling-tone. To this end, he must so combine, fuse, and integrate his meanings as to bring the idea into the foreground. The speaker's responsibility to his auditors is to make them (1) see a point, an explanation, or an illustration; (2) give some physical reaction to what he says; or (3) work their way through a problem, to solve a difficulty. The first kind gives us

the didactic, the expository, the descriptive address which aims chiefly to inform. The second type gives us the impressive, the stirring, the persuasive, the arousing speech,—designed to animate and to agitate, either emotionally or through overt performance. The third type is the argumentative address, which aims to set forth ideas in such a way as to make the hearer connect and relate them together in a new conclusion. Any appeal that influences an audience can be somewhere classified under these main rubrics. The speaker can take advantage of the dispositions of his auditors and he can polarize them effectively only as he appreciates which of these ends best fits the particular occasion.⁴

III. SUMMARY

The audience is a social congregate of the polarized kind. Its integration implies (i) a special priming or preparation of its members, and (ii) the establishment of certain relations between and among the members when prepared.

(i) Like the action- and the thought-complexes, the audience is *determined*. Determination or preparation rests upon *dispositions* or *tendencies* (*cf. sup.* "A preface to social psychology," p. 10), which are in part racial and in part of ontogenetic origin. These dispositions may be distinguished by the terms *receptivity*, *homogeneity of interest*, *sophistication*, *general cortical set*, *preliminary tuning*, and *associative tendency*.

(ii) The specific relations of the audience derive, on the one side, from preparation or determination, and, on the other, from the presence and functions of a speaker or actor. The process of polarizing integration involves (I) the establishment of rela-

⁴From this study certain problems suggest themselves for investigation and for laboratory treatment. A few are appended here by way of suggesting a wide field for research. 1. The effect of distance of the speaker from the mass. 2. The spatial configuration of the mass. 3. The comfort of the audience. 4. The effect of different kinds of material for visual perception. 5. The feeling tone of halls and churches. 6. The size of the auditorium relatively to the audience. 7. Acoustics and polarization. 8. Traditions of halls and their effect upon the set of the audience. 9. The effects of variation in pitch, rate, force, and quality of voice. 10. The effects produced by varying the ratio of gesture to action.

tions (a) among the mass (see Figure 1), (b) between the auditors, or secondary pole, and the speaker, or primary pole (Figure 2); and (2) the partial or total dissolution of the (a)-relations under the process of de-socialization of the mass (Figure 3). In some (elaborative or thinking) audiences, there appears also a dissolution of the (b)-relations, which leads to a breaking up of the congregate (Figure 4).

Violent and excessive performances of the audience, commonly referred to a social "mob-spirit" or "crowd-mind" are, on the contrary, to be chiefly referred to the dissolution of the "social" (a)-bonds within the mass. The effect of this dissolution is a release of inhibitions which permits old and deeply rooted desires and impulses, of an asocial kind, to usurp the psychophysical organism.

Over and above the dispositions, the integration and the endurance of the audience rest upon a vast congeries of stimulus-factors which underlie the mass's social apprehension of itself, of the speaker, and of the speaker's message.

SENSATION AND ITS PHYSIOLOGICAL CONDITIONS

By CARL RAHN

- I. Sensation and stimulus.
- II. Sensation and central neural process.
- III. Sensation and efferent neural process.
- IV. Sensation and sub-cortical process.
- V. Conclusion and summary.

The modern sensation as the psychical correlate of the process of stimulation of organs of sense might be traced from Plato's *αἰσθητόν*, through Locke's 'impressions' and Kant's 'phenomena,' to the fixing of the conception in the earlier experimental investigations of Weber and Fechner. The purpose of the present paper is briefly to trace this development, and then to point out some of the factors that are at the present time modifying or enriching our conception of the physical and physiological correlates of sensory consciousness.

I. SENSATION AND STIMULUS

Let us consider, first, the sensation that is the psychical correlate of stimulus.

Woodworth¹ tells us that "sensation is that conscious content which is in closest relation to the physical stimulus." And Watt² writes as follows: "We have sufficient security, if we find a means of pointing out to each other what of the whole mass of experiences we call sensation and intend to study. That means we find in the sense-organ and in its stimulation. We may accordingly define sensation as the simplest parts or elements of those experiences that are immediately dependent upon the stimulation of a sense-organ. Such a definition accords well with the practice of an experimental science."—These statements are taken from two recent papers growing out of two very different endeavors,—the one a "revision" of imageless thought, the other a

¹ Woodworth, R. S., *Psychol. Rev.*, 1905, xxii, 2.

² Watt, H. J., *Brit. Journ. of Psychol.*, 1911, iv, 131.

re-definition of sensation; the one favoring the postulation of a category of non-sensory content, the other trusting chiefly to a reconsideration of the nature of sensory experience itself. This reference to stimulus as a factor in the definition would appear, therefore, to be of some significance since it is the only common element which is to be found in these unlike attempts at a statement of psychological problems in which the category of sensation is involved.

Historical antecedents of this correlation are to be found in Locke's conception of 'impressions' made upon the *tabula rasa* of mind as a result of the action of 'foreign things' upon the sense-organs, and in the Kantian phenomena that are induced by the action of the *Ding-an-sich*. . . . It is significant to note that while in Locke's mind the original problem appears to have been: "How do the 'ideas' that we find in our minds have their rise?", *i.e.*, a *Fragestellung* essentially genetic, it soon takes on an analytic turn both in Locke and in the empiricists after him. It becomes: "Of what are our 'ideas' composed?" We incline to the interpretation that Locke's *dictum* that all our 'ideas' come through 'sensation', originally had this genetic significance for him, when we bear in mind that he was particularly bent on laying low the hobgoblin of the doctrine of innate ideas. His was a quest after the origin of our ideas. . . . Locke finds that it is only through experience that the mind is furnished with the 'ideas of sensation.' Then, having gotten these, the mind elaborates them, and we have the rise of the 'compound ideas.' Finally, the mind looks inward upon itself and notes that it thus elaborates these ideas gotten from sense, and we have other ideas of a somewhat different sort, 'ideas of reflection,' *i.e.*, ideas of psychical processes. Such new ideas are our concepts of 'thinking,' 'recognition,' 'attention,' 'willing,' 'memory,' etc. These are not 'innate ideas,' for they too arise through experience that has its original impetus in the impact of outer things upon the sense-organs. The account is still genetic in character. But in tracing the genesis of the compound ideas Locke necessarily refers to the 'simple ideas' of sensation, and at this point the account tends to become analytic. . . . The elements in his treat-

ment that seem to have become the important factors for later development of psychological categories, appear to be (1) just this analytic turn in his method at this point and (2) the conception of point to point correspondence between the 'foreign things' and the 'impression' upon the *tabula rasa*. And while Locke's purpose was epistemological, and while this correspondence which he sought to establish between the action of 'foreign things' upon the sense-organ, on the one hand, and the content of consciousness, upon the other, might therefore be called an epistemological psychophysical correlation, he may, nevertheless, be looked upon, historically, as being responsible for the impetus given to an empirical account of consciousness that is to be arrived at by a structural analysis and by the correlation of the precipitates of the analysis with the objective stimuli in the physical environment.

Beginning with Hume, empiricists after Locke refined upon the concept of sensation as a psychological category and came eventually to define it as an elementary ultimate constituent of consciousness. In tracing the development from Locke's 'copy theory' of sensation, so much emphasized by his critics, we find that it becomes definitely 'static' when it appears in the philosophic systems of the German idealists who, following Kant, take all the 'life' out of it when they place it over against the dynamic aspects of mind.³ This Kantian influence upon the content of our conception of sensation is manifest in those definitions of sensation which deny 'meaning' to it, and in those which in some way imply an abstraction from 'dynamic' aspects of mind, for meaning is the mark of the dynamic category of the 'understanding' in the Kantian duality. But more important for our present purposes is Kant's emphasis upon the point that the phenomena are in some way more closely correlated with the *Ding-an-sich*. In this, as in Locke's conception of 'impressions,' we have a forerunner of the sensation that is defined by Woodworth and Watt by means of a reference to stimulation of sense-organs. It is a conception that is basic both to Lockeian

³ Cf. Rahn, C., The relation of sensation to other categories in contemporary psychology; *Psychol. Monog.*, 1913, xvi (No. 67), 67-68, 108-110.

sensationalism and to Kantian idealism, and is indicative of the common origin of both these branches of modern philosophy in the Platonic conception of mind.

Further development toward the conception of mental elements that are in some way correlated with the non-psychical 'stimulus' is favored by the earlier endeavors in experimental research in psychological problems. Physical science had its atom, and the scientist entering psychology carries old concepts and old habits over into the new field. Fechner's conception of measurement required static units both of the mental and of the physical for a statement of psychophysical correlations. Weber's pioneer work in physiological psychology aimed at a statement of fixed psychophysiological correlations in which differences in mental elements meant parallel differences in the anatomical bases of physiological processes. After Weber one sought to discover the number of elementary qualities. With quality as the basic attribute of the element, other attributes, such as intensity and duration are assigned to it, and it is in terms of these attributes that the element comes to be defined. The physical, physiological, and neurological correlates of these attributes were then to be determined. This fixing of special end-organs as correlates of specific sensory quales and the mapping out of cerebral sensory projection-areas, and the tracing of paths from end-organ to cortex,—this whole movement finds its most characteristic expression in Müller's formulation of the doctrine of specific energy. . . . These early empirical investigations fall readily under the conception of sensation as laid down in the idealistic as well as in the sensationalistic branches of modern philosophy; a conception of atomic sensory elements, dependent upon, or correlated with, the process of stimulation,—however much the meaning of "stimulus" might vary from time to time, signifying at one time the physical process that adequately calls out activity in the peripheral end-organ, at another time the excitation of the neural pathway leading to the cerebral sensory projection-area, and at still another time involving even 'nervous predisposition' as one of the 'conditions of a powerful impression of the nervous system.'⁴

⁴ Cf. Titchener, E.B., *Lectures on the Elementary Psychology of Feeling*

II. SENSATION AND CENTRAL NEURAL PROCESS

But if the early history of experimental psychology was such as to favor the development of the conception of sensation that we have just traced, it does not necessarily preclude a modification of that conception under the influence of other interests. Physics, physiology and biology did not rest content with atomic and structural categories, but have been indefatigable in working out other conceptions and modifying the old in the light of new facts and new interests. So, too, psychology,—for latterly problems of mind have come to be envisaged in new ways, and factors in consciousness have come to be pointed out which cannot always be satisfactorily correlated with ‘stimulus.’ In later development, the conception of sensation undergoes modification chiefly under the influence of two different interests, the one an interest in the relation of sensation to an ‘apperceptive’ or ‘central’ factor, the other an interest in its relation to a ‘conative’ or ‘efferent’ factor.

The first of these developments, *viz.*, the conception of sensation as dependent upon ‘central’ or ‘apperceptive’ factors, we have elsewhere traced at greater length.⁵ Historically, it is closely related to the problem of conscious meaning,—the problem of ‘cognition’ of an older psychology. In this development we find two modes of procedure. On the one hand,⁶ Woodworth, Bühler, Ogden and others, coming upon the fact of meaning and thought in consciousness, affirm that ‘thinking’ is not a ponderous presentation of peripherally and centrally aroused sensations, with

and Attention, 1908. Titchener points out that in the enumeration of the conditions of sensory clearness, “we began our list naturally enough, with a reference to the attributes and elementary relations of stimulus. It is clear, however, that we are breaking away from stimulus” (p. 194). In the end, however, he relates even nervous predisposition in some way to stimulus by subsuming nervous predisposition and the usual attributes of stimulus under a common head, *viz.*, “conditions of a powerful impression of the nervous system” (p. 204). And finally he tells us that “the ultimate condition of clearness at large—may be designated as nervous predisposition, predisposition of the nervous system and its sensory attachment.”

⁵ Rahn, C., *op. cit.*

⁶ Woodworth, R. S., *op. cit.*: Bühler, K., *Arch. f. d. ges. Psychol.*, 1907, ix, 316; Ogden, R. M., *An Introduction to General Psychology*, 1914, 88.

their inseparable attributes, but that the essential nature even of perceptual consciousness is rather a non-sensory somewhat that is *sui generis*,—for which Woodworth even suggests a new class-term such as ‘kulp’ on the ground that “the ‘thoughts’ were gradually brought to light by the school of which Külpe was the guiding spirit.”⁷

On the other hand, we find Watt⁸ attempting to approach anew the problem of an adequate description of consciousness, not by developing new non-sensory categories and placing these alongside that of sensation, in order to do justice to the fact of conscious meaning, but by attempting a redefinition of sensation as a category of the conscious, and making a beginning—tentative, to be sure, but disclosing exquisite psychological analysis and originality in approach to problems—at a description of conscious complexes in terms of integrations of the attributive aspects of sensation. In this Watt is, perhaps, following a clue given by Külpe⁹ at a somewhat earlier date—in which he came to the conclusion that the historic sensation, as hitherto defined by psychology, need not appear with all its traditionally inseparable attributes in the actual conscious pulse, but that certain of these may be abstracted from. According to Külpe sensory consciousness, or, as he puts it, ‘consciousness of sensation,’ is dependent not merely upon the ‘sensation’ (in physiological terms we take this to mean stimulation of end-organ and activity of afferent pathway to sensory projection-area of cortex) but also upon ‘apperceptive’ or central factors under the influence of the *Aufgabe*. As in Watt and Külpe, we find also in Aveling’s¹⁰ careful study a similar emphasis upon the factor of variability in the relative importance of the different attributes of sensation for the conscious moment. . . . There are differences, to be sure, in the standpoints of these writers, due to differences in approach

⁷ Woodworth, R. S., *op. cit.*, II. It may interest the reader to refer to Binet’s modest and dignified claim to priority in this matter in *L’année psychologique*, 1911, xvii, 6.

⁸ Watt, H. J., *Brit. Jour. of Psychol.*, 1911, iv, 129-203.

⁹ Külpe, O., *Versuche über Abstraktion, Ber. I. Kongress f. exper. Psychol.*, 1904, 56-58.

¹⁰ Aveling, F., *Brit. Jour. of Psychol.*, 1911, iv, 211-227.

to the problem, but they have this in common: while nothing is more remote from their respective points of view than an interest in the 'biological function' that sensation may serve, they all emphasize the fact that the actual character of the sensation as conscious experience—regarded, in the terms of Titchener, 'existentially'—is conceived to vary in some manner with conditions under which the given sensation occurs in consciousness. Not only does sensation undergo characteristic modifications with respect to its attributes in their dependence upon stimulus, but also with respect to their dependence upon such items as 'apperceptive factors,' 'integrative bases,' or attentional emphasis.

Thus we note (a) that in connection with the problem of cognition the fact of meaning has at times been abstracted from sensation and hypostatized as a 'thought element' that is the correlate of some central process, leaving sensation as the correlate of 'stimulus,' and (b) that at other times there has been an attempt to proceed otherwise by modifying the status and content of sensation and making the quale of sensory consciousness dependent in part upon modifications of stimulus and in part upon central factors.

III. SENSATION AND EFFERENT NEURAL PROCESS

A further development affecting the content and status of sensation is the rise of the problem of its relation to motor response. . . . When the Golgi method made possible the formulation of the neuron-theory, a decided impetus was given to the physiological study of those neuron systems that are the mechanisms of reactions to stimuli. Without going into its history we would mention at this point also the reaction-time experiment and the interests out of which it grew. At the same time we have points of contact in the larger biological interest in adaptation. Not only were gross structural adaptations to environment studied in the species, but more specifically, also the relative fixity and modifiability of certain typical modes of adaptive responses to stimuli.¹¹ The physiological mechanism that represents the struc-

¹¹ Jennings, H. S. *Jour. of Exper. Zool.*, 1905, ii, 448-472; McCracken, I., *Jour. of Comp. Neur. & Psychol.*, 1907, xvii, 262.

tural basis of such behavior was analyzed, and thus emphasis came to be placed upon the biological function of the nervous system. This was seen to be twofold: first, through it were preserved previously established modes of behavior, racial or individual, and secondly, through it were established new modes of behavior.¹² It was pointed out that when automatized modes of response "fail," then the whole process may be 'precipitated into consciousness,' thus making possible a reorganization through the mechanism of the learning-process.¹³

We are here concerned, of course, with only one of the many questions that arose in psychology when the 'reflex arc' became a center of interest. Ours is the question of qualitative modifications that are the correlates not of modifications of stimulus and afferent portion of the reflex arc, but of modifications of the efferent path. . . . Our inquiry here continues still in terms of the parallelistic method. We are not concerned with movement or with efferent processes either as *causes* or as *effects* of psychological events;—and if at times we refer to the latter as being 'conditioned by' or 'dependent upon' the former, we imply always a parallelistic correlation.

Now, it might appear, at first blush, that when under this influence consciousness comes to be considered not only in the light of its relation to 'stimulus,' but also in the light of its relation to the 'response' as well,—in other words, to the whole of the 'reflex arc,'—such a radical change would have a decided effect upon the conception of sensation. We do have a general shift in the conception of the psychological from the Platonic to the Aristotelian point of view; and while this involves implicitly a change in the conception of sensation, curiously enough this is not always clearly recognized, for notwithstanding this shift in the conception of the psychological, which we have indicated,—affecting either the general envisagement of problems, or the emphasis upon part-problems,—it yet remains true that it has not always influenced very markedly the conception of sensation in its char-

¹² Cf. Pawlow, I., *Erg. d. Physiol.*, 1904, iii, 177, and 1911, xi, 345; Herrick, C. J., *Jour. of Animal Behav.*, 1913, iii, 231-232.

¹³ Angell, J. R., *Psychology*, 1908, chap. iii.

acter of a conscious existence. In an avowedly functional account we are still told that "the nature of the stimulus is thrown up in consciousness, as upon a screen." There is little implication here that the reflex adaptive tendencies that are presumably related to this stimulus in some way make a difference in the picture of the stimulus as it is thrown upon this 'screen' of consciousness. In it is revealed in pristine simplicity our Platonic and Lockeian heritage, in a conception of sensory consciousness that arises as a result of an 'impression' of 'foreign things' upon the *tabula rasa* of mind. Sensation is still *το αἰσθητόν* as of yore, and although we may be asked to consider the various 'functions' that this *αἰσθητόν* subserves in the biological economy, there is far less recognition here, than amongst the Platonizers, of the possibility of an influence of the 'function,' 'purpose,' 'end,' upon the conscious character of sensation; for while the platonizing intellectualistic trend in psychology may deprecate consideration of the biological function that sensation is supposed to serve, it has begun to recognize that the sensation is caught up in certain mental activities or acts, and that, descriptively, the character of sensation as conscious is dependent, in part at least, upon the specific activity in which it is caught up.

Historically, the point at which the biological influence did make itself felt in the direction of postulating a more specific dependence, in a parallelistic sense, of consciousness upon the 'response,' found its first most characteristic statement in the doctrine of the 'feelings of innervation' as a class of mental elements. But this doctrine in its original formulation fared badly. We would recall, only in passing, the treatment it received at the hands of James, whose argument is based chiefly on neurological considerations. Later criticism of the doctrine developed principally along four lines. (1) The fact that no consciousness is found correlated with stimulation of the motor cortex is often cited as an argument against the doctrine. (2) Then, again, it is urged that no biological utility would accrue to consciousness at that point in the neural arc. (3) The introspective warrant for such consciousness is questioned. (4) Consciousness is affirmed to be correlated essentially with 'centripetal,' 'afferent,' neural processes.

James'¹⁴ criticism of the doctrine proceeded upon the assumption that such feelings of innervation would have to find some sort of localization at the point of the motor areas of the cortex. Clinical evidence denies the occurrence of consciousness in connection with stimulation at that point. Such stimulation, it is believed, gives rise to movement, but not to sensation.¹⁵ . . . The doctrine is deprecated also on biological grounds. Assuming that feelings of innervation would necessarily have to be localized in the motor cortex, one has questioned the biological utility of consciousness in connection with efferent discharge at that point, for the fulfillment of the condition for the rise of these conscious processes, *viz.*, discharge into an efferent neural path, would, at the same time, be the condition for the release of the motor reaction. . . . But more cogent than purely biological or physiological considerations is the denial, on introspective grounds, of feelings of innervation as a special class of mental elements. Those who deny them assert that they cannot be found, and that the so-called feelings of effort, etc., are analyzable into kinaesthetic *quales*.¹⁶ . . . Thus the psychological phenomena in question came to be regarded as being processes that are immediately correlated with stimulation of peripheral end-organs (in this case in muscle, joint and tendon) and of afferent neuron systems. In other words, they are conceived as being essentially 'centripetal processes.'¹⁷

Notwithstanding the taboo, however, resting upon the doctrine of feelings of innervation, in its original form, some modification of it repeatedly finds formulation under some other name on introspective grounds. Our interest in these formulations here lies chiefly in the manner in which this factor is thought to be related to sensation. While referring only in passing to the physiological aspects of the question, Stout¹⁸ avers, most em-

¹⁴ James, W., *The Principles of Psychology*, 1890, ii, 494-500.

¹⁵ Cushing, H., *Amer. Jour. of Physiol.*, 1908-1909, xxiii, p. xxvi (Proceedings of the American Physiological Society).

¹⁶ Cf. Titchener, E. B., *A Text-Book of Psychology*, 1910, 169-170.

¹⁷ Cf. Binet, A., *L'année psychol.*, 1911, xvii, 44.

¹⁸ Stout, G. F., *Brit. Jour. of Psychol.*, 1906, ii, 1-15.

phatically, an introspective warrant for a distinction between cognitive and conative aspects of consciousness, and maintains that "there is an ingredient of the conative complex which has a privileged position, inasmuch as it communicates to the complex its distinctive character as conation." "This component is an unanalyzable immediate experience; it is immediately experienced in the same sense as pleasure or pain while they are being felt." Stout does not maintain that the conative factor is necessarily 'independent' of sensation, but he does maintain that it is not reducible to kinaesthetic or organic sensations, or images. The conative consciousness is not sensation but it may accompany sensation as affection accompanies sensation.

Again, there is Wundt. He may today deny feelings of innervation as correlates of efferent neural processes, but if we scrutinize his fundamental categories, we find in some of his classes of affective elements, such as his 'strain' and 'relaxation' as *non-sensory* constituents of consciousness, factors which for purposes of a descriptive introspective account of consciousness may serve very much the same ends as Stout's conative factors; for Wundt's categories find employment in his system to account, in part, for differences in conscious complexes that are very similar to the distinction that Stout makes between his cognitive and conative complexes. Also, like Stout, Wundt conceives this factor as an independently variable concomitant of sensation.

In Binet, likewise, we have a similar trend. He believes that "dès à présent, le point de vue sensationnaliste est dépassé,"¹⁹ and that there is need of some 'new conception' in psychology in order to account for what he calls the dynamic quale of the psychic life. This new conception he finds in the '*attitude*' which he regards as "an element as fundamental as the sensation and the image." He would make it a category on the same level with sensation and distinguishable from it by means of criteria very similar to those of Stout. In a descriptive psychology Binet's category would, we believe, serve very much the same purposes as the Wundtian categories cited above. Binet, not inclined to

¹⁹ Binet, A., *op. cit.*, 45.

rest the matter alone on introspective ground, invokes certain physiological considerations by means of which he hopes to illumine his contentions, but which in the end serve only to cast a shadow of doubt over them in his own mind. He proceeds to correlate these mental attitudes with certain phases of motor activity. He tells us that one might say, with some exaggeration, that "toute la vie psychique . . . dépend de cette suspension de l'activité motrice; les actes réels sont remplacés par des actes virtuels, des attitudes."²⁰ This is the common observation of the functional psychologist, as when Angell²¹ remarks that "the impulse to act, as such, we are hardly aware of, in any genuine sense, unless something impedes the impulsive movement." But after Binet has thus spoken of this mental attitude as an "element as fundamental as the sensation and the image," and after he has made this correlation of the attitude with impeded motor processes, he remembers the doctrine that posits consciousness in connection only with '*phénomènes centripètes*' and tends to deny it in connection with '*phénomènes centrifuges*.' The former have come to be correlated on the psychical side with the sensations and images as they are currently defined by a structural psychology. But these are for Binet merely 'static' somewhats that are thrown up into consciousness as upon a screen—and, in consequence, he almost denies his introspective verdict concerning the status of the *attitudes* as elements that are as fundamental as the sensation and the image.

Not our concern, however, the legitimacy of any of these categories. Suffice it that Stout, Wundt and Binet use strikingly similar terms in pointing out introspectively this element and its relation to sensation. Of these Stout and Binet make at least a general reference to the functioning of efferent and motor mechanisms as the physiological correlates of this factor that is affirmed to possess a peculiar quale different from sensation and image. While Wundt tends to deny the correlation with efferent neural processes—for these elements would thus become once more identical with the feelings of innervation—his feeling-

²⁰ Binet, A., *op. cit.*, 24.

²¹ Angell, J. R., *Psychology*, 1908, 366.

elements other than the traditional pleasantness and unpleasantness are, in introspective terms, closest kin to the mental factors singled out by Stout and Binet.

It was left for Dewey,²² however, to take a definite stand in asserting that the sensation is related not only to stimulus but to the response as well. Not that Dewey stands alone in his invocation of motor response, and efferent neural processes generally, in psychology.²³ We would recall, in passing, Ribot, James, Münsterberg, McDougall, and Judd. Dewey, with Ribot, James, and Münsterberg, invokes movement and efferent processes as a condition for the rise and occurrence of psychical processes; and with McDougall, Münsterberg, and Judd, he apparently holds that efferent neural processes are in some way responsible more specifically for the pattern or unity of the sensory and imaginal factors in the various complex mental formations. . . . It is not this kind of reference to response that interests us here, but rather the recurrent implication in Dewey that somehow psychical processes reveal *qualitative* modifications that must be correlated, on the physiological side, with the 'response of the organism.' But unlike Stout, Wundt, or Binet, Dewey contends that these modifications are to be conceived as integral factors of the sensory consciousness.

It is unfortunate that Dewey's whole conception of the nature of reality is couched in terms which do not readily admit of a comparison with other conceptions involving the postulate of a psychophysical parallelism. But in an historical survey of the conception of sensation in empirical psychology Dewey's conception must find a place. Taken from its pragmatist setting and restated in parallelistic terms, we find that this conception involves two sorts of reference to motor response which are not always clearly kept apart: (1) the dependence of a present sensation upon an already *consummated* motor response and (2) the dependence of a present sensation upon a response *about to be made*.

First, let us see what kinds of modification of sensory con-

²² Dewey, J., *Psychol. Rev.*, 1893, iii, 357.

²³ *Vide* Bentley, I. M., *Amer. Jour. of Psychol.*, 1906, xvii, 293-305.

sciousness are to be conceived as dependent upon the consummated response.—Speaking of the organism's adjustment to auditory stimulation, Dewey says that "it is just as true to say that the sensation of sound arises from a motor response," *viz.*, the reflex adjustment of attention to the auditory stimulus, "as that the running away is a response to the sound." Indeed, Dewey would do away with the dichotomizing conception of stimulus and response as parts of a reflex arc and would replace it by the conception of an organic circuit in which the act determines the stimulus, and therefore the sensation, just as much as the latter give rise to the act. "What we have is a circuit, not an arc, or broken segment of a circle. This circuit is more truly termed organic than reflex, because the motor response determines the stimulus, just as truly as sensory stimulus determines movement."

With reference to our problem of the nature of sensation and its physiological correlates, it is at once apparent that the sensory experience is conditioned not alone by stimulation of sense-organs and afferent path, but also by certain selective mechanisms within the organism. The momentary sensory experience is what it is because reflexly the organism selected that particular stimulus. In the classical case of the child and the candle, there is a reflex attentional adjustment of the visual organ; this reflex response conditions, in part, the specific visual experience. The organic constitution of the child, moreover, is such that it reaches after the object; thus, once more, the act represents one of the conditions for the specific sensation of pain that thereupon rises in consciousness. Such a statement emphasizes the part that the organism itself plays in determining stimuli, and thus the sequence and integration of sensory experience. All responses of the organism,—whether of the specific type as the reaching and the shrinking, or the type preparing for the reorganization of the stimulus, as the attention response,—play a part in conditioning, determining or selecting the stimuli, and thus the sensations that are precipitated into consciousness. These responses, reflexly made, therefore determine in part duration, clearness, perhaps even intensity, of sensation, and also their sequence and pattern

in the complex sensory consciousness. The stimulus thus precipitated into consciousness in the form of sensation would therefore bear upon it the mark of the organism's reactions to it to date. This represents a positive contribution to our problem and must be accepted as descriptive of the facts even by those who may deprecate the teleological considerations that Dewey elsewhere introduces into his paper.

This dependence of the present sensation upon the response made a moment ago, as described by Dewey, is a dependence in the sense that the response made may become one of the conditions for the actual rise and going on of the present sensation; it is a durational, an intensive, or an attentional dependence. This partial dependence of the sensation with respect to these attributes, upon the motor response of a moment ago, is obvious enough; but we must go on and ask whether the sensory experience depends also qualitatively upon this response. If we turn to analytic psychology we find that it tends to answer this question by saying that such a qualitative dependence exists only in so far as we take into account the kinaesthetic quale that is fused or otherwise psychically integrated with the auditory, visual, or other quale in the conscious moment. This kinaesthetic quale is mediated by an 'afferent' mechanism set into operation by stimulation of end-organs in muscle, joint or tendon,—a mechanism essentially similar to that mediating those other quales with which this kinaesthetic quale is integrated. Thus the response just now made conditions concomitant sensory quale, but not the quale mediated by the action of the original objective stimulus upon the auditory, visual, or other sense-organ. Analytic psychology would admit, therefore, with Dewey, a dependence of a present sensation upon already consummated motor responses in the sense that these responses introduce modifications into the stimulation of end-organs;—modifications which are accompanied by parallel modifications in the sensation mediated by such stimulation, with respect to duration, intensity and clearness; concerning quality, however, current psychology appears, on the whole, to be cautious in admitting such a dependence, unless the fusional integration of the sensation attended to with the kinaes-

thetic sensations arising in the adjustment to the stimulus be regarded as such a modification.

If, however, we go farther afield we become aware, on the other hand, of the existence of a rather pervasive assent to the doctrine that the organism's past behavior, taken comprehensively, plays an important part in conditioning present behavior and the mental processes accompanying it. The study of the learning-process is essentially such a study of the influence of past activities upon present consciousness and overt behavior. The results, too, of Pavlow's school,²⁴ on differentiation of 'conditioned stimuli' may be appropriately cited as relevant. This school points out the fact that after the salivary reflex has been developed as a response to other than the original 'physiological' stimulus, there is possible a further differentiation within the field of the newly established, the 'conditioned,' form of stimulation, so that the salivary reflex that was artificially associated, say with auditory stimulation of fairly wide range in pitch, comes presently to be associated with a certain specific vibration-rate. This is achieved by controlling the order of the animal's motor reactions by means of a careful ordering of stimuli. This entire process of differentiation within the field of auditory stimulation has a parallel in the conscious development of finer and finer discrimination of differences in sensory quale. Ontogenetically, therefore, there is some evidence that the differentiation of specific sensory quales as conscious is conditioned in greater or less degree by the repeated responses of the organism.²⁵ Whether this process of differentiation through discriminative reactions is to be regarded as a dependence of sensory quality upon these reactions is therefore not a question of fact but of system.

Dewey's position, however, involves another reference to 'response'. The present sensory consciousness arises not only from the response that has been consummated, and that has, therefore, at the present moment become an historic fact, but the quale of this consciousness is also in some manner conceived to be a func-

²⁴ Vide Morgulis, S., *Jour. of Animal Behav.*, 1914, iv, 362-379; and Hough, T., *Science*, n. s., 1915, xli, 415-518.

²⁵ Vide Rahn, C., *Psychol. Monog.*, 1913, xvi, (No. 67), 107.

tion of the response that is not yet an historic fact in the organism's career. This point is a bit subtle, but if we take into account Dewey's position as a whole we can perhaps restate it in the following terms: quale is conditioned not only by the selective mechanisms that determine the reflex attentional response to a given stimulus, and by the nature of the ensuing further stimulation and its afferent course, but also by the specific efferent neural path with which the afferent course is integrated. Such a statement does not imply that we have 'feelings of innervation' or 'conations' or 'attitudes' as correlates of efferent neural process;—Dewey himself deprecates the doctrine in his study of the consciousness of effort;—but it does imply that sensation is indeterminate so long as the response is indeterminate. The sensation becomes 'constituted' only when the response, too, is 'constituted'. Stimulus and response are "strictly correlative and contemporaneous"; the sensation depends upon both. "What the sensation will be in particular at a given time, therefore, will depend entirely on the way in which the activity is used. It has no fixed quality of its own."

The only interpretation that we can put upon these passages is that the sensory quale depends as much upon the 'response' that becomes correlated with a stimulus as upon the stimulus itself,—in other words, upon the efferent as well as upon the afferent portion of the arc. This interpretation seems justified in the light of a very much more recent paper of Dewey's²⁶ in which he points out that the object not only "exhibits what the organism *has* done, but exhibits it with the qualities that attach to it as part of the process of determining what the organism *is to do*." Unfortunately Dewey does not develop the conception further with reference to the nature of this qualitative modification that reveals what the organism is to do. But it is a conception that continually plays, in somewhat tantalizing fashion, into the hands of that other part of Dewey's doctrine that sensation depends upon the response just consummated. It is implicit also in the doctrine of the 'purposive nature of consciousness,' as well as in many of the formulations of the principle of dynamogenesis.

²⁶ Dewey, J., *Jour. of Philos., Psychol., etc.*, 1912, ix, 659 ff.

It can, however, be extricated from the various doctrines and restated as an hypothesis of psychophysical parallelism. If this is done we find that Dewey's conception involves a twofold dependence of sensation upon response; the one upon the response previously executed as actual muscular contraction, the other upon the response-that-may-be, the response-prepared-for, the response that is at present represented only by the 'set' of the efferent neural mechanism.

If this interpretation of Dewey is justified, this conception of sensation, as depending not only for its existence but also for its quale upon both afferent and efferent portions of the arc, must be distinguished from those in which sensation is correlated with the afferent portion only while the modification of consciousness due to the relationships of this afferent path with paths leading to the motor systems, is hypostatized as a non-sensory conative element,—a tendency that we discerned in Stout and Binet.

Thus we find that psychologically there are here two modes of procedure: (1) there is an hypostatization of the alleged conative or attitudinal factor in consciousness, as an independent element; or (2) this factor in consciousness that is attributed to the fact of the unitary functioning of the sensory and the motor mechanisms in the neural arc, is not thus abstracted, but is conceived as an integral part of the sensation.

These two procedures parallel very closely those which we found when the question of the dependence of the quale of consciousness upon the apperceptive or central neural factor was raised. There, too, we found that (1) sensation either continued as the correlate of stimulus and afferent path, while the factor of meaning or thought, that is revealed in the conscious moment, was abstracted as a new element by Bühler, Woodworth, and others; or else (2) sensation was conceived as dependent upon the cortical connections with other sensory systems as well as upon the afferent paths from sense organ to cerebral projection area,—in which case the actual sensory consciousness is conceived to vary as either of these portions of the arc might vary.

IV. SENSATION AND SUB-CORTICAL PROCESS

These historical notes suffice to indicate that the conception of sensation that developed along with the doctrine of specific energies continues in some psychological systems, while in others it is undergoing certain changes. Both lines of later development that we have been tracing have given rise to a modification of the conception in regard to the physiological correlates of sensation. Sensation is dependent not alone upon stimulus, afferent path, and cerebral projection-area, but also upon the system of neural paths with which the afferent impulse is integrated within the cerebral center. Two general types of modification of sensation, dependent upon the type of integration occurring at this point, had been distinguished in these different historical developments.

In the one, where the fact of meaning and thought became the chief problem, we have an approach to the view that variation in this meaning parallels the variation in the connections the afferent path makes with the sensory neural systems of the cortex. The activity of these systems is mediated into the process that is correlated with sensation and contributes to it the meaning or thought that is said to be carried by the sensation. Psychologically, this conception differs from the older associationism, for what is integrated in the sensory consciousness is not necessarily an 'image.' What we do have is essentially a sensation of the 'cognitive' type that carries the 'meaning' of the sensory systems that are functionally integrated within the cerebral centre. This meaning may or may not be given in terms of auxiliary imagery.

Similarly, the other development tended to emphasize the integration, within the cerebral centre, with paths that lead rather to the motor centres of the cortex. Such an integration may be paralleled in consciousness by the rise of a sensation of the 'conative' type. And this does not necessarily imply that we have consciousness correlated with, or located in, the motor centre. It does imply that the functional integration of the afferent mechanism with this motor centre determines the nature of the neural process in the arc just as much as does the afferent path;— and this in very much the same manner as the integration with the sensory systems contributes toward the character of the sen-

sation in giving 'meaning' to it without necessarily involving the rise of associated images in consciousness.

But besides these two types of modification of sensation distinguished thus far, we find a third type that is suggested by Herrick's interpretation,²⁷ in neurological terms, of Dewey's conception of the 'organic circuit.' Herrick conceives a sensation to depend upon the functioning of the sub-cortical centres through which stimulation passes, in very much the same way as it depends upon the sensory and motor systems with which the afferent path is correlated in the cerebral centre.

According to Herrick "there are no afferent tracts leading to the cerebral cortex directly from any peripheral sense organ or from any centre within the brain which is 'pure,' *i.e.*, devoted to a single sensory function. In other words, no simple sensory impulses ordinarily reach the cortex, but only nervous impulses arising from lower correlation-centres, where complex reflex combinations of various sensory systems are possible."²⁸ In Wilson and Pike's study of vertigo²⁹ we have an analysis of a specific case couched in terms of mechanisms essentially of this sort. They too point out that what is precipitated into the cortical activity is not a set of sensory impulses, but the disorganized reflexes that are involved in equilibratory activities.

Herrick then points out that the functional integration going on in the sub-cortical centre through which the afferent impulse is relayed in its transit to the cerebrum involves not only an integration with sensory centres but also with motor centres at that level. "From the standpoint of the cerebral cortex considered as an essential part of the mechanism of higher conscious acts, every afferent stimulus . . . is to some extent affected by its passage through various sub-cortical association centres, *i.e.*, it carries a quale of central origin." "But this same afferent impulse in its passage through the spinal cord and brain-stem may, before reaching the cortex, discharge collateral impulses into the lower centres of reflex coördination, from which incipient (or

²⁷ Herrick, C. J., *Jour. of Animal Behav.*, 1913, iii, 222-236.

²⁸ Herrick, C. J., *op. cit.*, 223.

²⁹ Wilson, J. G., & Pike, F. H., *Jour. of Amer. Med. Assoc.*, 1915, lxiv, 561-564.

even actually consummated) motor responses are discharged previous to the cortical reaction." Herrick is here interested in giving the neurological mechanism of Dewey's conception of the influence of the response upon the stimulus-complex. In so far as discharge into motor centres at the lower level brings about changes in the overt muscular adjustment, bodily attitude, or act, it is patent at once that the lower reflex response in its consummation "may in a literal physiological sense act into the cortical stimulus complex and become an integral part of it,"³⁰ in some manner like that described in our discussion of Dewey. But Herrick's exposition touches also upon the influence of the 'incipient response' at the lower level. The question arises: does this also 'act into' the stimulus complex of the higher centre? Apparently, yes. For he tells us that "sub-cortical elaboration of types of action system which ordinarily do not involve the cortex at all" may, upon occasion, "be linked up with cortical association processes and then come into consciousness in such a form as to suggest to introspection that they are all of a piece with the conscious process with which they are related."³¹

Thus interpreted and elaborated, this general conception of Herrick's would involve as one of its essential elements a parallelism between changes in synaptic relations in sub-cortical centres and modifications of consciousness. A modification of factors at the point of a synapse conditions a modification of neural impulses proceeding from that point to other, higher, centres. The sensory stimulus, in its passage to the cerebral centres, is affected by all the neural integrations that occur in the lower centres through which it is transmitted. In other words, the afferent path between receptor and cerebral projection-area is a variable factor. As the synaptic integrations in these lower-level centres vary, so will the neural impulse vary that represents the afferent stimulation for the excitation of the cerebral centre. More specifically, the lower-level integrations, involving both sensory systems and motor systems of the reflex type, are mediated into the afferent cerebral stimulation in very much the same

³⁰ Herrick, C. J., *op. cit.*, 233.

³¹ Herrick, C. J., *op. cit.*, 232.

manner as are the associated sensory and motor cortical systems with which this afferent impulse becomes coördinated in the cerebral centre itself. All of these lower-level integrations must be conceived, according to Herrick, as contributing their quota of modifications to the cortical excitation, and thus to the conscious process that is correlated with the cerebral activity.

Herrick ventures the suggestion that the psychical correlate of these modifications of the afferent path is the affective quale of sensation. Indeed, the afferent impulse, in passing through the thalamus, may innocently stir up a veritable hornet's nest of racial motor tendencies and racial sensory integrations, which contaminate the afferent impulse and give to the innocent little sensation the character of emotion. The question, however, arises: whether that little sensation is still mere sensation;—and also the question: whether the fragments of imagery that the *Denkpsychologen* have discovered as the sensory concomitant of thought—where a single syllable is often the 'bearer' of the meaning of a complex thought-content such as the general plan of a philosophic system, revealed all in a single flash—whether this is merely a bit of sensory consciousness, or more than that. These questions we must leave for the structuralist and the functionalist to decide each in his own way.

V. CONCLUSION AND SUMMARY

The modern sensation as the psychical correlate of the process of stimulation of sense-organs may thus be traced from Plato's *αἰσθητόν* through Locke's 'impressions' and Kant's 'phenomena,' to the fixing of the conception in the earlier experimental investigations of Weber and Fechner. It is the sensation that crystallizes in the later Wundtian psychology: the sensation that is the correlate of the objective stimulus, as over against feeling which always has a 'subjective' reference.

But, today, even there where sensation continues as correlate of stimulus, we find that certain of its attributes are made to depend not upon stimulus alone, but also upon such central factors as 'nervous predisposition.'

The more recent developments, however, which we have traced

in this paper, are characterized by attempts to give us a conception of this dependence that will be somewhat more specific than this very general one of nervous predisposition. These attempts are bringing about changes in the conception of sensation under the influence of three somewhat different directions of interest: (1) an interest in the relation of sensation to apperceptive or central factors; (2) an interest in its relation to conative or efferent factors; and (3) an interest in its relation to lower-level neural processes.

In the first of these developments, we found that (1) sensation either continues as the correlate of stimulus and afferent path, while the factor of meaning or thought, that is revealed in consciousness, is abstracted as a new element by Bühler, Woodworth, and others; or else that (2) sensation is conceived as dependent upon the cortical connections with other sensory systems as well as upon this afferent path from sense-organ to cerebral projection-area,—in which case the actual sensory consciousness is conceived to vary as either of these portions of the arc might vary.

In the second of these developments, we find, similarly, either that (1) sensation remains the correlate of stimulus, while the alleged conative, attitudinal, or impulse factor is abstracted from this sensation and made into a new element; or that (2) this aspect of consciousness, while noted, is not abstracted as an 'element' and placed over against sensation, but is conceived as an integral part of it (Dewey). Whatever the warrant for these differences in systematic procedure, they all represent attempts on the part of a descriptive psychology to do justice to those aspects of consciousness that are not solely or immediately dependent upon modifications in the stimulation of receptors.

The third, and more recent, development is suggested by Herick's neurological approach to the problem of sensation. Herick emphasizes the effect of varying synaptic relations within the subcortical centres through which the afferent impulse passes on its way to the cortex, so that the lower-level activity is conceived as being mediated into the cortical process.

It thus becomes patent that contemporary criticism of the conception of sensation indicates an endeavor on the part of psy-

chology to come to terms with the conception at three points: in connection with the problem of conscious meaning, with that of conative or impulsive consciousness, and with that of affective or emotive consciousness. Whether all of those modifications of consciousness, however, that are conceived as the psychical correlates of physiological processes other than stimulation of the sense-organ, are to be regarded as qualitative modifications of sensation, or as something over and above sensation, still awaits decision. But this is not of primary importance. What is significant is the course that the criticism of sensation has taken.

Involved in much of this psychological criticism there is either explicit or implicit reference to neural mechanisms. Associationism is being replaced by some sort of conception of a functional interrelation of neural centres. Even though our knowledge of the neural mechanisms may be meagre indeed, we do have reason to believe that the factors that are integrated in cortical processes are in part the afferent path involving subcortically integrated neural systems, the cortical sensory systems, and the cortical motor systems. It is these factors that determine in some way the character of the sensation.

Psychologists interested in the thought processes have emphasized the 'meaning aspect' of the sensation,—affirming that it may vary from moment to moment and that these variations are in some way variations of consciousness that can be directly ascertained. To a lesser extent, the conative, impulsive, dynamic character of sensation is singled out by others and treated in very much the same way. But neither the meaning nor the impulse is necessarily given in terms of concomitant sensations or images. Unless they are hypostatized as separate contents, they are variously conceived as peculiar modifications of the sensation itself. In the third place, we have Herrick's suggestion which, upon careful scrutiny, reveals close kinship, psychologically, with the procedure just mentioned. Just as the integrated cortical sensory and motor systems may be conceived as giving meaning and dynamic quale, respectively, to the sensation, so Herrick apparently conceives the sub-cortical systems to contribute what he believes to be its affective or 'emotional' quale.

The questions whether feeling is to remain a content alongside of sensation, and whether feeling, meaning and conation are to be interpreted in some way as functions of sensation, do not concern us here. Only this: that the neural process that underlies the sensory process consists in an integration of various factors, each of which is conceived by these writers to modify, in its own characteristic manner, the sensation. In this sense not only the motor response that is immanent although not actually consummated, but also the past experience of the individual, and presumably the past of the race, may in some way modify the sensory process without the presence of auxiliary imagery. In this conception of sensation psychology frees itself definitely from the bonds of associationism, and through it also there opens the way to a new interpretation of neural function that will be at variance with none of the known facts of psychology or of neurology.

THE PRINCIPLE OF DYNAMOGENESIS IN PSYCHOLOGY

By CARL RAHN

- I. Physiological statement: stimulus and movement.
- II. Psychological statement: consciousness and movement.
- III. Methodological implication: behaviorism.
- IV. Criticism of the principle: physiological.
- V. Criticism of the principle: psychological.
- VI. Conclusion and summary.

I. PHYSIOLOGICAL STATEMENT: STIMULUS AND MOVEMENT

James, writing of the principle of dynamogeny, says "Every sensorial stimulus not only sends a special discharge into particular muscles dependent on the special nature of the stimulus in question, . . . but it innervates the muscles generally."¹ And in so far as certain of these other muscles are directly responding to special stimuli of their own, their specific response may be augmented by this general innervation. It *may be* augmented; but Féré had also pointed out that not always is the effect thus *dynamogenic*,—it may be, at times, the opposite. James recognizes this when he uses Féré's results in connection with the law of diffusion; "A process set up anywhere in the centres reverberates everywhere and in some way affects the organism throughout, making its activities either greater or less."²

But in later psychological thinking 'diffusion' tends apparently to become 'diffusion to muscles'; and the effect of concomitant stimulation, which Féré had found sometimes to be in the direction of inhibition of the specific response and sometimes in the direction of its re-enforcement, comes to be interpreted as being always in the latter direction. And again, quite apart from the psychological facts revealed by studies of the effect of concomitant stimulation upon attention, which closely parallel the results of Féré, we find in Sherrington's differences between nerve-

¹ James, W., *The Principles of Psychology*, 1890, ii, 379.

² James, W., *op. cit.*, ii, 381.

trunk conduction and reflex-arc conduction a very relevant item. The peculiarity of the latter as compared with the former is that it does not reveal the one-to-one allignment of stimulus and motor response that the principle of dynamogenesis would demand.³

These several points may be urged against Baldwin's generalizations of the law of dynamogenesis. He tells us that "every sensation or incoming process tends to bring about action or outgoing process"⁴ and "changes in the conditions of sensory stimulation of the nervous system always show themselves in corresponding changes in muscular tension or movement."⁵ Diffusion is conceived as being necessarily diffusion to effectors and glands; and stimulation is thought of as being followed by an outgoing process that is necessarily tension producing. The fact of inhibitory effects noted by Exner and Féré is completely lost from sight. . . . And in addition we would recall to mind also the bearing of the fact of stimulus-threshold, originally urged by Stumpf⁶ against the law of dynamogenesis as propounded by Baldwin.

II. PSYCHOLOGICAL STATEMENT: CONSCIOUSNESS AND MOVEMENT

So much for the physiological form of the principle of dynamogenesis. Our interest, here, however, is directed to its psychological implications. There are diverse formulations. The most interesting statements are those of James. "Consciousness is in *its very nature* impulsive."⁷ "Movement is the natural immediate effect of feeling, irrespective of what the quality of the feeling may be. It is so in reflex action, it is so in emotional expression, it is so in the voluntary life."⁸ Furthermore, if consciousness does not produce action, it is due to the inertia of the

³ Sherrington, C. S., *The Integrative Action of the Central Nervous System*, 1906, 14.

⁴ Baldwin, J. M., *Mental Development: Methods and Processes*, 1895, 166.

⁵ Baldwin, J. M., *Dictionary of Philosophy and Psychology*, 1911, i, 302.

⁶ Stumpf, C., *Zsch. f. Psychol.*, 1899, xxi, 78.

⁷ James, W., *op. cit.*, ii, 526.

⁸ *Op. cit.*, ii, 527.

effector apparatus: "There is an inertia in the motor processes as in all other natural things." But this restrictive inertia "obviously introduces no essential alteration in the law which the text lays down."⁹

Thus consciousness, whether on a parallelist or an interactionist hypothesis, is related to a nervous process of which the reflex motor response to sensory stimulation is the type. This formulation of the principle, stating a general relationship between consciousness and action, was followed, historically, by a veritable renaissance in psychological thinking, especially along educational lines. There was something, too, of the nature of an aesthetic appeal made by this formulation. It satisfied a sense of fitness. The rise of a pragmatist *Weltanschauung*, also, may have helped it along. But fundamentally it meant a break with the old way of looking at the problem of consciousness.

We have elsewhere¹⁰ pointed out the fact that much of the early effort in empirical psychology was directed toward the correlation of modifications of sensation with modifications of stimulus. We also pointed out that this sort of endeavor fitted quite appropriately into the conception of mind that this early psychology takes over from philosophy,—a conception that, stripped of the metaphysical implications of various modern philosophies, reveals its origin in the Platonic conception of mind. In modern philosophy Platonism tends toward a dualism of soul and body, leading ultimately to the distinction of the psychical and the physical, of 'thinking substance' and 'extended substance.' For Platonism the function of the psychical is essentially cognitive under the two aspects of sensation and thought. The mind receives impressions from the things of sense, and it thinks. If we review in the light of this dialectic Kant's conception of an impression of the noumena upon the psyche in the form of phenomena (passive) and the operation of the understanding with reference to these (active), and Locke's conception of foreign things making an impression upon the *tabula rasa* in the form of simple ideas of sensation, and the

⁹ *Op. cit.*, ii, 526.

¹⁰ See above pp. 55 ff.

'actings of the mind' with reference to these,—when we review these conceptions of mind that are held respectively by these formulators of idealism and sensationalism, we note that, in so far as they involve a psychological system, this system reveals essentially the dialectic of Plato's psychology.

In James and Dewey we have a forsaking of this point of view and a more or less definite harking back to a position not prominent in the earlier development of modern philosophy. The psychological dialectic shifts from the Platonic to the Aristotelian,—a point that is not always clearly recognized in much of the mutual criticism of structuralist and functionalist, of 'objective' psychologist and behaviorist.

Let us review briefly the chief points in Aristotle's conception of mind. We recall that for Aristotle mind is the 'form-giving' principle in nature. It is the 'entelechy,' the organizing aspect of the vital process. The fundamental factors are 'functions' that involve other organized functions as their basis. These become the 'structures' for the organizing function. The activities of the entelechy are of three kinds: vegetative, appetitive, rational. In other words, the purely physiological functions of nutrition, the metabolisms, the glandular activities, the organization of instinctive responses, the conscious voluntary activities, are all conceived as inter-dependent functions of this entelechy. Functions, not structures, would appear to Aristotle primary: *τὰ ὄργανα πρὸς τὸ ἔργον ἢ φύσις ποιεῖ, ἀλλ' οὐ τὸ ἔργον πρὸς τὰ ὄργανα.* The psychical, forming, organizing aspect as it involves appetitive and emotional, and therefore, presumably, conscious factors, is more clearly brought out by this other quotation: *διὰ τὸ θυμὸν ἐχθεῖν ὄπλον ἐχει*, that is, since the insect is wrathful it has organs of attack.¹¹ The child desires the bright object placed before it; out of the mass of movements that he makes, an adequate grasping habit is finally built up. This habit imbedded within the nervous system would represent the 'structure' that has developed as a result of the 'desire' as a psychical function. . . . Such a point of view finds in its study of mind (1) certain already established reactive tendencies, caught up in (2)

¹¹ *De Partibus Animalium*, iv.

a re-organizing integrative process which goes on under the influence of (3) a 'biological end' or 'purpose.' One marvels at the fidelity with which this dialectic of the Aristotelian conception is adhered to, either explicitly or implicitly, not only in much of the later psychological literature, but also in physiological and biological discussions, as well.

The shift from the Platonic to the Aristotelian conception of the psychical is most satisfactorily brought out in connection with the problem of sensory consciousness. It involves a three-fold change in the conception of the nature of sensation or in its status. (1) Sensation may come to be regarded as partaking not only of the nature of a psychical existence, but also of the nature of an organic activity in which it is functionally related to the organism's reaction to stimuli. We are told that sensation instigates movement and that "a completed experience is not merely sensory it must be motor as well."¹² It is conceived as organically related to the reflex-arc. "Left to itself," writes Angell,¹³ "any conscious state converts itself into muscular motion." "The action theory," writes Münsterberg,¹⁴ "claimed that the inner experience depended not only upon the incoming but also upon the outgoing current: the central excitement is every moment related not only to the sense impression but also to the openness or closedness of the path of motor discharge." In the case of a child that reaches after a bright object, say a candle flame, there is the sensory experience of light, plus the tendency to reach after it and the sensation of pain plus the tendency to shrink or withdraw. (2) The activities in which these sensations are integrated into perceptual and ideational complexes are regarded not only as mental integrations of various degrees of complexity, but also as integrations and reorganizations of the several reflex arcs to which the sensations are organically related. "Every new shade of meaning from new associated elements must vary the impulse to reaction," writes Münster-

¹² Colvin, S. S., *The Learning Process*, 1912, 15.

¹³ Angell, J. R., *Psychology*, 1908, 363.

¹⁴ Münsterberg, H., *Psychology, General and Applied*, 1914, 155.

berg;¹⁵ and again: "we can only say that any group of sense impressions is held together as a perception, if it is connected with one responsive attitude of ours."¹⁶ In the case of the child and the candle the reflex tendencies may become ultimately reorganized in the sense that the child will tend to shrink from the light instead of reaching after it. Such a reorganization would involve a mental integration of light and pain sensations in the sense of Wundt's fusion or assimilation, and physiologically an integration resulting in the formation of a response very like the 'conditioned reflexes' of Pawlow. The reorganization of 'sensations' in mental activity is thus interpreted not only as a reorganization of sensations within the pattern of consciousness, but also as a reorganization of the reactive tendencies that are, hypothetically at least, related to the 'sensations' involved. (3) And the third factor in the Aristotelian conception emphasizes the fact that the sensations that are precipitated into this organizing activity do not arise fortuitously, or as a result merely of the action of physical stimuli upon the sense-organ, but are determined also by certain 'selective' functions of the organism itself. This organic determinant is variously conceived, depending upon our interest: psychologically it is conceived as the '*Aufgabe*,' or task, physiologically as the 'biological purpose,' and behavioristically as a 'hunger' or a 'state or appetite or aversion.'

Let us here make adequate apologies to Plato and Aristotle for thus using their names to distinguish between these respective views. Such a procedure is justified only because it succeeds in giving logical continuity and historic perspective to a very complex problem. Our problem is this: how do these two conceptions of mind stand related to the 'law' of dynamogenesis regarded as a psychological doctrine?

The first of these points of view emphasizes stimulus, sensation, and sensory integration in perceptual and ideational complexes,—these integrations being the correlate of neural integrations arising by reason of diffusion, not to muscle but rather

¹⁵ Münsterberg, H., *op. cit.*, 161.

¹⁶ Münsterberg, H., *op. cit.*, 146.

throughout certain central portions of the nervous system. It has little to say about motor response and the relation of consciousness to it, so that, left to itself, it would hardly espouse the doctrine of dynamogenesis. It is therefore not surprising that we find, as a rule, the antagonists of the doctrine, in its psychological form, amongst the Platonizers. As a matter of fact, the doctrine can gain a foothold amongst them only when the relation of consciousness to stimulus is emphasized. There where the sensationalistic doctrine that all consciousness has its rise in sensory stimulation is fundamental to psychological thinking, there the physiological doctrine that all stimulation of the organism leads to movement may take on a special significance; for if the latter is accepted as a general principle, it follows from the two premises that all cases of consciousness are in some way cases of movement. In general, however, the Platonic view of mind is inimical to the doctrine as a psychological principle. It is significant that it is the major premise, *viz.*, the original physiological doctrine of dynamogenesis, that is attacked by two of the chief opponents of the psychological doctrine. These are Titchener¹⁷ and Stumpf.¹⁸ The psychological points of view of these writers have this fact in common: they both reveal the influence of what we have called the Platonic conception of mind; the one, however, showing primarily a sensationalistic, the other an intellectualistic, bias. . . . The doctrine of dynamogenesis as a psychological principle is not an integral part of either of these developments of the Platonic conception of mind.

It is quite otherwise in the case of Aristotelianism in psychology. This tends to emphasize the point that the unity of the 'object' in perception and thought exists by reason of neural discharge to a coördinated motor system, and that the diversity within this unity exists by reason of tendencies to diffuse to other motor systems. The diverse factors are diverse because these incipient tendencies represent the beginnings of new integrations into different sensori-motor coördinations. This point of view regards consciousness as so completely involved in a

¹⁷Titchener, E. B., *A Text-Book of Psychology*, 1910, 488-489.

¹⁸Stumpf, C., *Zsch. f. Psychol.*, 1899, xxi, 78.

functional relationship to movement, that such generalizations as "consciousness is in its very nature impulsive" appear quite natural to it, and no critique of the doctrine has ever come, so far as we know, from a functionalist's pen.

III. METHODOLOGICAL IMPLICATION: BEHAVIORISM

Once the physiological generalization that excitation of receptors diffuses always to effectors has received the psychological interpretation just outlined, we discover that it involves a very definite methodological implication. If it were true that all mental integrations in perception, ideation, etc.,—whether the nervous correlates assigned them be diffusion from sensory projection-areas to other sensory systems or to motor systems,—find complete registration in modifications of activity in muscle or gland, then the method of 'objective' psychology and of behaviorism could claim to be adequate and sufficient for its task; for the method of behaviorism follows logically from the doctrine of dynamogenesis in both its physiological and psychological formulation. It becomes quite needless to refer to consciousness at all, for we obtain our registrations quite independently of such reference.

Thus the psychology that hoped to get on in a comfortable manner, by entertaining, in the goodness of its heart, all sorts of tentative hypotheses, has been, temporarily at least, dispossessed of part of its hereditary estate. It will profit little merely to assert that there are 'mental facts,'—for behaviorism will answer "perhaps yes, perhaps no, but by hypothesis all 'mental' processes 'produce' movement of muscle, or change in glandular secretion; we therefore are taking into account all that need be. The mythical mental processes that do not register thus do not concern us."¹⁹ Or with pragmatism it might say that that which makes no difference in the act (of muscle or gland), makes no difference in fact, and thus it would bring full-circle the development that began when James took over the principle of diffusion of Bain and that of dynamogeny of Féré and wove

¹⁹Cf. Watson, J. B.: "All organization, no matter what its character, shows directly for what it is worth in the appropriate muscles." *Behavior*, 1914, 324.

them into the fabric of his own fruitful thinking, concerning which no one can affirm that it was not an admirable case in point of the principle involved. And what behaviorist would undertake to catalogue the modifications of behavior, not only of American psychologists, but also of the people at large, that may be referable to the stimulation arising out of James's expressions?

But James, we saw, had been much influenced by Féré, and it is therefore of no small interest to turn to the latter's little classic and there find written, as far back as 1887, the *credo* that leads ultimately to the rejection of the psychical altogether by the behaviorist today. It is so clearly formulated that we cannot do otherwise than give it here in the original: "Or si on peut prouver expérimentalement que la pensée n'est autre chose qu'un mouvement de la matière, qu'il ne se passe rien dans l'esprit qui ne se traduise à l'extérieur par des mouvements, secretions, etc., par une modification générale des fonctions organiques, il s'ensuit qu'il est seulement nécessaire de savoir lire les signes extérieurs pour connaître ce qui se passe dans l'esprit."²⁰

IV. CRITICISM OF THE PRINCIPLE: PHYSIOLOGICAL

The outcome of this development of the principle of dynamogenesis, then, has been that the facts of the psychical life have no *point d'appui*, in terms of the principle, with reference to the functional system of neural arcs that connect the receptive organs of the body with its effectors. Indeed, the attempt to do so has succeeded quite effectually in leading, in some quarters, to the denial of the psychical.

Our criticism of the doctrine of dynamogenesis will involve, first an examination of the physiological principle that all stimulation of sense-organs necessarily 'expresses' itself in movement or in glandular secretion. And secondly, it will lead us to inquire into the status of the principle in its psychological form.

Since James gave the original impetus for its spread in this country, let us return to one of his formulations. "*Using sweeping terms and ignoring exceptions*, we might say that every possible feeling produces a movement, and that the movement is a

²⁰ Féré, C., *Sensation et mouvement*, 1887, 116.

movement of the entire organism, and of each and all its parts."²¹ The italics are ours. In the original the relation of the italicized and the unitalicized portions are just reversed. We are, for the present, of course, interested in what may be, for James, exceptions. We can discover only two such in James, and in the case of one of these it is doubtful whether it is, to his mind, truly an exception. We are told that sometimes consciousness does not produce action on account of the 'inertia' of the effector apparatus, but that, nevertheless, this restrictive inertia "obviously introduces no essential alteration in the law," for "there is an inertia in the motor processes as in all other natural things."²² And "there are probably no exceptions to the diffusion of every impression through the nerve centres. The effect of the wave through the centers may, however, often be to interfere with processes and to diminish tensions already existing there; and the outward consequences of such inhibitions may be the arrest of discharges from the inhibited regions as the checking of the bodily activities already in process of occurring." "In general, however, the stimulating effects of the sense-impression preponderate over the inhibiting effects, so that we may roughly say, as we began by saying, that the wave of discharge produces an activity in all parts of the body."²³

These two facts, that of 'inertia' of peripheral motor mechanism and that of inhibition, are recognized by James as possible exceptions. Let us consider them in their physiological implications.

In speaking of the 'inertia' of the motor processes James presumably means the factor of physical inertia in the muscle. But paralleling this muscular inertia is the inertia that is characteristic of the receptor mechanism, which is equally important. For if we entertain the conception of inertia at all, inertia both of receptor and of effector must be conceived as determinants of the 'latent time' of the arc. In addition to this inertia of the arc-terminals, we have a similar factor in connection with the

²¹ James, W., *op. cit.*, ii, 372.

²² James, W., *op. cit.*, ii, 526.

²³ James, W., *op. cit.*, ii, 374.

nerve-trunk. For it, too, has a latent-time.²⁴ And as a third factor, if we follow Sherrington, we have the 'resistance' of the cell-wall at the synapse. But these same three factors that thus enter in as part-determinants of the latent-time of the reflex arc must, on any hypothesis whatsoever, be conceived also as part-determinants of the stimulus threshold. Other things being equal, this threshold will vary as the 'resistance' offered by these elements in the arc. If now we take into account the fact of summation-effect of subliminal stimulation, the inference may be made with reasonable safety that the function of the successive subliminal stimuli has been, in part, to overcome the resistance offered by all these elements taken both as a whole and as parts of the arc,—no matter how this 'overcoming of resistance' may be conceived.

Thus, in part, the consequent of sensory stimulus consists in such *priming* of the elements of the arc,—and unless the threshold is reached, either through increase in strength of the stimulus, or through further summation of the subliminal stimuli,—we shall have the case of stimulation affecting the physiological mechanism without producing either muscular contraction or glandular secretion. . . . This is, of course, simply another statement of the argument of stimulus-threshold against the principle of dynamogenesis in its physiological form. But this slight variation in form makes possible the conception of the structural and functional unity of the arc,²⁵ without postulating that necessarily the only mode of functioning of such an arc or system of allied arcs is the production of actual contraction of muscle or of glandular secretion. The facts of summation-effect of subliminal stimuli, of latent-time of nerve-trunk conduction, of latent-time of reflex conduction,—all these taken together indicate that they are essentially facts that are referable to a very specific process going on in the organism, *viz.*, the *priming* of the specific neural path, including receptor and effector.

This conception may well be kept apart from that of *Bahnung*, for the reason that it does not refer, primarily, to the synaptic

²⁴ Sherrington, C. S., *op. cit.*, 18 ff.

²⁵ Cf. Watson, J. B., *Behavior*, 1914, 20.

function within our original arc,—for lowering the threshold at the point of neural connection is but one of the factors in this *priming* of the path. The other factors are the lowering of the resistance that is offered by receptor, effector, and conductor. The resistance of the wall in the efferent portion of the original path may or may not be lowered by the facilitating effect of other, allied, reflex functions concomitantly occurring, or raised by the inhibitory effect of still other, antagonistic, reflexes. These effects of other reflex activities may thus enter in as part-factors, furthering or hindering the priming of the original reflex path,—but only as part-factors, for we noted that that priming involves more; namely, the overcoming of the resistance of receptor, conductors, and effector.

The arc is thus seen to possess an individuality of its own quite apart from its relationship to other arcs. The effect of subliminal stimulation—though no overt response occur—is therefore necessarily to be considered an actual one. It prepares a *specific* path, it organizes it. Energy may be, ultimately, released in the effector, but before this can occur there must be organization of the arc. The process of organization is not ‘expressed’ elsewhere but in the condition of the arc itself.

Furthermore, the facts revealed by that long patient inquiry that began when Ebbinghaus first set himself to learning non-sense-syllables, leads to the inference that all repetition of acts effects something more than the release of energy in the effector,—it has a further effect upon the condition of the path itself; it may contribute to its further *priming*. It is this effect of stimulus that the psychology of learning states in terms of the effect of number and distribution of repetitions, of the ‘filled’ and the ‘unfilled’ post-assimilative period, etc.

Now certain other psychological facts that we shall mention later appear to demand the distinction between the condition of the neural arc itself and the effect that its relation to other arcs may have upon it. These other arcs may heighten or lower its responsiveness by reason of their inter-relationship at the synapse, as the facts of facilitation and inhibition indicate. But the determinants of the condition of the arc are not all enumerated

when we note this facilitating or inhibiting effect of other arcs upon it, for the excitation of the arc in its own, more immediate, function, involves work done that consists in the organization or patterning of all its structural elements, including receptor, conductors, synapses and effectors. This process we call *priming*.

Exner²⁶ used the term *Bahnung* to cover the entire range of neural facilitation, including not only this organization of a given arc, but also,—and that was the important thing for him,—the general fact of its facilitation through allied arcs. Furthermore, he thought more particularly of the synaptic resistance and not of the other factors dwelt upon above. Had it not been for this, the word *Bahnung* would have been a much more satisfactory term for the specific conception developed here. For Exner was, even at that early date (1882), speaking of an effect of sensory stimulation that was essentially an effect in the nervous system itself.

The organization of the arc is therefore to be conceived as a consequent of sensory stimulus just as much as is the release of energy in effectors. If the decrease in time for subsequent responses, the lowering of the stimulus threshold after previous stimulation both subliminal and adequate, the shortened time for re-learning, as well as the other facts of memory,—if these taken together indicate anything it is this: that all stimulation of the neural arc has a very real effect upon that arc, modifying it in the sense of preparing it. Furthermore, this activity, process, function, may at times go on without being accompanied, or followed by, an actual release of energy in the effector. This priming or organizing of the arc is a fundamental biological activity, involving, like all physical activities, the factors of time and of energy-transformation, just as the organization of an electric field involves a rearrangement of the molecules along the lines of force, and this organization of the machine is a process that is factually distinct from the function that the machine may subsequently perform as a source of energy.

But leaving aside the problem of the transformation of the

²⁶ Exner, S., (Pflüger's) *Arch. f. d. ges. Physiol.*, 1882, xxviii. 487-560.

energy involved in this process of organization (cf. Lehmann)²⁷ we have so much as the positive outcome of our inquiry: there is a mode of stimulation of the organism that does not 'express' itself in the release of energy in the effector but in the priming of paths. This mode of stimulation is of primary importance in the life of the organism and the 'response' to it is a constant reorganization of the elements in the neural arc and in the relationship of the arcs to one another. The organism is constantly exposed to such stimulation and a large part of its 'experience' is essentially of this sort—by no means involving necessarily motor response or contraction of muscles or secretion in glands, to say nothing of consciousness at this point.

The second point at which James's conception of the principle of motor discharge gave rise to possible misgivings was in connection with the facts of inhibition. Sometimes, he says, diffusion effects inhibitions, resulting in the checking of bodily activities in process of occurring. But generally the stimulating effects of a sense impression preponderate over the inhibiting effects. . . . It is not quite clear how James would have us regard the facts of inhibition. Are they exceptions to the general rule and therefore to be placed over against the usual effects of stimulation? Or are they a sub-class under the latter heading?. . . . But James wrote twenty-five years ago and it is only since then that much of the work, putting the facts of inhibition before us in a clearer light, has been done. At times he takes note of it as a central phenomenon and at other times he seems to interpret it as being essentially a muscular affair involving the opposition of antagonistic muscles. And if this was his conception, it is essentially borne out by the facts that have been gathered by the physiological study of the reflex mechanisms. That the inhibition, however, may be as much the effect of sensory stimulation as is motor excitation, may not have come home to him so definitely as it might today.

Sherrington writes: "The striking correspondence observed between the reflex inhibition and the reflex contraction, when examined in one and the same type-reflex, allows the inference

²⁷ Lehmann, A., *Grundzüge der Psychophysiologie*, 1912, 141 f., 534 f.

that the nerve-fibres from the receptive field of the reflex each divide in the spinal cord into end-branches (e.g. collaterals), one set of which, when the nerve fibre is active, produces excitation, while another set, when the nerve-fibre is active, produces inhibition. The single afferent nerve-fibre would therefore in regard to one set of its terminal branches be *specifically excitator*, and in regard to another set of its central endings be *specifically inhibitory*. . . . In denoting one set of central terminations of an afferent arc '*specifically inhibitory*', it is here meant that by no mere change in intensity or mode of stimulation can they be brought to yield any other effect than inhibition."²⁸ Inhibition, therefore, "is not a *neutral* process, for at least in many cases it leaves the reflex centre surcharged for subsequent response,"²⁹ as in the case of 'successive induction'. "It rather seems to predispose the tissue to a greater functional activity thereafter." And while "we do not yet understand the intimate nature of inhibition", its seat is in many cases "certainly central, and in all probability is . . . situated at points of synapses."³⁰ Inhibition, Sherrington is at pains to indicate, is not a 'neutral' process; and again, it is often a 'central' process.

It is significant that Sherrington should raise the question of 'neutrality' at all. It is not merely the case of an arc that does not respond or that ceases to respond to stimulation with an excitation of effector. The particular arc may function positively in bringing about cessation of muscular contraction; or if the muscle be relaxed to begin with, the presence of the inhibitory stimulation modifies the behavior of the effector when the stimulus, that otherwise is followed by a contraction of the muscle, is presently applied. The effector then does not respond with movement, so long as the inhibiting reflex activity lasts.

Furthermore, it is probably "a central and not a muscular affair." The distinction between peripheral and central mechanisms of inhibition is, of course, of especial interest to us. If antagonistic muscles are contracted, we have, to be sure, an inhi-

²⁸ Sherrington, C. S., *op. cit.*, 105.

²⁹ Sherrington, C. S., *op. cit.*, 194.

³⁰ Sherrington, C. S., *op. cit.*, 192.

bition of an overt act,—but there is nevertheless release of energy in the muscle. But if we have the muscle in a relaxed condition by reason of the functioning of a stimulus,—then we have no muscular movement or change. Such an effect of stimulus, then, is for Sherrington not a muscular affair. Its seat is “central, and in all probability is . . . situated at points of synapses.” We have here another effect in which stimulation brings about not muscular contraction, but the relaxation of muscle or a prevention of contraction, and so long as this condition in the neural arc lasts, stimuli, otherwise movement-inducing, cease to bring about their appropriate outward ‘expressions’.

The evidence, then, is for an effect of stimulation that is not expressed primarily in terms of movement and glandular secretion, but is to be stated in terms of changes in the organization and set of the neural arcs within the nervous system itself. This effect consists, in part, in raising or lowering the functional threshold of arcs, either in the priming of the arc as a functional unit, or in its inhibition or facilitation by other arcs to which it is related.

It is in these types of neural activity that we must seek for the physiological correlates, not only of the effects of practice that have been systematically determined by experimental psychology and stated as the conditions or laws of learning, but also of the various determinants of conscious patterns, that psychology has come to refer to as determining tendencies, both innate and acquired. Subliminal stimulation, as well as overt practice, *primes* the arcs involved in ‘association’; central inhibitions, and central facilitations as well, constitute the physiological basis for a continual shifting and development of ‘impulses’ and ‘motives’ that sometimes have a conscious correlate in felt needs, desires, and wishes, and also in the modifications of the pattern of thinking. The study of this pattern reveals the fact that the ‘laws’ of association, which under controlled conditions of learning show a regularity that parallels that which is found in other biological facts,—that these ‘laws’ are sometimes cut clear across by a change in the ‘determining tendency’. Witness Ach’s study on this point. Quite apart from the question of the felicitousness

of his controlling conception in the formulation of his problem, *viz.*, that of the 'will',—conceived, it almost seems at times, in terms of the much disdained faculty psychology,—his work and method constitute a brilliant contribution to our common aim: the knowledge of the nature and mechanisms of the psychical life. Now these mechanisms, in so far as they have been studied, reveal a mode of operation that parallels those that have been under discussion in this paper. We assume therefore, provisionally, that the correlate of much of that which is revealed in consciousness as modifications of mental events, in memory, volition and thought, is all of a piece on the physiological side with the mechanisms of the priming and mutual facilitation and inhibition of the neural arcs.

And much of this is a function of sensory stimulation that, quite contrary to the more general interpretation of the principle of dynamogenesis in its physiological form, finds no immediate 'expression' in muscular movement or glandular secretion. It is largely a 'response' in terms of central neural activities. In the light of the facts the physiological formulation of the principle of dynamogenesis becomes invalid. It is to be replaced by the principle that all stimulation effects a change in the set of the nervous system; and a distinction is to be made between change in neural set, on the one hand, and muscular excitation and inhibition on the other.

V. CRITICISM OF THE PRINCIPLE: PSYCHOLOGICAL

The major premise from which is derived the psychological formulation of the principle of dynamogenesis thus becomes invalid. This major premise was the physiological hypothesis that all peripheral stimulation of the organism finds expression in a reflex response in muscle or gland. It is beyond our purpose to trace this hypothesis in the French psychologists of the eighteenth century, in the early physiological interest in the reflex mechanisms during the early sixties, and in the latter-day fixing of the hypothesis as a guiding conception in the anatomical localizations of the neural paths that constitute the mechanisms of the sensori-motor activities. When psychologists took over this

hypothesis from physiology, they found it not at all incompatible with the older psychological doctrine that all consciousness derives from, or arises concomitantly with, or is the result of, the stimulation of sense organs,³¹—a conception that represents psychology's heritage from Lockeian sensationalism. With the physiological principle that all sensory excitation leads to movement, as the major premise, and the Lockeian principle that all consciousness derives from sense-organ excitation, as the minor premise, we have the rise of the statement that all consciousness involves a motor response. And this is the only form of the psychological statement that ever could be legitimately derived from the physiological formulation; but in so far as it rests upon this latter, it, too, must be abandoned.

We saw, however, that certain psychologists held another view of mind that leads directly to the enunciation of the principle of dynamogenesis as a psychological formula. In this view consciousness is related not merely to stimulus but to the neural arc as a whole. The typical activity of this neural arc is conceived as being essentially the bringing about of motor response to sensory stimulation. Hence consciousness, too, is conceived as being "in its very nature impulsive". "Left to itself," we are told, "every conscious state converts itself into muscular motion". It is—may we repeat?—with the Aristotelian in psychology that dynamogenesis has had its greatest vogue. As with James, by whom exceptions to the principle were minimized, so through the whole later development of psychology. Yet in spite of this emphasis upon motor discharge, certain factual observations that may prove ultimately to have a very real bearing upon the status of consciousness, have filtered through. The observation in question is that consciousness is a phenomenon that is to be noted not so much in connection with actual movement as in connection with the absence or surcease of movement. A study of the literature discloses the fact that notwithstanding the dominance of dynamogenesis as a psychological principle, we find repeated reference to the occurrence of consciousness as arising particularly in connection with impeded activity.

³¹ Cf. below, p. 105.

Curiously enough, the incompatibility of these observations with the assumption of the guiding principle is not always clearly recognized. Yet, rightly understood, this observation that consciousness is a phenomenon occurring not in connection with movement, but at the point of inhibition of overt behavior, becomes of utmost importance for a statement of the psychical.

It is unfortunate that a clear-cut distinction is not always made between the factual statement of motor inhibition as a condition for the rise of consciousness and the theory of neural function. Absence of movement—at any rate—is frequently interpreted at once as a ‘closedness’ of neural paths. And the fact that consciousness is noted to arise when there is cessation or absence of movement is often treated as if it necessarily committed us to the theory that it is the immediate correlate of activity at the point of the ‘closed’ or ‘difficult’ synapse. It is needful, therefore, to distinguish between the statement of the factual relationship of consciousness to the phenomena of inhibition and the theory of the relationship of consciousness to neural function. It is the former, and not the latter, relationship that interests us here.

Binet remarks to the point that with slight exaggeration one might say that “toute la vie psychique . . . depend de cette suspension de l’activité motrice; les actes réels sont remplacés par des actes virtuels, des attitudes.”³²

Angell writes as follows: “It may be asserted that consciousness in one or the other of its forms normally appears and participates only in such activities as can not be efficiently executed by the hereditary reflexes and acquired automatisms.” . . . “Obviously in the case of the infant there can be at the outset no acquired habits and it seems reasonable therefore to assume that conscious activities emerge at the point where reflex acts are found inadequate to meet the needs of particular situations.” “If the reflexes and the automatic acts were wholly competent to steer the organism throughout its course, there is no reason to suppose that consciousness would ever put in its appearance. Certainly we never find it obtruding itself where these conditions are observed, except in pathological instances.” In his chapter

³² Binet, A., *L'année psychol.*, 1911, xvii, 24.

on *impulse* he says that it is true that "left to itself, any mental condition would convert itself at once into some kind of muscular movement," but "this fact must not, however, be interpreted as meaning that all states of mind reveal these motor consequences in equal measure. It requires no elaborate demonstration to know that we are most distinctly cognizant of the impulsive nature of this reaction when for any reason its expression is *hampered* or *checked*. But the impulse to act, as such, we are hardly aware of in any genuine sense, unless something impedes the impulsive movement."³³

To these citations from Binet and Angell we might add many more from Marbe, Mayer, and Orth, who find specific modes of consciousness peculiar to frustrated, hampered, checked, or inhibited activities in connection with their study of the thought processes. And Mead,³⁴ in a suggestive paper, which, unfortunately, does not develop a method, even makes the process of inhibition *the* subject-matter of the science of psychology. "The statement of the conflict of an impulse with a coördination of impulses and the inhibition of these impulses will be a scientific treatment of the psychical."

While these writers may serve to indicate that the psychologist at times finds his problem at the point where consciousness arises in connection with some sort of inhibition, it must be said that he has yet to formulate it more definitely with reference to the different types of inhibition. It therefore becomes one of his tasks to discover just what types of inhibition represent conditions for the rise of consciousness, and to seek to correlate different types of consciousness with these different types of inhibition.

Not all inhibitions, Sherrington points out, are muscular affairs, in the sense that antagonistic muscles are contracted,—some are 'central' affairs. Some of these central inhibitory functions he places more specifically in the motor centers, others in the afferent neural mechanisms. Added to these is the possibility

³³ Angell, J. R., *op. cit.*, 363-364.

³⁴ Mead, G. H., The Definition of the Psychical, *The Dec. Pub. of the Univ. of Chicago*, 1903, iii.

of another type of 'peripheral' inhibition, that is not touched upon by Sherrington. It arises not by reason of the mutual inhibition of simultaneously contracted antagonistic muscles, but by reason of the *peripheral* relation of sensory and motor mechanisms as when the reflex attentional adjustment of a sense organ to a certain stimulus raises the threshold for all other stimuli and lowers it for the specific response to the given stimulus. This type of inhibition was noted already by Cabanis³⁵ who thus anticipates Dewey's conception of the 'organic circuit' in which the present response determines sensation as it shall be a moment hence.

Some of these types of inhibition are peripheral affairs and may be *directly* observed as a definite kind of motor response resulting from contraction of antagonistic muscles, and these would thus constitute the content of a 'behavior' that may be correlated with certain forms of stimulation, as was done by Sherrington. Others, however, are not peripheral but central; inferentially they are functions of the activity of the nervous system, factually they are given as modifications of consciousness. They are not directly 'expressed' in muscular response at all. It is significant that Watson in his book on *Behavior* refers only in passing to the phenomenon of inhibition, and lists it not at all in his index. . . . Now if it be true that conscious processes occur particularly in connection with these inhibitions, then a complete account of the life-process of the organism will require not only a statement of the behavior that may occur in response to stimulation, but also a statement of these conscious processes that occur when the stimulus produces no motor reaction, but rather an inhibition of movement.

In allowing one of its most significant observations, *viz.*, that consciousness is a phenomenon in some way related to inhibition, to be obscured by this unfortunate emphasis upon the 'law' of dynamogenesis as a universal principle, psychology has neglected one of its chiefest opportunities for arriving at a fruitful functional statement of consciousness.

³⁵ *Oeuvres complètes*, 1824, iii, 152 f.

VI. CONCLUSION AND SUMMARY

The principle of dynamogenesis has, psychologically, no intrinsic relationship to that Platonic conception of mind which emphasizes stimulus and sensation and the patterning of consciousness in various types of mental activity. For such a view the principle is an importation from physiology. . . . It is, on the other hand, enthusiastically espoused by those who hold what we have called the Aristotelian point of view in psychology.

In its physiological form, the principle of dynamogenesis maintains that neural discharge into muscle and gland is the primary and universal effect of stimulation. But our study has convinced us that these effects are neither universal nor primary. The immediate and direct effects upon the central nervous system are quite as important as the motor consequences. These central effects are, as we have shown, of three general kinds: *viz.*, (1) the *priming* of the individual arcs, (2) the initiation of reflex *inhibitions*, and (3) the *organization* of neural systems throughout the brain by means of mutual inhibitions and facilitations.

On the side of mind, we do not mean to deny that the fact of motor discharge is of great importance for those central processes which form the immediate conditions of consciousness. We do, however, mean to affirm (1) that consciousness does not reveal itself as "motor," but that, on the contrary, it arises in conjunction with the inhibition of movement; and (2) that its dependence upon neural organization,—which involves priming, simple inhibition, and the functional integrity of the whole central organ,—is quite as essential and as significant for psychophysical doctrine as its dependence either upon stimulus or upon motor response.

Although we reject, therefore, the principle of dynamogenesis, we must admit that its exponents have, in their insistence upon central inhibition as the essential condition for consciousness, unintentionally suggested a satisfactory substitute for their original doctrine; and rightly understood, this observation that consciousness is a phenomenon occurring, not in connection with movement, but at the point of inhibition of overt behavior, becomes of the utmost importance for a statement of the psychical.

THE PSYCHOLOGICAL ANTECEDENTS OF PHRENOLOGY

By MADISON BENTLEY

- I. The foundation of Gall's system.
- II. The influence of the French sensationalists.
- III. The influence of faculties and of German empirical psychology.
- IV. Gall's doctrine and modern psychology.

Dr. Franz Joseph Gall, a contemporary of the poet Goethe, was the founder of phrenology.¹ He is to be numbered among those brilliant and aggressive souls who create with like facility enemies and friends, who attract the reverent admiration of disciples as they attract the fires of denunciation, and who establish schools and creeds under the frown of emperors and flourish under the ban of episcopal authority.

Such men are difficult to measure. The emotional standards of their times either dwarf or exaggerate them. Only history can set them in just perspective; because history alone discovers their antecedents, traces their divergent course from the broad paths of tradition, and marks the impression which they leave upon men and upon knowledge. In the case of Gall we now know with some exactness how the man stood related to his own time, and we also know, in part, the influence which his doctrine has since exerted upon psychology, nervous anatomy, and the differential study of character. But the intellectual antecedents of his famous doctrine still remain in the obscure archives of science and philosophy. The elucidation of them is the task of the present essay.

I. THE FOUNDATION OF GALL'S SYSTEM

To understand Gall, then, it is as necessary to go behind the contempt of those who place all phrenologists with the students

¹Gall was born in Tiefenbrunn in 1758: he died in 1828. P. J. Möbius (in "Franz Joseph Gall"; *Ausgewählte Werke*, vol. vii, 1905) gives biographical sources and a short sketch of his life and writings.

of alchemy, palmistry, and astrology as it is to set aside the educational and moral constructions which have been shabbily built upon his doctrines of cerebral physiology.

The practitioners of phrenology have long been accustomed to invoke Gall's doctrine as a scientific sanction for their half-magical art of characterology; but their own popular expositions have, naturally enough, laid undue emphasis upon cranial peculiarities and the alleged significance of these in divining moral qualities and individual traits. These exaggerations and distortions of Gall we must ignore as we hope to do justice to the founder.

Gall was himself led in youth—so much we must acknowledge—to believe that certain facial and cranial features were symptomatic of mental traits.² Moreover, he seems always to have been interested in the determination of character and of mental capacity. Nevertheless, these practical issues may reasonably be regarded as secondary to his scientific doctrine. And in our historical quest the main enquiry will be directed toward the principle of psychophysical dependence which underlay the founder's whole system,—a principle which has steadily grown in importance with the empirical development of psychology and of the biological sciences.³

As applied by Gall, this principle alleged the existence of a

²Gall, F. J., *Anatomie et physiologie du système nerveux en général, et du cerveau en particulier, avec des observations sur la possibilité de reconnaître plusieurs dispositions intellectuelles et morales de l'homme et des animaux, par la configuration de leurs têtes*, vol. i, 1810 (Paris), p. ii (pre-face). The entire work includes four volumes of text and a volume of plates, and appeared during 1810-1819. The first two volumes (1810, 1812) Gall wrote in collaboration with his pupil and disciple, G. Spurzheim. This compendious publication lays the foundations of phrenology. The later work of Gall, *Sur les fonctions du cerveau, etc.*, 6 vols., Paris, 1825, is not a mere reproduction; it omits the descriptive anatomy and the plates and it includes much new critical material.

³Broca, Gratiolet, Déjerine, Pierre Marie, Möbius and other neurologists have commended Gall's use of this principle. Cf. Blondel, Ch., *La psychophysiologie de Gall; ses idées directrices*, Paris, 1914, 3-8. "La psychophysiologie générale de Gall," agrees Blondel, "se détache donc naturellement du reste du système, et nous nous croyons, par conséquent, en droit de limiter à cet objet notre étude" (15).

number of separate and distinct cerebral organs, which stood in functional relation to the several capacities and traits of the human and the animal mind. These organs, which exceeded twenty-five in number, were innate and heritable, although their development rested, in part, upon the exercise of function during the life-time of the individual.

Gall's method of investigation was empirical. He was a shrewd observer, and he seems to have been cautious in generalization.⁴ He examined the heads of men of talent and of genius, and the heads of the criminal, imbecile, and insane, making measurements or taking casts, and, if fortune favored him, adding the skulls to his large collection; he compared successive generations for common traits; he noted the mental and physical peculiarities of various animals, and he observed and dissected a great number of brains.⁵ He insisted—against many authorities and classical examples and on grounds of comparative physiology—that the neural pathways must be traced from below upward and not by slicing down from the vertex to the lower centres. By multiplying observations and experiment he sought to divide off the accidental from the essential and then, by generalization, to establish principles and laws.

So much by way of reference to the problem and the method of Gall is necessary if we are to view his work in the light of antecedent systems and doctrines. To his predecessors we now turn.

No one familiar with the history of psychology would seriously contend that the fact of the bodily dependence of mental phenomena awaited the discovery of an anatomist at the beginning of the nineteenth century. We readily trace psychophysical

⁴ Möbius (p. 5) quotes a contemporary, W—r, who wrote in 1802: "Auf-fallend ist es, wie langsam Gall in seinen Ueberzeugungen seinen eigentlichen Beobachtungen nachschreitet. Viele Behauptungen stellt er noch als Frage auf, zu deren Bejahung ihn doch eine beträchtliche Menge von Thatsachen berechtigen. Er ist unermüdet in Befragung der Natur."

⁵ In 1802 he was said (Möbius, p. 6) to possess over three hundred skulls of persons whose mental characteristics he knew, and one hundred and twenty casts of distinguished living persons. In subsequent years these collections were largely increased. Cf. Gall, *Anatomie*, etc., 1810, i, 27.

doctrines to the Greek physicians and philosophers, and we halt there, in all probability, only because we lose the thread of tradition. Were the historical gaps filled in, we should doubtless follow the uninterrupted lineage of these doctrines straight back to those early times in which men failed clearly to formulate a distinct difference between mental and physical existences. If our historical enquiry is to be significant, it must leave the paths of general psychophysical history and discover the appropriate antecedents of the special and peculiar form of the principle of dependence which was adopted by the founder of phrenology.⁶ These appropriate antecedents we look for first among the French sensationalists of the eighteenth century,⁷ and secondly among rationalistic and empirical systems current in Germany during the same period.

II. THE INFLUENCE OF THE FRENCH SENSATIONALISTS

The sensationalistic doctrine of the French school, with which Gall was familiar,⁸ was in the main an acceptance or a modifica-

⁶Gall himself bases his doctrine upon the following presuppositions: "(1) que les qualités morales et les facultés intellectuelles sont innées; (2) que leur exercice ou leur manifestation dependent de l'organisation; (3) que le cerveau est l'organe de tous les penchans, de tous sentimens, et tous les facultés; (4) que le cerveau est composé d'autant d'organes particuliers qu'il y a de penchans, de sentimens, des facultés qui diffèrent essentiellement entr'eux." *Sur les fonctions du cerveau, etc.*, 1825, i, pp. vi and vii. Cf. *Anatomie, etc.*, 1818, iii, 364. Among the anatomists and the physiologists of the time the doctrine of equivalent function, later brilliantly supported by the impressive experiments of Flourens seems to have been in vogue; although Gall gives a respectable list of men who had contended for localisation. *Anatomie*, ii, 356-364. Willis had recognised the principle of cerebral localisation, and it appears (H. C. Bastian, *The brain as an organ of mind*, New York, 1887, 514) that he had been known as the "father of phrenology." It is interesting to find Boerhaave, who had exerted (possibly through Van Swieten, his disciple) a powerful influence at Vienna, contending for diverse seats for "apperception" and imagination on the ground of the separation of these faculties in sleep (Gall, *Anatomie*, ii, 361). Gall was, however, pretty certainly the first to make strict localisation an empirical and, as he thought, a demonstrable hypothesis, stripped of metaphysical implications.

⁷For an examination of the psychologists of this group the author is indebted to Miss Ethel Sabin, fellow in philosophy, University of Illinois.

⁸It is probable that Gall was familiar with this doctrine long before he left Germany and took up his residence in Paris (1807). Condillac's *Traité*

tion of Locke. Among the exponents of this view, those most often and most respectfully mentioned by Gall are Condillac, Bonnet, and Cabanis. Etienne Bonnot, Abbé de Condillac (1715-1780), the friend of Diderot and Rousseau, did most to establish in France the philosophy of Locke; although Locke's views had been introduced, in the first instance, by Voltaire. Charles Bonnet (1720-1790) was a scientist of note whom failing eye-sight drove to the solace of philosophical reflection. He follows Condillac in the doctrine of sensation, which they both owe to Locke, and he follows him also—independently, as it seems—in the famous use of the statue to illustrate the nature of sensation. Pierre Jean George Cabanis (1757-1808) was a French physiologist of considerable reputation, famous as physician to Mirabeau in his last illness.

In the formulation of sensationalism by these three contemporaries we find an important thread of Gall's psychology. Let us look first to Condillac, since Condillac is the first and most important of the three. In his "Essai sur l'origine des connoissances humaines" (1746),⁹ Condillac accepts Locke's explanation of the double source of knowledge in reflection and sensation. Sensation, he maintains, is the material of our knowledge, and reflection and the other operations organizing this material, are the instruments of knowledge. But in the most important of Condillac's philosophical works, the "Traité des sensations," we find the disciple turned critic, rejecting Locke's theory of reflection. Sensations alone, he contends, are sufficient to explain knowledge. He now maintains that "the principal object of this work is to show that all our knowledge and all our faculties derive from sense or,—to speak with greater precision,—from sensations." In further criticism of Locke, Condillac declares that much that is significant about judgments has escaped his predecessor, for Locke supposes that the activities of the soul

des sensations was translated into German in 1780, Helvétius' *De l'esprit* in 1760, 1784 and 1787, and two of the essays of Bonnet about the same time. (Cf. Dessoir, M., *Geschichte der neueren deutschen Psychologie*, 1. Hlbbd., 2. Aufgabe, 1897, 128-30.)

⁹ *Oeuvres complètes* (vols. 23), Paris, 1798. Tome i, 19, 517.

participate in an innate quality, reflection, with no suspicion that they owe their single origin to sensations.¹⁰ In order separately to study sensation, Condillac imagines a statue equipped with a nervous organism which is ready to act but which has never acted. It is living, for it has a soul or mind, although it has never received an idea. Then upon the passive, waiting statue,—an obvious elaboration of Locke's *tabula rasa*,—the sensation of smell, the simplest of all sensations, is first allowed to play. This unmixed sensation of smell completely fills the psychic chambers as the light of a small wax taper may permeate an otherwise dark room;—if we may interpret metaphor by metaphor. The sensation of smell, like the light, is the only thing present. By the addition, then, of other sensations, this follower of Locke proceeds to reconstruct, without the overt use of any other materials, the whole series of mental phenomena.

In abolishing "reflection" as an organizing principle among ideas, Condillac should, in logical consistency, have reached Hume's sceptical conclusion that there is no uniting principle, that mind is a mere "heap of impressions." Gall observing either with more acumen or from a different perspective saw this difficulty and offered a solution. It was that mind is not only compounded but also organized and that there exists a material basis for the organization of mind just as truly as there exists a material basis for the sensations themselves. Again he says: "Bacon, Locke, Hume, Helvétius and Condillac found themselves obliged, in order to comprehend in some manner the possibility of the functions of the understanding, to have recourse not only to the senses which certain of these authors have so greatly exalted, but to a recognition of the association of sensations, or to attention, or to experience, or to reflection, or to induction. Although they have at times contradicted each other, they have nevertheless perceived that none of the faculties which we have just enumerated could appertain to any one of the senses. But if, in this life, no faculty at all could exercise itself without a material condition,—as we shall later prove beyond a doubt,—then there must of necessity be presupposed a material basis for

¹⁰ *Oeuvres*, tome iii, 3, 6. This work seems to have been published in 1754.

the exercise of the intellectual faculties. The investigation of those organs through which animals and men receive their material impressions of the external world has always been regarded as very important. Will it be less interesting, less noble, to try to discover the organs of the superior faculties of the spirit?"¹¹ This quotation offers the key to Gall's whole system. It marks the point at which he breaks with this doctrine taken in its strictest form. Yet his purpose is clearly sensationalistic in its nature; it is to fill a gap in this doctrine and to answer a question which is distinctly sensationalistic in origin. He proposed to give to the functions of the brain the same degree of certitude as to the functions of the sensory apparatus. Much as we have seen Condillac explaining the growth of knowledge by the gradual addition of new senses, so we hear Gall declaring that the "faculties of the soul" develop in correspondence with the development of their appropriate organs in the brain. The doctrine of faculties appears, then, as something imposed upon the groundwork of Gall's sensationalism. He seems never to question that the sensationalists are giving an account which is correct so far as it goes.¹²

In Bonnet's psychological works¹³ we find a resemblance closer,—in some respects,—than Condillac shows to the attitude of Gall upon the matter in question. Bonnet tells his readers again and again that man is a mixed being, in part physical and in part mental. Ideas come only by the intervention of the senses, and even the most abstract notions derive from the same source. It is in the body and by means of the body that the soul

¹¹ Gall, *Anatomie*, etc., 1810, i, 231-232.

¹² We cannot, of course, credit to Gall the discovery that the nervous system is, to a high degree, functionally integrated and unified. Functional interaction was empirically demonstrated at a much later time; although Cabanis (who wrote before Gall) firmly believed that "thought" depends upon the "intimate organisation" and the "integrity" of the brain. *Rapports du physique et du moral de l'homme* (1788—), tome iii, 189, in *Oeuvres complètes de Cabanis* (vols. 5), Paris, 1823-25.

¹³ *Collection complète des œuvres de Charles Bonnet* (vols. 18), Neuchâtel, 1779-1788. The principal psychological volumes are *Essai analytique sur les facultés de l'ame* (1759), tomes xiii, xiv; *Essai de psychologie* (1754), tome xvii; and *La palingénésie philosophique* (1769), tome xv.

acts. We must, he says, always return in our consideration to the physical as the first cause of all the experiences of the soul. Gall is equally insistent upon explaining mind by reference to the body;—or rather more insistent, since it is the very heart of his theory. Are we in a better position, he asks, to explain hunger and thirst than thought? Although we can find no physical substance to be called hunger and thirst in the digestive tract, we still maintain that they are inside of us. Then why not admit, when we can find no physical traces of houses and trees in the eye and still localize vision there, that thoughts and ideas are in a similar manner dependent upon the brain?

The empirical tendencies in French psychology appear quite as strongly in Cabanis, the surgeon and physician, as in Bonnet. Sensibility is, with Cabanis, the final term. The sense organs on the outside of the body furnish the materials for reason, the organs within, the materials for the instinctive life. Innate needs account for the faculties. The mental constitution is determined by the physical; although education is able to change both mind and body. The diverse functions of the brain are to combine and to rearrange impressions, to attach signs, and so to produce thought.¹⁴

In these declarations we find the French sensationalists, as well as Gall, approaching the problem of mental organization. They seem, moreover, to be in essential agreement. The disagreement lies not in principle but in emphasis. The French sensationalists look to the structure of the brain and nervous system to account for what they call the diversity of sensations and the unity of consciousness, and they make attention, desire, volition, memory, and even judgment, the result of the combination in the brain of sensory excitations. Gall, on the other

¹⁴ "C'était par Locke que devait, pour la première fois, être exposé clairement et fortifié de ses preuves les plus directes cet axiome fondamental, *que toutes les idées viennent par les sens ou sont le produit des sensations.*" *Oeuvres*, tome iii, 11. Gall remarked in precisely the same spirit that "il est impossible au naturaliste de douter plus long-temps que, dans cette vie, l'esprit ou l'ame a besoin d'instrumens matériels, et que ceux-ci sont multipliés et diversifiés, suivant que les facultés de l'ame sont plus variées et plus nombreuses." *Anatomie*, 1810, i, 10.

hand, does not rest in sensation but exalts those integrative functions which he calls the "higher faculties" and which possess, as he thinks, organs as strictly localized as are the organs of sense.

Gall himself was not unaware of his close relation to the sensationists, and he believed, moreover, that they too were tending toward some theory of integrative faculties. Of Bonnet he says that his predecessor found in the brain fibres with particularized functions which could be likened to his own cerebral organs. Moreover, he recalls that Bonnet also held that any one who should thoroughly understand the structure of the brain would be able to read all that passed there "as in a book."¹⁵ Finally, he says, the time is not far distant when, convinced by the evidence, we shall agree with Bonnet, Condillac, Herder, Cabanis, Prochaska, Sömmerring, Reil and others that all the phenomena of animate nature are based on the organism in general and all intellectual phenomena on the brain in particular.¹⁶

That Bonnet at least was working in the direction of faculties appears in other instances than those noted by Gall. This trend is clearly seen in his exposition of the benefits of education,¹⁷ which, by the way, is almost identical with Gall's theory, of which the followers of phrenology today make capital. Both believe that by the exercise of the organs of the "higher senses,"—fibres for Bonnet, cerebral areas for Gall,—a superior power and strength will accrue to these organs and thus the "higher" nature will gain control over the lower.

¹⁵ Gall, F. J., & Spurzheim, G., *Recherches sur le système nerveux en général, et sur celui du cerveau en particulier; mémoire présenté à l'institut de France, le 14 mars, 1808; suivi d'observations sur le rapport qui en a été fait à cette compagnie par ses commissaires*, Paris, 1809, 248. On the same page, the authors remark that Herder, also, had conceived the idea of "la pluralité des organes intellectuels."

¹⁶ *Ibid.*, p. 273.

¹⁷ Bonnet, Ch., *Oeuvres*, etc., tome xiii, (*Essai analytique sur les facultés de l'ame*), p. 516.

III. THE INFLUENCE OF "FACULTIES" AND OF GERMAN EMPIRICAL PSYCHOLOGY

We come now to the "faculties" themselves, as they appear in Gall and in his predecessors. The criticism of faculties which has come to be a tradition in psychology complains that the doctrine confuses description and explanation, that it uses such class-terms as thought, memory and will to stand for the causes or at least the empirical conditions of observed mental phenomena.¹⁸ There is no doubt that the logic of the doctrine is faulty. That is a spurious explanation which refers a fact to its class-name. A given instance of choice may be better understood as a fact when it is identified as an instance of will, but it is not thereby explained; and we know nothing further about the antecedents of an eristic outburst of temper after we have been told that the outburst is due to a faculty of combativeness.

Now the atmosphere in which Gall matured at Strassburg and Vienna was the atmosphere of faculties. Wolff had written his *Psychologia Empirica* in 1732, his *Psychologia Rationalis* in 1740, and among the defendants and critics of the Wolffian teachings had stood the names of Baumgarten, G. F. Meier, C. A. Crusius, and J. A. Eberhard. Gall spoke the language of faculties as naturally as we speak the language of organic evolution, of commercial barter, and of international strife. But notice also that Gall, the man of science, was constrained to use the doctrine of faculties in a manner that must seem to us peculiarly modern and familiar.

I mean that Gall-the-anatomist and Gall-the-follower-of-Condillac-and-Bonnet was bound to replace the empty causes of Wolff by the organic causes of anatomy and of sensationalism. Nothing is more evident in Gall's expositions of his doctrine than

¹⁸ G. F. Stout (*Manual of Psychology*, 1899, 103 ff) suspects that we condemn too harshly the doctrine when it merely refers "this or that state or process to a corresponding faculty without pushing the enquiry further so as to raise the question of causal explanation"; but it is surely just this vague intimation that the "reference" is an approach to explanation that makes the doctrine especially vicious and dangerous. Current psychologies are full of these half-faculties. Instances that come at once to mind are James's fiat, Wundt's apperception, Lipps's unconscious, and Angell's attention.

his attempt to realize Bonnet's hope that a thorough understanding of the structure of the brain should make that organ an open book to the psychologist;—should provide, that is to say, a complete organic basis, not alone for sensations but for all the more involved and elaborate functions of mind.¹⁹

In our search for the antecedents of Gall's theory, the strongly empirical trend in German psychology which appeared toward the close of the eighteenth century must not be overlooked. Crusius, who died (1775) just before Gall reached maturity, had rejected Wolff's potential faculties (*Vermögen*), the *nudae agendi possibilitates*, because they explained nothing. He substituted for them the forces (*Kräfte*) of thought, judgment, imagination, and the like, which he conceived as empirical powers of mind.²⁰ This revised conception of faculties, rather than Wolff's, seems to have been the view current in Gall's time. The physiological psychologist Karl Franz von Irwing (1728-1801) came a step nearer the position of the sensationalists in his declaration that the most abstract integration of ideas, as well as sensations themselves, found a basis in the fibrous structures of the brain. Over this "finer organization" the mind presided with its faculties of analysis, synthesis and comparison.²¹ Irwing's emphasis upon feelings and impulses, conceived as the springs of mental activity, leads naturally to Gall's doctrine that the faculties are innate, and that they appear throughout the development of the individual in the form of instincts, tendencies and aptitudes.

Gall's whole psychophysical system is plainly based upon heredity. The original nature of man furnishes his fundamental problem. It is natural, then, that both the Wolffian *nudae possibilitates* and the more empirical mental forces of his own day should have seemed, to Gall, to be vague and empty concepts.

¹⁹ Gall is careful to say (*e.g.*, *Anatomie*, i, p. xxv) that he does not pretend to *explain* the faculties by reference to cerebral organs; but he does find that the structures of the brain have a "necessary and immediate relation" to their functions.

²⁰ Crusius, C. A., *Entwurf der notwendigen Vernunftwahrheiten*, 3rd ed., 1766, 129, 130, 137.

²¹ *Erfahrungen und Untersuchungen über den Menschen*, Berlin, 2nd ed., 1777, i, 73, 88, 128, 419.

Putting together the crude psychophysics of Condillac, Bonnet, and the German physiologizing psychologists with his own superior knowledge of cerebral anatomy and of comparative physiology, Gall is led to insist that the sensory and motor centres in the cortex must be supplemented by other similar organs which provide the constitutional basis for the whole range of mind. It is, then, a logical consequence of his empirical methods which took Gall beyond will, attention, understanding, imagination, and the like general and abstract attributes of mind, and which prompted him to seek the particular and special impulses, memories, instincts, and capacities, actually to be observed in a given species or in a given individual.²²

IV. GALL'S DOCTRINE AND MODERN PSYCHOLOGY

Surely no time could be more favorable than our own to the appreciation of a man who insisted that education had been overdone, that man is not, as current belief made him, a blank volume to be written full by the schoolmaster, that character is not the product of environment; who insisted, on the positive side, that the psychophysical constitution is innate and that the springs of experience are to be sought in heritable structures with their inclinations and functions impressed upon them by racial history.

So long as we are content, as Gall was not content, vaguely to use "habit," "instinct," "past experience," and "neural arcs" as speculative or undefined terms of explanation, so long we cannot, with good grace, set Gall aside as a fantastic master of cranial prominences.

It is, of course, evident to us, after a hundred years, that the faculties and forces of the eighteenth century were not based upon a proper classification of observed mental functions,—the proper classification for which we still are searching. Some of them may indeed turn out to be inherited integers: we hear a good deal of "general intelligence," and geneticists have soberly affirmed that musical capacity represents a unit character; but

²² Gall's principles of analysis, by which he arrives at the fundamental forces, are given in *Anatomie*, etc., 1819, iv, 277-78.

the fate of faculties does not matter. The main point is that Gall took current psychology of both kinds, the German kind and the Anglo-French kind, and by conjoining it with a knowledge of the central nervous system which seems to have been decidedly superior to the neurology of his contemporaries, he tried to establish the bodily conditions of mental existence and of mental performance.

Surely we, in our day, can understand and applaud this attempt. So energetically do we try to do the same thing that we are prone,—unless we are balanced by historical perspective,—either to fabricate these organic conditions out of shreds of fact and speculation about arcs and synapses, or else, through biological and philosophical bias, completely to divest ourselves of psychological interests and to plunge headforemost into physiology and kinetic ecology.

Gall himself was zealous in his search for biological explanations; but his psychology, such as it was, he never forsook. His fixed conviction that mental processes and functions have a specific, not a general, dependence upon bodily processes running in heritable grooves we still maintain, although we now know (thanks to better scientific technique) that the brain does not show the kind of localizable functions that Gall—or, for that matter, that Paul Flechsig—believed in. But our own neurological knowledge is far from being adequate to the psychological facts. Current books and articles are full of neurological terms which give out, when sounded, a hollow ring. Whenever the weight of explanation is laid upon them there is danger that they, too, as much of Wolff's *vis repræsentativa*, will become mere names used to conceal ignorance.

To conclude, then, the founder of phrenology attacked the venerable problem of the organic conditions of mind. Mind, regarded from the more "active" side, he described in the terms of the native German psychology of his day, viewed from the more "passive" side (as the historical distinction runs), in the terms of the English and French sensationalists. Finding his clue in the organs of sense and their central correlates, he proceeded to dispose of the several functions or faculties, in a simi-

lar way. For Bonnet's specialized fibres, which had a transforming and integrative function, Gall substituted a large group of innate cerebral organs which corresponded—as he thought—to the mental talents and faculties. The historical importance of Gall touches not so closely the vagaries of his doctrine of phrenology as the fact that he sought empirically to integrate the psychological and anatomical knowledge of his time. Gall's problem is still in process of solution. At times it is evaded and at times it is distorted by the illicit use of mental or neurological faculties for which our own riper time offers no justification. Neither evasion nor distortion, however, is likely to advance the problem, which still requires a candid and empirical resolution.

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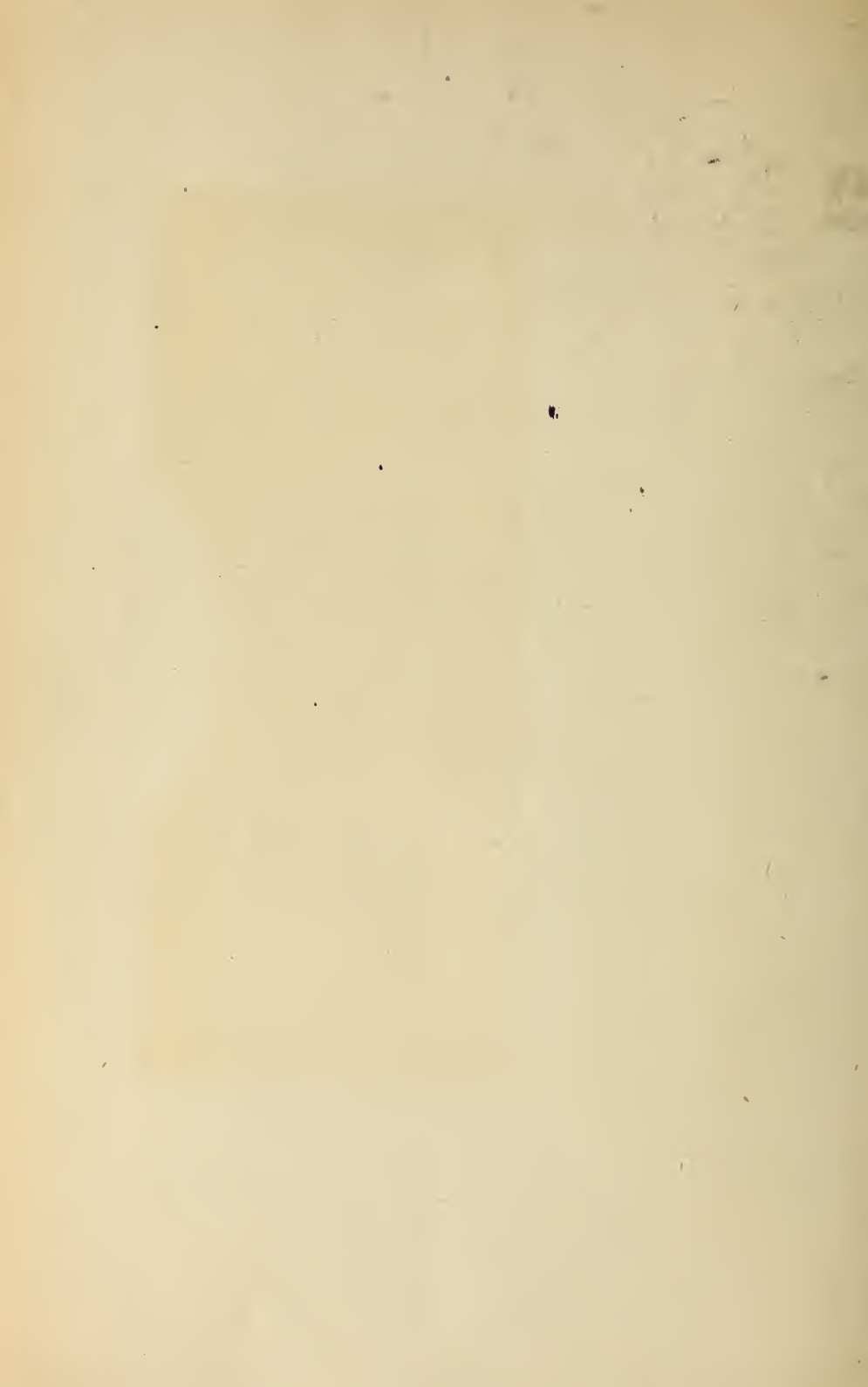
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