**Experimental Psychology.** — *"Intercomparison of some results obtained in the Investigation of Memory by the Natural and the Experimental Learning Method."* By Dr. F. ROELS. (Communicated by Prof. C. WINKLER).

(Communicated in the meeting of June 30, 1917.)

## II.

This paper is to be considered as a sequel to a similar communication published in the Proceedings of the Meeting of March 31, 1917 Vol. XXV p. 1309, and treats more particularly of the way in which the experimental method benefits the spontaneous tendency to use rhythm in learning by heart.

, For the method and the technique of our investigation we refer to our first communication (Ibid p. 1310).

It has long been known that, under the formal conditions of imprinting the material, rhythm tends largely to save repetitions and learning time. In daily life people are fully convinced of this; when they have to learn something by heart they use rhythm. In our experiments this tendency was strong with the natural method (I); with the experimental method (II) it is still noticeable, though less distinct. The following tables illustrate the rhythm of the first repetition of the series and also how the rhythm varies when the observer gets more familiarised with the material. The tables were constructed as follows: The duration of the repetition was split into groups, corresponding with the grouping of the material according to the rhythm used by the observer. Then I determined the time required for every syllable of the several groups by dividing the time required for every group by the number of the syllables it contained. From these timevalues the means were calculated. The intervals between two successive groups were determined from the time elapsing from the moment the last syllable of a group was pronounced to that on which the first of the following group was read. In short, we determined the mean time falling to every syllable of the group in a learning (l.) and a repetition (r) experiment; when compared with the time of the syllables consti-

tuting a group, the time required by the last syllable of a group indicates the rhythm used by the observer.

As to the tables illustrating the changes which the rhythm undergoes when the familiarity with the material increases, we have divided the number of repetitions required in learning and repeating a series into three groups of successive repetitions in the manner just described (Vide Proceedings of the meeting of 31 March 1917, Vol. XXV p. 1316). We then determined the mean 'time of every syllable of the various groups and intervals. R. and D. learned the series in three groups of four syllables. M. in two groups of six, each sub-divided into three groups of two. The stress fell invariably on the last of the two syllables. For the rest the tables are self-evident. All timevalues are expressed in seconds. Tables I, II, and III refer to the rhythm of the first repetition, while Tables IV to IX show the changes in the rhythm resulting from the observer's greater familiarity with the material.

When studying the data of Table I, II and III we see directly that our observers used rhythm already at the first repetition, with I as well as with II. M. alone, seems to make an exception with II; anyhow with him the time falling to the last syllable of the group is shorter than the mean duration of the remaining syllables constituting the group. With all our observers the rhythm with I undergoes a slight acceleration from the very beginning, which is rather peculiar. (M 0.82, 0.80; R 1.07, 1.04, 1.01; D 1.02, 0.99, 0.86).

While the mean time of the syllables, constituting the various groups, is gradually diminishing from the beginning to the end, the intervals decrease for R also (1.51, 1.40); for D however they remain approximately constant (1.43, 1.45). Since M learned the series in two groups of six syllables, no data referring to him could be procured.

In the repetition experiments the duration of every syllable is, as a rule, shorter than the corresponding duration in the learning-experiments. The same may be observed regarding the intervals, viz. a decrease with all observers. The acceleration of learning in the repetition-experiments benefits the group as well as the intervals. Just as the rhythm of the learning-experiments that of the repetition-experiments is also slightly quickened from the beginning towards the end, as the acceleration, observed in the learning-and in the repetition-experiments, follows, almost without exception, the order of the groups and the intervals, i. e. the farther group and interval are advanced in the series, the greater is the decrease.

With II there is in the learning-experiments a tendency to constantly increase the velocity while retaining the rhythm, as the

TABLE I. Observer M.

| Groups | | | Arithm mean | Mean deviation | Median |
|---|---|---|---|---|---|
| I (20) | 1st | 1 | 0.82 | 0.06 | 0.79 |
| | | r | 0 82 | 0.05 | 0.82 |
| | interval | 1 | 1.31 | 0.16 | 1.22 |
| | | r | 1.29 | 0.10 | 1.30 |
| | 2nd | 1 | 0.80 | 0.06 | 0.80 |
| | | r | 0.83 | 0.06 | 0.84 |
| II (20) | 1st | 1 | 0 96 | 0.05 | 0.94 |
| | | r | 0.94 | 0.06 | 0.92 |
| | interval | 1 | 0 84 | 0.09 | 0.80 |
| | | r | 0.88 | 0.12 | 0.80 |
| | 2nd | 1 | 0.80 | 0.09 | 0.79 |
| | | r | 0.78 | 0.06 | 0.76 |

mean duration of the syllables decreases in the order of the groups. (M 0.96; 0.80; R 0.94; 0.73; 0.72; D 0.98; 0.79; 0.75). The duration of the interval decreases a little with R; with D, however, it rather increases. With a single exception only (insignificant for R, more significant for D) the mean duration of the syllables is in the repetition-experiments smaller than the corresponding time-values of the repetition-experiments. The relation of the lengths of the intervals in the learning-, and in the repetition-experiments presents, in the main, no uniformity.

For M it decreases a little; for R the intervals increase, while for D the first interval increases, the second decreases. Irrespective of the exceptions just alluded to, it may here also be observed that the acceleration, which the learning undergoes in the repetition experiments, increases in the order of the groups.

A comparison of the values for the mean deviation is of some importance as it shows us in how far the rhythm, irrespective of the peculiarities alluded to above, (acceleration in the order of the groups etc.), remains constant. Now it is manifest that with I, as well as with II, in the learning-as well as in the repetition-experiments, the mean deviation is considerably greater for the intervals than for the groups. This goes to show that the observer sticks better to his rhythm in the groups than in the intervals. It also

TABLE II.  O b s e r v e r  R.

| Groups | | | Arithm. mean | Mean deviation | Median |
|---|---|---|---|---|---|
| I (20) | 1st | 1 | 1.07 | 0.10 | 1.06 |
| | | r | 1.02 | 0.09 | 1.02 |
| | interval | 1 | 1.51 | 0.40 | 1.67 |
| | | r | 1.31 | 0.35 | 1.45 |
| | 2nd | 1 | 1.04 | 0.12 | 1 |
| | | r | 0.95 | 0.10 | 0.95 |
| | interval | 1 | 1.40 | 0 40 | 1.55 |
| | | r | 1.17 | 0.38 | -1.27 |
| | 3rd | 1 | 1.01 | 0.12 | 1.03 |
| | | r | 0.88 | 0.11 | 0.90 |
| II (19) | 1st | 1 | 0.94 | 0.11 | 0.90 |
| | | r | 0.91 | 0.04 | 0.90 |
| | interval | 1 | 1.04 | 0.12 | 1 |
| | | r | 1.06 | 0.18 | 1.10 |
| | 2nd | 1 | 0.73 | 0.08 | 0.73 |
| | | r | 0.74 | 0.09 | 0.69 |
| | interval | 1 | 1.01 | 0.17 | 1 |
| | | r | 1.05 | 0.18 | 1 |
| | 3rd | 1 | 0.72 | 0.11 | 0.70 |
| | | r | 0.67 | 0.06 | 0.67 |

appears, that the mean deviation with I as well as with II, for groups and intervals is most times greater in the learning than in the repetition-experiment; in the latter the rhythm is consequently more constant. It also appears that the experimental method is more favourable to a constant rhythm than the natural method, the mean deviation being generally smaller with II than with I. With II it is especially the intervals that are more equalized.

Concerning the influence exerted on the rhythm by an increased familiarity with the material, we see in tables IV, V, VI, VII, VIII, IX in the learning-experiments with I, an increase of the time falling to every syllable of the group (1, 2 and 3) from A to C, i.e. in the case of greater familiarity with the material. For M and

TABLE III.  Observer  D.

| | Groups | | | Arithm. mean | Mean deviation | Median |
|---|---|---|---|---|---|---|
| I (18) | 1st | | 1 | 1.02 | 0.17 | 0.97 |
| | | | r | 0.90 | 0.16 | 0.87 |
| | interval | | 1 | 1.43 | 0.18 | 1.42 |
| | | | r | 1.31 | 0.20 | 1.32 |
| | 2nd | | 1 | 0 99 | 0.15 | 0.97 |
| | | | r | 0 83 | 0.17 | 0.77 |
| | interval | | 1 | 1.45 | 0.20 | 1.32 |
| | | | r | 1.24 | 0.21 | 1.20 |
| | 3rd | | 1 | 0.86 | 0.16 | 0.77 |
| | | | r | 0.75 | 0.18 | 0.72 |
| II (8) | 1st | | 1 | 0.98 | 0.09 | 1.02 |
| | | | r | 1.07 | 0.05 | 1.07 |
| | interval | | 1 | 1.04 | 0.19 | 1 |
| | | | r | 1.06 | 0.13 | 1.10 |
| | 2nd | | 1 | 0.79 | 0.05 | 0.80 |
| | | | r | 0.72 | 0.04 | 0.72 |
| | interval | | 1 | 1.13 | 0.19 | 1.10 |
| | | | r | 1.09 | 0.14 | 1.02 |
| | 3rd | | 1 | 0.75 | 0.07 | 0.73 |
| | | | r | 0.65 | 0.08 | 0.61 |

R there is always a progressive increase, viz. it is larger from B to C than from A to B, whereas for D there is in two cases a decrease, in one case an increase from A to B. The tendency of the rhythm to accelerate in the order of the groups is maintained also with a greater familiarity with the material. For M and D the time invariably decreases from the first to the last group; for R the time-values of the third group are always smallest, whereas those of the first are sometimes smaller, then again greater than those of the second.

In comparing the time-values of the intervals from A to C and from 1 to 3, again a certain uniformity is to be observed. With R there is without exception an increase from A to C; with M the

TABLE IV. Observer M.

| | | | | 1st group | interval | 2nd group |
|---|---|---|---|---|---|---|
| I | 1 | A | A.M. | 0.85 | 1.34 | 0.83 |
| | | | M.D. | 0.05 | 0 15 | 0.05 |
| | | | M. | 0.85 | 1.30 | 0.82 |
| | | B | A.M. | 1 | 1.41 | 0.92 |
| | | | M.D. | 0.08 | 0.15 | 0.07 |
| | | | M. | 1 | 1.42 | 0.91 |
| | | C | A.M. | 1.18 | 1.41 | 1.07 |
| | | | M.D. | 0.19 | 0.26 | 0.18 |
| | | | M. | 1.12 | 1 40 | 1.04 |
| | r | A | A.M. | 0.82 | 1.31 | 0.83 |
| | | | M.D. | 0.05 | 0.11 | 0.06 |
| | | | M. | 0.84 | 1.35 | 0.86 |
| | | B | A.M. | 0.99 | 1.47 | 0.93 |
| | | | M.D. | 0.09 | 0.26 | 0.11 |
| | | | M. | 0.99 | 1.37 | 0.96 |
| | | C | A. M. | 1.31 | 1.32 | 1.14 |
| | | | M.D. | 0.37 | 0.39 | 0.35 |
| | | | M. | 1.13 | 1.30 | 0.93 |

interval increases from A to B; from B to C it remains constant. With D the interval from B to C always increases; from A to B, however, it always decreases.

Leaving a few deviations out of consideration we can state that the first interval is either larger than the second or equal to it. The tendency of the second interval to decrease in relation to the first, which we found vaguely indicated in studying the tables relating to the rhythm of the first repetition, is thus seen to maintain itself all through the learning-process.

With I the data yielded by the repetition-experiments present the same uniformities, though less distinctly. A greater familiarity with the material induces a. progressive increase of the time falling to every syllable of the groups 1, 2 and 3 for M, to those of groups 1 and 2 for R. The time-values for D that formed an exception

TABLE V. Observer M.

| | | | 1st group | interval | 2nd group |
|---|---|---|---|---|---|
| | A | A.M. | 0.94 | 0.84 | 0.79 |
| | | M.D. | 0.06 | 0.07 | 0.04 |
| | | M. | 0.93 | 0.83 | 0.78 |
| I | B | A.M. | 0.93 | 0.85 | 0.79 |
| | | M.D. | 0.05 | 0.08 | 0.04 |
| | | M. | 0.93 | 0.81 | 0.79 |
| | C | A.M. | 0.94 | 0.82 | 0.83 |
| | | M.D. | 0.06 | 0.05 | 0.05 |
| | | M. | 0.92 | 0.81 | 0.82 |
| | A | A.M. | 0.94 | 0.88 | 0.80 |
| | | M.D. | 0.06 | 0.11 | 0.06 |
| | | M. | 0.92 | 0.86 | 0.77 |
| r | B | A.M. | 0.91 | 0.83 | 0.78 |
| | | M.D. | 0.05 | 0.08 | 0.05 |
| | | M. | 0.91 | 0.80 | 0.77 |
| | C | A M. | 0.95 | 0.85 | 0.80 |
| | | M.D. | 0.06 | 0.09 | 0.06 |
| | | M. | 0.94 | 0.81 | 0.77 |

(II spans the r section in the left margin.)

even to the general rule in the learning-experiments do not present anything uniform here either, except perhaps the average duration of the syllables of the last group, which is always smallest.

The accelerations of the rhythm in the order of the groups appears very distinctly in the repetition-experiments with R. and in a smaller degree with M. With R the decrease of the mean time for one syllable of the several groups, proceeds regularly from 1 to 3; with M a decrease reveals itself from A to B, while the time-value in A is about equal for the three groups. With D decrease in A is regular; in B and C we observe an increase from 2 to 3.

If we eliminate D, it appears that the second interval is apt to increase, in relation to the first as well from A to C as from 1 to 3. This is most distinct for R, who presents only a single exception. With M we observe an increase from A to B, a decrease from B to C, whereas the time-values for D are not uniform at all.

TABLE VI. Observer R.

| | | | | 1st group | interval | 2nd group | interval | 3rd group |
|---|---|---|---|---|---|---|---|---|
| | | A | A.M. | 1.07 | 1.55 | 1.04 | 1.40 | 1.06 |
| | | | M D. | 0.12 | 0.37 | 0.12 | 0.39 | 0.21 |
| | | | M. | 1.07 | 1.62 | 1.02 | 1.55 | 1.08 |
| | | B | A M. | 1.15 | 1.60 | 1.18 | 1.50 | 1.05 |
| | 1 | | M.D. | 0.18 | 0.45 | 0.14 | 0.53 | 0.21 |
| | | | M. | 1.10 | 1.75 | 1.13 | 1.50 | 1.07 |
| | | C | A.M. | 1.29 | 1.71 | 1.32 | 1.82 | 1.12 |
| | | | M.D. | 0.52 | 0.78 | 0.39 | 0.99 | 0 50 |
| I | | | M. | 1.05 | 1.40 | 1.14 | 1.45 | 0.84 |
| | | A | A.M. | 1.02 | 1.29 | 0.95 | 1.17 | 0.87 |
| | | | M.D. | 0.12 | 0.37 | 0.11 | 0.40 | 0.13 |
| | | | M. | 0.97 | 1.50 | 0.93 | 1.25 | 0.90 |
| | | B | A.M. | 1.04 | 1.44 | 0.98 | 1.75 | 0.68 |
| | r | | M.D. | 0.22 | 0 48 | 0.20 | 0.79 | 0.15 |
| | | | M. | 1 | 1.20 | 0.92 | 1.65 | 0.65 |
| | | C | A.M. | 1.16 | 1.56 | 1.08 | 1.57 | 0.79 |
| | | | M.D. | 0 42 | 0.74 | 0.24 | 1.14 | 0.22 |
| | | | M. | 1.07 | 1.60 | 1.17 | 1 | 0 93 |

Whereas in the learning-expiriments with I the time falling to every syllable of the group generally increases from A to C, hardly any regular increase is discernible with II. For M e.g. the time values remain nearly constant; for R they regularly increase in the first group from A to C, while in the second and in the third groups B is greatest. For D we always observe an increase from B to C, whereas from A to B the time alternately decreases and increases.

The acceleration of the rhythm in the order of the groups is very distinct with M and R. For both observers the decrease from 1 to 3 in A, B and C proceeds regularly. With D we observe the same in A and B; in C, however, an increase is observed from 1 to 2, a decrease from 2 to 3.

Whereas the intervals for M in A, B and C are about of the same length, with R and D we observe a regular increase from A

TABLE VII. Observer R.

| | | | | 1st group | interval | 2nd group | interval | 3rd group |
|---|---|---|---|---|---|---|---|---|
| II | 1 | A | A M. | 0.93 | 1.03 | 0.71 | 1.02 | 0.70 |
| | | | M.D. | 0.11 | 0.14 | 0.08 | 0.12 | 0 08 |
| | | | M. | 0.94 | 1.09 | 0.71 | 1 | 0.72 |
| | | B | A.M. | 0.87 | 1 51 | 0.70 | 1.10 | 0.59 |
| | | | M.D. | 0.13 | 0.57 | 0.09 | 0.08 | 0.09 |
| | | | M. | 0.87 | 1.37 | 0.67 | 1.09 | 0.57 |
| | | C | A.M. | 0.86 | 1.59 | 0.84 | 1 10 | 0 64 |
| | | | M D. | 0.22 | 0.62 | 0.20 | 0.17 | 0.11 |
| | | | M | 0 85 | 1.32 | 0.74 | 1.12 | 0.62 |
| | r | A | A.M. | 0.91 | 1.07 | 0.71 | 1.05 | 0.70 |
| | | | M.D. | 0.04 | 0.14 | 0.08 | 0.19 | 0.08 |
| | | | M. | 0 90 | 1.10 | 0.69 | 1.05 | 0.68 |
| | | B | A.M. | 0.86 | 1.17 | 0.65 | 1.14 | 0.61 |
| | | | M.D. | 0 10 | 0.23 | 0.06 | 0.18 | 0.10 |
| | | | M. | 0.85 | 1.20 | 0.64 | 1.15 | 0.64 |
| | | C | A.M. | 0.85 | 1.51. | 0.69 | 1 32 | 0.61 |
| | | | M.D. | 0.15 | 0.66 | 0.16 | 0.36 | 0.13 |
| | | | M. | 0.79 | 1.20 | 0 64 | 1.15 | 0.67 |

to C. The second interval evinces, here also, a tendency to decrease. Anyhow, with R it is, as a rule, smaller than the first.

Whereas in the learning-experiments with II we could hardly distinguish a regular increase of the mean time falling to one syllable of the several groups, in the repetition-experiments there is even a tendency to decrease from A to C.

Whereas with M the time-values for A, B and C are still about equal, with R we see already a tendency to decrease, and with D this tendency comes to the front unmistakably (only one exception). The decrease from 1 to 3 continues regularly; only D presents an exception.

The intervals in the repetition experiments with II increase regularly for R and D from A to C, for M they remain about constant. With R the second interval is always smaller than the first, with D it is always greater.

## TABLE VIII. Observer D.

| | | | 1st group | interval | 2nd group | interval | 3rd group |
|---|---|---|---|---|---|---|---|
| | A | A.M. | 1 | 1.45 | 0.91 | 1.45 | 0.81 |
| | | M D. | 0.18 | 0.14 | -0.14 | 0.20 | 0.07 |
| | | A. | 0.94 | 1.46 | 0.84 | 1.36 | 0.75 |
| | B | A M. | 0.90 | 1.40 | 0.87 | 1.36 | 0.83 |
| 1 | | M.D. | 0.17 | 0.14 | 0.15 | 0.19 | 0.12 |
| | | M. | 0.89 | 1 40 | 0.80 | 1.32 | 0.81 |
| | C | A.M. | 0.91 | 1.51 | 1.03 | 1.51 | 0.99 |
| | | M.D. | 0.18 | 0.33 | 0.27 | 0.38 | 0.48 |
| | | M. | 0.84 | 1.35 | 0.91 | •1.37 | 0.79 |
| | A | A.M. | 0.89 | 1.29 | 0.81 | 1.27 | 0.73 |
| | | M.D. | 0.16 | 0.19 | 0.16 | 0.16 | 0.17 |
| | | M. | 0.90 | 1.32 | 0.80 | 1.30 | 0.70 |
| | B | A.M. | 0.81 | 1.26 | 0.96 | 1.33 | 0.71 |
| r | | M D. | 0.16 | 0.18 | 0.23 | 0.30 | 0.13 |
| | | M. | 0.83 | 1.31 | 0.91 | 1.23 | 0.67 |
| | C | A.M. | 0.82 | 1.40 | 0.83 | 1.22 | 0.79 |
| | | M.D. | 0 14 | 0.48 | 0.19 | 0.23 | 0.21 |
| | | M. | 0.83 | 1.20 | 0.82 | 1.20 | 0.73 |

Considering the values of the mean deviation it appears that, just as we observed about the mean deviation in the first repetition it is considerably greater for the intervals than for the group, which proves that, just as with the first repetition, with I as well as with II, the rhythm is more constant for the groups than for the intervals all through the learning- and the repetition-process.

The rhythm adopted by our observers, in the learning- as well as in the repetition-experiments, with I and II affects the recitation in that here also the mean time falling to a syllable of a group, is generally shorter than that of the last syllable of a group, in other words the recitation also proceeds - in groups and intervals (See Tables X, XI and XII, which are constructed -in the same way as Tables I, II and III). We shall not enter into a discussion about the question whether this is owing to the direct tendency of the

TABLE IX. Observer D.

| | | | | 1st group | interval | 2nd group | interval | 3rd group |
|---|---|---|---|---|---|---|---|---|
| II | I | A | A.M. | 1.04 | 1.05 | 0.76 | 1.14 | 0.75 |
| | | | M D. | 0 06 | 0.17 | 0.05 | 0.15 | 0.06 |
| | | | M. | 1.07 | 1.01 | 0.75 | 1.13 | 0.73 |
| | | B | A.M. | 1.01 | 1.12 | 0.71 | 1.26 | 0.64 |
| | | | M.D. | 0.06 | 0.18 | 0.03 | 0.21 | 0.08 |
| | | | M. | 1 | 1.15 | 0.71 | 1.21 | 0.66 |
| | | C | A.M. | 1 | 1.28 | 0.72 | 1.28 | 0.68 |
| | | | M.D. | 0.09 | 0.31 | 0.08 | 0.07 | 0.09 |
| | | | M. | 0.99 | 1.33 | 0.73 | 1.26 | 0.65 |
| | r | A | A.M. | 1.09 | 1.06 | 0.69 | 1.12 | 0.65 |
| | | | M.D. | 0.04 | 0.13 | 0.04 | 0.14 | 0.07 |
| | | | M | 1.07 | 1.07 | 0.69 | 1.11 | 0.63 |
| | | B | A.M. | 1.02 | 1 15 | 0.68 | 1.15 | 0.71 |
| | | | M.D. | 0.06 | 0.16 | 0.05 | 0.13 | 0.16 |
| | | | M. | 1.01 | 1.12 | 0.67 | 1.16 | 0.71 |
| | | C | A.M. | 0.99 | 1.20 | 0.66 | 1.24 | 0.70 |
| | | | M.D. | 0.10 | 0.18 | 0.04 | 0.18 | 0.12 |
| | | | M. | 1.01 | 1.19 | 0.64 | 1.29 | 0.72 |

observers to recite with rhythm, or whether it results from the circumstance that the rhythm used in learning and repeating the series, the groups, being apperceptive wholes are easier to reproduce than the first syllable that forms the transition from the one group to the other. It is a fact that the rhythm of recitation bears a great resemblance to that of the learning and repetition-experiments. In the same way we notice in the recitation that, broadly speaking, the mean time falling to a syllable of the groups decreases in the order of the groups.

This is the case in the recitations of I and II and those of the learning- and repetition-experiments. The time required in the recitation of the last group of the series is remarkably short, a fact that we also noticed in considering the changes undergone by the rhythm in the learning process. In this respect the intervals are less uniform. This is not surprising if we consider that, as stated above, the first

TABLE X.  Observer M.

| Groups | | | Arithm. mean | Mean deviation | Median |
|---|---|---|---|---|---|
| I (20) | 1st | l | 1.36 | 0.44 | 1.15 |
| | | r | 1 17 | 0.29 | 1.06 |
| | interval | l | 2 | 1.26 | 1.25 |
| | | r | 2.15 | 1.05 | 1.78 |
| | 2nd | l | 0.97 | 0.31 | 0.87 |
| | | r | 0.82 | 0.13 | 0 77 |
| II (19) | 1st | l | 1.20 | 0.29 | 1 |
| | | r | 1.04 | 0.23 | 1.06 |
| | interval | l | 1.26 | 0.54 | 0.92 |
| | | r | 1.59 | 0.98 | 0.90 |
| | 2nd | l | 1 | 0.24 | 0.92 |
| | | r | 0 97 | 0.23 | 0.86 |

syllable of a group is much more difficult to reproduce than the others, in consequence of which the tendency to use rhythm interferes with reproduction-tendencies of different degree.

The process of the recitation agrees in another respect with that of the mean duration of the time falling to a syllable of one of the groups, viz. in this that with l as well as with II, the mean duration is almost without exception, longer in the learning-experiments than in the repetition-experiments. In a much smaller degree this also applies to the intervals, their duration being in most cases also shorter in the repetition- than in the learning-experiments.

The mean deviation is for all observers, with I and with II, in the learning- and in the repetition-experiments greater for the interval than for the groups, from which follows that here also the rhythm is kept up better for the groups than for the intervals.

The mean deviation being in the majority of cases smaller with I than with II it would seem that, broadly speaking, the natural method is more favourable than the experimental to an orderly recitation of the learned series.

## CONCLUSIONS.

1. With only a few exceptions all our observers used rhythm

TABLE XI. Observer R.

| | Groups | | Arithm. mean | Mean deviation | Median |
|---|---|---|---|---|---|
| | 1st | l | 1.03 | 0.30 | 0.96 |
| | | r | 1.10 | 0.39 | 0.90 |
| | interval | l | 1.91 | 1.16 | 1.45 |
| | | r | 1.68 | 0.95 | 1 20 |
| I | 2nd | l | 1.21 | 0.56 | 0.88 |
| (20) | | r | 0 97 | 0.28 | 0.83 |
| | interval | l | 1 42 | 0.73 | 1.20 |
| | | r | 1.02 | 0.38 | 0.90 |
| | 3rd | l | 0.82 | 0.41 | 0.58 |
| | | r | 0.73 | 0.25 | 0.65 |
| | 1st | l | 1.07 | 0.51 | 0.77 |
| | | r | 0.96 | 0.40 | 0.87 |
| | interval | l | 2 01 | 1.56 | 1.20 |
| | | r | 1.34 | 0 64 | 1 |
| II | 2nd | l | 1.31 | 0.96 | 0.43 |
| (19) | | r | 1.07 | 0.61 | 0.73 |
| | interval | l | 1.83 | 1.04 | 1.40 |
| | | r | 1.80 | 1.09 | 1.07 |
| | 3rd | l | 1.03 | 1.03 | 0.65 |
| | | r | 0.72 | 0.31 | 0.58 |

in the first repetition: i.e. the imprinting occurred already with the first repetition in groups and intervals.

2. The rhythm of the first repetition shows almost invariably the tendency to slightly accelerate in the order of the groups. With I (natural method) this quickening confers a benefit on the groups as well as on the intervals, both in the learning- and in the repetition-experiments, though in the latter less distinctly than in the former. With II (experimental method) this quickening is clearly demonstrable only for the groups. In the repetition-experiments the time-values of the groups and intervals are always smaller than the corresponding values in the learning-experiments. In the first repetition the experimental method is generally more favourable than the natural as to consistency in the rhythm; especially the duration of the in-

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TABLE XII.  O b s e r v e r  D.

| | Groups | | Arithm. mean | Mean deviation | Median |
|---|---|---|---|---|---|
| I (18) | 1st | l | 0.90 | 0.16 | 0.83 |
| | | r | 0.79 | 0.13 | 0.80 |
| | interval | l | 1.28 | 0.37 | 1.05 |
| | | r | 1.11 | 0.20 | 1.10 |
| | 2nd | l | 1.05 | 0.37 | 1.02 |
| | | r | 0.81 | 0.23 | 0.75 |
| | interval | l | 1.60 | 0.65 | 1.30 |
| | | r | 1.99 | 1.06 | 1 40 |
| | 3rd | l | 0.96 | 0.21 | 0.95 |
| | | r | 0.72 | 0.16 | 0.72 |
| II (8) | 1st | l | 0.99 | 0.37 | 0.82 |
| | | r | 0.80 | 0.15 | 0.77 |
| | interval | l | 1.43 | 0.55 | 1.25 |
| | | r | 2.36 | 1.24 | 1.80 |
| | 2nd | l | 0.91 | 0.42 | 0.66 |
| | | r | 0.66 | 0.17 | 0.60 |
| | interval | l | 1.66 | 0.98 | 1.07 |
| | | r | 1.50 | 0.74 | 1.35 |
| | 3rd | l | 0.79 | 0.39 | 0.65 |
| | | r | 0.90 | 0.69 | 0.47 |

tervals is generally more uniform with II, though here also the rhythm is as a. rule preserved better for the groups than for the intervals.

3. With respect to the changes in the rhythm with greater familiarity with the material, we observe that most often the time, falling to every syllable of the groups into which the series is divided, increases progressively as the observer gets more familiar with the material. The tendency of the rhythm to quicken in the order of the groups is kept up when the familiarity with the material increases. Barring an occasional deviation, the first interval is either greater than the second or equal to it. The tendency of the second to decrease, in relation to the first, as vaguely indicated already in the rhythm of the first repetition, is kept up all through the learn-

ing process. In the repetition-experiments the same similarities may be discerned. They are however hardly noticeable in en ploying the experimental method, though here also, with a greater familiarity with the material the rhythm is maintained better for the groups than for the intervals.

4. The recitation occurred in groups and intervals; the mean time falling to one syllable of the groups is here also in most cases shorter than that of the last syllable of a group.

With I and with II, both in the learning- and in the repetition-experiments the mean time falling to one syllable of the groups decreases in the order of the groups. The intervals are less uniform, which is not surprising, if we consider that the first syllable of a group is much more difficult to pronounce than the others, so that the tendency to use rhythm interferes with reproduction-tendencies in different degree.

In the recitation also the mean time, falling to one syllable of one of the groups is longer for the learning-experiments than, for the repetition-experiments with I as well as with II. In a much smaller degree this holds good for the intervals; nevertheless their duration is, in the majority of cases, shorter in the repetition- than in the learning-experiments.

The rhythm of the recitation is also kept up better for the groups than for the intervals. It seems moreover that the natural method is more favourable than the experimental to a rhythmic recitation of the learnéd material.

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