AN EXPERIMENTAL STUDY OF THE IMPROVEMENT OF MENTAL AND PHYSICAL FUNCTIONS IN THE HYPNOTIC STATE

By H. J. EYSENCK

From the Psychological Laboratory, University College, London

(1) Statement of problem

The debate as to whether there is or is not agenuine improvement in performance under hypnotism has been going on for several decades. In spite of the large number of experiments performed specially to settle this point, very little agreement seems to have been reached.

One reason for this unsatisfactory state of the problem is that the methods used by many investigators have not been uniform. Sometimes the methods used in the researches have not been stated at all, and when they are stated, they are often open to severe criticism.

These criticisms have already been fully discussed by Young (1925, 1931), Williams (1929) and Lichtenberger (1927). Young (1931) advises us to disregard almost all the researches done before the Great War; and this has been done in the following short discussion of the present state of opinion with regard to our problem.

Among the experimental workers who have taken up this question, we can discern two fairly well-defined groups. On the one hand are those who claim that there is a definite improvement of performance in the hypnotic state, as compared with the normal; Wells (1928) might be cited as maintaining that position.

On the other hand, there are those who claim, with Young (1925), that there is no real evidence for any such improvement; in fact, it is even suggested that the normal state may be superior to the hypnotized in this connexion. In view of this difference of opinion, a short review of the researches on which both sides base their conclusions may not be out of place.

Nicholson (1920) found that 'a very definite increase in muscular efficiency can be obtained by suggestion in the hypnotic state'. This was shown by 'an increase in the amount of work done', 'an increase of endurance' and 'a decrease in fatigue both subjective and objective'.

Nicholson was later criticized by Williams (1929) for failing to give suggestion in the waking state, thus introducing two changes at once in his experiment—hypnosis and suggestion. This criticism, however, can hardly altogether explain the results obtained by Nicholson.

Wells (1928), comparing the ability of one subject in the waking and the hypnotic state respectively by means of reaction times, memory, tapping, etc., came to the conclusion that on the whole the hypnotic performance seemed somewhat better than the waking performance. Results with memory tests were irregular, and no definite improvement was found here.

Dr M. Smith was good enough to show me the results of some experiments on retentivity in the hypnotic state, in which she had collaborated with Prof. McDougall. These experiments were never published, but the results were summed up by McDougall himself in his *Outline of Abnormal Psychology*: '. . . in the few experiments I have made along this line, I have failed to find evidence of increased retentiveness' (1926).

Lifschitz (1927, as quoted by Young, 1931) found that suggestion lowered the auditory threshold by 65 % in waking and by 1355 % in deep hypnosis. He worked with forty-one subjects.

Young's research (1925) is the most extensive and careful hitherto published. Using fifteen tests and twenty-two subjects, he came to the conclusion that 'on the whole, there is no noticeable difference between the normal and the hypnotic states in the abilities of normal persons in the fields of sensation, perception, finer discrimination, present memory (learning and retention), or physical work which does not involve fatigue'.

These conclusions would seem to contradict not only the results of several of the writers quoted above, but also the almost unanimous opinion of the great hypnotists. We will come back to a critical discussion of Young's research later on.

(2) Description of research[1]

The main subject in this series of experiments was a Mr R., a former schoolmaster, about fifty, who had been chosen because he fell into a deep hypnotic sleep very easily, and because the depth of his sleep varied little from experiment to experiment. By way of control, a number of the tests

[1] I wish to express my indebtedness to Mr Norman A. Brangham, who enabled me to secure the services of an excellent hypnotic subject, and whose experience as a hypnotist was of great value.

were also done by Miss L., a young lady of twenty-five. She also proved to be a good subject.

It may be objected that two subjects are not really sufficient in an experimental study of this kind. It must be admitted that a larger number of subjects would have been preferable; but there are one or two considerations which I would like to offer in extenuation.

Firstly, should the conclusions reached here have been at variance with the experimental findings of other investigators, I should have hesitated to publish them; but since actually they were largely in agreement with the results of others, I feel we have some reason for accepting them as substantially correct.

Secondly, the stress in this investigation was placed not on the number of subjects, but on the number of tests. Twice as many tests were used as had been used in any other research; and each test was repeated so often that even a small difference between the two states would have appeared clearly.

Nearly all the tests were done in the Psychological Laboratory at University College. Approximately 60 hr. were spent in giving the tests to Mr R. alone; about 10 hr. on testing Miss L.

Both subjects were in very deep hypnosis, with complete post-hypnotic amnesia (somnambulism). In the method of hypnotizing, the usual fixation-of-eyes method with verbal suggestion was followed. (In this, as in several other details, the procedure was the same as that adopted by Young (1925).)

Ordinary laboratory apparatus and test material were used, as described in the usual textbooks (Myers, 1931; Whipple, 1924). The actual tests given are described below.

With one exception, noted in the text, each experiment was completed in one session. Each experiment consisted of four 'runs', two normal, two with hypnosis, which were given in cyclic order. Half the time the order N–H–H–N was used, half the time the order H–N–N–H. This method would seem to guard against the influence of fatigue and practice as far as possible.

The highest possible performance was demanded at all times. Instructions were given at the beginning of each run; during the run the subject was neither urged on nor praised; after the run was over, the subject was praised, whatever his performance. (There were a few exceptions to this rule: when he noticed himself that he had done rather badly, praise would only have made him suspicious.)

Fraud, conscious or unconscious, is an ever-present possibility in experiments of this kind. The following considerations rather speak against the possibility of fraud in this series of experiments.

Firstly, Mr R. was not told the purpose of the research and he did not guess it himself till about half-way through the series. There is hardly any

difference between the results obtained at the beginning and at the end of the series.

Secondly, some of the tests in which improvement was shown make fraud quite impossible—except on the assumption that the subject possesses even more remarkable powers than he might be credited with if we take the results at their face-value.

Thirdly, in the memory tests, where 'cheating' is easiest, and where I had confidently expected a great improvement, there was no improvement at all.

Tests used

(1) Reaction times. Reaction times to sound, taken in thousandths of a second on the Hipp Chronoscope.

(2) Line drawing. To draw a line equal to a given line; standard 8 cm.

(3) Precision of movement. To move a metal stylus as far down as possible between two V-shaped wires without touching.

(4) Müller-Lyer illusion. The well-known double-arrow illusion.

(5) Colour equation. To equate two colour mixtures, measured in terms of the deviation from the correct mixture.

(6) The same, only the judgment is changed from 'same' (when the two colours are approaching each other) to 'different' (when they get more differentiated).

(7) Arm movement. Ability to repeat extent of passive arm movement; scored in terms of deviations from correct movement.

(8) Dotting. Dotting as rapidly as possible in squares, $\frac{1}{10}$ in., without touching the lines forming the square.

(9) Multiplying. The multiplication of two figures in Kraepelins Rechenheft for a specified period.

(10) Adding and subtracting. The subject is given a number to start with, he adds 2, subtracts 1, adds 2, etc.

(11) Cancelling. Crossing out certain letters from a large selection of letters printed on a special sheet.

(12) Adding. Adding two figures in Kraepelins Rechenheft.

(13) Bee-hive. A 'bee-hive' pattern is drawn on sectional paper; the subject is required to continue the pattern.

(14) Counting in threes; subject to count in threes on being given a number.

(15) Tapping. Number of taps in a given time.

(16) Sorting cards. Number of cards sorted in piles.

(17) Rings on pole. Time taken to put number of rings on pole.

(18) Weights in order. A number of weights to be graded in the correct order; scored in terms of deviations from this order.

(19) Writing SZ. The usual perseveration test.

(20) Steadiness of motor control. To hold a stylus in a number of holes of varying dimensions without touching; scored in number of times touched.

(21) Nonsense syllables; memory for nonsense material.

(22) Memory span for digits.

(23) Recognition of cards. Six cards are shown to the subject; then they are shuffled in with fifty others. The original six are to be picked out again. The cards contain drawings of geometrical shapes.

(24) Recognition test. The reverse side of an ordinary playing card is shown to the subject; the card is then shuffled in with ten others. The subject has to pick out the original card.

(25) Audiometer. The Seashore audiometer test for loudness discrimination.

(26) Discrimination of pitch. Seashore's record test.

(27) McDougall dotting test. Dots to be put into circles on a moving paper band; scored in terms of dots correctly put in.

(28) Dynamometer test of strength of grip.

(29) Recognition of dots. A card with a number of dots (between four and twelve) is exposed to the subject; he is required to state how many dots there are on the card.

(30) Time judgements. Subject asked to judge time intervals as equal to 5 sec., 10 sec., 15 sec. and 30 sec. Scored in deviations from correct time and in average length of time guessed.

(3) RESULTS

The detailed results for Mr R. are reported in Tables I–IV and in Fig. 1. Below we will discuss briefly each of these tables. Right from the start, however, it may be pointed out that an average improvement of almost exactly 33% over the normal was found in the hypnotized state. This average includes all tests except those mentioned on page 311. Miss L. showed almost exactly the same improvement.

In Table I are reported the results of seven tests which admit of the use of the critical ratio[1] as a means of deciding their significance. The critical ratios obtained vary from 3·4 to 6·5; in this connexion Guilford may be quoted: 'If the C.R. is at least 3·00, we may say that the difference is certain beyond reasonable doubt; if the C.R. is between 2·00 and 3·00, we may say that the difference is fairly certain' (Guilford, 1936). We may conclude

[1] The C.R. (or experimental coefficient) is the ratio of the observed difference to its standard error. It is calculated by the formula

$$\text{C.R.} = \frac{\text{diff.}}{\sigma_{\text{diff.}}}$$

and tells us how far below the average difference a difference of zero falls, in terms of sigma as the unit (Guilford, 1936).

then that the differences observed in these tests are significant beyond reasonable doubt.

This conclusion is strengthened, if such strengthening be needed, by the fact that all the variations are in one direction. The hypnotized state is superior to the normal in every single case.

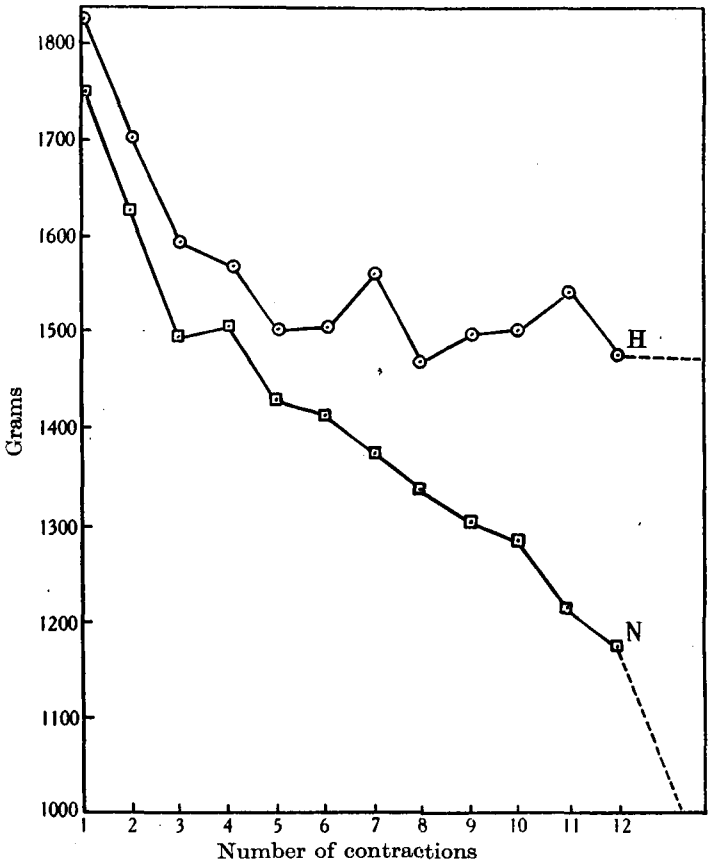

Fig. 1. Curves showing development of muscular fatigue in normal and hypnotized states.

Table I

Test	Average: Normal	Average: Hypnotized	S.D.-n.	S.D.-h.	Number	C.R.
Reaction times	264·8	206·6	93·6	50·6	100	5·5
Line drawing	9·7	8·6	0·836	0·775	100	6·5
Precision of movement	13·47	16·72	5·52	4·70	100	4·4
Müller-Lyer	5·85	3·00	3·16	2·93	40	4·1
Colour equation	24·5	17·5	10·6	6·8	40	3·5
Colour equation	12·5	6·8	9·36	4·91	40	3·4
Arm movement	4·8	2·1	3·72	2·23	100	4·3

Apart from the average performance being better in the hypnotized state, the variability, too, is less in that state than in the normal. This can be seen easily by comparing the standard deviations for the two states in the table; S.D.$_h$ is smaller in every case than S.D.$_n$. If we use the C.R. as a test of significance, we find that it varies between 5·7 and 0·3—the average being 2·5. As again the results all tend in one direction, this result too may be accepted as significant.

Table II shows a summary of those results where a C.R. could not be calculated, as we are dealing with totals, not with averages; hence only the percentage improvement can be given, which varies between 77% and 12%. Again there is an improvement in every test.

Table II

Test	Normal	Hypnotized	% improvement
Dotting	543	962	77
Multiplying	200	278	39
Adding and subtracting	58	94	62
Cancelling	322	414	29
Adding	689	884	28
Bee-hive	254	305	20
Counting in threes	81	91	12
Tapping	294	461	57
Sorting cards	195	225	15
Rings on pole	245	209	17
Weights in order	340	270	27
Writing SZ	345	404	17

An interesting fact, which may be of great importance, is that the simpler tests, such as dotting and tapping, show the greatest improvement. By 'simple' I mean most mechanical in this connexion, without wishing at the moment to enter into a discussion as to how we are to calculate the exact degree of simplicity of an experiment.

In this connexion it may be noted that Mr R. used to be a teacher of elementary mathematics, and that therefore addition and the other processes of arithmetic would assume a quite mechanical character for him. Naturally this fact would influence the 'order of simplicity' of the tests for him; indeed slight variations in that order are to be expected between any two subjects.

Table III shows how Mr R. improved in his time judgements under hypnosis. Again we notice the same phenomena as before—not only is the average (in this case the equivalent) better under hypnosis, but the spread, too, is much smaller. Of the figures in this table, each one is the result of twenty separate tests.

Table IV is practically self-explanatory. Each of the figures given for 'number of touches' is the sum of ten separate tests. The fact that the

Table III. *Time judgements*

Standard sec.	Sum of deviations		Equivalent	
	Normal	Hypnotized	Normal	Hypnotized
5	18·5	8·5	5·9	5·1
10	50·2	15·8	12·1	10·5
15	55·7	32·4	16·3	15·3
30	86·0	42·5	33·7	29·3

Table IV. *Steadiness of motor control*

Hole	Number of touches	
	Normal	Hypnotized
1	0	0
2	0	0
3	5	2
4	30	20
5	47	32
6	60	44
Average, 6 holes:	23·7	16·3

ratio normal/hypnotized is practically constant throughout the test (1·5 in every case) shows that the number of trials was sufficient to get a fairly regular and reliable answer.

Eight tests did not show any improvement in the hypnotized condition: Nonsense syllables; Memory span, digits; Recognition of cards; Recognition test; Recognition of dots; Audiometer test; Discrimination of pitch; and McDougall dotting test.

With one exception, the McDougall dotting test, all these are memory tests or discrimination (threshold) tests. The 'McDougall dotting test' the subject found very difficult indeed; both his observed behaviour and his introspections make this clear. If my theory that improvement varies with the complexity of the task is correct, it should serve to explain the fact that no improvement was found in this test.

The last test given to Mr R. was designed to show the course and development of fatigue in the normal and the hypnotized states. On ten separate occasions, the subject was asked to pull a dynamometer twenty-four times in succession as hard as he could, with rest pauses of 10 sec. between one pull and the next. The trials were alternatively 'normal' and 'hypnotized', giving a total of five trials for each of the two states. These trials for each of the states were averaged, giving one average for each of the twenty-four pulls in the normal, and one for each of the twenty-four pulls in the hypnotized state. To smooth out irregularities, the first and second, the third and fourth, the fifth and sixth, pulls were taken together, and so on for the rest of the twenty-four. The final twelve results are plotted in Fig. 1, each point representing the average of ten pulls.

Both curves, the normal and the hypnotic, show the usual waves of the ordinary fatigue curve, but they also show a great difference in their actual course. At no point does the N curve rise above the H curve: as time goes on, the distance between the two curves grows larger and larger, till it is about seven times as large as at the beginning.

The H curve hardly falls at all after the tenth pull of the twenty-four; the N curve goes on falling almost as steeply as ever. To amplify this difference, the subject was asked once or twice to go on after he had finished the ordinary run. The dotted lines in the graph show the result: in the normal state the subject is nearing exhaustion, in the hypnotized state he goes on, machine-like, without tiring.

This completes the summary of the results obtained from Mr R. As mentioned above, Miss L. did several of the experiments also, with results very similar to those of Mr R. Her average improvement was 41 %; in the corresponding tests Mr R. showed an improvement of 46 %. This rather striking similarity between the averages would seem to show that the results obtained from Mr R. were not exceptional, but rather representative.

Closely connected with the question 'Is there any improvement in the hypnotized state?' is the question 'Is there any improvement in the post-hypnotic state?' Koster (1928) has reported that the effect of post-hypnotic suggestion is somewhat greater than that of suggestion carried out under hypnosis. To test this conclusion, Mr R. was given seven of the tests he had done in the hypnotic state to do under post-hypnotic suggestion.

The resulting improvement on the normal state was 28 %; in hypnosis the improvement was 38 %. Owing to the small number of tests, this finding can have no great significance, but it may serve to show that this question is still an open one.

Discussion of results

On a previous page it was said that the results reached in this research did not contradict the results of other investigators, but rather tended to support them. How is it possible, the critical reader will ask, to square that statement with the fact that an average improvement of over 30 % was observed in the case of Mr R. and Miss L., whereas in Young's experiment, admittedly the most careful and scientific to date, no improvement was found?

Let us see if the disagreement is really as complete as it seems. In the first place, it must be remembered that Mr R. did not improve in all the tests he was given; the tests on p. 310 showed no improvement at all. It might be that Young's experiments were largely of a kind similar to those which led to negative results in this research also.

Indeed, we find that about half of Young's fifteen tests were tests of memory. Now neither McDougall nor Wells, in the researches quoted at

the beginning of this article, found any evidence of improvement in this sphere; and my own results are in entire agreement with that conclusion. Memory evidently is not one of the functions of the mind (if we may use such associationist language) which is improved by hypnosis.

Secondly, it would seem that several of Young's tests were too difficult to give positive results. I have tentatively suggested, in the discussion of my own results, that improvement decreases as difficulty increases. If this should prove to be the case, we would not expect the more difficult tests in Young's battery to give positive results.

Young himself seems to recognize implicitly the truth of this principle; he even offers an explanation substantially similar to my own. In comparing his test 5 ('Spelling backward'—where there is no improvement) with test 6 ('Saying the alphabet backwards'—where he finds a slight improvement) Young says: 'With a few repetitions of the alphabet backwards, a habit is formed. *The more mechanical saying of the alphabet may not disturb the hypnotic relaxation...*' (my italics).

There is some proof for the contention that this kind of test may be too difficult for use in hypnotic experiments. The 'Writing the alphabet backwards' test was given to Mr R. He showed only very slight improvement, his comment being: 'This is too difficult!'

Thirdly, Young finds no improvement in a discriminatory test—'Pressure of two hairs on skin'. Apart from the fact that this, too, is a rather difficult test, the result agrees with the fact that in my own battery only one of the threshold experiments gave a positive result, all the others showing no sign of improvement.

Fourthly, we have the dynamometer test, not as a test of fatigue, but as one of strength. Young finds no improvement under hypnosis; this experiment was repeated on Mr R. and again no improvement was noted. This can be seen, too, in Fig. 1—at the beginning of the experiment the two curves are very close together, showing very little difference in actual strength before fatigue sets in.

Fifthly, we have a test where we should definitely expect an improvement—the 'Steadiness control' test. Here it seems necessary to criticize Young's otherwise excellent study in two ways. For one thing, his data are not always analysed statistically in the best possible way, and, secondly, they are not complete enough in the form given to permit of such treatment by anybody else. In this, unfortunately, Young's study is the rule rather than the exception. Progress in this field might have been more rapid if a stricter statistical treatment had been adopted.

This test is a case in point. In comparing the scores of the hypnotized and the control subjects, Young finds that the hypnotized are on the average superior. His comment is: 'The low scores of the controls can be explained by chance on the basis of the small number of Ss.' 'If this small,

possibly chance difference. . . needs explanation, it may lie in the fact that this experiment. . . bordered lightly on a fatigue experiment.'

We cannot tell whether the difference is significant or not, as from the data given by Young no unambiguous result can be obtained; to do that we should need data not presented in the article. If, on the other hand, Young had given us the critical ratio of the difference we would know exactly how much value to attribute to it.

Going back to the article, we find Young saying: 'All the deep hypnotic subjects. . . give results clearly in favour of hypnosis, the average ratio being 132.' Now this is an improvement of 32 %—almost exactly the same percentage as Mr R.'s average for all the tests. How in the face of this statement Young can claim that there is hardly an improvement, I frankly do not understand.

It must be left to the reader to judge if I have succeeded in showing that in this 'Steadiness control' test, where we expected an improvement, there is at least some sign of such an improvement.

Lastly, we come to the only one of Young's tests which showed a significant difference, according to him. It is his Experiment 1, 'Movement of the arm over a sector'. Strangely enough, this difference does not lie in the direction in which we should expect it to lie; the normal performance is distinctly better than the hypnotic!

The 'Arm movement' test used in my own research is rather similar to Young's test; yet we found a significant difference tending the other way. Two considerations may be taken into account in trying to explain this difference between Young's findings and my own: firstly, judging from his description of his experiment, he set his subjects a harder task than I did. Having guided their arms once through the correct angle, he asked them to repeat the movement six times. In my experiment, only one repetition was asked for; that would naturally make the task easier and more mechanical.

Secondly, to get through the requisite number of repetitions, my test had to be continued for a long time; this may have introduced the fatigue factor more prominently than it appeared in Young's test. Yet on looking through the records the difference between the normal and the hypnotized performance seems only slightly larger towards the end than at the beginning. This difference in our results then remains to be explained.

Apart from this one exception, I believe, there is no real discrepancy between Young's results and my own. In the statement of conclusions, therefore, I shall try to incorporate his results, and those of the other investigators mentioned in this article, with my own.

Owing to the relatively few data at our disposal, these conclusions cannot be considered final. Any definitive research would require more subjects than a single investigator could readily obtain. For this reason, I have worked out a routine for a communal experiment; i.e. a battery of tests

which can easily be given in a comparatively short time, and without any special apparatus. If a certain number of those in contact with persons easily hypnotized would follow that routine, and send the results to me to be analysed, I believe more definite results could soon be obtained.

(4) Summary and conclusions

To determine if any improvement of the mental and physical functions of a normal subject occurred in the hypnotized state, as compared with the normal, thirty tests were given to a good hypnotic subject, Mr R.

Several of these tests were also given to Miss L., to show whether the results obtained from Mr R. could be considered typical. The two sets of results appeared very similar.

To determine whether improvement was more marked in the hypnotic or in the post-hypnotic state, seven of the tests were repeated under post-hypnotic suggestion.

The main conclusions reached were the following:

1. Both mental and physical functions may be improved by hypnosis.
2. The extent of the improvement depends among other things on the nature of the function tested, on the subject used, and perhaps on the depth of the hypnosis.
3. There is roughly an inverse relation between the difficulty of a test, and improvement in it under hypnosis; the easier and more mechanical the test, the greater the improvement.
4. In the hypnotic state, variability of performance is less than in the normal state.
5. Memory in its various aspects does not show any significant improvement.
6. 'Threshold' experiments do not show any improvement in general.
7. Under hypnosis, fatigue is inhibited to varying degree.
8. Both mental and physical functions show improvement following post-hypnotic suggestion.
9. Post-hypnotic improvement is not quite as marked as hypnotic improvement, although the difference is not significant statistically.
10. Some recognized statistical technique ought to be used in the treatment of results and the report of the data, particularly with regard to their significance.

REFERENCES

Guilford, J. P. (1936). *Psychometric Methods.*

Koster, S. (1928). 'Untersuchungen über Hypnose.' *Zsch. ges. Neurol. Psychiat.* **109.**

Lichtenberger, M. (1927). 'L'état actuel du problème de l'hypnotisme.' *Proph. ment.* **3.**

Lifschitz, G. (1927). 'Experimental investigations of suggestibility.' *Zh. Nevropat.* **20.**

McDOUGALL, W. (1926). *Outline of Abnormal Psychology.*
MYERS, S. (1931). *Textbook of Experimental Psychology*, vols. I, II.
NICHOLSON, N. C. (1920). 'Notes on muscular work under hypnosis.' *Johns Hopk. Hosp. Bull.* **31**.
WELLS, F. L. (1928). 'Reaction times and allied measures under hypnosis.' *J. abnorm. (soc.) Psychol.* **24**.
WHIPPLE, G. M. (1924). *Manual of Mental and Physical Tests*, vols. I, II.
WILLIAMS, G. W. (1929). 'The effect of hypnosis on muscular fatigue.' *J. abnorm. (soc.) Psychol.* **24**.
YOUNG, P. C. (1925). 'An experimental study of mental and physical functions in the normal and hypnotic states.' *Amer. J. Psychol.* **36**.
—— (1931). 'A general review of the literature on hypnotism and suggestion.' *Psychol. Bull.* **28**.