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CONTENTS:

CORNELL UNIVERSITY AND HER	BOOK-REVIEWS.
TECHNICAL DEPARTMENTS..... 141	An American Geological Railway
THE TIME-RELATIONS OF MENTAL	Guide..... 151
PHENOMENA. <i>Joseph Jastrow</i> .. 142	A Stem Dictionary of the English
NOTES AND NEWS..... 147	Language..... 151
LETTERS TO THE EDITOR.	An Elementary History of the
A Study of California Soils	United States..... 152
C. H. Shinn 150	AMONG THE PUBLISHERS..... 152

THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 147.]

The effect of the *mode of re-action* upon the re-action time is the same here as in the simple re-action. Re-acting by the voice in the incomplete form of re-action has been found to be longer than re-acting by the finger; and whenever the re-action takes the form of speaking or naming, it takes some time to place the organs in position and speak the word. But a very special and important effect in adaptive re-actions is that of (5) *the association between movement and stimulus*.

As the effect of a special or a general practice, certain modes of re-acting to certain types of stimuli have become natural, easy, and familiar, while in other cases (e.g., the re-acting by pressing a key, — a process learned only for the purposes of the experiment) the association is extremely artificial. If we compare, in Münsterberg's series, the experiment in which the five fingers re-act to the numbers "one," "two," "three," "four," "five" (XXIV.), with that in which they re-act to the declensional forms of a Latin noun (XXV.), we recognize that the former is a more natural association than the latter, and seem justified in at-

tributing a good share of the increase in time to this difference. Again: to re-act by naming is a process in which we have had considerable training, and it is quite evident that the time needed for naming one of 26 different impressions (XV.–XVIII., and XX.) is much shorter than would be needed for re-acting by 26 artificial and irregular movements of the hand. The difficulty in learning a foreign language, or a telegraphic code, or a shorthand system of writing, is largely the difficulty of forming associations between complex stimuli and movements; and the great decrease in time that is brought about when such associations have been mastered emphasizes the importance of the factor now under discussion, which, in turn, may be regarded as an expression of the effect of practice.

We may push the analysis a step farther. The process of naming is much more closely associated with a word or a letter than with a picture or a color; for the former are artificial symbols, merely becoming significant only when so interpreted, while the latter reveal their meaning directly without needing to be named or read. Accordingly, we find that it takes longer to name a color (601σ) or a picture (545σ) than to name a letter (424σ) or a word (409σ), though the recognition of a color or a picture is a quicker process than the recognition of a letter or a word (compare XV., XVII., XIX., XX., and V., VI., VII., X). Furthermore, if the time of naming or reading is thus mainly conditioned by the strength of association involved, we may in turn utilize this process as an index of familiarity with the naming or reading, or, more briefly, with the language. Thus Cattell, an American, reads English words more quickly than German (XVII. and XVIII.), while with Berger, a German, this relation is reversed. To name a picture in German occupies Cattell for 614σ; in English, 588σ. It occupies Berger in German for 501σ; in English, 580σ. The inference is the same (though the absolute time is much shorter) if we read words in construction instead of isolated. By this method Cattell finds that he can read an English word in 138σ, a French in 167σ, a German in 250σ, an Italian in 327σ, a Latin in 434σ, and a Greek word in 484σ, this being the order of his familiarity with these languages. The particular nature of the association may be revealed in the study of these time-relations. Thus, while in all cases it takes longer to read words from right to left than from left to right, this difference is relatively least in the least familiar languages; i.e., in those in which the bond of association between the words is least significant. For a like reason letters are read much more quickly from above downwards (102σ) than from below upwards (264σ).

(6) *The Overlapping of Mental Processes*. We pass now to a point of critical importance in the application of results gained in the laboratory, to the mental operations of daily life. While in the former case we are performing a set task in isolation for purposes of investigation, in the latter case (i.e., in such operations as reading, copying, playing upon instruments, and the like) we are performing a continuous, more or less extended, series of re-actions, bound together by bonds of common purpose and associations of habit. It is not a mere aggregate, but an organization of mental processes; and this makes possible the performance of the several factors of the process in part at the same time. It leads to an "overlapping" of the mental elements. It is a