MEASURING HALLUCINATIONS.

In Science, 1893, XXII, 353, attention was called to a method of measuring the intensities of hallucinations. The method is, in brief, as follows:

In an unsuspecting subject the stimulus R under the condition P is used to produce a sensation S. The sensation is a function of the stimulus, $S=f(R)$, and is measured by means of it. By means of appropriate adjustment of the conditions P the sensation can be made to appear just the same whether is present or not.

When R is not present, the sensation is called a hallucination; let it be denoted by the H, although the person experimented upon does not distinguish sensation from hallucination. We have thus in such cases $H=S$, and likewise $S=f(R)$, with R used measure the intensity of the hallucination. It is also evident that $H=F(P)$, and likewise (a fact seldom fully regarded in psychology) $S=F(P)$.

With this method Dr. C. E. Seashore has, under my guidance, carried out measurements of hallucinations and has just published the results in the *Studies from the Yale Psychological Laboratory* for 1895. As the fundamental idea may interest others than those reached by the *Studies*, I will state it briefly here.

It was at first intended to end every experiment in a measurement according to an absolute scale of units of energy, *e. g.*, light by reference to a standard source of illumination or to a bolometer-reaction (Langley, Mem. Nat. Acad. Sci., 1891, V, 7), sound in units of atmospheric displacement (Wien, Wied. Ann., 1889, XXXVI, 834), etc.; but it was soon decided that it was preferable to first explore the region of suggestion and hallucination with convenient arbitrary scales without waiting to reduce these scales to standards. This course has been amply justified by the results; the proper methods of producing hallucinations have been found for all the senses and the arbitrary scales have been so arranged that future investigators can repeat the experiments under exactly the same conditions, merely changing the scale. To be sure, this latter step is generally very expensive in many ways; in our case width of exploration was preferable to minuteness.

A typical case of the application of the method is found in measuring hallucinations of sound. The person experimented upon was placed in a quiet room and was told that when a telegraph sounder clicked, a very faint tone would be turned on, and that this tone would be slowly increased in intensity. As soon as he heard it, he was to press a telegraph key. The experimenter in a distant room had a means of producing a tone of any intensity in the quiet room. The apparatus for producing the tone consisted in an electric fork interrupting the primary circuit of an inductorium in the experiment room and a telephone in the quiet room (unknown to the subject), which was in connection with the secondary coil of the inductorium. The intensity of the tone depended on the distance between the two coils of the inductorium; this distance was recorded in millimeters.

In the first few experiments a tone would be actually produced every time the sounder clicked, but after that the tone was not necessary. It was sufficient to click the sounder in order to produce a pure hallucination.

The persons experimented on did not know they were deceived, and said that all tones were of the same intensity. The real tone could be measured in its intensity, and since the hallucination was of the same intensity it was also indirectly measured.

Similar experiments were made on other senses. For example, in regard to touch, a light pith ball would be dropped regularly

on the back of the hand to the sound of the metronome. After a few times it was not necessary to drop the ball. The person would feel the touch by pure hallucination.

Similar experiments were made on taste. Of six bottles two contained pure water and the other four a series of solutions of pure cane sugar—the first one-half per cent., the second ten per cent, the third two per cent. and the fourth four per cent. sugar, according to weight. A block was placed in front of them so that the observer could not see them, although he was aware that they stood near him, because he saw them when he received his instructions. It was required of him to tell how weak a solution of sugar he could positively detect.

The experimenter took a glass dropper and deposited drops on his tongue, drawing first from the two water bottles, and then from the sugar solutions, in order of increasing strength. The sugar in the solutions was detected in the first trial. Proposing to repeat the test, the experimenter proceeded as before, but drew from the first water bottle every time. The result was that when the pure water had been tasted from two to ten times the observer almost without exception thought he detected sugar.

A test on olfactory hallucinations was conducted similarly, with the result that about three-fourths of the persons experimented upon perceived the smell of oil of cloves from a pure water bottle.

In another set of experiments the subject was told to walk slowly forward till he could detect a spot within a white ring. As soon as he did so, he read off the distance on a tape measure at his side. The spot was a small blue bead. The experiment was repeated a number of times. Thereafter the bead was removed, but the suggestion of having previously traversed a cartain distance was sufficient to produce a hallucination of the bead.

The investigation was carried out in various problems of hallucination and suggestion; in each problem the work was kept up till the appropriate method of producing hallucinations was found. I cannot here go into the details of Dr. Seashore's experiments, but the fundamental idea is, I hope, clear.

The surrounding and internal conditions P were of a given character in the first experiment, namely, definite place, apparatus, expectation, etc. The sensation S resulted from R. Each repetition of the experiment produced a change in the attitude of expectation; P was consequently changing. Finally, the production of a given value of P was sufficient to entirely replace R in producing the sensation.

It is to be clearly understood that the persons experimented upon were perfectly sane and normal. They were friends or students, generally in total ignorance of the subject, who supposed themselves to be undergoing some tests for sensation. One case was found, however, of a suspicious observer who expected deception and who declared that he had waited every time till he was sure of the sensations; the results were just as hallucinatory as usual.

The value of the method and the experiments lies mainly, I think, 1, in pointing out a method of determining the portion of a sensation due to the suggestion of circumstances rather than to the stimulus; 2, in application to mental pathology; 3, in beginning a scientific treatment of hypnotism and suggestion.

E. W. SCRIPTURE.
YALE UNIVERSITY.

LIFE HABITS OF PHRYNOSOMA.

IN a recent number of the 'Zoölogischen Anzeiger' Prof. Charles L. Edwards, of the University of Cincinnati, gives the following interesting notes upon the habits of the horned lizard of Texas:

While living in Austin, Texas, from