

conditions.' *Rules* for the teacher to obey should not be given by psychology, but *principles* should be established, which may be applied under varying conditions. This last factor, variation, brings out most clearly the value to the individual teacher of the study of psychology. If principles are understood, and some facts underlying the principles are known, new facts will be assimilated and arranged with the old, and methods will be changed accordingly. With fixed rules, however, new conditions find the teacher unprepared by training, and method becomes forced and stilted.

Finally, what the teachers need "is a broad, general course in psychology to bring them back into a vital sympathetic relation with the practical investigation of the child's mental condition. Such training places the individual teacher above the theory."

SHEPHERD IVORY FRANZ.

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The present volume includes (1) short studies by Professor Seashore on the Müller-Lyer illusion, a material-weight illusion, localization of sound, acuteness of hearing, pitch discrimination and motor ability; (2) an account of experiments upon the analysis of the perceptions of taste; (3) a discussion of some phenomena of the secondary personality, and (4) the description of two new pieces of apparatus.

1. The first series 'have been selected,' we are told, 'with reference to the need of data, their interrelations, and the adaptation of methods and apparatus.' Some of the experiments are standard ones, 'some have been developed by other investigators and are here developed a step farther, and some are new.'

(a) Various forms of the Müller-Lyer illusion were used to note the effect of the illusion under varying circumstances. The limiting lines were circles, coins, squares and angles. It was found that the force of the illusion decreased with the size of the coin, and when, instead of coins, circles were used the illusion was lessened. Complexity of outline increases the force of the illusion, and "it also appears that the fainter the outline is the more the eye strives to follow it." The introduction of a base line lessened the illusion, and the limiting lines greatly affect the amount of the illusion—circles, 13 %; squares, 1 %. "A vertical distance is overestimated when compared with a horizontal distance." Practice has no effect in increasing or diminishing the illusion if the subject remains in ignorance of its presence,

but there is a decrease in variability. Women are more susceptible to the illusion and are more variable than men. Two hundred children that were tested showed double the effect noted on adults, but no difference was noted for the two sexes. There seemed to be no regular decrease with growth and no general relation with mental ability was found.

(*b*) The material-weight illusion. Each of three cylindrical blocks of wood, iron and cork, of the same size and of uniform weight, was compared with standard sets of blocks and the estimation of weight was noted. Eight determinations were made by each subject with each block. In general the cork and the wood blocks were overestimated and the iron block underestimated. The illusion is about 18 % of the actual weight, and is about the same for women as for men. The essential condition of the illusion is that the preliminary estimation of the weight of the different blocks shall be wrong—*i. e.*, the subject has the autosuggestion that the cork and the wood blocks are light and the iron one heavy; but when lifted the cork and the wood blocks are felt heavier than was supposed, while the iron block is much lighter than was judged. The illusion persisted even when its nature was known, but not so strongly. There seems to be no variation with age or sex.

An interesting suggestion is made that it may be possible to increase the muscular ability by means of the illusion. If the subject *thinks* he is lifting less than what he is actually lifting, would he be as greatly fatigued after lifting this weight one hundred times as he would be if it felt heavier? And, in like manner, may not the maximum effort be increased by means of this illusion? A few experiments show that the maximum effort was affected by the size-weight illusion. "Nearly all who have tried it can lift more in the barrel (a flour-barrel) than in the half-peck measure."

(*c*) Localization of sound in the median plane. A 100 v.d. tuning-fork connected with an induction coil gave sounds in three different places relative to the observer—above, right and left. Strong and weak sounds were given, and sometimes two sounds together. Estimations were made of the distance in feet, and the direction in degrees in the vertical and horizontal planes. There was a tendency to locate the sound produced overhead as 'upward and forward.' Of the fused sounds (right and left together), 25 % were thought to be in front of the vertical plane, 73 % back of it and 3 % in it. 72 % of the sounds were located above the horizontal plane, 12 % below and 16 % in it. The grouping of the subjects into three classes according to the

differences in acuteness of hearing between the two ears showed a marked tendency to locate a median sound toward the side of the stronger ear. When the sounds were in the median plane and their probable location unknown, there was found little ability to locate them properly. The ability was not improved when the probable location was known.

(*d*) Hearing-ability and discriminative sensibility for pitch. In these tests great individual differences were noted. The average hearing ability of the men and women was found to be about equal. The women, however, had much better discriminative ability for pitch. No marked relation between keenness of hearing and accuracy of pitch discrimination was noted. The keenness of hearing of children seems to increase with age, and likewise the pitch discrimination. Some of the differences, however, may be due to lack of understanding on the part of the younger scholars, not to mention the error of drawing conclusions from such a small number of children that were tested. No relation was found to exist between pitch discrimination and mental ability, the distribution of cases seeming to be a chance arrangement. It is concluded that "this is the strongest evidence in favor of the theory that the discriminative sensibility for pitch depends principally upon the natural structure of the end-organ and is subject only to small variation with education." It seems to the reviewer that a more extended series of observations must be made, and the results confirmed ere this conclusion can be safely accepted.

(*e*) Motor ability, reaction time, rhythm and time sense. Fifty-six subjects were tested, and no differences were found between men and women either in rapidity of movement or in the variation. Reaction to sound gave the shortest and least variable times, reactions to touch were next in length and reactions to light took the longest time. Discrimination time—*i. e.*, the whole time less the simple reaction time—was found to be about 75σ and the choice time about 90σ. The variation in each of these series was about equal. A free rhythm was kept quite constant for 90 seconds by all observers. The pressure with which the rhythm was made constantly increased. The rhythm established seemed to be somewhat determined by the respiratory and circulatory processes. In a regulated rhythm, the subject making taps in conjunction with a mechanical stimulus, there was found a marked tendency to accelerate the movement, and the men seemed to be slightly more accurate than the women. Estimations of empty time intervals of  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, 2, 5, 10, 20 and 40 seconds by the method of average error showed an overestimation for the shorter intervals and

(with two exceptions) an average underestimation for the longer times. School children made almost correct estimations of 5 seconds, but underestimations of the 10- and 20-second intervals. No sexual differences were noted in this test.

2. In this article Professor Patrick gives an interesting and valuable account of taste experiments with an anosmic subject. Popularly the taste of any substance is thought to be conditioned largely by taste sensations. It is known, however, that smell, touch and sight play large parts in our taste perceptions. The analyses of the influence of each of these factors have been few and incomplete, and the present study will be gladly welcomed. The several theories regarding the qualities of tastes are noted. The theory that there are four primary tastes, which by combinations and fusions produce an indefinite number of other tastes, was tested with the anosmic and three normal women as observers. Mixtures of salt, sweet, bitter (quinine) and sour (tartaric acid) solutions were used to discover whether such mixtures gave new qualitative tastes or permitted the simple constituent tastes to be perceived. The latter condition was found to be true. All the observers were able to analyze the mixtures with a considerable degree of accuracy. After considering other investigations the author concludes "that the hypothesis which seems at present most in accord with known facts is that there are only four taste sensations (possibly only two); that these remain distinct in consciousness, not subject to fusion or mixture with each other, and that the manifold taste perceptions of daily experience are made up of these four taste sensations, with their grades of intensity, and sensations of smell, touch, temperature, sight, and muscle sensations." Of touch and smell, the more important is probably touch, while sight plays a more important part than has commonly been supposed. In any analysis of tastes various difficulties confront the investigator and the only factor easily eliminated is sight. With normal subjects smell cannot be entirely eliminated even by closing the nostrils, while it is almost impossible to exclude touch sensations. In complete anosmia results may be obtained which are uninfluenced by smell sensations, since these are wholly wanting. The observer used was a woman peculiarly suited by education for such experiments. Blindfolded she was unable to get any reaction or sensation from over twenty-five substances which ranged through the nine classes of smells enumerated by Zwaardemaker. Those substances which could be determined were found to give taste sensations in the back of the throat or to produce touch sensations in the mucous membranes. The observer's taste sensations were then tested with

numerous familiar chemical and household substances, and the results were compared with those from several normal persons. The anosmic was found to be less active in judgment of salt, quinine and acid solutions. She had finer discrimination for passive touch. It was found that the substances that could not be recognized by any of the subjects depended entirely upon visual sensations for their supposed qualities, those recognized by the normal observers evidently depended upon the smell qualities, those recognized by all depended upon taste, touch and muscular sensations, while those recognized only by the anosmic depended upon differences in texture (*i. e.*, in touch sensations). "On the whole the experiments confirm the hypothesis made in this article, and while not diminishing the importance which has been given to sensations of smell in the 'tastes' of common experience, they indicate that touch and muscle sensations play an unexpectedly important part." The article brings out clearly some of the unsolved problems of the relations of the less intellectual senses and it will undoubtedly draw the attention of many to this almost virgin field.

3. Professor Patrick's second article is already known to readers of the REVIEW, from which it is reprinted (Vol. V., No. 6). It needs no further mention.

4. Two new pieces of apparatus are described by Dr. Seashore. The spark chronoscope is a pendulum chronoscope with arrangements for taking records by the graphic method while the pendulum is in motion. The following excellences are claimed for the new instrument: "Accuracy, adaptation for a variety of connections, soundless action, direct reading, ease and permanence of adjustment, and quickness and convenience of manipulation."

The audiometer is an instrument to produce variations in sounds and to measure the keenness of hearing. The new feature of the instrument is the use of varying sized secondary coils of an induction apparatus for sending currents to telephone receivers. The larger the secondary coil—*i. e.*, the greater the number of wire turns—the more intense will be the sound produced. The intensities vary from 1 to 1079. Simplicity, convenience, accuracy, constancy and size are noted as some of the merits of the apparatus.

The whole volume is interesting and instructive. The sole criticism the reviewer would make is that the first series of articles are 'minor studies.' None of the problems are treated exhaustively and, as Dr. Seashore rightly suggests, "all the time and energy might well have been devoted to one of the problems or a part of one." It is hoped that the researches here begun will be completed in future issues of the Studies.

SHEPHERD IVORY FRANZ.