alike. We thus have a means of varying one without the other. The independence of the two processes (distinction and choice) is further shown by the fact that II. is the quickest distinguisher, while III. is the most ready chooser. III. is slowest in both operations, but differs less in the readiness of her sensibility and judgment than in the alertness of her will. Perhaps an educational truth with regard to the development of the mental powers is hinted at here.

4. *Association time.* — Here our apparatus reduces itself to a clock and some slips of paper; but the number of persons involved in the experiments must be increased from two to three. Let each of the three write on the slips of paper ten or twenty words, say, of one syllable each, and the names of concrete things. Avoid any natural connection between the words by not writing them in the order in which they were thought of. Now let I. and II. be the subjects of the experiment, while III. records the time. 1°. Let I. begin by calling, as soon as he hears the signal, the first word on his list: hereupon II. answers by the first word which he can associate with the call-word, and immediately upon this calls his first word to I., who in turn performs the association and calls his second word; and so on to the end. If there are ten words on the list of each, then each person has called ten words, has answered ten words, and has performed ten associations. 2°. Now let I. and II. each have twenty words before him, and let each call a word as soon as he hears the answer of the other.[1] This operation will differ from the former only by the fact that the association has been omitted. The difference in time between 2° and 1° divided by 10, will give the sum of the association times of I. and II.

Now let I. and III. be the subjects, and II. take the time, and the sum of the association times of I. and III. will be obtained. Then get the sum of the times for II. and III., and the solution of a very simple algebraic equation will give the value of the association time of each.

I have also used another, perhaps somewhat simpler method. It differs only in that in each operation one person acts as caller, and the other as associater, throughout. In this way the values of six equations are gotten: i. e., I. (caller) + II. (associater) = ?; II. (caller) + I. (associater) = ?; and so with each pair. We then eliminate the value of 'I. (caller),' 'II. (caller),' etc., by getting the value of the three equations, — 'I (caller) + II. (caller),' 'I. (caller) + III. (caller),' etc., just as before. The results of the two methods agree very well, and one may be used as a check upon the results of the other. The effect of practice in reducing the time is at first very considerable.

It remains to be noted, that after I have ascertained my own association time and my own calling time, and know it to be fairly constant, the work of finding the reaction time of a fourth person is much reduced. We have simply to get the sum of our association times and of our calling times, and subtract from these my own association and my own calling time.

I will give the results of the first method, because here alone is the effect of practice (in two of the subjects) eliminated. The subjects are the II. and III. of our former experiments, and the times are .803 and .872 of a second respectively, which agrees very well with .764 of a second, which is the time found by Professor Wundt by the more elaborate methods. The great difference between this time and that necessary for a distinction or a choice, shows how much more elaborate the former process is.

The methods above described leave much to be desired; but the principle upon which they depend (namely, of substituting a series of reactions for a single one, and of arranging the apparatus so that the subject himself produces the sensations upon which the distinction and choice is made) seems to be the one by which the desired simplification can be best accomplished. If the above account shall be the means of setting others to work at the same problem, and of popularizing to any extent the study of experimental psychology, its object will be more than fulfilled. JOSEPH JASTROW.

[1] The words should be pronounced distinctly, and no more rapidly than in the first operation.

THE HYGIENE OF THE VOCAL ORGANS.

THE experience which Dr. Mackenzie has had for the past twenty-five years, as a specialist in the treatment of diseases of the throat, renders him thoroughly competent to advise on the important subject of which he treats in the volume before us. Additional interest attaches to his utterances for the reason that during this active career, the most famous singers have come under his professional care and observation, including Nilsson, Albani, Vallina, Patti, and a host of others.

Dr. Mackenzie well says that hygiene has a positive as well as a negative side. The preservation of health means not only that actual mischief is avoided, but that the body is kept in the best working order. The hygiene of the voice, therefore, must include a consideration of the best methods of developing its powers to the highest

The hygiene of the vocal organs; a practical handbook for singers and speakers. By MORELL MACKENZIE, M.D. London, *Macmillan*, 1886. 12°.

pitch as well as protecting it from injury or decay.

After describing the anatomy of the vocal organs, the author passes to a consideration of the uses of the laryngoscope. Although this instrument is of inestimable value in the recognition and treatment of disease, it has, nevertheless, added very little to the knowledge of the physiology of the larynx. This is accounted for by the greater amount of skill required for the examination of the larynx in the act of singing than for ordinary medical purposes, and also by the fact that but few throats are sufficiently tolerant to permit of such a prolonged examination as is necessary to obtain results of much value.

The development of the voice receives considerable attention in the author's methods. Many children can be taught to sing little airs when they are between three and four years old. From the age of six until that of fourteen or sixteen the voice undergoes but little change except in the way of gaining power. At this time a marked change occurs, more noticeable in boys than girls, that is, 'the changing of the voice.' This is due to an increase in the size of the larnyx in all its dimensions, enlargement and consolidation of the cartilages, and an increase in length and thickness of the vocal cords.

In speaking of the training of the singing voice, Dr. Mackenzie recommends vocal gymnastics and a development of the breathing capacity, by walking, hill-climbing, running, fencing, and swimming, and in a chapter devoted to the care of the formed voice directs the avoidance of strain and complete inaction of the vocal organs when out of order. The influence of the general health upon the voice is very marked. Whatever is good for the singer's general health is *pro tanto* beneficial to his voice. Alcohol and tobacco should not be used. The hoarse tones of the confirmed votary of Bacchus are due to chronic inflammation of the lining membrane of the larnyx: the originally smooth surface being roughened and thickened by the irritation of alcohol, the vocal cords have less freedom of movement, and their vibrations are blurred, or rather muffled, by the unevenness of their contiguous edges.

In discussing the speaking voice, its compass, mechanism, and defects are fully considered. The various diseases of the larynx, paralysis, and abnormal growths are not overlooked, and a special chapter treats of the training of the voice for speaking in public. The importance of early training is dwelt upon, and the improvement which is possible to a poor voice by proper methods of culture.

In concluding the volume, Dr. Mackenzie desires it to be understood that he speaks as a physician, rather than as a singing-master or an elocutionist, and that his aim is to furnish the vocalist and public speaker with a guide to the diseases of the voice, and the best means of avoiding them. He has accomplished his object in a manner which is no surprise to those who know his skill and acquirements.

RECENT EARTHQUAKE LITERATURE.

Report on the East Anglian earthquake of April 22, 1884. By R. MELDOLA and WILLIAM WHITE. London, 1885.

THE Essex field-club of England has devoted vol. i. of its 'Special memoirs' to the Essex earthquake of April 22, 1884, which has already been the subject of sundry articles in scientific periodicals and society transactions. This publication is much the most extended discussion of the phenomena which has appeared, and its authors have here given us an excellent example of the thorough presentation and discussion of the facts observed. It forms a volume of two hundred and twenty-three pages, with four maps and numerous illustrations in the text. It begins by giving a list of nearly sixty previous British earthquakes which had caused structural damage, the records being drawn from various sources, and including some that are not mentioned in Mallet's 'British association catalogue.'

After describing the careful methods of collecting and sifting the data in regard to the present shock, some twenty pages are devoted to its general character. It is regarded as the most serious seismic disturbance that has affected Great Britain for four centuries, extended over fully five thousand square miles, and in intensity is estimated as about one-twentieth of the great Lisbon earthquake of 1755. Pages 44 to 155 are given up to a detailed description of the phenomena at various places, the accounts being in many cases in the original language of the reporter, and in many more giving the result of personal examination of the localities, immediately after the occurrence, by the authors themselves or by competent persons authorized by them. No one who has not himself engaged in similar work can understand the labor involved in the collection and arrangement of the materials here presented. They are accompanied by numerous wood-cuts illustrating the damage done to particular buildings, and the general impression produced by their perusal is that the shock was much more severe and destructive than the accounts published at the time had led us to suppose. Many instances are given of buildings so wrecked as to be uninhabitable, and in some towns the injured buildings are numbered by