

I would agree that scientific method needs to be considered in the philosophic curriculum, but it ought to be discussed without complicating it with the questions of elementary logic.

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NEW YORK.

The Elements of Experimental Phonetics. EDWARD WHEELER SCRIPTURE. Yale Bicentennial Publications. New York, Charles Scribner's Sons. 1902. With three hundred and forty-eight illustrations and twenty-six plates. Pp. xvi + 627.

The matter represented in this volume is of a much greater variety than one expects in a book on phonetics. However, the author is certainly right in expressing his opinion that the science of phonetics cannot be confined to a study of the physics and physiology of speech sounds, and that the problems of speech perception, of the psychology of language, of rhythm and verse, etc., can all be treated by experimental methods and must be included. The book, indeed, includes an enormous amount of details, even the most elementary, of every science in any respect related to the problems of speech production and speech perception. And being written in a rather popular style, without entering into any deeper discussion of contradictory theories of these auxiliary sciences, it seems to be written for any one who possesses as much as a high school education. This fact does not, of course, exclude the book from being used also by more specially trained readers. Indeed the extraordinary number of titles of books and scientific articles quoted by the author seems to prove that he had also such readers in mind. He certainly deserves praise for collecting such an amount of material. If, however, the first class of readers will be much benefited by this material in its present form of representation, seems doubtful to the reviewer. Yet this judgment is entirely subjective, and others may disagree with it.

The reviewer, while reading the book, wondered if the author could actually have read all the books and articles quoted. He feels sure that the author has not mentally digested all of them. To the naïve reader the text gives the impression to be the critical decoction of the numerous articles quoted at the bottom of nearly every page. A critical comparison of the text with the notes, however, and the enormous size of the volume too, make one rather believe that the author wrote the text partly from memory, quoting now and then the sources of his information as he remembered them, and mostly by compiling rather uncritical abstracts made by himself and others; and that, hav-

ing completed this, he had some librarian distribute the titles of the catalogue of some scientific library over the different pages of the book. A possible explanation of this would be, that the pressure of the Yale bicentennial caused abortion of the product before it was quite mature. A bibliography is a good thing, but it might prove more useful if printed as an appendix than if connected with a text which is not always its progeny. The naïve reader who for further information reads the articles quoted at the bottom of the page, will often waste much time by reading articles insignificant for the problem, and sometimes not finding at all the one which contains the best information; the latter being absent, because its title does not disclose all of its content, the former being present, because it is *entitled* to be. This criticism, of course, is not intended as a reproach to the author, but merely to warn the reader not to expect to find more in the book than it offers, although this latter is a great deal.

Part I.: *Curves of Speech*.—The author explains in detail vibratory movement, how it is produced, influenced by friction, by exterior forces like an electromagnet with an intermittent current, how it can be graphically represented. The phonautograph and manometric flames are then discussed. Both make speech visible, but imperfectly. The phonograph is then described, which is greatly superior as a recording instrument and has the additional advantage of permitting to prove the accuracy of the record by means of reproduction. The different methods of reading the phonograph record are mentioned. A description of the gramophone and of the author's method of enlarging gramophone records follows. The last two chapters of this part are on the analysis of speech curves obtained by the recording instruments mentioned.

Part II.: *Perception of Speech*.—The anatomy of the organ of hearing is illustrated by six very clear-cut figures. Aphasia, agraphia, etc., are discussed, together with the accepted theory of the action of the cortical centers. The perception of musical tones is treated in the way in which this is commonly done. The reviewer was shocked to find here the somewhat sweeping statement: 'To the mind the tone from a violin is just as simple as that from a tuning fork or an organ.' The author seems to have a general tendency to decide difficult theoretical questions by leaving the decision to the common sense. This does not please the reviewer, but it may satisfy others. Further, the perception of speech elements is discussed. More or less different sounds are perceived under certain conditions as like. Language tends to bring into prominence such elements as are necessary for dis-

tion, and to suppress needless distinctions. In a chapter on speech ideas, the phonetic unit is distinguished from the phonetic element: a phonetic unit is a complex sound representing a single idea. It may consist of more than one 'word.' Phonetic elements are the simplest speech sounds which we are able to remember. In the same chapter are discussed visual and auditory lapses, misreadings and misperceptions of spoken words. Another chapter is on the association of ideas. The last three chapters of this part report on the results of experiments concerning association with special regard to speech. A pendulum chronoscope is described, measurements of association time are mentioned, the significance of transposition and substitution of speech elements for the development of language is discussed, methods of memorizing are compared by briefly stating the results of the several investigators.

Part III. : *Production of Speech.* — The first chapter gives a detailed description of the most important apparatus for recording muscular movements in general, particularly of the Marey drum. The second compares breathing under ordinary conditions with breathing during speech. Three further chapters give a very clear description of the anatomy of the vocal organs, including the muscles of the lips, tongue, soft palate, etc., of the action of the larynx and methods of observing it. The action of the vocal bands cannot be regarded as vibratory motion of strings or membranes, but rather of cushions of a highly complicated structure and function. The mathematical laws of vibrations of the air in cavities are mentioned and briefly applied to the cavities of the mouth, as far as this is possible at the present time. The methods of obtaining palatograms (of tongue contacts) are described and a number of palatograms of several languages are reproduced and compared. The author then discusses tongue positions and movements. He emphasizes that one should not overrate the importance of a certain position found in the production of a certain sound. This position may be of much less significance for the production of this sound than the manner in which the tongue moves to this position and away from it. Further chapters discuss the action of the pharynx, nose, velum, lips and jaw, simultaneous and successive movements of the several organs functioning during speech, and vocal control by the nervous system.

Part IV. : *Factors of Speech.* — A careful study of vowel records shows that vowels are produced by air puffs emitted from the larynx, which may be like sinusoids or more like explosive blows. The tone corresponding to the frequency of these puffs, the cord tone, varies

during a single vowel in pitch as well as in intensity. The tone (or tones) produced by each puff in the mouth cavity is, according to the Helmholtz theory, an overtone of the cord tone; according to the Willis-Hermann theory its pitch is independent of the pitch of the cord tone. The author accepts the latter theory, stating and comparing the arguments for either theory. He makes the contradictory statement (p. 420) that 'the two forms of treatment imply that the *cavity tone* is to be considered in the one case as a *free vibration* of the air in the cavity, and in the other case as a *forced vibration*.' The cavity tone is never a forced vibration; for a forced vibration of a body (or a volume of air) cannot be called a tone of this body, *e. g.*, the forced vibrations of a sheet of paper which I hold in my hand while listening to an orchestra, cannot be called the tones of the paper, but only the tones of the orchestral instruments. What the author refers to, is that according to the Helmholtz theory the mouth cavities only reënforce overtones of the cord tone, whereas, according to the Willis-Hermann theory the mouth cavities may not only, of course, do this, but also produce tones independent of the pitch of the cord tone. These independent tones then fluctuate very rapidly in intensity, because the blast from the larynx is not constant, but consists of puffs. Forced vibrations of the air in the mouth (*i. e.*, vibrations of periods greatly differing from the natural periods of the vibrating body, the air in the mouth) are a matter of course, but do not enter into this problem at all.

A further statement which does not seem consistent with the author's views is this (p. 426): "The supposition that spoken and sung vowels consist of whispered vowels plus a cord tone is an absurdity. A whispered vowel produced at the same time with a violin note does not become a sung vowel by the addition." This is no argument. The violin tone is by no means identical with the cord tone of the same pitch, since the cavities of the mouth reënforce special overtones of the cord tone, but not of the violin tone which is far away. I have taken the experiment of producing at the same time *very strong* whispered vowels (by very strong expulsions of air) plus weak violin tones and must report that the compound sounds, however imperfect the experiment is, do not seem so unlike sung vowels to warrant the author's judgment of 'absurdity.' The only argument against the above theory, which the reviewer sees, is that in whispering the blast is constant, in speaking or singing intermittent, so that the independent tones of the mouth must be of constant (or gradually decreasing) intensity in whispering, intermittent in speaking and singing.

Liquids and consonants are then discussed. Sound fusion: "Speech cannot be considered as made up of separate elements placed side by side like letters. In the flow of speech it is just as arbitrary a matter to consider certain portions to be separate sounds as to mark off by a line where a hill begins and the plain ends." Progressive change: "The various hypotheses that have been put forth as explanations of phonetic changes might be directly tested by reproducing the conditions and recording the speech results. Thus the hypothesis that the changes known as Grimm's law are the results of increasing rapidity of speech might be tested by recording language spoken at different speeds." Melody of speech: "The present chapter will be confined to a study of pitch in speech." The cord tone alone is treated as the basis of this study. "A vowel is in fact not a melody alone but a harmonized piece of music. Experimental data on this subject are almost entirely lacking." Duration: "The experiments on speech sounds have made it clear that at best the terms *long* and *short* for the vowels or syllables of a word can mean no more than that they are on an average long and short." Loudness: "Among the hundred or so English vowels that I have inspected, I have been unable to find one that can with any close approximation be considered as steady in intensity and constant in pitch. * * * It seems to be the rule in English that a vowel following a pause shall be a rising or crescendo one, and one preceding a pause shall be a falling or diminuendo one." Accent: "The one property that characterizes auditory accent is impressiveness; this may arise from increase in loudness but also from decrease, from rise in pitch but also from fall, from lengthening of the duration but also from diminution—in short from any *change* that produces a mental effect." The last two chapters discuss auditory and motor rhythm in general and speech rhythm in particular. "Since even in scanning the syllables do not have simple relations of length, it is justifiable to conclude that in naturally spoken verse the relations differ even more widely from the theoretical ones. * * * If we assume that the movements of the hand and vocal organs are executed simultaneously, we can conclude from the foregoing experiments that the point of emphasis in rhythmic speech comes before the vowel and before or in the course of the consonant which precedes the vowel. In other words, the point of emphasis in rhythmic articulation lies at the *beginning* of the movement of the vocal organs for the production of the sound."

The relative length of the four parts may be seen from the following: I.-75, II.-112, III.-211, IV.-159.

Three appendices are added: Fourier analysis, studies of speech curves and free rhythmic action.

Although the book is not in all its parts a critical digest of the matter treated in it, but leaves a large amount of the critical work to the reader, it is certainly an extremely useful collection of material to him who knows how to use it.

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Problems of Evolution. F. W. HEADLEY. New York, Crowell & Co. 1901. Pp. xv + 373.

The author of the delightful 'Structure and Life of Birds' appears before the public in the present volume as an ardent and versatile champion of the extreme Darwinian school, and certainly proves himself worthy of being enrolled among the company of English scientists, comprising Wallace, Lankester, Poulton, Meldola, Ll. Morgan, Kidd, Ball and others, who are disposed to stand by the guns of their great compatriot at a time when the biologists of continental Europe 'are half inclined to reject Darwinism' if not 'to scoff at the bridge by which the scientific world made its way to evolution over a sea of difficulties.'¹ We are of course reminded of the fate which overtook physical science during the period of Newton-worship in England, and prediction, based on historical analogy, would probably point to the more independent scientists of the continent as the sources of any further great biological advances in the immediate future. Perhaps the revival of Mendel's work, a return to experimental breeding, from which Darwin himself started, may be a partial confirmation of this prediction.

Mr. Headley has undertaken a task before which a less intrepid writer and one with less English breadth of interests might stand aghast. In the small space of 368 pages he sweeps through the gamut of biology from the mitotic division of the cell to Chinese sociology, of course only *per summa cacumina rerum* and often leaving to one side whole masses of facts that could be used very effectively in support of his views. He often displays a refreshing neglect of the enormous literature on natural selection, Lamarckism, etc., playing about his subject in short, crisp, often delightfully facetious sentences. This is a new departure and one perhaps to be commended in a general work of this kind. Even the old stock of evolutionary puzzles

¹ *Conf.*, e. g., the epithet 'Kleinigkeitskrämer von Down' applied to Darwin by a bumptious German, and the sensational title of a recent work, 'Am Sterbelager des Darwinismus.'