or translations of foreign works upon the subject. And again we may ask, Why is it that so many of the translations hail, not from this side of the water, but from America? The only possible reply seems to be that the scientific Englishman is not fond of writing.

The book under review, which has been translated by Dr. F. J. Pond, assistant professor in the State College of Pennsylvania, is dedicated by its author to Prof. Wallach. We are not surprised at this, because, owing to the careful and splendid experimental work of Prof. Wallach, the chemistry of the terpenes has become systematised and simplified (*i.e.* relatively simplified) in a manner which at one time seemed almost out of the question.

The book commences with an introduction of twelve pages. Naturally, the study of the camphors or oxidised compounds of the terpenes could not be left out of any work which dealt with the terpenes. Dr. Heusler explains that

"Japan camphor, while closely allied to the terpenes, has such an extremely large number of derivatives that an exhaustive description of them would demand as large a space as the derivatives of all the remaining members of the terpene group taken together."

Therefore Dr. Heusler only mentions those which are most closely related to the members of the terpene group. But at the same time, it would have been both interesting and instructive if he had seen his way—perhaps in the form of an appendix—to give a summarised discussion of some of the controversial points under consideration in the camphor problem. As it is, he only gives Bredt's formula for camphor and passes over the others, as he considers that the present state of our knowledge is scarcely sufficient to allow of criticism. If we take down the British Association notes for 1900 and study Dr. Lapworth's very able report upon the camphor question, we see that it is possible to summarise shortly the camphor literature in a lucid and satisfactory manner.

Under the heading "Hemiterpenes," there is a short description of isoprene and some of its derivatives. The connection of such vegetable products as guttapercha and the terpenes is noteworthy, isoprene being of special interest, since when acted upon by concentrated hydrochloric acid it polymerises into a rubber-like substance. On the other hand, isoprene, along with other substances, is produced when the vapour of turpentine is passed through a red-hot tube.

We then come to the study of the terpenes proper; this portion of the book occupies nearly one hundred pages. Naturally, pinene, the chief ingredient of turpentine oil and the most widely distributed of the terpenes, is first studied. Under each terpene, the preparation and properties are first given, and then their behaviour towards oxidising agents and various reagents.

Following the terpenes, we come, on p. 133, to the study of the oxidised compounds; this is divided into two parts—(1) Substances which cannot be regarded as derivatives of the hydrocymenes, analogues of pinene, camphene and fenchene; (2) substances which may be regarded as derivatives of the hydrocymenes. Camphor, which falls under the first category, is first discussed, and here again Bredt's formulæ for camphor, camphoric and

camphoronic acid are given. The study of the olefinic members of the terpene series follows on p. 377; the first portion is devoted to the study of the hydrocarbons and the second part to the oxygenated compounds, such as linalool, geraniol, the pleasant-smelling constituent of Turkish and German oil of rose and citronellol. The last twenty pages are devoted to the study of the sesqui- and poly-terpenes.

Taking the book as a whole, it will be found to be a very interesting review of some of the most important work which has been carried out in connection with the chemistry of this very abstruse but exceedingly interesting branch of chemical science. At times there is a tendency to lapse into a "dictionary" style of writing, but it should be borne in mind that descriptive writing is of all writing the most difficult. The book should be of great value to all those who are engaged upon the study of the terpenes or of camphor, but when this work of 450 pages has been carefully studied, it will still be found necessary to consult the original literature. Fortunately, Dr. Heusler has given fairly full references, and for this he cannot be too highly commended.

The book can hardly be recommended to the general student, because he would be apt to lose himself in a maze of compounds a previous knowledge of which is taken for granted.

Dr. F. J. Pond has evidently taken great pains in translating the book, and he certainly deserves a word of thanks for his trouble.

F. MOLLWO PERKIN.

EXPERIMENTAL PHONETICS.

The Elements of Experimental Phonetics. By Edward Wheeler Scripture. Pp. xvi + 627; 26 plates and 348 illustrations. (New York: C. Scribner's Sons; London: Edward Arnold, 1902.)

THIS handsome volume is one of a series of books issued by a number of the professors and instructors of Yale University in connection with the bicentennial anniversary of that institution. It is an effort to collect and arrange the data at present available concerning the voice in song and speech, and it is enriched by an account of much valuable work done in the field of experimental phonetics by the author himself.

During the last decade, the science of phonetics has made rapid progress, more especially in France, Germany, America and Scandinavia; it has now a nomenclature and methods of its own, and it is cultivated with much earnestness and ability by many workers, some of whom are a singular combination of physicist, physiologist and philologist. The scope of the science is a study of the physical, physiological and psychical phenomena connected with language. It deals with the physical basis of the sounds of language, with the physiological mechanisms by which these sounds are produced, with the cerebral phenomena connected with the psychical processes that lie at the root of the nervous mechanisms by which ideas find expression in articulate sounds, and with the laws of emphasis and of rhythm.

In this work, Dr. Scripture surveys the whole field. He first of all deals with the physical aspect of the subject in a series of sections on the curves of speech—that is

to say, with the sound and speech curves produced by the phonautograph, phonograph and gramophone, and by the observation of the movements of vibrating flames, discs and membranes. He also describes in great detail the harmonic analysis of such curves. The next part of the work is devoted to the perception of speech, and here we find a full description of the ear, a discussion of the theories of hearing now so much debated, and, lastly, a detailed consideration of what may be termed the psychology of speech, such as the perception of speech elements, the nature of speech ideas, the laws of association, more especially the special associations of speech and the formation of such associations. Dr. Scripture rightly sees that the discussion of the nature of language must not be concerned only with the vibrations that constitute the sounds of words, or with the physiological mechanism of the articulating organs, but must take into account psychical phenomena associated therewith.

The following section deals with the production of speech, and here we find by far the most complete account that has yet been written of the action of the larynx and the movements of the tongue and pharynx. Most ingenious are the methods for determining tongue contacts, or the exact position of the tongue and soft palate in articulate speech. Here also the author treats of the tones of the vocal cavities in connection with the vexed question of the nature of vowels, and in general he supports the views of Prof. Hermann. Last of all, we have a section on the factors of speech, in which Dr. Scripture deals with vowels, consonants, melody, rhythm, accent, &c. There are three valuable appendices, the second of which, being studies of speech curves, shows magnified tracings taken by the author from gramophone records of certain admirable recitations. These tracings are by far the best that have yet been obtained, and they are carefully analysed as to varying amplitude or intensity, pitch, and period or frequency. When one looks at the long series of waves representing the sounds of spoken words, as shown in these tracings, the ultimate analysis seems almost hopeless, and more sure progress would be made if an analysis were carried out of very simple monosyllabic sounds, such as "pat," "bat," "cat," &c. Dr. Scripture also gives a table of phonetic symbols, and there is an excellent index. There are full bibliographical references to the works of all who have contributed to experimental phonetics, and the only name we miss is that of Dr. Marage, of Paris, whose recent researches are of much interest and value were it only for the fact that he has succeeded in placing the theory of vowel tones in a concrete and simple form.

It is not easy to find fault with such a work as we are considering, which, in the way of thoroughness and clearness of exposition, may take its place alongside the "Sensations of Tone" of Helmholtz. An author must be allowed to work out his subject in his own way, and if we think certain parts, such as the description of the ear and of the larynx, and the phonetic discussion of sound fusion, might have been shortened, still Dr. Scripture may not be of the same opinion. We would also observe that in dealing with psychological phenomena (and the same fault may be found with some

physiologists as to the language they use in describing nervous phenomena) there is a tendency to make use of expressions which have a definite meaning in physics, but when applied to other phenomena they are words, mere words. Thus, at the beginning of chapter x., on speech ideas, we have the following sentences:—

"The current of thought in consciousness varies in its density from moment to moment. The regions of less-density may be used to divide off parts of greater density; such portions of greater density are what we usually term 'ideas' or 'thoughts.' Each denser portion of the speech current in consciousness is an 'auditory idea' or—as a matter of speech—a 'phonetic unit.'"

The use of the words "density" and "current" are liable to misconception; at all events, it does not appear to us that this mode of stating the case makes it any clearer. Altogether, however, this is a great book, and we congratulate the author on its production.

JOHN G. MCKENDRICK.

OUR BOOK SHELF.

Notions fondamentales de Chimie organique. By Prof. Ch. Moureu. Pp. 292. (Paris: Gauthier-Villars, 1902.) Price 7.50 francs.

THERE is nothing calling for special remark in this little compendium of organic chemistry. It belongs to a type of scientific literature with which we are thoroughly well acquainted in this country, and has been written for the use of elementary students as an introduction to this branch of the science. The six chapters deal respectively with preliminary theoretical notions, hydrocarbons, oxygen-containing compounds, nitrogenous compounds, organometallic compounds and heterocyclic compounds. This classification will be unfamiliar to English chemists, and although it may possess certain advantages, it necessarily results in the association of the most heterogeneous groups. With the exception of this arrangement, the work follows the usual course, and the subdivisions of the chapters bring out with sufficient clearness the family resemblances arising from similarity of chemical type. Of course, the great difficulty which all writers of these short manuals have to contend with is the compression of such an enormous range of subjects into a limited number of pages without distorting the perspective view of each branch. Every original worker—and M. Moureu's contributions to synthetical chemistry entitle him to a prominent position in this capacity—has a tendency, often quite unconsciously, to give undue prominence to his own branch of the subject or his own particular theoretical views, and this is a real danger from which the elementary student cannot be too carefully guarded. No fault can, however, be found with the work from this point of view, and the author has maintained a fairly uniform balance throughout. The short treatment of stereochemistry (12 pp.) is particularly lucid so far as it goes, although the author only leaves himself half a page for the stereochemistry of nitrogen and sulphur. On the whole, this manual, regarded as a descriptive treatise to be used in association with laboratory work and lecture-room attendance, may safely be commended to the class of students for whom it is written:—

"Ouvrir l'esprit de l'élève en l'initiant graduellement au mécanisme des transformations de la matière et en lui présentant les grandes lignes de la Science avec le relief qui leur convient, le préparer ainsi à suivre avec fruit un *Cours complet* et à faire un usage profitable des *Traité*s proprement dits, tel a été notre but, notre unique objectif