essential parts of the Claude and Linde air liquefiers and the principles underlying their working. The Hampson liquefier is not described. The fractionation of liquid air is illustrated by diagrammatic representations of Linde's and Claude's fractionating plants, and the merits of the two systems are compared.

The theory of refrigeration is dealt with from the thermodynamic point of view, and a consideration of the expansion of gases against external pressure and without external pressure leads up to the behaviour of the working substance in a refrigerating machine. A comparison of ideal indicator diagrams of the cycle with those obtained in practice is utilised to bring out the points needing careful attention in work of this nature. The construction of the essential parts of refrigerating machines is described in some detail, and profusely illustrated with excellent reproductions. The book concludes with a chapter on the applications of refrigeration to ice-production, cold storage, and the preservation of foodstuffs, and a description is given of the construction of railway wagons and steamships designed for the transport of perishable foodstuffs.

On the whole, the subject-matter of the book is well thought out and presented to the reader in logical sequence and in a very lucid and readable form. The illustrations are numerous, well reproduced and explained, and deserve a special word of commendation. The bibliography in the second part of the book is fairly comprehensive, but the value of the first part might, perhaps, be enhanced by a little further attention to this point.

The utility of the book would be increased by the addition of an index.

A. G. G. LEONARD.

THE NERVOUS IMPULSE.

The Conduction of the Nervous Impulse. By Dr. Keith Lucas. Revised by E. D. Adrian. Pp. xi+102. (Monographs of Physiology.) (London: Longmans, Green, and Co., 1917.) Price 5*s*. net.

IN the spring of 1914 Keith Lucas by good fortune was called upon to deliver the Page May memorial lectures at University College, London. He intended to rewrite the lectures for the present monograph, and by July, 1914, had completed eleven of the thirteen chapters. At the outbreak of war he offered his services to the country, and was posted to the Royal Aircraft Factory at Farnborough, where, until he was killed in an aeroplane accident on October 5, 1916, he was fully occupied with problems of flying. The two missing chapters have been written by Mr. Adrian, pupil and fellow-worker, for the most part from the lecture notes.

Nearly one hundred years of intensive investigation has been devoted to the nervous impulse. The volume of the work and the number of workers of outstanding ability who have engaged in attempts to discover the nature of a wave probably of no great intrinsic complexity may appear strange to a physicist. The reason is one of scale: the single conducting unit, the nerve-fibre, being only some 18 to 20 μ in diameter, is too delicate for separate treatment. It is necessary, therefore, to work with the nerve, which is a bundle of many hundreds of fibres. For this reason so simple a matter as the relation between the intensity of the stimulus and the amplitude of the wave is incapable of direct measurement, for it is impossible to determine directly whether an increase in the integral response of the nerve is due to an increase of the response of individual fibres or to an increase in the number of fibres called into action.

Owing to this ineradicable difficulty, the whole structure of our knowledge of the nervous impulse is based upon an assumption, namely, that the molecular wave suffers a decrement in traversing a region the conductivity of which has been impaired by some narcotic such as the vapour of alcohol, and that the capacity of the wave for traversing a narcotised region is a measure of its amplitude. The effect of this fundamental insecurity is, to quote Lucas's words, that "the argument of the experiments becomes somewhat complex. . . . The experiments are often easily made, even with a considerable degree of accuracy; it is in their interpretation that the real difficulty begins. And this difficulty arises again and again from the same cause, that nerves and muscles are not units, but each composed of many fibres."

What is the nature of the wave? It is accompanied by a change of electric potential, but as the rate of travel is only of the order of 40 ft. per sec., it cannot be a simple electrical wave. It is true that on Kelvin's cable theory and by making many assumptions it can be shown that a wave of simple displacement of electricity would travel in a structure like the nerve-fibre at a speed of this order. But by delicate microchemical technique it has been found possible to detect an increased output of carbon dioxide during the passage of the wave, and a rise of temperature has been measured of the order of 7×10^{-6} of a degree Centigrade, not to be accounted for save as heat liberated during the passage of the wave, which would therefore appear to be one of exothermic chemical change.

These and other cognate problems are discussed in the clear logical way so characteristic of Lucas's mind, and from these relatively simple issues the author proceeds to consider how far the phenomena of the isolated nerve may be used to interpret the much more complex phenomena of the central nervous system.

I commend the book to physicists—to the physiologist it is a matter of professional interest, but to the physicist it should come as a romance.

Of the gifted author himself there is no space to speak. His skill, his courage, his clear vision are fittingly dwelt upon in a prefatory note by Prof. Starling which could not be bettered.

W. B. HARDY.