

production which in that case accompanies the rapid oxidation of luciferin; otherwise the process occurs without the evolution of light. The cold-water extract glows for a time until its luciferin is completely oxidised, and it may be made reluminescent by adding some of the hot-water extract.

The bacterial theory of animal light, though possibly consistent with the enzymic one, is based on entirely different data. In its modern form, as an explanation of the phosphorescence of fireflies, glow-worms, and such marine animals as *Pyrosoma* and certain cuttlefish, it is due to Italian zoologists, and especially to the work of Pierantoni. Dr. Buchner is a convert to this view and is a worker in this field. He gives a very interesting account of the evidence, which is of a biological, and not, as in the case of the enzyme school, of a chemical character. According to these observations, the luminous organs of cephalopods, be they never so complicated, are essentially cultures of bacteria in media suitable for their nutrition, and in situations favourable for obtaining oxygen.

In the common *Sepia*, for example, the organ (hitherto called the accessory nidamental gland and regarded as part of the egg-producing mechanism) consists of a modified part of the mantle within which different kinds of bacteria occur. Some are luminous, others are not. They also occur in the egg membrane before development, and Pierantoni describes the infection of the embryo by bacteria derived from those of the egg capsule. In a similar manner he explains the relationship between the luminosity of the egg of the glow-worm and that of the larva and adult beetle. The cells of the luminous organ of *Pyrosoma* contain structures that are also apparently symbiotic organisms. *Noctiluca*, however, has not yet been examined from this point of view.

The difficulty that many will feel in regard to this or the rival solution of an admittedly complex problem is the incompleteness of the explanation hitherto given of flash and occultation and of the apparent transmission of a mechanical stimulus from one part of a luminous animal (as in *Pyrosoma*) to another, lighting the "lamps" as it travels along. The solution seems to lie in the phases and disturbances not only of respiration, but of other controlling factors leading to continuous or alternating evolution of light.

Dr. Buchner has performed a signal service by collating much of what is known of intracellular symbiosis in animals, and his book is one that is most suggestive for further experiment and observation. It indicates the fruitfulness of border-line investigation, and should be widely known amongst biologists to whatever section of organic science they may belong.

F. W. GAMBLE.

Our Bookshelf.

Industrial and Power Alcohol. By Dr. R. C. Farmer. (Pitman's Technical Primer Series.) Pp. x+110. (London: Sir Isaac Pitman and Sons, Ltd., 1921.) 2s. 6d. net.

THE author has certainly contrived to include a very large amount of information regarding alcohol in this little book, which contains clear descriptions of the properties of the alcohols and the methods of production. There are interesting chapters on the technical applications and the use of alcohol for the development of power. By no means the least informative part of the book is the numerous references to government regulations and restrictions. Thus, after a statement of some of these restrictions, we read on page 31:—"Plant is stereotyped, and there is no encouragement to introduce improvements in method or in apparatus. Transport by tank is forbidden, and no distillery is permitted to be more than a quarter of a mile from a market town, whereas it would frequently be better to situate the distillery near to the raw materials." We can commend this book to any who are interested in the development of alcohol as a fuel.

Les Combustibles liquides et leurs Applications. Par le Syndicat d'Applications Industrielles des Combustibles liquides. Pp. iii+621. (Paris: Gauthier-Villars et Cie, 1921.)

ONE may liken this volume to the many similar pocket-book issues extant in this country as compendious guides to the various branches of applied science. It serves a double purpose as an epitome of petroleum technology and as a standard work of reference for immediate requirements in the field, refinery, and office, and although written essentially for the use of the French industries concerned with inflammable liquids, it deserves a much wider sphere of utility. This type of publication, though frequently condemned as inimical to the best interests of scientific work and commercial production, commands a degree of popularity for which it is not, perhaps, difficult to account.

H. B. MILNER.

The Development of Institutions under Irrigation; With Special Reference to Early Utah Conditions. By Prof. G. Thomas. (The Rural Science Series.) xi+293. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1920.) 16s. net.

PROF. THOMAS aims at tracing the evolution of water legislation in Utah from 1847, when the Mormon pioneers founded Salt Lake City, to the present time. He shows how the Mormons, if not the first people in America to practise irrigation, were certainly the first to establish it on an extensive scale, the whole of their civilisation practically resting on this type of agriculture. They showed the way to reclaim vast areas of arid land and on their pioneer attempts have been based the methods utilised in other parts of the United States. He also traces the influence of this type of agriculture on the plan and design of the cities of Utah. The book would have been improved by the addition of a map.