blood corpuscles, and oxidizing and catalyzing organic substances. We see, therefore, that the organism develops its enormous surfaces in the tissues and colloidal ferments not only because it requires osmotic processes, but on account of the very great catalytic activity of such surfaces. If, as Boltzmann says, the war for existence which living matter must wage is a war about free energy, certainly, of all the forms of free energy the *free energy of surface* is the most important for the organism.

"In conclusion, I need scarcely state that I do not maintain that there is any mysterious identity between the metals and the enzymes. But, without exaggerating the overwhelmingly large number of analogies, we are compelled to regard the colloidal solutions of the metals, in many relations at least, *as inorganic models of the organic enzymes.*"

HARRY C. JONES.

SCIENTIFIC BOOKS.

Electric Lighting. By FRANCIS B. CROCKER, E.M., PH.D., Professor of Electrical Engineering in Columbia University, N. Y., and Past President of the American Institute of Electrical Engineers. New York, D. Van Nostrand Co.; London, E. & F. N. Spon.

This book is the second volume of a work, the earlier of which appeared in 1896. The complete work is intended to be a practical treatise on electric lighting for engineers, students and others. The prior volume dealt mainly with the establishment and equipment of electric lighting stations, including locations, buildings, power, dynamos, accumulators, switchboards, measuring instruments, lightning arresters, etc. The present volume, on the other hand, is devoted to that part of an electric light installation which includes the distribution of current and its utilization in various forms of lamps for light. As the author points out in his preface, the space available would not permit the more abstruse consideration of the several divisions of the subject, and this may well be admitted. A glance shows, indeed, that the volume has no waste space; the descriptions are brief, and the data compact and apparently quite accurate. In these respects it is excellent.

The book is eminently practical, but does not neglect the full consideration of principles necessary to a full understanding of the topics treated. It will be valuable as a reference book for engineers on account of the inclusion within its pages of many useful tables and examples.

Beginning with a chapter upon the physical properties of conductors, which includes the application, under limitations and modifications, of the so-called Kelvin's law, and the maximum carrying capacity, there follows a thoroughly adequate treatment of the various systems of electrical distribution in several succeeding chapters. The series systems, parallel systems, three-wire and five-wire distribution, direct current transformer systems and networks of electrical conductors, share the space alloted, in accordance with their importance in actual practice.

Chapters VII. and VIII. contain brief, but very lucid, expositions of the principles of alternating currents and polyphase currents respectively, after which follows a chapter devoted to a similar treatment of that very important adjunct, the alternating current transformer. The two succeeding chapters relate to alternating current systems of distribution and the calculation of such circuits. The matter appears to be well put together, and is amply elucidated by diagrams. The part of the work devoted to the distribution of delivery of energy to the place desired is concluded by a full and judicious consideration of overhead and underground conductors. Here may be found ample details of line construction, conduits, etc., as exemplified in the most recent construction, particularly in America.

The remaining portion of the volume proper is devoted to the utilization of the energy for lighting, as in arc lamps and in incandescent lamps, in addition to the accompanying interior wiring, and electric meters. The work concludes with appendices, one of which contains the National Electric Code of the Board of Fire Underwriters, and the report of the Committee

of the American Institute of Electrical Engineers on Standardization. The inclusion of this matter is certainly to be commended, and it increases the value of an already valuable technical treatise.

The chapters on electric arcs and arc lamps will be found to embody the later knowledge and developments, such as have only appeared in separate scientific papers or technical publications. Likewise the section on incandescent lamps is fully modern, as could not fail to be the case, as it has been revised by Mr. John W. Howell, whose authority on the subject is beyond dispute.

The work has so much calling for commendation that it would be surprising if a few slips of the pen did not occur. In dealing with such a large amount of technical matter it is difficult to avoid occasional use of phrases a little crude, but if the meaning is clear no harm is done. Exception may be taken to some things stated as facts, which are still undetermined. For example, on page 322, 'the retention of the heat by the bulb' in inclosed arcs is involved to save this type of arc from inefficiency as compared with the open air arc. Also, just following, it is stated that "Evidently a large bulb will be less efficient than a small one and will *also tend to produce a carbon deposit by chilling the vapor on its cooler surface.*" This involves the inadmissible idea that carbon vapor can *exist* away from the arc flame as such, when in fact carbon would be condensed as soot unless burned before leaving the arc flame. If we deprive the inclosed arc too completely of air a small bulb is more rapidly rendered opaque by soot deposits than a large one.

There is a manifest inconsistency seen in comparing paragraph headed 'Current and Voltage,' page 312, with paragraph 'Efficiency,' page 325. Here the inclosed arc is made to appear by tests accredited to Freedman, at least as efficient as the open air arc, in contradiction to the opening sentence under 'Efficiency,' page 322. The fact is that there are other measurements of arcs extant which are far less favorable to the inclosed arc than those used in the book, and the former are probably nearer the truth.

The author has, in several instances, wisely availed himself of publications issued by the manufacturing companies, and many chapters are followed by references to papers and publications which have been consulted, though the chapters dealing with arcs and arc lamps are an exception. This brings to notice what may appear to some as a defect of the work. It is evidently not intended to be historical, yet names and sometimes dates are used, but there appears throughout no consistent policy in that respect. Names occur sometimes in connection with relatively unimportant suggestions, though in other more important connections they are omitted. Credit is even given, sometimes, to the same worker for certain things and withheld at other times, though the objects in the latter case may be of the greater practical value. Few instances appear to exist in which the credit given is misplaced, as with the transformer figured on page 174. Notwithstanding this, the work gives ample evidence of the ability and industry of its author, and must be welcomed as a valuable addition to electrical literature. It is well printed, admirably illustrated, and the figures are clear and well chosen.

ELIHU THOMSON.

Chemical Technology. Edited by E. CHARLES GROVES and WILLIAM THORP. Vol. III. *Gas Lighting*, by CHARLES HUNT. Published by P. Blakiston's Son & Co., Philadelphia. Large 8vo. Pp. 312. Price $3.50.

This work deals very fully and satisfactorily with the manufacture of gas for the purposes of illumination, the various forms of retorts, settings, condensers, scrubbers, governors, etc., being carefully and minutely considered. The methods of chemically testing and measuring the gas are clearly and concisely explained.

More than one-eighth of the book is devoted to oil and water gas, nearly every important process for their manufacture being detailed. The treatise closes with an excellent chapter on burners, all the principal ones being described; no mention is made of the 'bec Feron,' a French mantle burner of high power using a mixture of gas and air under pressure.

In view of the extended use of inclined retorts, the reviewer considers the treatment of this subject too brief; this remark applies also