"the latent heat of steam formation" is given as 967, instead of 970.4. On page 154, the method given for the determination of moisture and volatile carbon in coal could be replaced by standard ones. On page 155, the author states that, from the data of the proximate analysis, "the calorific power of the coal can be *approximately* calculated by Lenoble's formula" which he gives. A description and instruction in the use of a standard calorimeter at this point would not be amiss. On page 158, under "Water," the direction is to dry total solids and the residue, before driving off organic and volatile matter, at 130 degrees Centigrade to constant weight, instead of at 103 degrees for one half hour. On page 162, the soap method for hardness is given, but no mention is made of the titration methods.

In the chapters on analytical control in cane-sugar factories, beet-sugar factories and refineries, the author tabulates the work involving control of sugar materials and products, indicating what determinations are necessary on each. He avoids repetition as much as possible by referring to the directions for analytical methods given in the chapters devoted to outlines and discussions. One would call attention to the direction for determination of sucrose in molasses, on page 181. Under Clerget, on this page the following is given: "The direct polarization and the polarization after inversion should be carried out on portions of one and the same solution; for this reason two or three times the normal weight of molasses should be dissolved in 500 c.c. of water. The determination is then carried out as previously directed." Doubtless he intends that the dilution should be to 500 c.c. instead of "dissolved in." Since in giving the method of Clerget on pages 71 and 178–179, it is stated that the use of subacetate of lead is not permissible, but if a decolorant must be used specially prepared blood-carbon or bone-black should be employed, the operator or student would refer to these directions when preparing his solution for the double polarization of molasses, thereby omitting clarification with lead compounds and subsequent deleading but resorting to decolorization with bone-black or blood-carbon, unless he perchance referred to the Meissel-Hertzfeld method as given in chapter 6, page 94, which he is hardly expected to do since this method is given and discussed in the chapter given to the determination of sucrose by optical and chemical methods and not to the determination by optical methods as Clerget calls for. Evidently the author would not recommend clarification of molasses with subacetate of lead when determining sucrose by the Clerget method.

Chapter 12 is an invaluable addition to the volume, as a résumé of the work of the International Commission is here given, which is not always at the hands of the chemist, either in the original transactions or in compilation. It is commendable that this so-important work is compiled and condensed in an available form.

The tables given are well selected and will meet the needs of the sugar analyst, except table 18 (that used in calculating the percentage of commercial sugar recovered from the sucrose in the massecuite as given by I. H. Morse), which is incomplete and would be of little service except in refineries.

The subject-matter of the volume is well correlated, repetitions are few, and the style and appearance of the book are good. Although criticism is here brought of some of the methods of analysis, as given in chapter 8, and attention called to the method for the preparation of the solutions in the determination of sucrose in molasses, and to the incompleteness of table 18, this work will be an addition to any technical library and of aid to the analyst experimenter and student, when working on commercial sugars and allied products and following routine analytical work in sugar houses and refineries.

C. S. Williamson, Jr.
Tulane University of Louisiana

Electric Arc Phenomena. By Ewald Rasch. Translated from the German by K. Tornberg. New York, D. Van Nostrand Company. 1913. Pp. 194.

The introduction contains a discussion of the relative merits of the electromagnetic and

the electrodynamic theory of light in which the author demonstrates the ascendency of Wilhelm Weber over James Clerk Maxwell and predicts that "the explanations furnished by the electronic theory . . . contain the germs of future progress in electric-light engineering." The reasons for this prophecy, however, are not disclosed.

After explaining what an arc is, the conditions under which it is formed and the method of adjustment the author describes the physical and chemical properties of typical electrode materials and the process of manufacture of carbon electrodes. This is followed by a brief discussion of the theory of electrical discharges based upon the electronic theory. In the fifth chapter the author reviews some of the investigations made upon spark discharges between electrodes of different shapes in air. The treatment of this subject seems scant and antiquated in view of the many pertinent investigations made during the past ten years. The effect of gas pressure, humidity, temperature and kind of gas is not considered.

The most valuable contributions to the subject are made in the last three chapters. The sixth chapter has to do with the voltage and current conditions in the direct and alternating-current carbon arc lamp, the seventh with the distribution of energy in carbon arc lamps and vapor tubes, and the eighth with the relation between power and light emitted by plain and mineralized carbon arc lamps and vapor tubes.

The author confesses that some of his remarks are of purely didactic nature, and these digressions, although prohibitive of smooth development of the subject, contain many valuable suggestions. In expressing his disapproval of the term "watts per candle" the author has anticipated the recent suggestion of the term "lumens per watt." In remarking that "physiological effects can no more be expressed in mechanical horse-power than can, for instance, Beethoven's 'Ninth Symphony'" it would seem, in view of the measurements reported by our modern nutrition laboratories, that the author might have chosen a less vulnerable example. The text at times seems to rise above the subject, the discussion in places being supported by cosmogonic reflections and the fourth dimension.

R. G. HUDSON
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SPECIAL ARTICLES

LIGHT AND THE RATE OF GROWTH IN PLANTS

A STUDY of the development of about a hundred seed-plants in darkness in an equable temperature chamber from 1900–03 in the New York Botanical Garden gave foundation for the following statement:

> The failure of a large proportion of the forms examined to make an accelerated or exaggerated growth when freed from the influence of light, even when provided with an adequate food-supply, shows that light has no invariable or universal relation to increase in length, or thickness or to the multiplication or increase in volume of separate cells.[1]

Precision appliances for the measurement of illumination and of other environmental conditions in daylight were not available at that time, and it was therefore not possible to follow the contrasting reactions which accompanied illumination and shading of the large plants which were the subjects in the extended experiments. In one series, however, the peduncles and scapes of *Arisaema* nearing the end of their period of elongation showed in initial acceleration when light was totally excluded from the plants. This acceleration reached its maximum in twenty-four hours then decreased to a minimum equivalent to the original rate in about four times this period. The older plump assertion that "light retards growth" continued to be cited without modification by writers of text-books and compendiums. The few investigators who turned attention to the subject have been content with referring to such cyclopedias. Thus Blaauw[2] says, in discussing positive and negative photogrowth reactions:

[1] MacDougal, "Influence of Light and Darkness on Growth and Development," *Mem. N. Y. Bot. Garden*, 2, pp. 307, 308, 1903.

[2] "The Primary Photogrowth Reaction and the Cause of the Positive Phototropism in *Phycomyces nitens*," Kon. Akad. van Wetensch. te Amsterdam. Proc. of meeting, January 31, 1914.