their curricula, as well as different methods of prescription of entrance requirements. The one supplements the schools, and must build smoothly up from below; the other builds down from the profession, and must, at all hazards, make its junction at the upper end effective, while its entrance requirements must be such as will least embarrass the aspirant while satisfying the proper demands of the profession. Each curriculum, however, must be constructed by experts in its own field, and the professional must be relied upon to perfect the courses and prescribe the requirements of the technical school, as must the expert in academic education be expected to be given a free hand in the upbuilding of general education.

Shorter papers on laboratory work, on details of educational apparatus, 'thesis work,' courses of instruction in various departments and reports of committees, fill the volume with a mass of material hitherto unparalleled in this line, and which must deeply interest, not only workers in this field, but all educators, and particularly all who are interested in the promotion and improvement of our still defective and inadequate educational provision for the best interests of the industrial classes, and in the advancement to still higher planes of our professional schools. The careful study, not of this volume only, but of the series, beginning with the organization of the Association at the Educational Congress at Chicago, in 1893, in connection with the Columbian Exhibition, cannot but well reward every one interested in the modern and current movements in this politically, as well as socially, important department of the scheme of national education, the perfection of which is so vital an element in determining what shall be the political and the moral and intellectual status of our country in coming generations.

R. H. THURSTON.

SCIENTIFIC BOOKS.

Die chemische Energie der lebenden Zellen. DR. OSCAR LOEW. Munich, Dr. E. Wolff, publisher. 1899. Pp. 170.

This publication gives the results of a series of observations on the chemical characteristics of living matter. It is proved that the proteids of living matter are of very labile nature and different from those of the dead matter, into which they are transformed by atomic migrations in the molecules. It is also demonstrated that in many plants a labile reserve-protein occurs which is not yet organized, but is changed by the same conditions as kill the cells. The book contains the following chapters:

1. Views on the causes of the vital activity.
2. General characteristics of living matter.
3. Chemico-physiological characteristics of living matter.
4. The essential concomitants of protoplasm.
5. The character of the biochemical work.
6. On the formation of protein in the lower fungi.
7. On the formation of protein in the green plants.
8. Theory of protein formation.
9. A labile protein as reserve material in plants.
10. Chemical characteristics of the labile protoprotein.
11. Lability and activity in the protoplasm.
12. Theory of respiration. Chapters 9 and 10 give the results obtained in conjunction with Th. Bokorny.

The most modern progress of theoretical chemistry has been brought to bear in this work. The theories advanced in the work and the suggestions which they contain will make the book invaluable to students of bio-chemistry and physiology. Doctor Loew has concluded his work with the following brief summary:

"It may be briefly recapitulated in a few words how much the theses put forth correspond or coincide with the observations made. In the first place, it should be remembered that the living substance shows a great resemblance to a chemically labile body and that the dying process of the protoplasm is suggestive of the transition of a labile into a stable modification of organic compounds. According to the theory developed in the eighth chapter concerning the formation of albumin, the lability of the plasma-protein is due to the simultaneous presence of aldehyde and amido groups. The

toxicological facts reported in the eleventh chapter, indeed, support this view.

The further inference from the theory, that very labile but not yet organized protein substances possibly occur in plants, has also been verified. An exceeding labile reserve protein of an aldehyde nature was proved by Bokorny and myself to exist in many kinds of plants; its characteristics are described in the ninth and tenth chapters.

Labile substances contain kinetic chemical energy; they contain certain loosely bound atoms, which under the influence of heat become more mobile than in case of a more stable arrangement. As a result chemical reactions are caused, the energy of these atoms being transferred to certain susceptible substances (sugar, fatty acids), which are thus drawn into a state of higher reactive power, especially with the otherwise indifferent oxygen of the atmosphere. In other words, catalytic actions are produced through a charge with chemical energy. The proteins of living substances appear as relatively firm structures in which separate labile atoms perform great oscillations. This conception is essentially different from that of Pflüger and Detmer, both of whom ascribe to all atoms in the plasma-proteins such an intense state of motion that a dissociation results, to be followed by a similarly energetic regeneration. Pflüger says:* "I do not expect to meet with any opposition if I consider the living matter as not only being astonishingly changeable, but steadily decomposing."

Yet, when we consider that a minimal attack of extremely small quantities of a poison will produce the death of a cell, one may well doubt whether such a metabolism as Pflüger assumes would not sooner lead to death than to a possibility of regeneration. Neither can we, therefore, agree with Verworn when he says:† "The life process is the sum-total of all processes connected with the building-up and destruction of the 'biogens,' or, "life consists in the metabolism of the albuminous bodies." A more correct definition would be the following: Life is the sum-total of the effects made possible by the labile nature of the plasma-proteins and their respiratory activity, and governed by the specific tectonic of the energides and of the active paraplastic structures.*

The nature of the living matter is in the first place determined by lability and organization, that is, by a systematic kind of motion in a structure (tectonic) of labile proteins. The principle of organization is not yet known. Even if we assume with Pflüger that the process of organization consists merely in a polymerization, the complicated details in generation and karyokinesis, would still defy explanation, and the genetic differentiation would not become better intelligible. Difficult problems are here facing us. Still it may be considered a slight advance to know at least a little more about the cause of respiration and the chemical energy of the cells than formerly. It is the lability of the plasma-proteins, which, supported by the effects of light, leads to the building-up of the carbohydrates in the green plants out of carbon dioxide and water with separation of oxygen. It is also this lability which assists in combining the organic substances with oxygen and renders the obtained energy applicable to physiological work.

In addition to the well-known fact that all life functions are based upon the energies of the sun, it must be inferred that the lability of the plasma-proteins is necessary to transform this sun energy into vital action.

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* Pflüger's Archiv 10, p. 311.

† Allgemeine Physiologie, 2d edition, p. 509.

* Kupffer designates the contractile substance of the muscular fibrille, the nervous fibre and the red blood corpuscles as 'paraplastic' formations.

Physical Geography. By William Morris Davis, assisted by William Henry Snyder. Boston, Ginn & Company. 1898. Pp. 431.

Professor Davis well states in his preface the central principle of this volume: "Physiographic facts should be traced back to their causes and forward to their consequences." We find thus the widest departure from the piecemeal description and recital of facts, of most works in physical geography. We should expect this from one who has long been eminent as a student and teacher of the science and who