authors, but whose occurrence there is doubtful, is given in an appendix, where the alleged claims of each to a place in the Michigan fauna are set forth. A bibliography of some twenty-five closely printed pages, a glossary of technical terms, a list of contributors to the work, and an index round out the volume, which will take its place among the best of the state ornithological manuals.

J. A. A.

A School Chemistry. By F. R. L. WILSON, M.A., Assistant Master at Charterhouse, and G. W. HEDLEY, M.A., Head Science Master, Military and Civil Side Cheltenham College. Oxford, H. Frowde. 1912.

This work has been prepared to supply a demand for a shorter course than the author's "Elementary Chemistry." One who has completed the work in a satisfactory manner is prepared to take the matriculation examinations for a number of English universities. The directions for work are very full and the selection and arrangement of experiments are excellent. Wherever possible the experiments are carried out quantitatively and questions and problems are introduced at the end of each chapter. The use of this book by a student should develop his powers of observation and scientific method of reasoning and give him a good insight into the fundamental principles of chemistry.

J. E. G.

Practical Chemistry for Engineering Students. By A. J. HALE, B.Sc. (London), with an introductory note by Professor R. MELDOLA. London, Longmans, Green & Co. 1912. $1.00 net.

In the introductory note attention is called to the fact that while chemistry is recognized as necessary for engineering students, owing to the short time at their disposal for this subject and the lack of appreciation of its value by the students themselves, the course in this subject must be so arranged as to give as much as possible in a short time. In order to get some training in quantitative analysis they must know some general chemistry and qualitative analysis. Although this book is intended primarily for engineering students it is possible, by the selection of certain designated experiments, to use it in connection with a course in the chemistry of building materials. The experiments in general chemistry are well selected to bring out the general principles of the subject, and the experiments are arranged in such a manner as will bring out the quantitative relations whenever possible. This is followed by a short course on qualitative analysis and work in quantitative analysis, the latter being selected to give practise in the preparation of standard solutions, gravimetric and volumetric determinations and methods of analysis of materials of special importance for the engineer, such as water analysis, determinations of the value of fuel, furnace gases, analysis of cements and alloys. While the general method here used would be approved by most chemists, the necessarily limited number of quantitative methods which can be given would no doubt lead to a wide divergence of opinion as to the ones best suited for the purpose.

J. E. G.

Review Questions and Problems in Chemistry. By M. S. H. UNGER, A.M., Head Master, St. John's School, Manlius, N. Y. Ginn & Co. 50 cents.

An excellent manual for use in reviewing classes or formulating examination questions in preparatory school work, covering as it does all the material necessary for college entrance or college board examinations.

J. E. G.

SPECIAL ARTICLES

THE TEMPERATURE COEFFICIENT OF THE COAGULATION CAUSED BY ULTRAVIOLET LIGHT

IT has been pointed out in a previous paper[1] that certain proteins coagulate when exposed to ultraviolet light. In order to learn something about the nature of this reaction it seemed desirable to investigate its temperature coefficient. As photochemical reactions in general are nearly independent of tempera-

[1] SCIENCE, N. S., 37: 24–25, 1913.

ture, it seemed possible that the speed of the coagulation might not be greatly affected by temperature.

In order to test this matter, crystallized egg albumin was prepared by the method of Hopkins and Pinkus. The albumin was recrystallized seven times; the ammonium sulfate was not dialyzed out. A 5 per cent. solution of this albumin was placed in quartz test tubes and exposed to the light from a quartz mercury vapor lamp. The temperature was controlled by keeping the quartz test tubes in water baths automatically maintained at various temperatures and so arranged as to give the tubes equal illumination. The amount of coagulation was estimated by measuring the amount of deposit in the test tubes after centrifuging in sedimentation tubes. The result of these experiments indicated that the temperature coefficient equals or exceeds two.

Of especial interest is the behavior of the tubes which were kept at 0° C. These tubes were still clear after being exposed to the light for 35 hours, while those exposed at higher temperatures contained coagulum. If the tubes which had been exposed at 0° C. were warmed a few degrees their contents began to coagulate. If they were put back into the ice water as soon as the coagulum began to appear the reaction was reversed and the tubes cleared up. This result could be obtained only by cooling the tubes to 0° C. as soon as the coagulum began to appear.

We are dealing here with at least two reactions, first, the change produced by the light, and, second, the production of a visible coagulum.[2] Only the latter has a temperature coefficient as high as two. To demonstrate this it is only necessary to expose tubes at various temperatures for a few hours, turn off the light, remove the tubes from the bath at 0° C. and place them in a warm bath. Although the tubes are perfectly clear when removed from the ice water, a coagulum appears as soon as they begin to warm up. The amount of this coagulum is about the same as if the tubes had been kept in the warm bath during the entire period of exposure to the light. It is therefore evident that the action of the light is about the same at 0° C. as at the higher temperatures. We are apparently justified in concluding that the light produces a substance which promotes coagulation and produces it about as rapidly at the lower temperature as at the higher, but that this substance is unable at 0° C. to bring about any visible coagulation, at least during the time of this experiment. Evidently the temperature coefficient of the light reaction is very low in this case, as is the rule in light reactions. The method of the experiment yielded only approximate results, since the tubes which were kept at 0° C. and which remained clear during the exposure allowed a better penetration of light than those maintained at higher temperatures in which coagulum formed. The highest temperature was only 50° C.

These experiments allow an interpretation of the results of Blackman and Matthei[3] according to whom the process of photosynthesis has a temperature coefficient as high as two. It is of course highly improbable that a photochemical reaction has a temperature coefficient which is so high. It seems much more probable that in photosynthesis, as in the coagulation above described, light acts almost independent of temperature in producing a substance which then undergoes a reaction with other substances, and that it is this latter reaction which has the high temperature coefficient.

The time-temperature curve of the coagulation of proteins by heat has been worked out with great care by Chick and Martin.[4]

[2] In the presence of certain salts some proteins in solution may be denatured by heat, but no visible coagulum forms until the salts are dialyzed out. Whether this has any relation to the phenomenon here described can not be discussed at present.

[3] "Experimental Researches on Vegetable Assimilation and Respiration. III. On the Effect of Temperature on Carbon-dioxide Assimilation," *Phil. Trans. Roy. Soc. of London*, B., 197: 47–105, 1904.

[4] "On the Heat Coagulations of Proteins," *Journal of Physiology*, 40: 404, 1910; *ibid.*, 43: 1, 1911.

In order to determine whether the character of this curve is altered by exposing the protein to ultraviolet light experiments were made with egg albumin which had been freed from ammonium sulfate by dialyzing for a long time against tap water. The albumin was exposed at 0° C.: samples were then placed in tubes and heated to various temperatures in a water bath. The tubes were centrifuged and the volume of coagulum estimated. The method gave only approximate results. However, they were consistent, and the differences in the amount of coagulum obtained under the various conditions were so great that it is evident that the temperature-time curve for coagulation, by heat, of egg albumin which has been exposed to the light, is of the same general form as the one given by Chick and Martin. But the curve lies at all points from 10° to 15° C. below the one given by them.

The chief result of these experiments is that two reactions are involved in the coagulation of proteins by light: the chemical change caused by the light, and the production of a visible coagulum. The light reaction has a very low temperature coefficient, while the reaction producing the visible coagulum has a much higher temperature coefficient. It is probable that similar relations exist in other biochemical and physiological processes which result from the action of light.

W. T. BOVIE
LABORATORY OF PLANT PHYSIOLOGY,
HARVARD UNIVERSITY

THE BOTANICAL SOCIETY OF AMERICA

THE annual meeting of the Botanical Society of America was held in the Chemical Building of Western Reserve University, Cleveland, Ohio, December 31 to January 2, 1913.

The following officers were elected for the ensuing year:

President—D. H. Campbell, Leland Stanford University.

Vice-president—M. A. Howe, New York Botanical Garden.

Treasurer—Arthur Hollick, New York Botanical Garden.

Councilor—George F. Atkinson, Cornell University.

These with R. A. Harper and William Trelease, councilors, and George T. Moore, secretary, constitute the council for 1913.

The following botanists were elected to associate membership: Robert F. Griggs, Ohio State University; Alfred P. Dachnowski, Ohio State University; Warner Jackson Morse, Maine Experiment Station; L. Lancelot Burlingame, Leland Stanford University; John J. Thornber, University of Arizona; James Theophilus Barrett, University of Illinois; Arlow Burdette Stout, New York Botanical Garden; Ezra Brainerd, Middlebury, Vt.; Norman Taylor, curator, Brooklyn Botanic Garden; William Dana Hoyt, fellow by courtesy, Johns Hopkins University; Edward M. Gilbert, University of Wisconsin; Lester Whyland Sharp, Alma, Michigan; William Skinner Cooper, Carmel, California.

A symposium on "Permeability and Osmotic Pressure" was held January 1, participated in by Professors Jacques Loeb, Harry C. Jones, W. J. V. Osterhout and Burton E. Livingston. The papers will be printed in the *Plant World*.

The address of retiring President W. G. Farlow, on "The Change from the Old to the New Botany in the United States,"[1] was delivered at the dinner for all botanists, on the evening of January 1.

Amendments to the constitution, making it possible for all those actively interested in botanical work to become eligible for membership and providing for "fellows," were adopted. The dues for 1913 were made $1.00. Active steps for the publication of a botanical journal by the society were taken.

First Generation Hybrids between Œnothera Lamarckiana and O. cruciata: GEORGE H. SHULL, Carnegie Institution.

Constant Variants of Capsella: HENRI HUS, University of Michigan.

Pedigree cultures from the original individual proved the existence of constant forms, not previously reported. Some of these apparently are not identical with the biotypes previously described by Shull. Emphasis is laid on the importance of the study of seedling stages, since, for purposes of identification, climax leaves may be relied upon under certain conditions only.

[1] SCIENCE, January 17, 1913.