though, as in the other strata of the State, the preservation of the fossils leaves much to be desired. It is to be regretted that the absurd pale yellows allotted by international agreement to the Tertiary, make it almost impossible to prepare an intelligible map of a Tertiary region in color. We should advise Professor Harris in future to use plain black and white symbols for this purpose.

The work on the Tertiary accomplished by this survey is most important, and would have been impossible for any one less versed in the lower Eocene paleontology than Professor Harris. He demonstrates the presence of the Midway horizon in Louisiana, for the first time, in two localities and further search will doubtless reveal others.

The Chickasawan (Mansfield of Hilgard's earlier work and one of the multitudinous 'Lignitics' of authors) is now found to cover a large area in Louisiana. Parts of it, through absence of expert paleontological knowledge, have been referred to the Vicksburg, Jackson, Claiborne and other subdivisions of the Eocene, in earlier work. Now we have its boundaries approximately defined and a well illustrated faunal list of species provided. In future work we trust Professor Harris will discard entirely the obsolete and misleading name of Lignitic and adopt the geographical term for this stage which is accepted by the majority of geologists interested in this horizon.

Jacksonian strata extend, as the author shows, from the Oachita river to the Texas boundary, while the Oligocene beds of the Vicksburg horizon are confined to the region between the Oachita and Red rivers.

Considering the small appropriation available for the work, the State of Louisiana is to be congratulated on the amount and quality of that which has been accomplished. It is to be hoped that Professor Harris may be able to continue his labors, and that the perplexities presented by the Pleistocene deposits of the State may yield to persistent study in the future.

W. H. Dall.

The Physiological Rôle of Mineral Nutrients. By Dr. Oscar Loew. Bull. 18, U. S. Dept. of Agriculture. 1899.

Dr. Loew discusses the actual part of the various mineral substances in the physiology of the vegetable organism, a matter of prime importance to the agricultural experimenter, as well as the botanist. Every advance in this subject has been won by the most arduous labor, and only in a few instances may the conclusions reached be considered as final.

The treatment of such an unsettled subject within the limits of a bulletin must result in many omissions in order to bring points of the greatest interest prominently to the attention. By reason of such necessity one does not find the names of Wieglieb, Marcgraf, Senebier, or Boussingault in the historical resumé of the subject, which otherwise traces the course of investigation on the subject somewhat clearly.

Phosphoric acid is necessary for the formation of the essential constituents of the nucleus and plastids, inclusive of the chloroplasts and chlorophyll; secondary potassium phosphates are found in combination with certain proteins; iron takes part in the formation of chlorophyll although it does not enter into the composition of the molecule of this substance, and is not to be considered of more importance in this connection than many other substances. Attempts to replace iron with manganese have met failure so far. Chorides are necessary for but few species; they are taken up in quantity by aquatics and other plants however.

The presence of potassium salts seems necessary for the synthesis and translocation of carbohydrates and proteins. This element may be replaced by rubidium or caesium in certain fungi.

The relation of calcium salts to the translocation of carbohydrates is not clearly defined, but this substance is abundant in all parts of the bodies of the higher forms of plants. It is notable that many of the simpler organisms may exist and attain full development without this element, and Dr. Loew advances the theory that the development of the higher plants both in form and differentiation of function becomes possible only when the capacity to assimilate calcium and use the resulting calcium proteid compounds is acquired; a theory which is based chiefly on coincidence.

Magnesium is found in nuclear substances

and is abundant in embryonic tissues; its exact rôle cannot be defined. The relation of the element sodium to the organism is most problematical; it may exert a stimulating effect upon protoplasm, or its presence in the substratum may facilitate beneficial chemical changes. It does not enter into the composition of the plant in appreciable quantity however. The bulletin does not give adequate treatment to the pure mechanical functions of salts in the maintenance of turgidity, and it might have gained in value to the agricultural experimenter by the delineation of lines of practical investigation to be followed. It is highly controversial in parts and one is impressed with the very great differences of conclusions which may be reached from a consideration of the same facts by a comparison with the sections of Pfeffer's Plant Physiology or any other publication treating the same subject.

D. T. MACDOUGAL.

Science Sketches: Chemistry its Evolution and Achievements. By FERDINAND G. WIECHMANN, PhD. New York, William R. Jenkins. 1899. Pp. vii + 176.

The study of the evolution of chemical science from its earliest beginnings possesses a fascinating interest. The author of this little book has endeavored so to present the subject as to make it useful to all who take a general interest in science. In matters which pertain to the development of chemistry before the nineteenth century the treatment is satisfactory. For the present century the book does not altogether succeed in tracing the *evolution* of the science. It seems rather to give a series of more or less isolated facts about the growth of chemical knowledge than to give a clear picture of the development of the science. Perhaps this should not be too severely criticised, for it is immensely difficult to give such a picture for the period in question.

If the theory that diamonds are extra-terrestrial in origin has actually been proposed by any one as suggested on p. 117, it must have arisen from a curious confusion as to Moissan's thought in the matter. Moissan says that in discovering the diamonds in the meteorites he has 'caught nature in the act,' meaning, not that the diamonds were in the meteorites as they flew through space, but that they were formed during the passage of the meteorite through the air and its subsequent cooling. This thought seems to have guided Moissan in his successful production of diamonds.

In the discussion of liquid air the failure to mention the pioneers Cailletet and Pictet is remarkable. Some reference should also have been made to the Linde machines by which liquid air is now produced in quantity on essentially the same principle as that used by Tripler.

W. A. NOYES.

BOOKS RECEIVED.

Scientific Papers. PETER GUTHRIE TAIT. Cambridge, The University Press. 1900. Vol. II. Pp. 500.

Railroad Construction, Theory and Practice. WALTER LORING WEBB. New York, John Wiley & Sons; London, Chapman & Hull, Ltd. 1900. Pp. x + 456.

Introduction to Science. ALEXANDER HILL. London, J. M. Dent & Co. Pp. 140.

SCIENTIFIC JOURNALS AND ARTICLES.

THE April number (Vol. I., No. 2) of the *Transactions* of the American Mathematical Society contains the following articles: 'On the metric geometry of the plane n-line,' by F. Morley; 'On relative motion,' by Alexander S. Chessin; 'Plane cubics and irrational covariant cubics,' by Henry S. White; 'A purely geometric representation of all points in the projective plane,' by Julian Lowell Coolidge; 'The decomposition of the general collineation of space into three skew reflections,' by Edwin B. Wilson; 'A new method of determining the differential parameters and invariants of quadratic differential quantics,' by Heinrich Maschke; 'On the extension of Delaunay's method in the lunar theory to the general problem of planetary motion,' by G. W. Hill; 'On the types of linear partial differential equations of the second order in three independent variables which are unaltered by the transformations of a continuous group,' by J. E. Campbell.

THE May number of the *Bulletin* of the American Mathematical Society contains the following articles: 'On the geometry of the circle,' by Dr. Virgil Snyder; 'Isomorphism between