

servation to the behavior of river waters and natural drainage will be willing to admit the great importance of colloidal action in natural river waters, but this truth will not be abetted in any way by the circulation of statements which lack coordination with the other equally important factors in the case.

So far as lime salts are concerned it would seem to be true of fresh waters as it is of sea waters that organic life and organic "matter" tends to remove them, and that in so doing will pull down an appreciable quantity of other suspended matter. The clarity or non-clarity of the resulting stream will then depend, will it not, upon another adjustment of factors such as the relative amounts of "clay matter" suspended in it, the intake of other streams along its course, and the degree of removal of the original lime and organic matter. It has always seemed to the present observer that the condition of the lower portions of such streams as the greater rivers, the Nile, Mississippi, Ohio, etc., is a sort of survival from a series of natural "experiments" rather than due to the action of one set of factors; and that assertions to the effect that a certain river always does this or that are true only when, as is not always the case, a definite series of like reactions are set up. The apparent preponderance of the "lime salts" over organic matter in the final stages of the Mississippi, and indeed the relative abundance of any of the usual "salts" commonly recorded in water analyses are still in too chaotic a state of coordination with modern ideas of ionization, etc., to be taken too weightily. That colloidal action plays an important part in the reactions constantly in process in river waters may presumably be taken as correct; that such actions play the all-important or even the most important part in such reactions is another matter and is by no means to be given the preeminence ascribed to it in the quotation as given.

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### SCIENTIFIC BOOKS

*The Osteology of the Reptiles.* By SAMUEL WENDELL WILLISTON. Arranged and edited by William King Gregory. Cambridge, 1925. The Harvard University Press. Price \$4.00.

A THING that has been lacking hitherto in the literature of vertebrate palaeontology is a comprehensive and adequate treatise on the osteology of reptiles. There have been many excellent discussions of the osteological characters of special groups and a certain amount of high-grade text-book treatment of the

skeleton of the Reptilia. None of these could fill the need of a comprehensive reference book on reptilian osteology.

This need Williston's "The Osteology of the Reptiles" has filled in an admirable manner. The book is divided into two sections; the first, comprising two thirds of the volume, deals with the reptilian skeleton from a strictly morphologic viewpoint; the second, comprising the remaining third, consists of a brief classification of the Reptilia, with definitions of the major groups and many of them minor ones.

The section on the primitive skeleton of reptiles, in the introduction, is a discussion of particular value. Professor Williston's specialty, in his later years at least, was the morphology of the Permian amphibians and reptiles, and his account of the primitive reptilian skeleton forms a very adequate groundwork for the discussion of the skeleton in the later and more specialized groups. The tabular key of the bones of the primitive skeleton sums up for the student the names of the bones of the reptile skeleton and their location in a very clear and compact way.

Following the introduction is a chapter on the skull of reptiles, occupying nearly a third of the book. Horns, processes, fenestrae, etc., are given a general discussion and their more striking modifications in the various groups are noted. Then the bones of the skull are considered one by one, their primitive positions and contacts noted and their special characters and modifications in the later and more highly specialized reptilian groups discussed. A table of synonyms of names of skull bones adds to the usefulness of this section.

Following the discussion of the separate skull elements is a series of sections dealing with the skull in the various orders of reptiles, noting general form, elements present, degree and kind of fenestration, dentition and adaptive modifications.

After the chapter on the reptilian skull is one on the vertebral column, in which the vertebra are discussed and their elements, developments and modifications, both as individual vertebra and as regions of the vertebral column.

Similar chapters follow on ribs and sternum, pectoral and pelvic girdles and limbs. In each of these the primitive characters of the Permian reptiles are discussed adequately and the modification from the primitive conditions considered as such.

This part of the volume is complete in itself and might be used independently of Part II, which deals with the classification and systematic treatment of the reptilian orders.

Part II begins with a brief chapter on the principle or problem of classification, which points out clearly the difficulties in the way of arriving at a

comprehensive and accurate genealogical classification of reptiles. The principles upon which the present classification is founded are discussed and an account of the early evolutionary history of the Reptilia is included. A diagram showing the classification of the reptiles and amphibians follows this chapter.

The classification of the reptiles is outlined in synoptic form in Chapter VII. Five subclasses, Anapsida, Synapsida, Synaptosauria, Parapsida and Diapsida are listed and a brief definition of the characters of each is given. Nineteen orders and their various suborders are listed and defined briefly.

Five chapters following the synoptic classification deal with the five reptilian subclasses. In each of these the various orders and suborders, intermediate groups and families are listed and defined. One or two apparently inadvertent omissions in this treatment, such as the coelosaurid, megalosaurid and deinodont theropods, are unfortunate.

While there may not be unanimous agreement regarding the status of some groups in the classification, such as the Parapsida possibly, there can be no doubt that this is the most adequate, well-defined classification of the Reptilia that has been proposed, possibly the most natural one. It is largely in agreement with that published by Broom in 1924.

The book is illustrated by nearly two hundred text figures, partly drawings by the author and partly derived from other sources, for which credit is always given. The figures are well chosen and illustrate very well the characters discussed. Complete cross-references in the text bind text and figures together in a way that increases the value of both.

The editorial work upon the volume consists of more than the usual editorial preparation and oversight of the text and illustrations. Numerous comments in brackets by the editor call attention to different viewpoints by various authors, especially to work done since Williston's death in 1918. This applies particularly to notice of recent work by Broom, Watson and other specialists on the earlier reptiles. These comments serve partially to bridge over the gap between the preparation of the manuscript by Williston in 1918 and earlier and its publication in 1925. An alphabetical finding index of genera would have been a useful addition.

The small and convenient size of the book (three hundred pages, octavo), its attractive appearance and its reasonable price ought to insure widespread use of the volume aside from the value of its contents. It is really surprising to find the wealth of useful, accurate, thoroughly digested information this book contains in so small a space. "*The Osteology of the Reptiles*" is the final work of a distinguished morphologist and paleontologist. It is based upon

many years of thorough, patient work upon the earlier reptiles by a brilliant mind. It includes also the mature results of the author's studies of the later reptiles. The information is clearly expressed and compact and is readily available to inexperienced students and more mature research workers alike.

The book fills a place long empty in scientific literature and is a credit to every one concerned with its appearance, first its author, the late Professor Samuel Wendell Williston, and also to its sponsors, Professor T. H. Barbour and the Harvard University Press, and its editor, Professor William King Gregory and his associates.

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## SPECIAL ARTICLES

### THE PRESENCE OF SULPHATE REDUCING BACTERIA IN OIL FIELD WATERS

*Statement of the problem:* The reduction of sulphates in sea water and the waters of certain springs through the agency of living microscopic organisms has been well established by the researches of Sir John Murray and many other observers whose work will be cited in a more detailed paper to be published later. The following equations are types of those which have been postulated by these observers to explain the results of these reactions of metabolism.

- 1a.  $\text{CaSO}_4 + \text{CH}_4 \rightarrow \text{CaS} + \text{CO}_2 + 2\text{H}_2\text{O}$ .
- 1b.  $\text{CaS} + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CaCO}_3 + \text{H}_2\text{S}$ .
2.  $\text{Na}_2\text{SO}_4 + \text{CH}_4 \rightarrow \text{Na}_2\text{S} + \text{CO}_2 + 2\text{H}_2\text{O}$ .
- 2a.  $\text{Na}_2\text{S} + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{S}$ .
3.  $\text{CaSO}_4 + 2\text{C} \rightarrow \text{CaS} + 2\text{CO}_2$ .
4.  $\text{MgSO}_4 + 2\text{C} \rightarrow \text{MgS} + 2\text{CO}_2$ .
5.  $\text{Na}_2\text{SO}_4 + 2\text{C} \rightarrow \text{Na}_2\text{S} + 2\text{CO}_2$ .

Within recent years geological studies principally in the United States have disclosed evidence of the reduction of sulphates with the concomitant development of hydrogen sulphide and of carbonates in the deeply buried waters of oil fields.<sup>1</sup> Somewhat analogous conditions have been postulated by Siebenthal<sup>2</sup> in the zinc districts of Missouri, Oklahoma and Kansas.

Although most of the equations above listed were originally written to express reactions recognized as due to living organisms, geologists concerned with the reduction of sulphates in connection with oil have

<sup>1</sup> G. Sherburne Rogers, "The Sunset-Midway Oil Field, California," Professional Paper 117, U. S. Geological Survey, 1919.

<sup>2</sup> C. E. Siebenthal, "Origin of the Lead and Zinc deposits of the Joplin region," Bull. 606, U. S. Geological Survey, 1915.