tigations relating to physical constants and properties of proteins. This line of study, as the author remarks, certainly deserves consideration on the part of chemists and biologists, although it is not yet satisfactorily developed. The book is divided into four parts: (1) chemical statics in protein systems (dealing with preparations of pure proteins and hypotheses concerning protein compounds); (2) electrochemistry of proteins (conductivity, etc); (3) physical properties of protein systems; (4) chemical dynamics in protein systems (hydrolysis of proteins, action of enzymes). Naturally the author's own investigations are discussed at length. In these he tries to apply those quantitative laws which, as a rule, are classified specifically as physicochemical: the gas laws, van't Hoff's theory of dilute solutions and all those other laws which can be derived from them on the basis of thermodynamics. The numerical data of the measurements fit the calculations well in most cases; the conclusion of the author, however, that protein solutions do not contain discrete particles does not seem perfectly justified, since investigations by Einstein and by Perrin have shown that even emulsions allow the application of the gas law in a certain form. Nevertheless the book will certainly prove extremely useful as a manual for all those who are interested in the further development of this important branch of science.

R. BEUTNER

Die Vorzeitlichen Säugetiere. By O. ABEL. Jena, Gustave Fischer, 1914. Pp. v + 309, with 250 figures and 2 tables in the text.

In the introduction the author emphasizes the dominance during the Mesozoic of the great reptiles—dinosaurs on land, mosasaurs in the sea, pterosaurs in the air—which, though mammals, had existed from the Upper Trias to the limit of the Cretaceous, put an effective check upon their evolutionary advancement. The principal abiding place of the mammals has always been the continents, yet by Middle Eocene time one finds the sea mammals, such as the whales and Sirenia, already evolved, and although the aerial realm has never been a domain of the mammals, the bats have for a long time competed with the birds, the heirs of the pterosaurs.

According to Steinmann, the different reptilian stems were not extinguished at the end of the Cretaceous period, but the great dinosaurs are said to have still existed in the great land mammals of the Tertiary, the ichthyosaurs in the dolphins, the mosasaurs in the baleen whales, the plesiosaurs in the sperm whales, the pterodactyls in the bats. This view Abel refutes upon anatomical and other grounds, and derives the mammals from a much more primitive reptilian stock. The author discusses the remarkable preservation of fossil mammals, as seen in the asphalt beds of the Rancho La Brea in California, frozen cadavers in the tundras of Siberia and those preserved in the oil-steeped soil of Galicia and the dry caverns of Patagonia, as well as in the ordinary mineralization of the bones. The principal localities which have produced mammalian remains are recorded; first those of the Mesozoic, then the European localities in their geologic sequence, followed by those of Asia, Africa, North America, South America and Australia in the order named. A very carefully wrought out chronological table is given, correlating the faunas of the five continental regions, the North American column presenting the six successive faunal phases as originally proposed by Osborn.

The oldest mammalian remains are discussed, no Permian ones being known, but the Upper Trias producing forms which seem to point to an origin at the latest by Permian time. The position of the ancient mammals in the "system" of living mammals is next dealt with historically. Abel recognizes the difficulty of erecting a system of classification which shall also give the phylogenetic stages in the history of any stock, and states that it almost seems as if it were impossible, on the basis of our present taxonomy, to form a satisfactory compromise between that and phylogeny. His own classification, though in many cases it does not give full recognition to phylogenetic facts, seeks, where possible, to lay emphasis on the historic and genetic

events in the history of the mammalian stocks.

The bulk of the book is taken up by a summary of the extinct mammals; first those without the placenta (Eplacentata), or the marsupials, including the Allotheria or multituberculates, the African *Tritylodon, Ptilodus* and *Polymastodon* of North America, and the various types described by Ameghino from Patagonia. After these comes a discussion of the diprotodont marsupials in Australia and South America, while the triconodonts are included with the polyprotodont types. Placental mammals embrace the Pantotheria or trituberculates and all forms above them, of which the insect-eating types or Insectivora are the most primitive; the author also includes under this head the unique Tillodonta, *Tillotherium* and its rare allies, whose position in the mammalian scheme is very doubtful. The relationships of the creodonts and fissipede Carnivora are clearly set forth, after which Abel describes the ancient whales.

The group of edentates are discussed under two distinct heads, the Xenarthra or "poor-toothed" mammals of South America, and the Nomarthra, those of the Old World, of which there are relatively very few. Rodents are briefly dismissed, the curious horned types, *Epigaulus* and *Ceratogaulus,* of the Miocene of Colorado and Kansas being emphasized as the most remarkable.

The hoofed mammals are always the most conspicuous and numerous forms in every fossil fauna, and to them the greater part of the volume under consideration is devoted. Twelve orders are recognized, of which the first is the "Stammordnung" Protungulata, embracing all of the forms usually included under the order Condylarthra and certain additional families such as the Pantolambdidæ, here considered as ancestral to the Amblypoda instead of being placed under that order as is the usual custom. The Bunolitopternidæ, ancestral to the Litopterna, are also placed here.

Following the ungulates, the primates are discussed, but a very brief section only is given to fossil man.

The final chapter of the book is upon the rise, dominance and decline of the mammalian stem. Of particular interest is the author's discussion of the causes of extinction, great emphasis being laid upon the possibility of contagious diseases having an extensive influence in the extinction of faunas.

Altogether the book is a well-balanced production which avoids excessive technicalities but gives a very good general idea of the more essential facts of mammalian anatomy, classification and relationships as disclosed by paleontology. It shows, moreover, how necessary for systematic work in recent zoology an adequate knowledge of extinct animals has become. An interesting commentary upon the advancement of paleontological science is afforded by the fact that the great bulk of illustrative material is drawn from American authorities and based upon the fossil resources of the New World.

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The Vegetation of the Nebraska Sand Hills

The average traveler regards the prairies and plains as regions of extreme monotony; particularly is this true if his way takes him through a region of sand hills. The total incorrectness of this view is admirably illustrated by the publication of Professor Pool's researches in the Nebraska sand hills.[1] From an earlier and semi-popular presentation by the same author we had learned to know something of the fascination and scientific interest of these dynamic landscapes, and now we have his detailed results.[2]

The Nebraska sand-hill country covers an area of about 18,000 square miles, that is, nearly a fourth of the area of the state. There are similar but smaller areas of sand hills in Kansas, Colorado and the Dakotas. The soil

[1] "A Study of the Vegetation of the Sandhills of Nebraska," Raymond J. Pool. *Minn. Bot. Stud.,* III., 4: 189–312, pls. 15, figs. 16, map 1, 1914.

[2] "Glimpses of the Great American Desert," Raymond J. Pool. *Pop. Sci. Mon.,* 80: 209–35, figs. 17, 1912.