

lished here, they would find in the ethnical relations such a basis of power, and accordingly obtain such a firm foothold, that their dislodgement would be no easy task.

We have still to speak of the part which Herat, for the very reason of the advantages referred to above, has played in the past. Herat is to-day, to some extent, the centre of trade between India, Persia, and central Asia, where new goods are exchanged, the packages are overhauled and re-arranged, and the caravans spend some days, or even weeks, in resting for their farther journeys. And so, in antiquity, Herat was the point from which almost all the conquerors of India and western Asia set out. Alexander the Great stopped there in 327 B.C.; the Mongolians under Dshengiz halted there in 1220 A.D., before going on to the Indus; Timur passed through Herat on his march toward India in 1381; Sheibani Khan, the Uzbek prince, was intending, in the beginning of the sixteenth century, to start from Herat to India; and Nadir Shah, in 1731, did not dare to attempt the way toward southern Hindostan until he was in possession of Herat.

History repeats itself everywhere with very similar episodes. What the early Mohammedan and Buddhist adventurers attempted when they crossed the Oxus, and, attracted by the rich treasures of India, went towards the south, is the same thing which the present successors and representatives of the Tartar warriors — viz., the Russians — are aiming at; for they, too, have an eye upon the fields of India, however much czars and ministers disclaim the fact, or Russian scholars talk of the 'noble mission of culture' fulfilled by the attempts of their army in Asia. If Russia had not already spent over four hundred million dollars in carrying out her policy in central Asia, and if this central Asia were not such a useless acquisition, which can never be a source of revenue, but always an expense, we might put some faith in these assertions; but no one is so simple nowadays as to ascribe persecution on the part of individuals or states to purely philanthropic or unselfish motives. Russia wants the 'Gate of India' in order to reach India; and the essential difficulty in her plan consists in the fact that the land on the Ganges and Indus is controlled, not by effeminate Brahmins, or the degenerate successors of Baber, but by the active, highly educated, and powerful Briton, and that any aggressor at present, instead of carrying home the golden gates of the palace of Somnath, as did Mahmud the Ghaznewid, would be much more likely to come off with a broken head.

#### COPE'S TERTIARY VERTEBRATA.

WHEN this immense work is completed by the issue of the second part, we shall have by far the most extensive and valuable survey yet

attempted of the tertiary vertebrates, which have been discovered in our western territories in such amazing profusion. Dr. Leidy's excellent volumes now cover but a small portion of the ground, which has been so greatly extended since they were written. In Professor Cope's new book, which looks as formidable as an unabridged dictionary, one hardly knows whether the vast collections which he has brought together, or the skill with which they have been worked up, is most to be admired; for this book is no mere wearisome compilation of descriptive details, but a notable contribution to morphology and the theory of evolution.

After a general account of the tertiary formations of the central United States, the introduction proceeds to a much-needed discussion of the correspondences between the geological periods of Europe and North America. This has often been attempted before; but the new material lately obtained sheds much light upon these vexed and difficult questions. In the paleozoic formations, these identifications can in many cases be made easily and certainly; but in the mesozoic, and still more in the tertiary, deposits, they become very problematical. A starting-point, however, seems to be given to us in the Wasatch of America, which seems to be the exact equivalent of the French Suesonian: later than that, the correspondences seem to be but general. Professor Cope still maintains his former view, that the Laramie (the great coal-bearing formation of the region west of the Missouri) is of cretaceous age. In this connection, it is interesting to compare with Professor Cope's arguments those advanced by Professor Lesquereux in his work on the cretaceous and tertiary flora, which has just been issued as volume vii. of this same series of reports. Professor Lesquereux attacks the problem chiefly from the botanical side, but, after reviewing all the evidence attainable, pronounces emphatically in favor of the tertiary age of the Laramie. It seems to us that Lesquereux makes out rather the better case, and that possibly the Laramie may prove to be contemporary with the earliest eocene formation of this country, the Puerco; the former being composed of swampy and estuarine deposits, and the latter of lacustrine. This view is much strengthened by the recent discoveries of Laramie dinosaurs in the Puerco, and of marsupials like those of the Puerco in the Laramie. Further evidence must, however, be awaited, before the hypothesis can be accepted.

It is to be regretted that Professor Cope

*The Vertebrata of the tertiary formations of the west.* By E. D. COPE. Book 1. (Rep. U. S. geol. surv. terr., vol. iii.) Washington, Government, 1884. 1,009 p., 135 pl. 4°.

did not add to this section of his introduction a general survey of the animal life in each of the periods which he afterwards treats in detail. Such a summary would have been exceedingly useful.

Before examining the book in detail, it will be of advantage to direct the reader's attention to Dr. Hayden's summary of "the most important contributions to paleontology and evolution," contained in his letter of transmittal of the volume before us. These are: 1°. The discovery of the Puerco fauna. This includes the discovery and description of three new families of a new order (the Taxeopoda), and a new sub-order (the Taligrada); also the discovery of the *Plagiaulax* type (of the Jurassic), and other marsupials, and of a genus of Laramie saurians. 2°. The discovery of complete remains of the Wasatch types, *Phenacodus* and *Coryphodon*. "The light thrown on the phylogeny of the Ungulata by this discovery exceeds that derived from all other sources together." 3°. The new classification of the lower clawed mammals, founded on the analyses of a great number of new genera and species. 4°. The restoration of the four-toed Wasatch horse, *Hyracotherium*. 5°. The restoration of the Bridger genera, *Hyrachyus* and *Triplopus*. 6°. The determination of the systematic relations of the Dinocerata.

Turning, now, to the body of the work, the first chapter to demand notice is that on the fishes. The shales of Green River, Bear River, and Florissant, Col., have long been famous for their abundance of fish-remains. Our knowledge of these forms is almost entirely due to Professor Cope, but hitherto he has figured none of them. In the present volume there is a very welcome series of plates that illustrates all the types. It is a pity that Professor Cope has adopted the classification he uses, which, being founded entirely on the skeleton, and ignoring the structure of the soft parts, is necessarily imperfect and misleading.

Perhaps Professor Cope's most signal service to paleontology is his discovery of the exceedingly curious and interesting Puerco fauna, the earliest known from any tertiary formation. This assemblage of mammals is of extraordinary interest, both to the morphologist and the geologist, and goes a long way towards bridging over the gap between the tertiary and mesozoic ages. The characteristics of this fauna were given above, but we must again insist on the immense value of its discovery.

In the Wasatch, the second epoch of the

eocene, we are presented with a no less interesting series of mammals and reptiles. The only full account extant of American tertiary turtles and crocodiles is here given. Further, our knowledge of the Wasatch mammals is almost altogether owing to Professor Cope, whose explorations of the Big Horn basin in Wyoming yielded such extensive collections. The chapters on the ungulates of this formation are of especial importance. The study of these has confirmed the author's prediction, made in 1873, that the earliest ungulates would prove to be five-toed and plantigrade, and has enabled him to construct a scheme of all the ungulate series, which, however we may differ as to its details, must be admitted to be a masterly presentation, and full of most valuable suggestions. These chapters, and especially the descriptions of the skeletons of *Periptychus* from the Puerco, and the Wasatch genera *Phenacodus* and *Hyracotherium* Owen (*Orohippus* Marsh), of which Professor Cope gives the first complete account, are to be particularly commended to careful study.

A very welcome section of the book is that on the order Amblypoda, which includes the Dinocerata and the Coryphodons. This order, proposed in 1873 by Professor Cope, has recently been adopted under the name of Amblydactyla by Professor Marsh. The latter's work on the Dinocerata is so much fuller and more complete than Professor Cope's chapters on them, that we need not stop to consider the latter, except to mention the curious Bathypsis. But nearly all that is known of the Coryphodons is due to Professor Cope's labors, and the value of his results in this field it is difficult to exaggerate.

Professor Cope has brought order out of the chaos of the small mammals which abound in the eocene, and which, with great diversity, pass into each other by imperceptible gradations. He groups together the early flesh-eaters—which were not true carnivores, but small-brained forms allied to the insectivores—under the name Creodonta, giving in many cases very complete accounts of their structure, and indicating the forms from which descended the various families of the true carnivores. The same service has been done for the primitive lemurs, the most interesting of which is the little Wasatch *Anaptomorphus* homunculus, which has as large a brain as, and in some respects a higher type of dentition than, any existing lemur, and which seems to be a progenitor of the monkeys. Did space permit, the curious *Taeniodonta* would demand notice.

In the Bridger formation, Professor Cope has not achieved such great things as in the earlier periods. Nevertheless, the sections on the reptiles, the rodents, and the tapiroids Hyrachyus and Triplopus, are notable contributions to the subject.

In closing this very brief and inadequate sketch, we must call attention to the beautiful series of miocene carnivores with which part i. ends. Nothing can exceed the perfection of their preservation, and they enable the paleontologist to follow the evolution of the group without difficulty. Professor Cope says with much truth, "No fuller genealogical series exists than that which I have discovered among the extinct cats."

As is unavoidable in the case of a volume nearly five years in course of printing, this book contains much that riper judgment and fuller knowledge have modified. Thus have arisen the occasional contradictions between different parts of the book; and in recent articles in the *American naturalist* the author has expanded and modified many of his conclusions. But, aside from these, some of his results are open to serious question, and with scarcely any of his phylogenetic tables can we fully agree. His tendency seems to be to generalize too hastily from the study of some special structures, as the dentition or the feet, to the exclusion of other important parts. The book has been rather carelessly printed, and shows many typographical errors; and the references to the plates are frequently and annoyingly wrong, compelling the reader to a tedious search. The plates themselves cannot be praised: many of the figures are badly drawn, and in one case, at least, the drawing is ludicrous (woodcut, fig. 25a). With few exceptions, the lithographic work is not up to the usual standard of the Sinclairs, and contrasts unfavorably with the exquisite workmanship of Professor Marsh's volumes.

But, in spite of these drawbacks, Professor Cope has done a grand work, which is an ornament to American paleontology, and must ever remain a landmark in the history of the science, as well as "a monument to the labor and genius of its author."

#### PHILLIPS'S ORE-DEPOSITS.

CONSIDERING the immense importance of the mining industries, it is remarkable that there have been so few treatises on the manner of

*A treatise on ore-deposits.* By J. ARTHUR PHILLIPS, F.R.S. London, Macmillan & Co., 1884.

occurrence and origin of the various ore-deposits.

With two or three noteworthy exceptions in Germany, and one or two in France, the literature on this subject is confined to the vast number of special papers. Whitney's 'Metallic wealth of the United States,' a model work which has been of great usefulness, treated, in its descriptive part, only of our own country. Mr. Prime's translation of von Cotta's 'Erz-lagerstaettenlehre' has been for years the only general work on the subject in the English language. Since that was written, our manifold mining industries have assumed an importance that will be best understood when we say that during the year 1880 there were nearly ten thousand mines of all kinds and sizes operating east of the 110th meridian. This does not take into account the mines of the precious and other metals of the west, which must number over three thousand. There is a pressing need of a general work based on a survey of our own rich field.

Pending the appearance of such a work, this book by Mr. Phillips, who has visited many American mines, draws largely, both for facts and theory, from the American experience of its author, and will be found to be very serviceable.

In its general plan and appearance it recalls von Cotta's work. The first hundred pages are devoted to the general classification of deposits. The remaining five hundred or more pages describe in detail the noteworthy and instructive occurrences throughout the world.

The classification adopted is well chosen, and is as simple as is consistent with our knowledge of the subject.

- |                    |   |   |
|--------------------|---|---|
| I. Superficial.    | { | a. Deposits formed by the mechanical action of water.   |
|                    |   | b. Deposits resulting from chemical action.   |
|                    |   | a. Deposits constituting the bulk of metalliferous beds formed by precipitation from aqueous solutions. |
| II. Stratified.    | { | b. Beds originally deposited from solution, but subsequently altered by metamorphism.                   |
|                    |   | c. Ores disseminated through sedimentary beds in which they have been chemically deposited.             |
|                    |   | a. True veins.  |
|                    |   | b. Segregated veins.  |
|                    |   | c. Gash veins.  |
| III. Unstratified. | { | d. Impregnations.   |
|                    |   | e. Stock-works.   |
|                    |   | f. Fahlbands.   |
|                    |   | g. Contact deposits.  |
|                    |   | h. Chambers, or pockets.  |

In the general part, which follows, these different forms are discussed in the light of the latest investigations.

The forming of the siliceous gangue in fissures by lateral secretions is illustrated in the