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(Read before the Academy of Natural Sciences, April 11, 1867.)

On the Geologic Age of the Vertebrate Faunæ of the Eocene of New Mexico.—Prof. COPE presented a synopsis of the species described from the Eocene of New Mexico, arranged in the following manner:—

MAMMALIA	..	54
Perissodactyla	..	10
Amblypoda	..	9
<i>Pantodonta</i>	9	..
Incertæ sedis	..	3
Quadrumana	..	10
<i>Prosimia</i>	10	..
Rodentia	..	3
Insectivora	..	19
<i>Taniodonta</i>	4	..
<i>Bestia</i>	2	..
<i>Creodonta</i>	13	..
AVES	..	1
REPTILIA	..	24
Crocodilia	..	7
Testudinata	..	15
Lacertilia	..	2
PISCES	..	8
Ginglymodi	..	2
Plagiostomi	..	6

This total number of eighty-seven species may be considered in two aspects, viz., in regard to their geological position, and their anatomical structure.

As regards the former, it may be observed, that the record preserved in these beds is doubtless more imperfect than that found in many others, owing to various physical conditions. One of these is an evident disturbance of temperature and moisture which they have sustained, perhaps in connection with the volcanic phenomena which played so important a part in New Mexico during the later tertiary times. The fossils are generally found in a fragmentary condition, and often distorted by pressure. The fractures of the surface are often of such a kind as to indicate that the bones have been in a plastic state (see the figures of *Stypolophus hians*) during which the fissures thus created in them have in many instances been filled with a siliceous limestone. This material now presents a rough external surface of great hardness, and sometimes incrusts the teeth in such a way as to render it a difficult matter to expose them. Nodules of the same material abound on the bluffs (see the geological report). Not unfrequently the bones are covered with an incrustation highly charged with the red oxide of iron, and this substance gives its characteristic color to a large percentage of the fossils, the others being gene-

rally black or dark brown. The light colors of our miocene beds are almost unknown, and the bones are always much harder than these, or even than the fossils of the Bridger group of Wyoming. These facts, in connection with the reduced number of exposures of the beds, account for the comparatively small number of species obtained, and the feeble representation of certain groups, *e. g.*, the birds, lizards, rodents, etc. Nevertheless a large number of individuals were obtained, and a considerable extent of country explored, and I believe that the synopsis above given is an approximation to an expression of the characteristics of the most abundant types, or, of the relative numerical representation in the fauna of the different genera, orders, etc.

Comparison with the established scale of geological horizons of Europe has established the fact that the beds in question belong to the Eocene category, as I have already shown¹ to be true of the longer-known Bridger beds of Wyoming. It remains to collate them with the numerous subdivisions of that period. The differences between the Wahsatch and Bridger faunæ have been in part pointed out in my Report on the Vertebrate Fossils of New Mexico, 1874,² and may be more fully stated as follows:—

1. Divisions found in the Wahsatch beds not yet reported from the Bridger beds. Aves, genus *Diatryma* (allied to *Gastornis*); mammalia, *Tæniodonta*; *Phenacodus*; *Coryphodon*;³ *Meniscotherium*; most species of *Hyracotherium*.

2. Divisions found in the Bridger beds not yet found in the Wahsatch: fishes, *Amiïdæ*; reptiles, *Ophidia*; *Anostira*; mammals, *Mesonychiidæ*; *Tillodonta*; *Achænodon*; *Dinocerata*; *Palæosyops*; most species of *Hyrachyus*.

The Wahsatch horizon of Wyoming has not yielded so many species of vertebrata as those of New Mexico, but the close resemblance of the two faunæ may be observed in the following list of forms which I obtained at several localities: Fishes, *Siluroids*; mammals, *Hyracotherium*, two species; *Phenacodus*; *Coryphodon*, two to three species. As is well known the Wahsatch beds underlie those of the Bridger group, and we therefore look for their European equivalent in the lower part of the series. It has been already pointed out⁴ that the absence of *Hyopotamus* and *Anoplotherium* and allied genera, from the Bridger horizon precludes an identification with the upper Eocene of Europe. The comparison of the Wahsatch fauna with that of the lowest of the three divisions into which Professor Gervais has arranged the European

¹ Proceedings American Philosophical Society, 1872, February and July.

² Annual Report of Chief of Engineers, p. 592.

³ The species described by me as *Bathmodon* constitute a section of this genus, characterized by the absence of tubercle or ridge between the inner cusps of the last lower molar. I do not maintain this section as a distinct genus.

⁴ See Report of the U. S. Geol. Surv. Terrs., 4to. ii. p. 33-39.

⁵ Ann. Rept. U. S. Geol. Surv. Terrs., 1873 (1874).

Eocene, shows a remarkably close correspondence. This epoch, the Suesonien of D'Orbigny (Orthrocene Gervais), includes the marls of Rilly, and lignites of Soissons, the Thanet sands, London clays, etc. Fossils from these beds appear to have been no better preserved than those of the Wahsatch beds of the Rocky Mountains, yet some of the genera are identical, and others closely correspondent, as follows:—

Wahsatch.	Suesonien.
<i>Ambloctonus.</i>	<i>Palæonyctis.</i>
<i>Hyracotherium.</i>	<i>Hyracotherium.</i>
<i>Coryphodon.</i>	<i>Coryphodon.</i>
<i>Diatryma.</i>	<i>Gastornis.</i>
<i>Lepidosteus.</i>	<i>Lepidosteus.</i>

As a point of difference between the beds, may be mentioned the absence of the *Tæniodonta* from the Suesonien, a suborder not yet known out of North America.

The Wahsatch formation includes the Green River beds of Hayden, a name which I formerly applied to the entire series. It, however, applies properly to the fish shales of Green River, containing *Asineops*, *Clupea*, *Osteoglossum*, etc., which are probably local in their character.

The Bridger formation will then represent on the American continent more nearly than any other, the middle Eocene or Parisien of Cuvier, Brogniart, and Renevier.

The teeth of sharks described in the reports quoted are of uncertain origin. They are associated with oyster shells, and both have the appearance of having been transported; nevertheless some of the mammalian teeth found associated with them have a similarly rolled appearance. It therefore remains uncertain whether the ocean had for a limited time access to the Eocene lake, or whether the shark's teeth and *Ostrea* were derived from the cretaceous beds which formed its shores. Similar, and in one instance the same species of sharks were found in both formations, the division of the cretaceous being No. 3 and 4 of Hayden.¹

In conclusion, the classification of the North American Eocene may be represented as follows:—

Formation.	Equivalent.	Locality.	Characteristic Fossils.
Bridger Form.	Middle Eocene.	S. W. Wyoming.	{ <i>Palæosyops.</i> <i>Tillodonta.</i> <i>Dinocerata.</i>
Wahsatch Form.	Lower Eocene.	{ N. E. New Mexi- co, S. W. Wyo- ming.	{ <i>Coryphodon.</i> <i>Tæniodonta.</i> <i>Phenacodus.</i> <i>Diatryma.</i>

¹ The same state of things exists in the siderolitic deposits of the canton of Vaud, Switzerland. Mingled with the mammalian remains are teeth of sharks, of which M. La Harpe remarks that their appearance does not warrant the belief that they have been transported, or are not indigenous to the Eocene fauna.