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NOTICES OF MEMOIRS.

ON THE MAMMALIA OF EUROPE AT THE CLOSE OF THE MIOCENE EPOCH.
 CONSIDÉRATIONS SUR LES MAMMIFÈRES QUI ONT VÉCU EN EUROPE
 A LA FIN DE L'ÉPOQUE MIOCÈNE. par PROF. ALBERT GAUDRY,
 (Extrait du Mémoire Intitulé: Animaux fossiles du Mont Lé-
 beron, Vaucluse. Paris, 1873.)

FROM the study of the remains of the fossil Mammalia of Pikermi,
 M. Gaudry considers it more probable that the successive
 species occurring at different geological ages have been derived from
 each other, than that they were created independently. His conclu-

sions are based upon the discovery of numerous intermediate forms between genera which have heretofore been considered as very distinct: for example, an ape intermediate between the *Semnopithecus* and *Macacus*; a carnivore between the *Hyaena* and Civet; a pachyderm between the *Anchitherium* and Horse, a ruminant between the Goat and Antelope. The comparison of fossils from other localities has afforded similar results. With the view of combating the opinions opposed to him, M. Gaudry has studied the fossil Miocene Fauna of Mont Léberon, and has arranged his observations under the following headings:—

1.—The close of the Miocene Period was characterized by a great development of Herbivora.

2.—The Miocene Mammalia prove that the types of the higher forms have been more variable than the lower.

3.—An examination of the Mammalia proves that the Upper Miocene of Europe can be divided into two stages.

4.—The study of the Miocene Mammalia supports the hypothesis that the separation of the Faunas has been only the result of the local displacement of the Faunas.

5.—On the analogous forms of Mammalia which have preceded and followed those of the Upper Miocene.

6.—On the distinction of races and species of some Mammalia at the close of the Miocene Period.

1.—The study of the ancient animals of Vaucluse shows that the *Dinotherium* was accompanied by a large wild boar, two species of *Rhinoceros* and the *Helladotherium*, the most majestic of all the ruminants which inhabited Europe. The plains were covered with herds of the *Hipparion*, of Gazelles with harp-like horns, together with a *Tragocerus* related to the antelopes, a *Cervus* (*C. Matheronis*), also a large tortoise and some smaller species. Few Carnivora troubled the peaceful pastures of the Herbivora, the remains of *Machairodus*, *Hyaena*, and *Ictitherium* having only rarely been met with. The following list shows that the quadrupeds of Léberon were, in all probability, contemporaneous with those of Pikermi (Greece), Baltavar (Hungary), and Concué (Spain).

MONT LÉBERON (Vaucluse).	PIKERMI (Greece).	BALTAVAR (Hungary).	CONCUÉ (Spain).
<i>Machairodus cultridens</i>	x	x	
<i>Hyaena eximia</i>	x	x	x
<i>Ictitherium hipparionum</i>	x		
— <i>Orbigny?</i>	x		
<i>Dinotherium giganteum</i>	x	Dinotherium	
<i>Acerotherium incisivum?</i>	x?		
<i>Rhinoceros Schleiernmacheri</i>	var		
<i>Hipparion gracile</i>	x	x	x
<i>Sus major</i>	<i>S. erymanthius</i>		
<i>Helladotherium Duvernoyi</i>	x	x	
<i>Tragocerus amaltheus</i>	x	x	x
<i>Cervus Matheronis</i>	x
<i>Gazella deperdita</i>	x	x	x

The above list shows the great development of Herbivora, a characteristic feature of the close of the Miocene period. During the Calcaire Grossier and Gypsum period of the Paris Basin, the pachyderms predominated; the *Lophiodon*, *Chæropotamus*, *Hyraotherium*, *Palæotherium*, *Anchilophus*, and *Anoplotherium*. The most herbivorous animals were the *Xiphodon*, *Dichodon*, and *Amphimeryx*, so near the pachyderms that some Naturalists range them in the same order. Although found in the Lower and Middle Miocene with some modifications in their dental structure, and the more or less ankylosed character of the metatarsal bones, as in the *Gelocus*, *Drematherium*, and *Anchitherium*, it was in the Upper Miocene that the Herbivora were most largely developed. The Giraffe and *Helladotherium* attained a size unknown among preceding ruminants, the Antelopes and Stags were of more varied forms, the *Hipparion* succeeded the *Anchitherium*. M. Gaudry does not consider the prairies resembled those of northern Europe at present, for, from the character of the dentition of the animals, the grasses did not form an important part of the vegetation with which the country was then covered. During the Pliocene, Quaternary, and present (or Modern) periods the ruminants, as well as the *Solipedes* (or *Equidæ*), were very numerous in Europe, and the prairies were more extended. The evolution of the Carnivora followed that of the Herbivora. At the commencement of the Eocene period the beasts of prey were of small size and not numerous; the *Hyænodon* and *Pterodon* did not exceed the size of the wolf. Soon after appeared the great *Amphicyon*, in character intermediate between the bear and the dog, inclining one to the belief that they were probably omnivorous in habit, and devoured more dead flesh than living prey. It was at the close of the Miocene period that the Carnivora arrived at their apogee, and were represented by two extreme types, the *Hyæna* and the *Machairodus*.

II.—Palæontologists have often supposed that a great difference existed in the variation of the higher as contrasted with the lower types of organic beings. Indeed it has been considered that many of the Miocene Mollusca, as well as a certain number of the Eocene, were identical with living species; on the contrary, the Mammalia appear to have been restricted to certain geological horizons; thus the *Lophiodon* is found only in the Middle Eocene, the *Palæotherium* only in the Upper Eocene, the *Rhinoceros* does not appear below the Miocene; so that we are fully entitled to say “the age of *Lophiodon*,” “the age of *Palæotherium*,” and “the age of *Rhinoceros*.”

But on the other hand a minute examination of the older species of the Tertiary Mollusca has shown characters which distinguish them in general from living species.

MM. Deshayes, Fischer, and other conchologists, who have studied the relations of the Tertiary species, think that the absolute identity is not very common among the Mollusca of different ages; on the other hand, the researches of MM. Tournouër, Thomas, etc., have shown that the *Palæotherium* has been contemporary with the

Lophiodon and the *Rhinoceros*; thus the Mollusca have had a less longevity than we at first thought, and the Mammalia have had a greater longevity than we had supposed.

Nevertheless, M. Gaudry is unwilling to admit that variability of the types of the Mollusca has been equal to that of the Mammalia. MM. Darwin and Lyell have long since made this remark, and M. Gaudry has had occasion to confirm the greater longevity¹ of the lower as compared with the higher forms of animals, from his researches in Greece and Mont Léberon, and he shows that the Mollusca have a longer duration in time than the Mammalia, and that the beds at Cabrières, containing among others 15 species of living marine shells, are inferior (stratigraphically) to the bone deposit of Léberon, where the Mammalian remains either present some differences to existing species, or belong to entirely extinct genera, as the *Machairodus*, *Ictitherium*, *Dinotherium*, *Acerotherium*, *Hipparion*, *Helladotherium* and *Tragocerus*.

III.—From the study of the different Mammalia, and their distribution at Eppelsheim, Léberon, and Pikermi, M. Gaudry considers that the Upper Miocene may be divided into two zones, and that the deposit at Eppelsheim is not of the same age as the last two; but the solution of this question is not without difficulty. At first some reasons favour the idea that the Eppelsheim deposit is more recent than those of Pikermi and Léberon; for the wild boars of Eppelsheim differ less from the living species; the *Mastodon Pentelici* of Greece seems to be intermediate between the *M. angustidens* of Sansan and the *M. longirostris* of Eppelsheim; the *Leptodon* of Pikermi, of the *Palæotherium* type, is not found at Eppelsheim; the Tapir of Eppelsheim, which has not occurred at Léberon or the three other localities of the same age, has a greater resemblance to the Pliocene species of France; the large tortoise, appearing to indicate a very warm epoch, has not been observed at Eppelsheim. Nevertheless on the whole the proofs are more numerous which infer the deposit at Eppelsheim to be the more ancient. Thus, there are traces of the great Ape at Eppelsheim as at Sansan; the ape of Pikermi does not resemble that of Sansan, but that of the Pliocene marls of Montpelier and the living apes. The Hyænas are found at Léberon, Concué, Baltavar, and Pikermi, but not at Eppelsheim; it is a recent type unknown in the Middle Miocene. The *Simocyon* of Eppelsheim has persistent premolars, in that of Pikermi they are in part deciduous

¹ If, by longevity of forms, is understood, not the life of the individual, but, the lifetime of the race, it seems hardly possible in some instances to comprehend the vast periods of time which a marine species may have existed, especially among the Mollusca. *Lingule*, differing but little from the living species, occur in the Cambrian rocks of Wales. *Terebratula fimbria*, of the Inferior Oolite, might (externally) pass for the living *Waldheimia Australis*. The King-crabs (*Limuli*) of the Solenhofen stone can hardly be said to differ from those of the China sea to-day! Prof. Owen long since pointed out that the chance of survival among land animals was in inverse proportion to their bulk; the largest being always the first to suffer by droughts and all the other causes which affect terrestrial existence, but which are unfelt by and unknown to the fauna of the sea.—EDIT. GEOL. MAG.

The absence of Giraffes and Antelopes, the presence of *Dorcatherium* near to *Amphitragulus* of the Lower Miocene gives to Eppelsheim an ancient aspect. The *Dicrocerus anocerus* of the same bed has the horns simply forked as those of the young *Cervus elaphus*, which shows an evolution less advanced than the *C. Matheronis* of Léberon in which the horns have three tines; besides, it approaches much more the *Dicrocerus Aurelianensis* of the Middle Miocene.

From this it appears the Upper Miocene of Europe may be divided into two stages; one, more recent, represented by Pikermi, Léberon, Baltavar, and Concud; the other, more ancient, represented by Eppelsheim.

The Upper Miocene is not the only stage where we find appreciable differences in the fauna. As geology progresses, the better do we recognize that the organic world has undergone many changes. The following table shows the succession of the terrestrial faunas of the Tertiary Mammalia:—

PLIOCENE.—

- a. Fauna of Cromer, Saint Prest, and Saint Martial.—It is distinguished from the preceding fauna by the disappearance of *Mastodon*; the *Elephas meridionalis* has the molars with more serrated laminae and a more compact enamel; the stags assume more branched and more expanded horns.
- b. Fauna of Perier and of the Norwich Crag.—Distinguished from the preceding by the abundance of stags, the rarity or absence of antelopes, the disappearance of Apes. Co-existence of *E. meridionalis* with the *Mastodon*.
- c. Fauna of Montpellier.—Distinguished by the absence of *Helladotherium*, *Dinothierium*, *Ictitherium*, and *Ancylotherium*; the presence of the Tapir and *Hyenarctos*. Co-existence of stags with antelopes.

UPPER MIOCENE—

- d. Fauna of Mont Léberon and Pikermi.—Distinguished by the profusion of antelopes, the presence of *Helladotherium*, *Ictitherium*, and *Hyæna*, the absence of *Dorcatherium* and Tapir.
- e. Fauna of Eppelsheim.—Distinguished by the substitution of *Hipparion* for *Anchitherium*, *Mastodon longirostris* for *M. angustidens*, and also by the presence of the great wild boars together with the *Dorcatherium*, *Simocyon*, and Tapir.

MIDDLE MIOCENE—

- f. Fauna of Simorre.—It differs slightly from the preceding by the presence of *Dinothierium giganteum*, *Histriodon*, *Rhinoceros brachypus*, and *Simorreensis*; and the absence of *Chalcotherium* and antelopes.
- g. Fauna of Sansan.—Notwithstanding its close relation, it is separated from the preceding fauna by the absence of *Anthracotheerium*, *Cainotherium*, *Dremantherium*, and by the abundance of antelopes.
- h. Fauna of the sands of Orleannais.—Distinguished from the preceding by the absence of *Hyænodon*, and the presence of many species common to Sansan and even of Simorre, associated with *Anthracotheerium onoideum*, *Palæochærus*, *Cainotherium*, *Dremantherium*, *Dicrocerus Aurelianensis*. Reign of *Dinothierium Cuvieri*, *Mastodon angustidens*, and *M. turicensis*.

LOWER MIOCENE—

- i. Fauna of a part of the Allier étage (age of the Limestone of Beauce).—Distinguished by the disappearance of *Palæotherium*, the incoming of *Anchitherium*, and the replacement of the *Gelocus* by the *Dremantherium*.
- k. Fauna of Ronzon and Villebramar (age of the Sands of Fontainebleau).—Differs slightly from the preceding fauna by the rarity of the *Palæotherium*, absence of *Anoplotherium*, the abundance of *Bothryodon*, and of ruminants named *Gelocus*. Continuation of the reign of *Enteledon*.

UPPER EOCENE—

- l. Fauna of the phosphonites of Caylux (age of the Limestone of Brie).—Distinguished from the preceding by the increase of the *Enteledon*, the great *Anthracotherium*, the *Cainotherium*, contemporary with the *Anoplotherium* and *Palæotherium*.
- m. Fauna of the gypsum of Paris, of Bembridge, and of the lignites of Debruge.—Distinguished from the preceding by the absence or rarity of *Lophiodon*. Reign of *Palæotherium*, *Anoplotherium*, *Charopotamus*, *Dichobune*, *Xiphodon*, *Hyænodon*, and *Pterodon*.

MIDDLE EOCENE—

- n. Fauna of Hordwell and Mauremont (age of Sands of Beauchamp).—*Dichodon*, *Microcherus*, *Rhogatherium*. The appearance of the *Palæotherium* with the *Lophiodon*.
- o. Fauna of Egerkingen, Argenton, Issel, and Calcaire-Grossièr of Paris. Reign of *Lophiodon* and *Pachynolophus*.

LOWER EOCENE—

- p. Fauna of London Clay.—*Hyracotherium*, *Pliolophus*.
- q. Fauna of the Plastic Clay of Soissonnais.—*Coryphodon*, *Palæonictis*.
- r. Fauna of the grits of La Fère.—*Arctocyon*.

IV.—From the preceding summary it will be seen that the fauna of Eppelsheim must have had a different facies from those of Léberon and Pikermi, because it contained neither Hyæna, *Helladotherium*, Giraffe, nor those great herds of Antelopes which gave an African aspect to the faunas of Léberon and Pikermi. But with these contrasts we find identical species in the deposits of Germany, Greece, and Provence; all the faunas of the Upper Miocene of Europe represent degrees of evolution so related, that at first it is difficult to say which has been the more ancient. M. Gaudry considers that the difference of age between the two sub-divisions of the Upper Miocene is but trifling, and that the different faunas may be attributed in part to the changes in the physical features of the surface which altered the habitats of the animals, and occasioned the displacement of the faunas. For in supposing that the organic world has gradually progressed, if geologists find sudden appearances of fossils in passing from one stage to another, it is because they have in general placed the limits on points where there have been displacements of faunas. The paleontologist, who does not believe in migrations and local extinctions, seeks in vain to connect the chain of ancient beings; he finds appearances, disappearances, and recurrences without being able to explain them.

V.—From the reasons given in the preceding paragraph it would be useless to seek in the same country for an uninterrupted chain of fossil beings; to find such a chain we must uncover all the strata of the earth. But if in passing from one stage to another we perceive breaks, we find also analogous forms. Thus, in comparing the Mammalia of the Upper with the Lower Miocene, we find—*Simocyon* analogous to *Amphicyon*, *Ichitherium* *Orbigny* to *Viverra*, *Machairodus cultridens* to *M. palmidens*, *Ancylotherium* to *Macrotherium*, *Mastodon longirostris* and *Pentelici* to *M. angustidens*, *Rhinoceros Schlettermachers* to *B. Sansaniensis*, *Sus palæocher* to *S. chæroides*, *Chalicotherium* to *Anisodon*, *Dicrocerus anocerus* to *D. Aurelianensis*, *Gazella perperita* and *brevicornis* to *G. Martiniana*. Many Pliocene

species of Europe ought in their turn to be considered analogous to the animals of the Upper Miocene. These are—*Semnopithecus monspessulanus* is analogous to *Mesopithecus*, *Hyæna Perrieri* and *brevirostris* to *H. eximia*, *Sus provincialis* to *S. antiquus*, *Mastodon arvernensis* to *M. longirostris* and *Pentelici*, *Tapirus arvernensis* and *major* to *T. priscus*, *Antilope Cordieri* to *Tragocerus amaltheus*, *Dicrocerus australis* to *D. aninocerus*. These analogies reveal a certain resemblance between the fauna of the Upper Miocene and those which have preceded and followed it. Although this resemblance shows itself more in the general aspect than in the detail, it ought to be fully considered by those who wish to understand the plan of creation. Indeed, in admitting that which is called the law of creation, we must suppose either that in creating the beings of one geological epoch, the Creator has partly taken for models those of preceding epochs, or believe that the analogies represent a connexion with some near or remote parentage. M. Gaudry prefers the latter hypothesis, because the majority of species have a greater number of resemblances, than of differences, so that it would appear more simple to derive one from the other, than to destroy them in order to replace them, and thus species have not a distinct origin, but are of the same type which has undergone slight modifications.

VI.—“For more than twenty years,” writes M. Gaudry, “the history of the modern period appeared to indicate the absence of natural races.

“The Mummies of Egypt have not offered any differences which the animals now living do not maintain, and we can only conclude that the species were unchanged.

“But now it is acknowledged that the actual epoch reaches back much further than the age of the Egyptian mummies; so that, as remarked by the illustrious Pictet (whose loss we all deplore), the existing Fauna is only a part of the Quaternary Fauna; for that period comprehends nearly all the modern species of Mammalia, and we can perhaps only distinguish a few of the larger quadrupeds which were displaced before historic times.

“But it is very probable that many of the animals named as characteristic of the Quaternary epoch are of the same species as those now existing, and represent only particular varieties or races: for example, the spotted Hyæna, the Lion, the European Bison, the existing *Bovidæ*, the *Cervus elaphus*, seem to be only modified varieties of the *Hyæna spelæa*, the *Felis spelæa*, the *Bison priscus*, the *Bos primigenius* and the *Cervus Canadensis* of the Quaternary deposits.

“I could greatly multiply examples; these, however, are doubtless sufficient to explain within what limits animals issuing from the same parents appear to me to merit the name of species or represent only the race.

“Whatever be the difficulties of indicating the separation between extinct species and races, I think that this task is worthy to attract the attention of Naturalists.”

J. M.