

# THE EVOLUTION OF TERTIARY MAMMALS, AND THE IMPORTANCE OF THEIR MIGRATIONS

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## THIRD PAPER.<sup>1</sup> MIOCENE EPOCH.

AFTER having investigated the migrations of the *Eocene* and *Oligocene* epochs (*Comptes rendus*, 6 novembre, 1905, et 12 mars, 1906), I will now consider those of the *Miocene*.

C. MIOCENE FAUNA.—I. Lower Miocene (*Burdigalian*), fauna of the *sands of the Orléanais*: principal localities (Neuville-aux-Bois, Marigny, Rebréchien, Fay-aux-Loges, Beaugency, Tavers, Les Barres; Chevilly, Neuville, Artenay, Ruan, Chilleurs, Suèvres, Pontlevoy, Thenay, Blasois, Chitenay; Manthelan, etc.), and of the *limestone of Montabuzard*, underlying the sands.—The marine deposits of Eggenburg and Linz (Lower Austria), of the “*Muschelsandstein*” of Bruttelen, Macconens, La Molière, Bucheggberg (Switzerland), of Saint-Nazaire-en-Royans (Drôme), of the white Molasse of Angles (Gard), of Horta de Tripas near Lisbon.—Fauna of the fissures of the *Solenhofen* quarries.

1. *Local Evolution*.—Continuance of Tapiridæ (Paratapirus), of some genera of Rhinocerotidæ (Aceraotherium, Diceratherium), of Chalicotheriidæ (Macrotherium), of Anthracotheriidæ (Brachyodus becoming extinct), of Suidæ (Palæochærus, Hyotherium), of Tragulidæ (Hyæmoschus), of Cervulinæ (Palæomeryx, Dicrocercus), of Castoridæ (Steneofiber), of Cricetinæ (Cricetodon), of Lagomorph Rodentia (Prolagus), of Talpidæ (Talpa), of Tupaiidæ (Galerix), of Canidæ (last of

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Cephalogale), of Amphicyoninæ (Amphicyon), of Mustelidæ (Stenogale, Palæogale, Stenoplesictis), of Lutrina (Lutricteis, Lutra), of Felidæ (Pseudælorus, Machairodus).

2. *Very Important African or Afro-Asiatic Migrations* of Proboscidea (Mastodon, Dinotherium), of Antilopinæ (Protragocerus), of certain Cervulinæ (Micromeryx), of some Rhinocerotidæ (Teleoceras, Ceratorhinus), of some Suidæ (Chærotherium, Listriodon), and of anthropoid apes (Pliopithecus).

3. *North American Migration* of Equidæ (Anchitherium).

II. Middle Miocene (*Vindobonian*, divisible into three substages: *Helvetian*, *Tortonian*, *Sarmatian*). Corresponding to these three substages are three mammalian faunæ, grading into one another by almost imperceptible transitions. These assemblages may be denoted as follows, the names being derived from those localities in the sub-Pyrenean basin where each is typically represented: (1) *horizon of Sansan*, (2) *horizon of Simorre*, (3) *horizon of Saint-Gaudens*.

1. *Horizon of Sansan*.—Principal localities: Sansan, Jegun (Gers), calcareous marls of the Loire (Pontlevoy, Sainte-Maure, Manthelan); marine Molasse of the environs of Romans (pont de l'Herbasse, Bren, Clérieux); marine Molasse of Suabia (Baltringen, Rammingen, Heggbach, Hausen; Niederstozingen, Süssen, Ursendorf, Hochgeland); of the lignites of Styria (Eibiswald, Göriach, Wies, Voitsberg, Gamlitz, Parschlug, Neufel) and of Lower Austria (Leoben, Leiding, Feisternitz, marine sands of Grund at Guntersdorf); Georgengsmund (Bavaria), Engelswies (Baden).

2. *Horizon of Simorre*.—Principal localities: Simorre, Bonnefond, St. Cristan, Tournon, Villefranche d'Astarac, l'Île-en-Dodon (Gers); Saverdun (Ariège); marine deposits of Mirabeau (Basses-Alpes), of Sorgues (Vaucluse), of Romans (Drôme); Steinheim, Nordlingen, Ries, Althausen, Urlau (Suabia); Hohenhoven (Baden); intra-

Alpine basin of Vienna (Dornbach, Vordersdorf, Fünfkirchen, Loretto, Bruck-a.-Leitha, Breitenbrunn, Margarethen, Mannersdorf, Neudorf); Abstdorf, Franzensbad (Bohemia); Woskressensk (Russia); Pesth, Ssoskut (Hungary); Trauenzinen (Silesia), Krivadia and Gyulu-Mendru (Transylvania).

The rich "terrain sidérolithique" ("Bohnerz") of La Grive-Saint-Alban (Isère), of Mont Ceindre (Rhône), of Pretty near Tournus (Saône-et-Loire), of Gray (Haute-Saône), of Mösskirch, Genkingen, Willmardingén, Heuberg, Melchingen, Jungnau (Suabia) belong in large part to this horizon.

3. *Horizon of Saint-Gaudens.*—Principal localities: Valentine, Saint-Gaudens, Montréjau (Haute-Garonne); Delsberg, le Locle, La Chaux-de-Fonds, Vermes, Oeningen, Ellg, Kapffnach, Weltheim (Switzerland); Høeder, Dinkelscherben, Günsburg, Diessen, Reichenau, Reisenburg, Dasing, Fraising, Tutzing, Stätsling, Reichertshofen, Frontenhausen, Flinz of Munich, Sankt Georgen (Bavaria); Hernals, Heiligenstadt (Vienna basin); Mt. Bamboli (Tuscany); San Isidro near Madrid; Aveiras de Baixo (Portugal); Kriwoi-Rog, Nicolaieff, Sébastopol, Tiraspol (Russia).

1. *Local Evolution.*—Continuance of Equidæ (Anchitherium), of Tapiridæ (Paratapis), of Rhinocerotidæ (Aceratherium, Teleoceras, Ceratorhinus), of Chalicotheriidæ (Macrotherium), of Suidæ (last representatives of Hyotherium and Chærotherium; Listriodon; finally Sus itself), of Tragulidæ (Hyæmoschus), of Cervulinæ (Dicrocerus, Micromeryx, last representatives of Palæomeryx), of Antilopinæ (Protragocerus), of Proboscidea (Mastodon, Dinotherium), of Theridomyidæ (last remnants of Theridomys), of Myoxidæ (Myoxus), of Sciuridæ (Sciurus), of Castoridæ (Steneofiber), of Cricetina (Cricetodon), of Lagomorph Rodentia (Prolagus, Lagomys), of Talpidæ (Talpa, Proscapanus, Scaptonyx), of Myogalidæ (Myogale), of Tupaiidæ (last of Galerix and Lantanotherium), of Soricidæ (Sorex, Crocidura).

last Dimylidæ (Plesiodimylus), of Erinaceidæ (Erinaceus, last of Palæoerinaceus), of Chiroptera (Rhinolophus, Cynonycteris, Vespertilio, Vesperugo), of Canidæ (Galecynus), of Amphicyoninæ (Pseudocyon, Hemicyon, Dinocyon, last Amphicyon), of Mustelidæ (Haplogale, Stegogale, Pseudictis, Mustela, Palæogale, Proputorius, Trochictis, Trochotherium), of Lutrinæ (Lutra, Enhydriodon), of Viverridæ (Viverra, Herpestes, Progenetta), of Felidæ (Machairodus, Hyænailurus, last Pseudælurus, first true Felis).

2. *Migration of South American origin* (by way of Africa) of the Hystricidæ (Hystrix).

3. *Migrations, Probably Asiatic-African*, of the Ursidæ (several branches, Pseudarctos, Hyænarctos, Ursavus), of the catarrhine monkeys (Oreopithecus), and anthropoids (Dryopithecus).

III. Upper Miocene (*Pontian*). *Fauna of Pikermi*.—Principal localities: Pikermi (Greece); Isle of Samos (Asia Minor); Maragha (Persia); Tchernigow, sands of Balta, limestone of Odessa and of Groussolowo (Russia); Manzati (Roumania); Baltavar, lignites of Baróth-Kôpez (Hungary); Eppelsheim (Germany); Siebenhirten, Congeria gravels of the Vienna basin, vicinity of Eggenburg (Lower Austria); Mont Luberon, Visan (Vaucluse), Aubignas (Ardèche), Puy-Courny (Cantal), Saint-Jean-de-Bournay, La Tour-du-Pin, La Trappe de Chambaran (Isère), Montmirail, Tersanne (Drôme), La Croix-Rousse and Sainte-Foy à Lyon, Ambérieu, Soblay, Saint-Jean-le-Vieux (Ain), rocher du Dragon at Aix-en-Provence, Montredon (Hérault), Estavar (Cerdagne), Orignac (Hautes-Pyrénées); Concud (Spain); Archino (Portugal); Grastelli (Sicily).

To the same horizon belongs the greater part of the "terrain sidérolithique" of Salmendingen, Melchingen, Trochtelfingen, Ebingen, Undingen, Heuberg (Suabia).

1. *Local Evolution*.—Continuance of Tapiridæ (Tapirus), of some groups of Rhinocerotidæ (Ceratorhinus,

last Aceratherium and Teleoceras), last Chalicotheriidae (Chalicotherium), of Suidae (Sus, last Listriodon), of Tragulidae (last Hyamoschus), last Cervulinae (Dicrocerus, Micromeryx), of Castoridae (last Chalicomys, earliest Castor), of Hystricidae (Hystrix), of Canidae (Simocyon), last Amphicyoninae (Dinocyon), of Ursidae (Hyenarctos, Ursavus), of Mustelidae (Mustela, Promeles, Promephitis), of Viverridae (Ictitherium), of Felidae (Machairodus, Felis), of anthropoid apes (Dryopithecus, Anthropodus).

2. *North American Migrations* (perhaps by way of Asia) of one of the Equidae (Hipparion) and of the Leporidae (Lepus).

3. *Afro-Asiatic Migrations* of some Rhinocerotidae (Atelodus), of Cervidae (Capreolus), of Giraffidae (Helladotherium, Palæotragus, Camelopardalis, Samotherium), of several groups of Antilopidae (Palæoryx, Gazella, Palæoreas, Protragelaphus), of Ovidae (Criotherium), of Hyenidae (Lychyæna, Hyænictis, Hyæna), of Muridae (Acomys), of catarrhine monkeys (Mesopithecus).