Zoogeography

Lesson 17

Pattern in the Past

- Early h e Mid-Creace
- Distrib nd large deserts ad worldv

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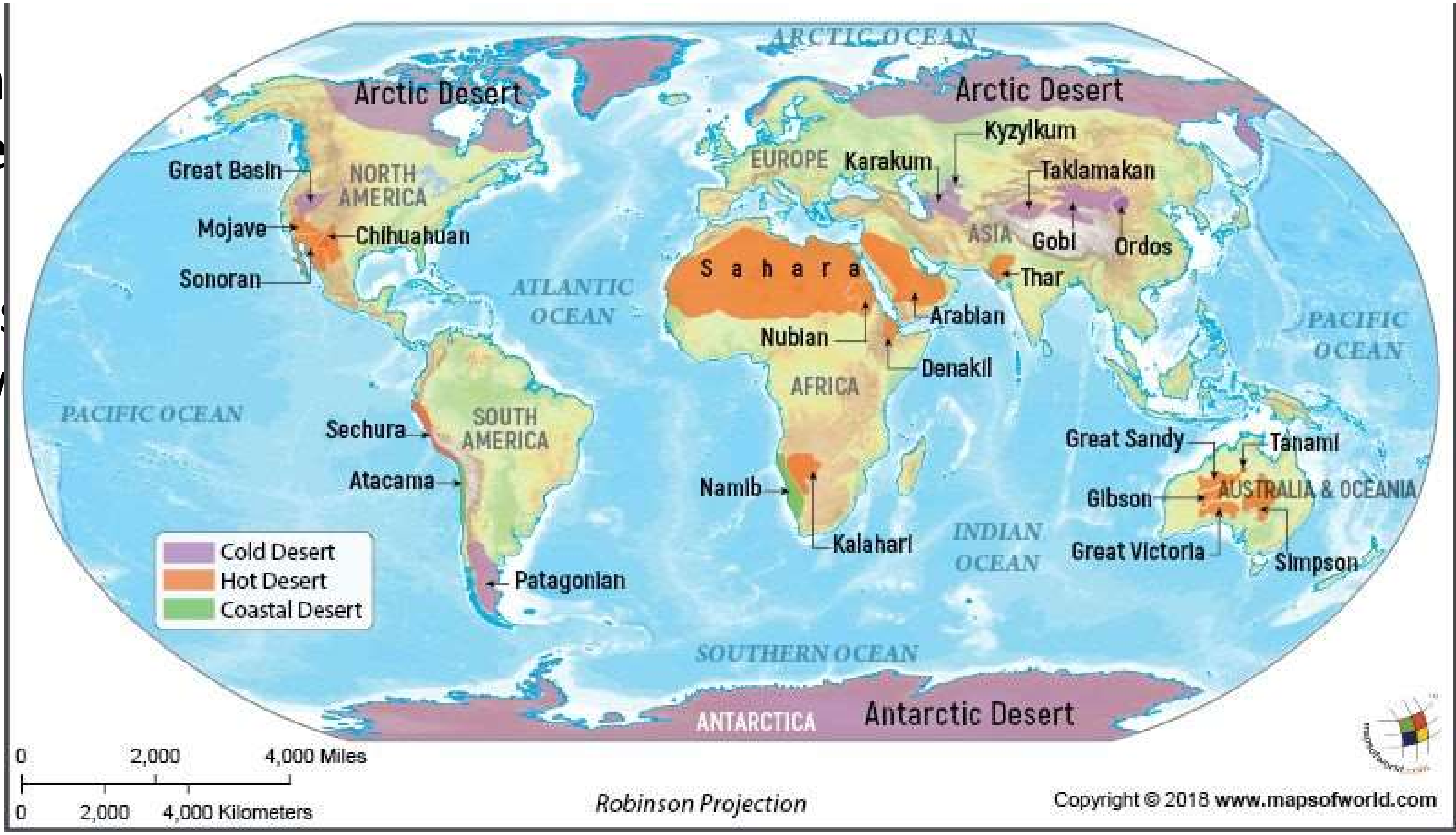

Early Land Life on the Moving Contintents

- The earliest time at which there is enough evidence to discern patterns of life is the Early Devonian, about 380 million years ago.

- Early amphibians found in near-equatorial Euramerica (confined to a warm, humid equatorial zone, bordered by dry subtropical belts, until that continent collided with the great supercontinent made up of all of today's southern continents known as Gondwana in the Late Carboniferous)

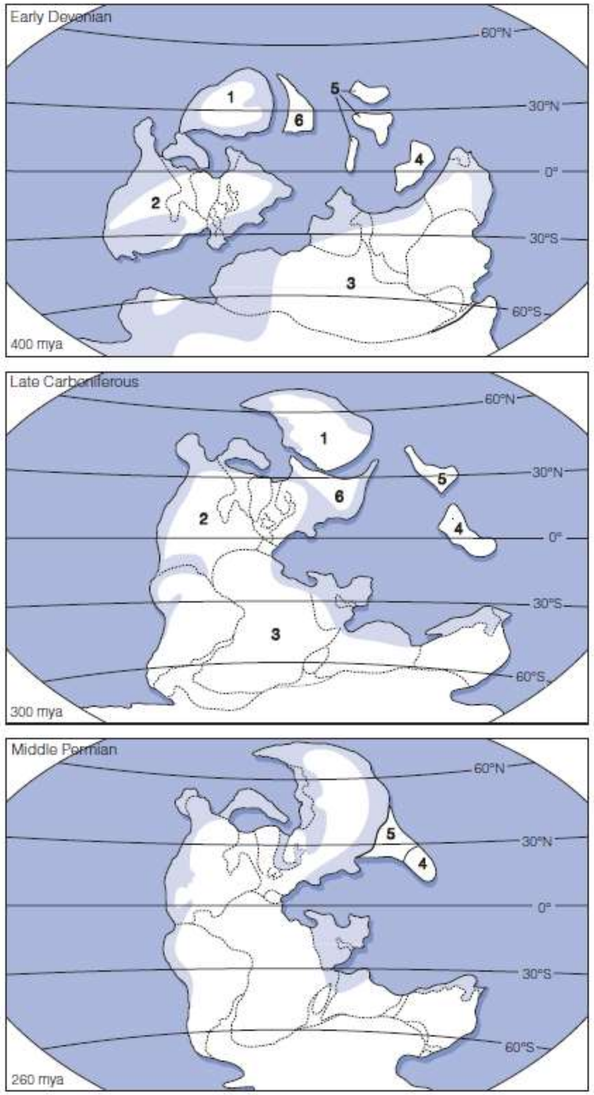

Figure 10.1 World geography at three different stages in the past: Tripel–Winkel projection. Dark tint indicates ocean; epicontinental seas (light shading) after Smith *et al.* [38]. Dotted lines indicate modern coastlines. Continental positions after Metcalfe [39]. (1) Siberia; (2) Euramerica; (3) Gondwana; (4) southern China; (5) northern China; (6) Kazakhstan.

- Theory suggests that the photosynthetic activities of the plants would have reduced the carbon dioxide → ice-house effect
- The cooling began in the middle of the Carboniferous

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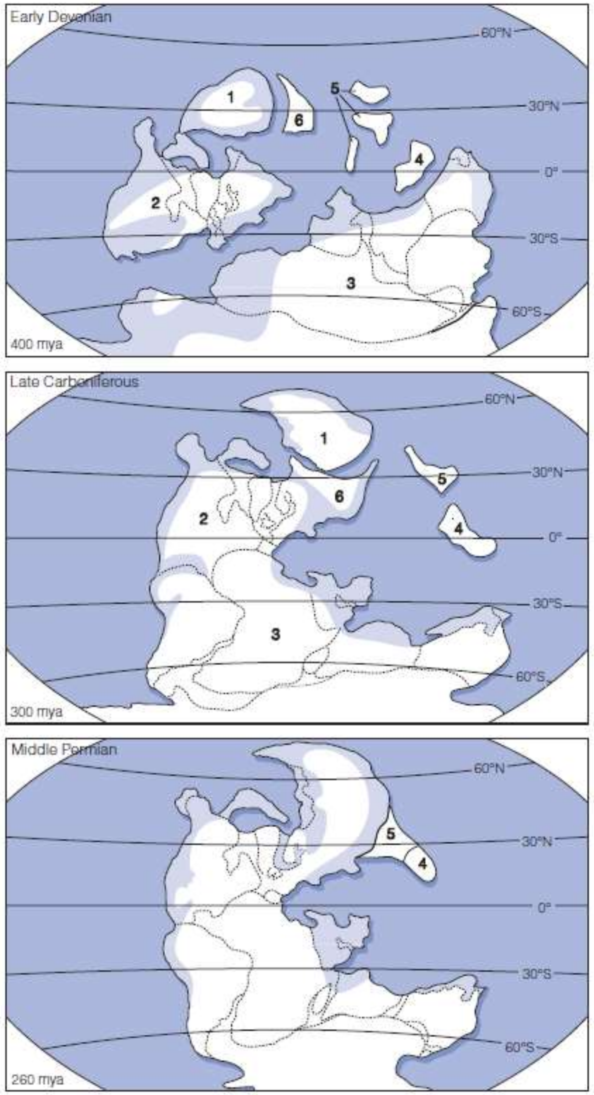
led to the appearance of ice sheets around the South Pole, similar to those of Antarctica today.

The low temperatures around the South Pole caused the latitudinal ranges of the Carboniferous floras to be compressed towards the equator.



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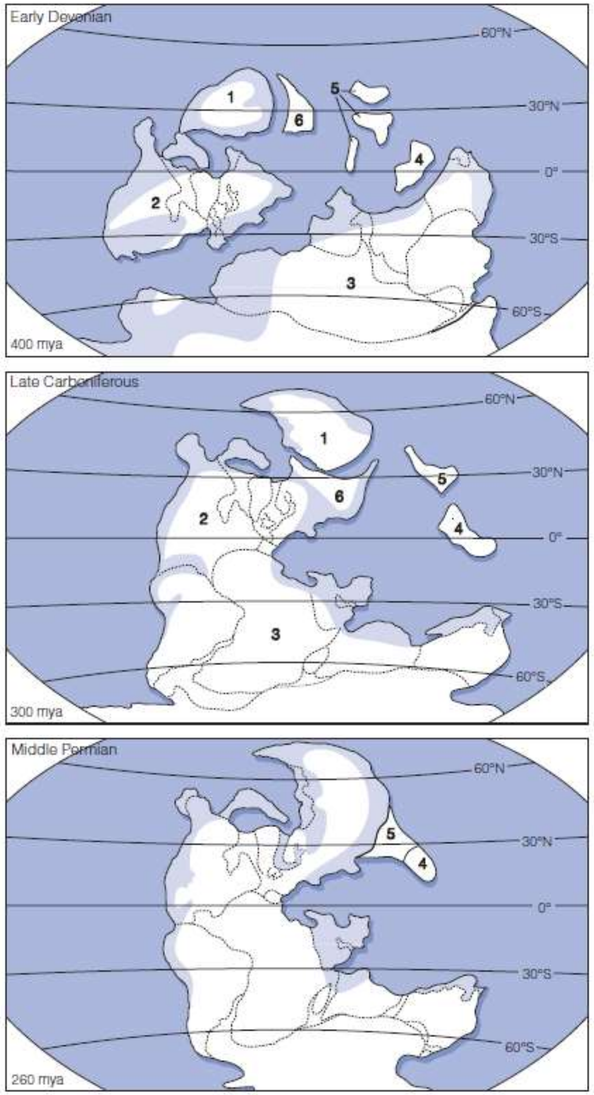
- In the Late Permian the equatorial belt narrowed and the subtropics expanded, while the polar ice caps disappeared.
- Land vertebrates did not reach Siberia or China until after those landmasses had joined the world supercontinent in the Mid to Late Permian.
- Rich faunas of Late Permian fossil reptiles found in mid-latitude regions of southern South America and Africa that, (annual temperature changes of 40–50°C – similar to those of Central Asia today, and not very congenial to reptiles.



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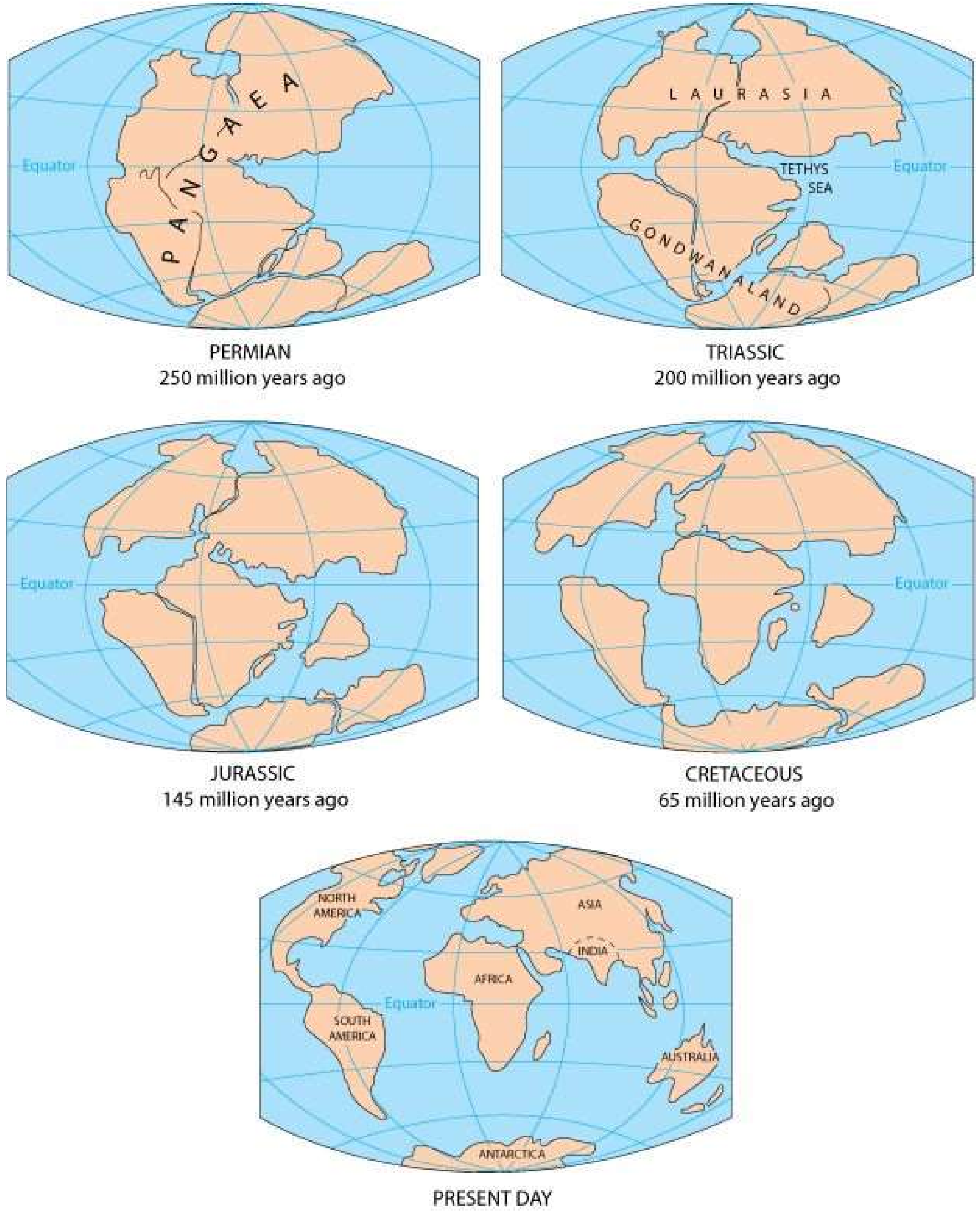
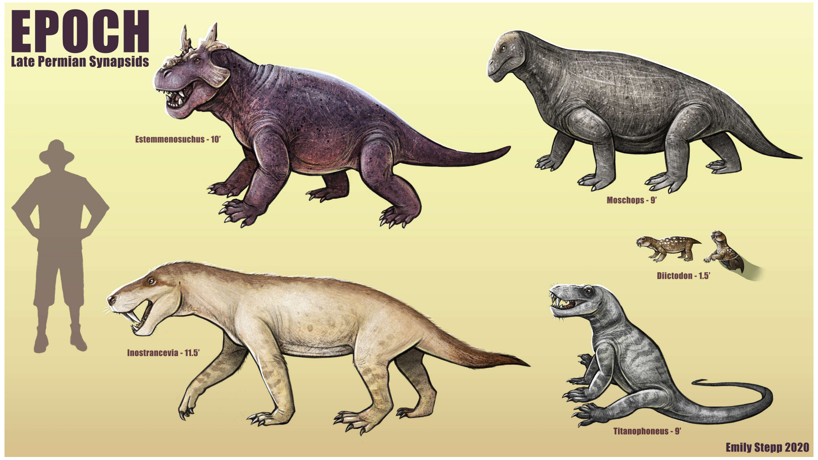
One world – for a While

- During the Triassic (2 million yrs ago): world steadily warmer and drier.
- Formation of the super-continent Gondwana
- the new, lofty mountain ranges that still marked the regions where Euramerica, Siberia and China had collided provided physical and climatic barriers to the dispersal of their floras and faunas.

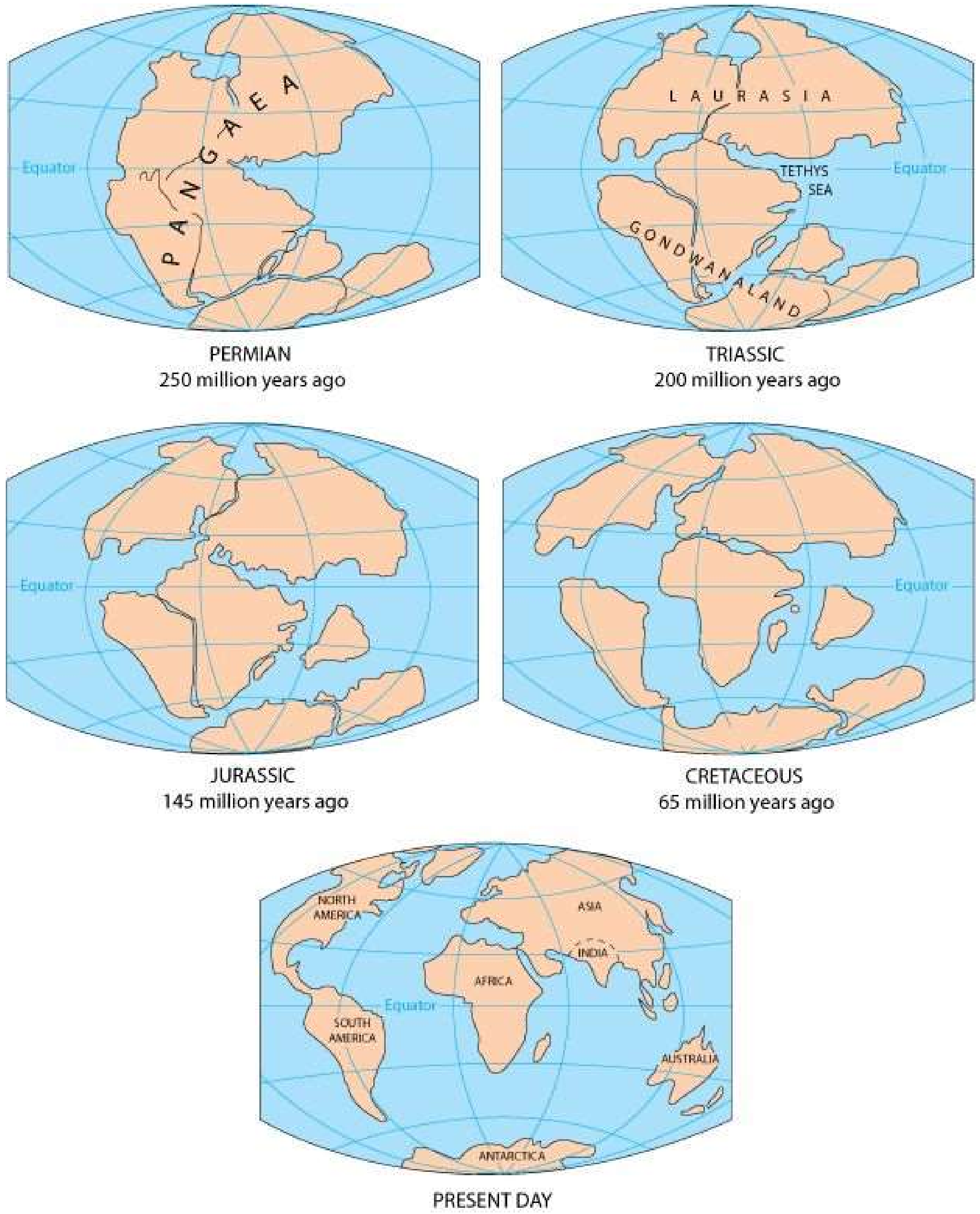


- By the middle Permian: Pangea came to contain a fairly uniform fauna, with little sign of distinct faunal regions.

Fauna: synapsid and mammal-like reptiles)



- Triassic: great change in fauna worldwide.



Biogeography of dinosaurs

- American biogeographers Chris Noto and Ari Grossman studied dinosaurs ecology:

- in more **arid biomes**, there are more large-bodied groups, with large herbivorous sauropods, better able to cope with the lower resource density and quality of the vegetation, together with large theropods that preyed upon them.

- there are few ground-foraging herbivores and small carnivores, as there is little ground cover in which the herbivores could hide.

- In **semi-arid or seasonally wet biomes**, where there is more ground vegetation, the small groups are more common.

- Today there is a latitudinal gradient in which biodiversity is controlled by climate (peak in the tropics, declining towards the poles)

dinosaur diversity is correlated with the distribution of land area, and is therefore highest in temperate palaeolatitudes, where there was more land than closer to the poles.

Zoogeography of the Earliest Mammals

- Over the last 10 yrs: increasing understanding of the relationship between three main phenomena:

1) Diversification of the placental mammals,
2) The disappereance of dinosaurs,
3) Patterns of break-up of the supercontinental land masses by plate tectonics

- The most primitive mammals appeared in the Triassic Period, not long after the first dinosaurs, but they almost certainly laid eggs, as do the living monotremes (the platypus and spiny anteater of Australia).
- The modern mammals are divided into two major groups, the **marsupials** and the **placentals**.

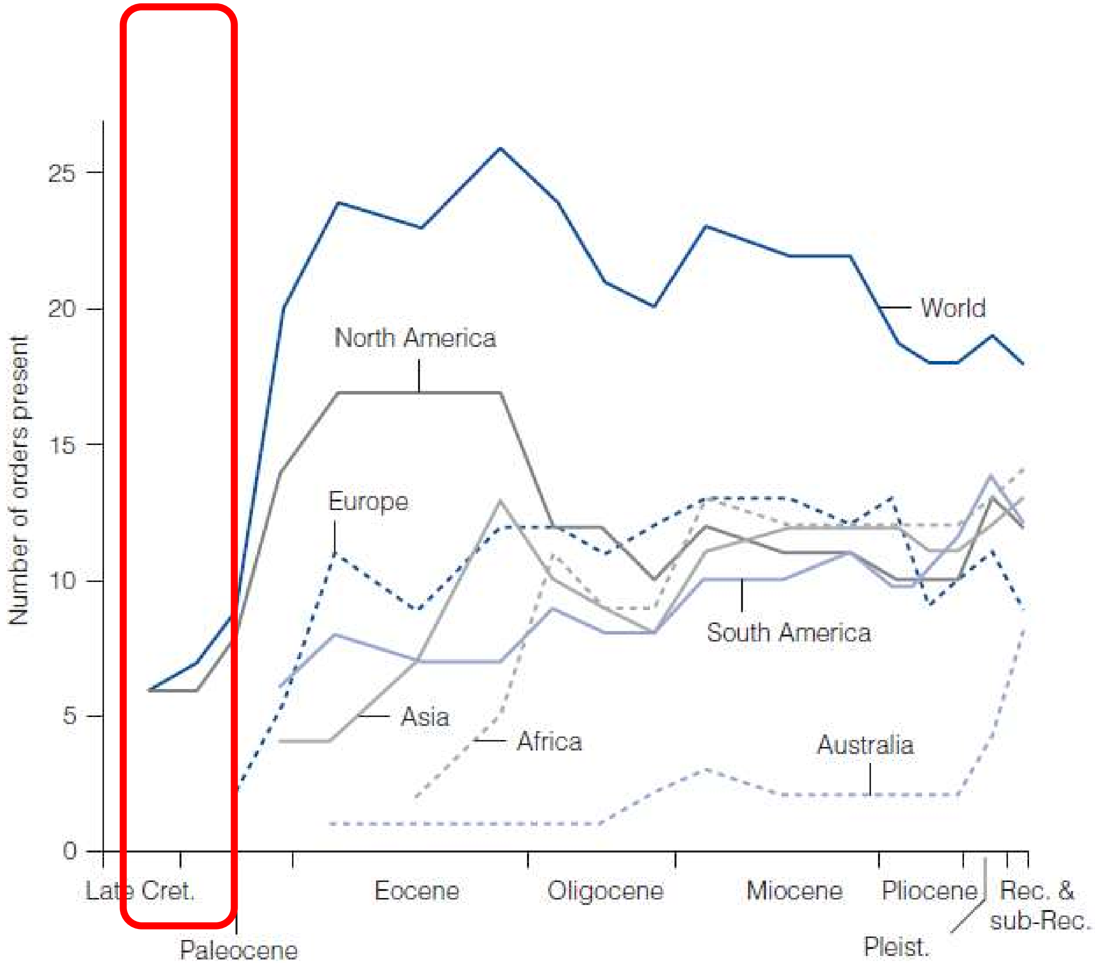


Figure 10.4 Graph of the numbers of mammalian orders through time for the world as a whole and for each continent. Pleist, Pleistocene; Rec, Recent. Adapted from Lillegraven [41].

EVOLUTION OF A CLADE

Crown group: Their common ancestor, plus all of its descendants (M and P in the figure).

Stem group: Earlier orders.

The evolutionary histories of the stem groups of the marsupials and placentals converge back in time to the common ancestor of all the modern mammals (A in fig 10.5).

Other fossil mammals are known, which lived during the Jurassic or Cretaceous, they were probably egg layers like their modern Australian descendants.

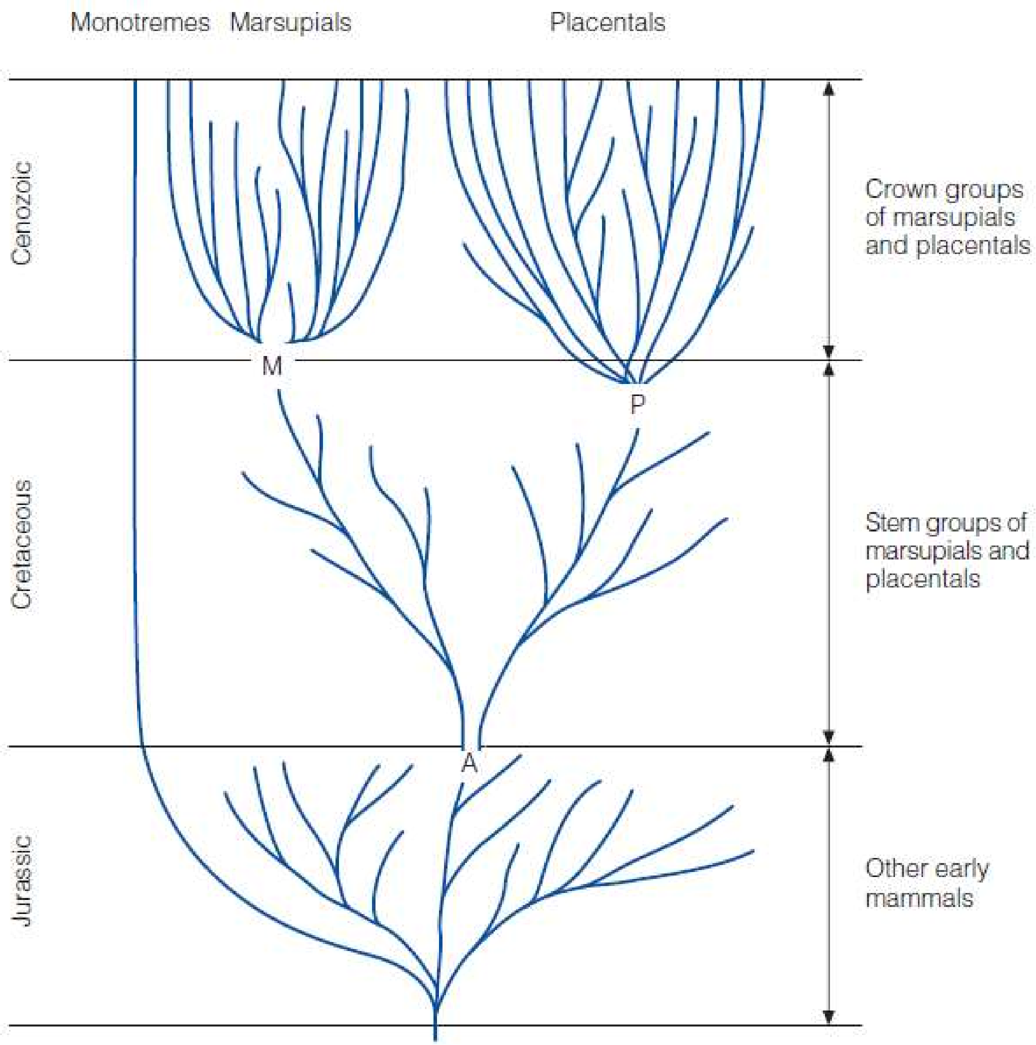


Figure 10.5 The history of the mammals through time. See text for explanation.

- Th… s took place much earlier than th… ods had suggested.

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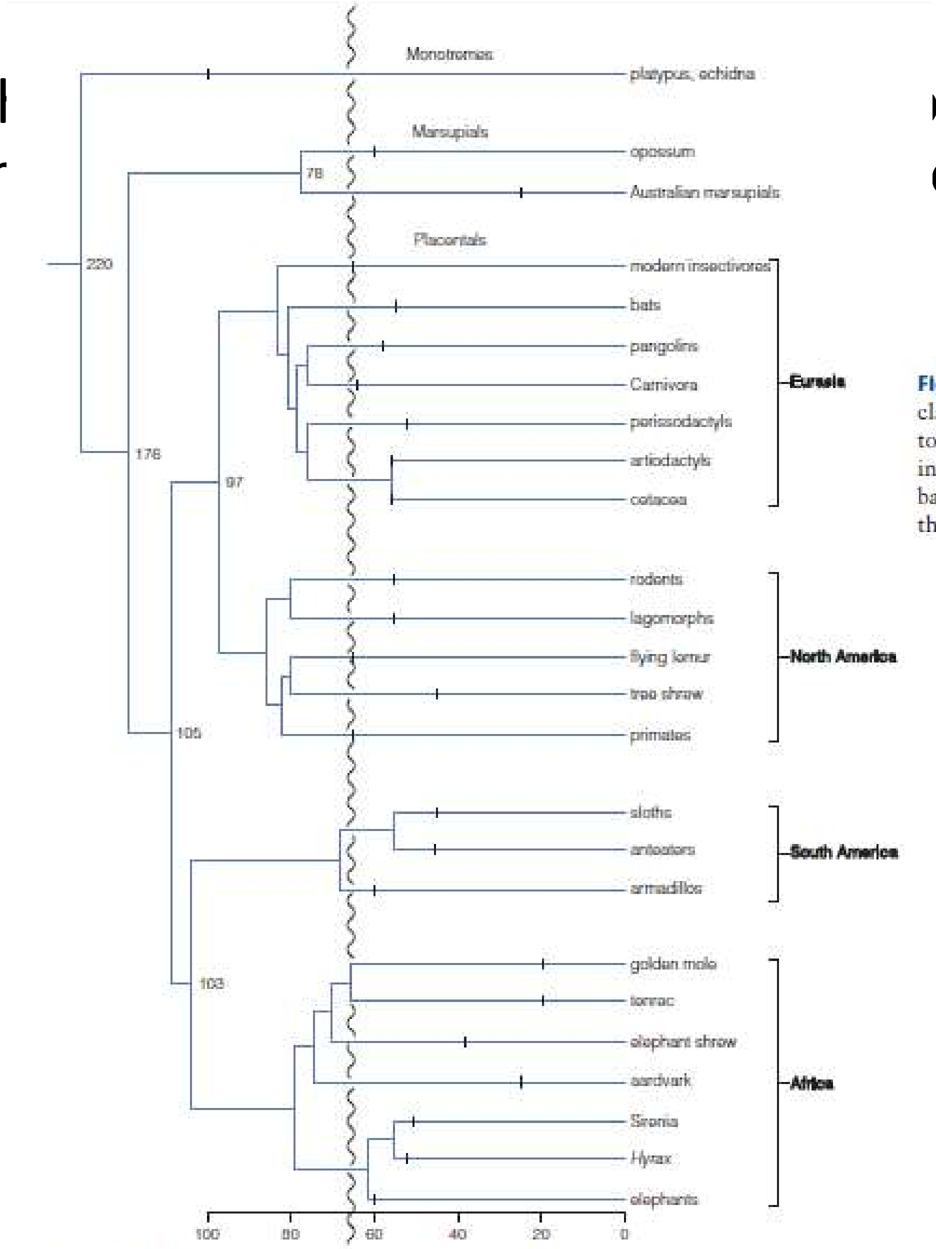
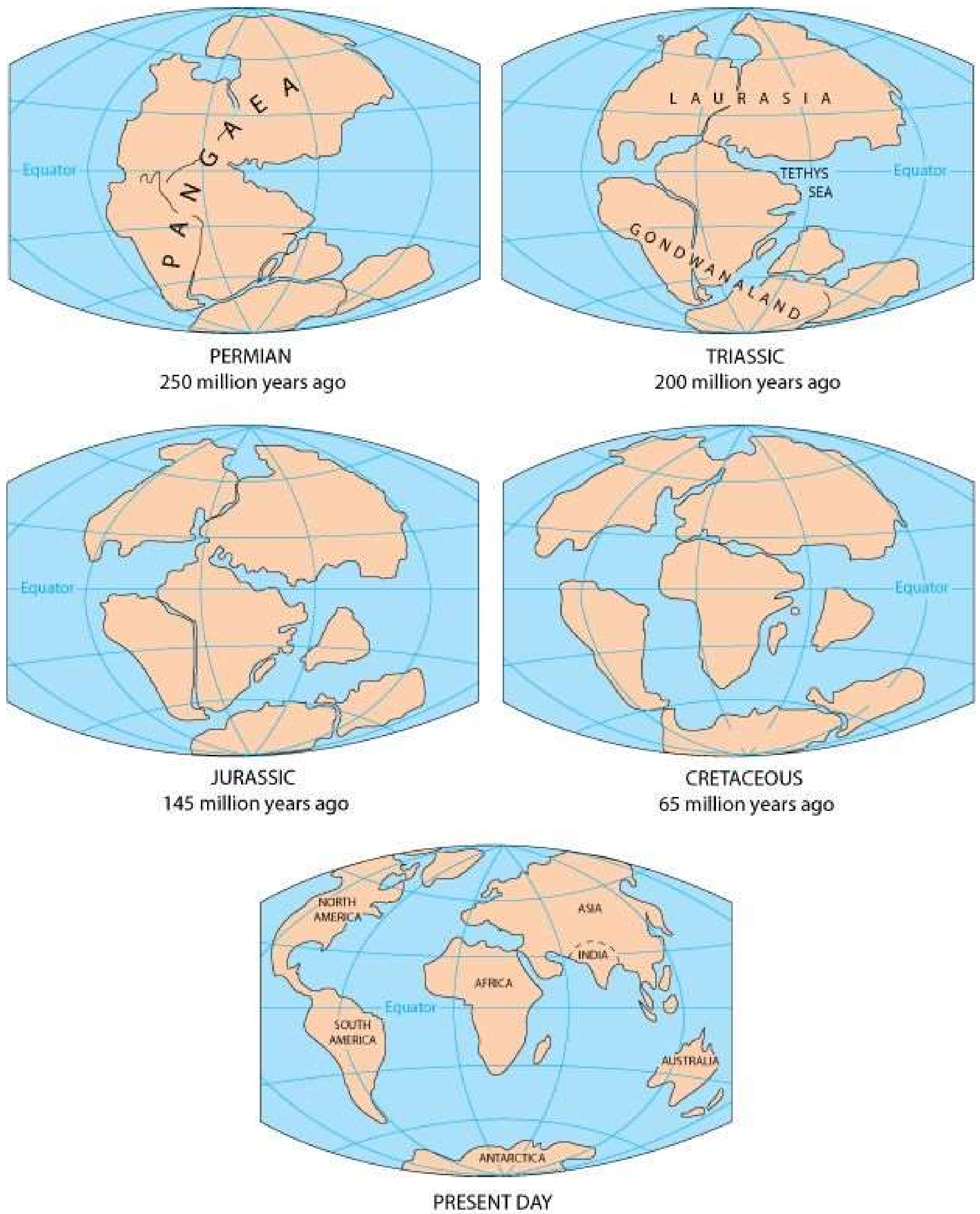


Figure 10.6 Timetree of mammalian evolution and its relationship to biogeography. The cladistic diagram shows the relationships between the different groups. They are joined together at the times suggested by molecular studies; the short vertical bar on each lineage indicates the age of the oldest known fossil of that group. NB: The timescale is only linear back to 100 million years. The vertical wavy line at 65 million years indicates the date of the K/T boundary. Based on data in references [18–20,42–44].

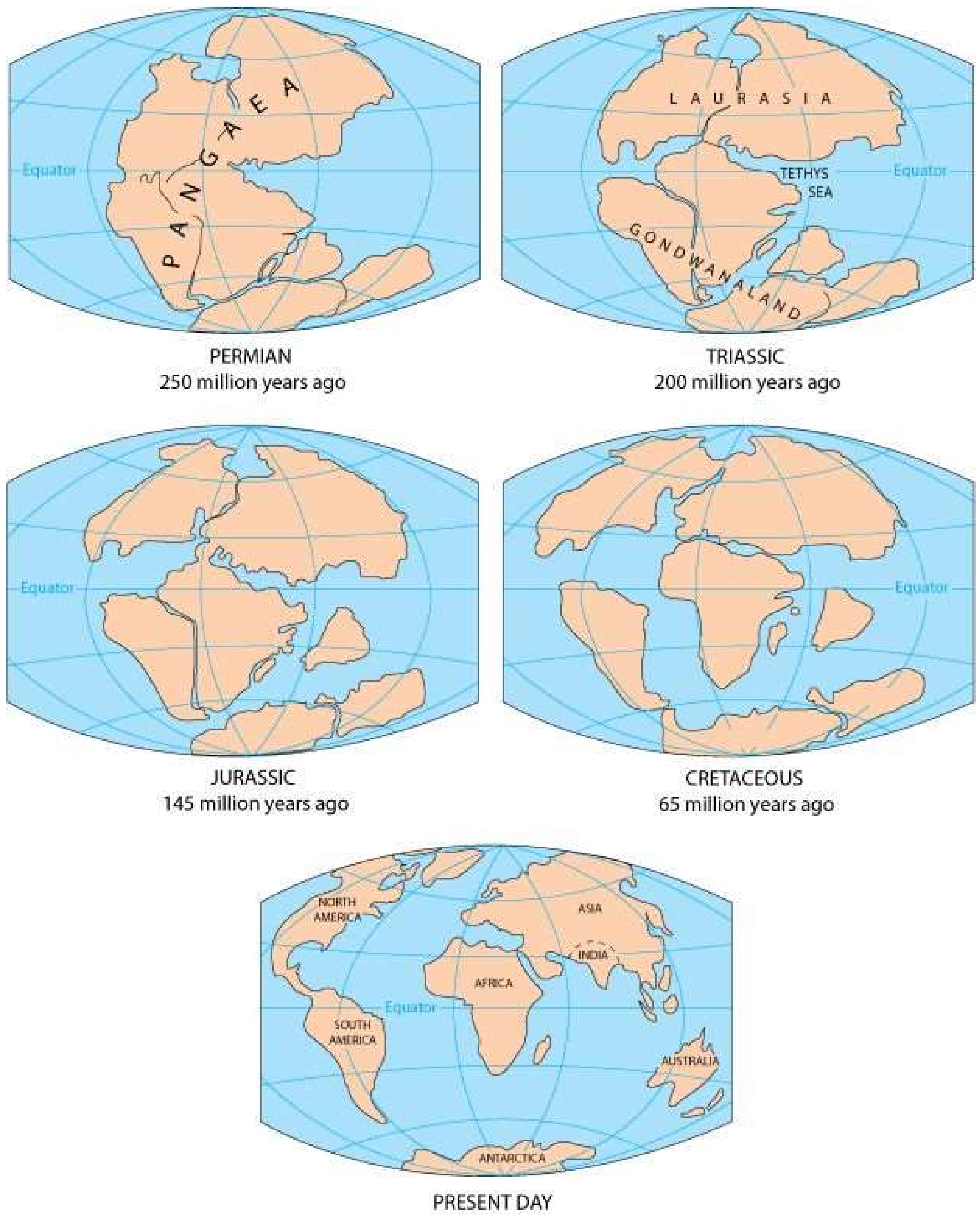
Interestin problems on early mammals:

- The earliest fossil records of both marsupials and placentals are from the Early Cretaceous of Asia.
- In Eurasia, the placentals were dominant throughout the Cretaceous.
- In North America, placentals were absent from that continent for most of Cretaceous and did not attain appreciable diversity until the last 10 million years of the Cretaceous.



Interestin problems on early mammals:

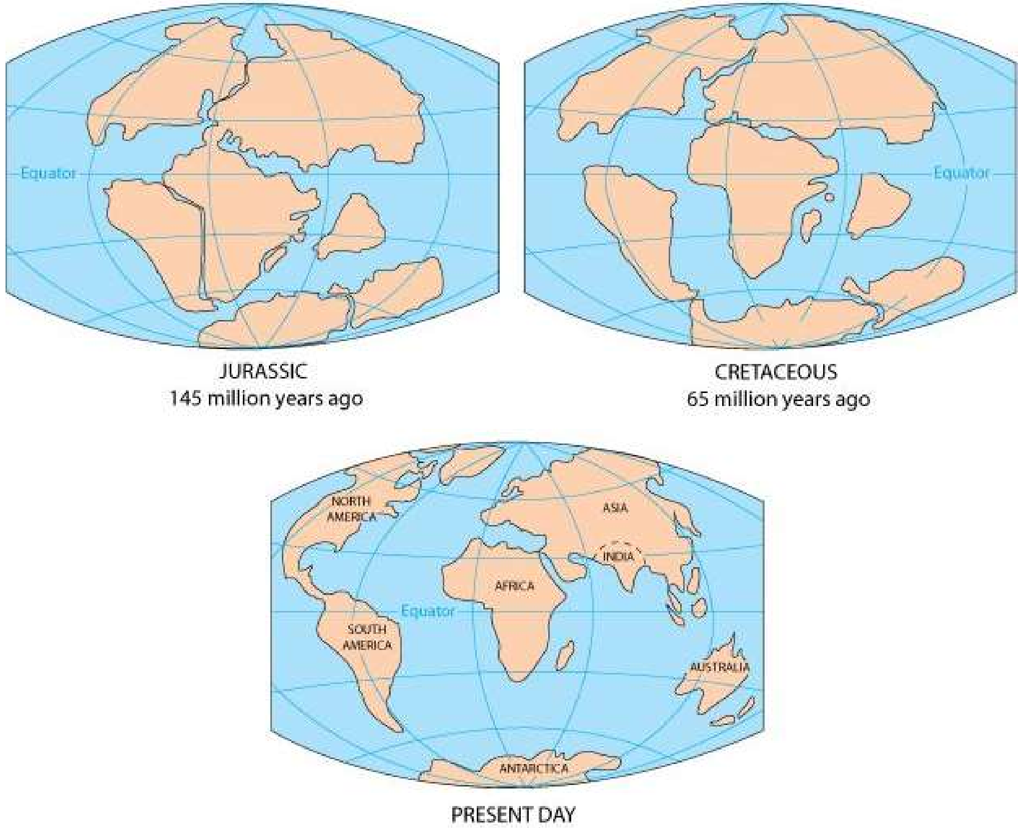
- By the Eocene, 55 million years ago, marsupials had arrived in both Europe and Africa, but later became extinct in both the Northern Hemisphere and Africa.
- Neither marsupials nor placentals were able to reach India or Madagascar in the Cretaceous, for those two areas of land, still joined together, had separated from the rest of Gondwana in the Jurassic.



Gaps in our understanding of the biogeographical history of mammals in South America, Antarctica and Australia.

- Antarctica had warm climates at this time, with forests extending close to the location of the current South Pole.
- Both marsupials and placentals are known from the Late Cretaceous of South America, and are also found in western Antarctica, which was still connected to it at that time.

→ But we have no fossil record of the mammals of the much larger land mass of eastern Antarctica, nor of those of the Early Tertiary of Australia.

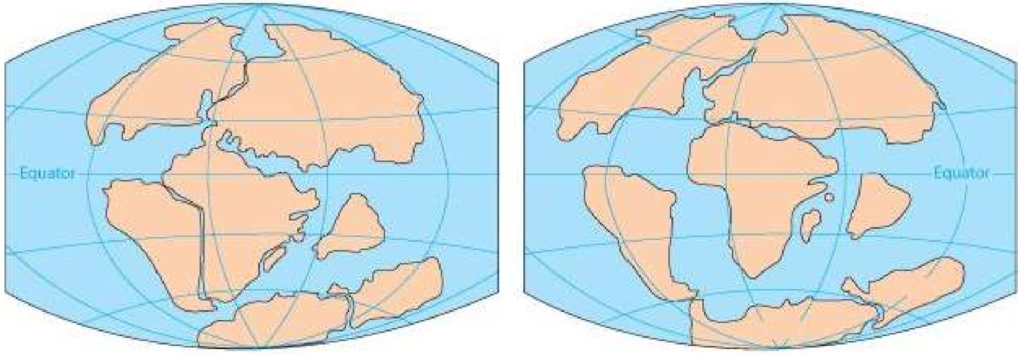


- Genetic work suggests two dispersals of South American marsupials across Antarctica to Australia:

1- the peramelids (bandicoots) are related to the South American *Caenolestes*

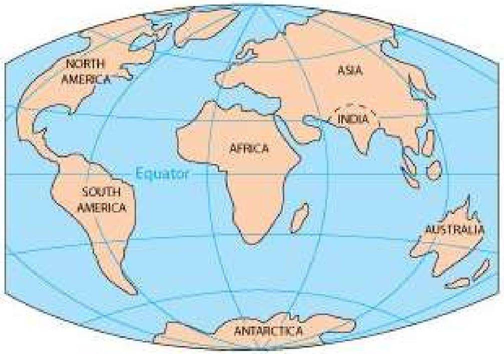
2- the Eometatheria are related to the little South American *Dromiciops*

- The marsupials of South America and Australia were later separated by the extinction of mammals in Antarctica, caused by its glaciation.
- Such a barrier might also have been responsible for the absence of placentals from Australia: there is no trace of them alongside the varied Australian marsupials that we know from the Oligocene (tertiary) onward.



JURASSIC
145 million years ago

CRETACEOUS
65 million years ago



PRESENT DAY

Patterns of Distribution today of Mammals

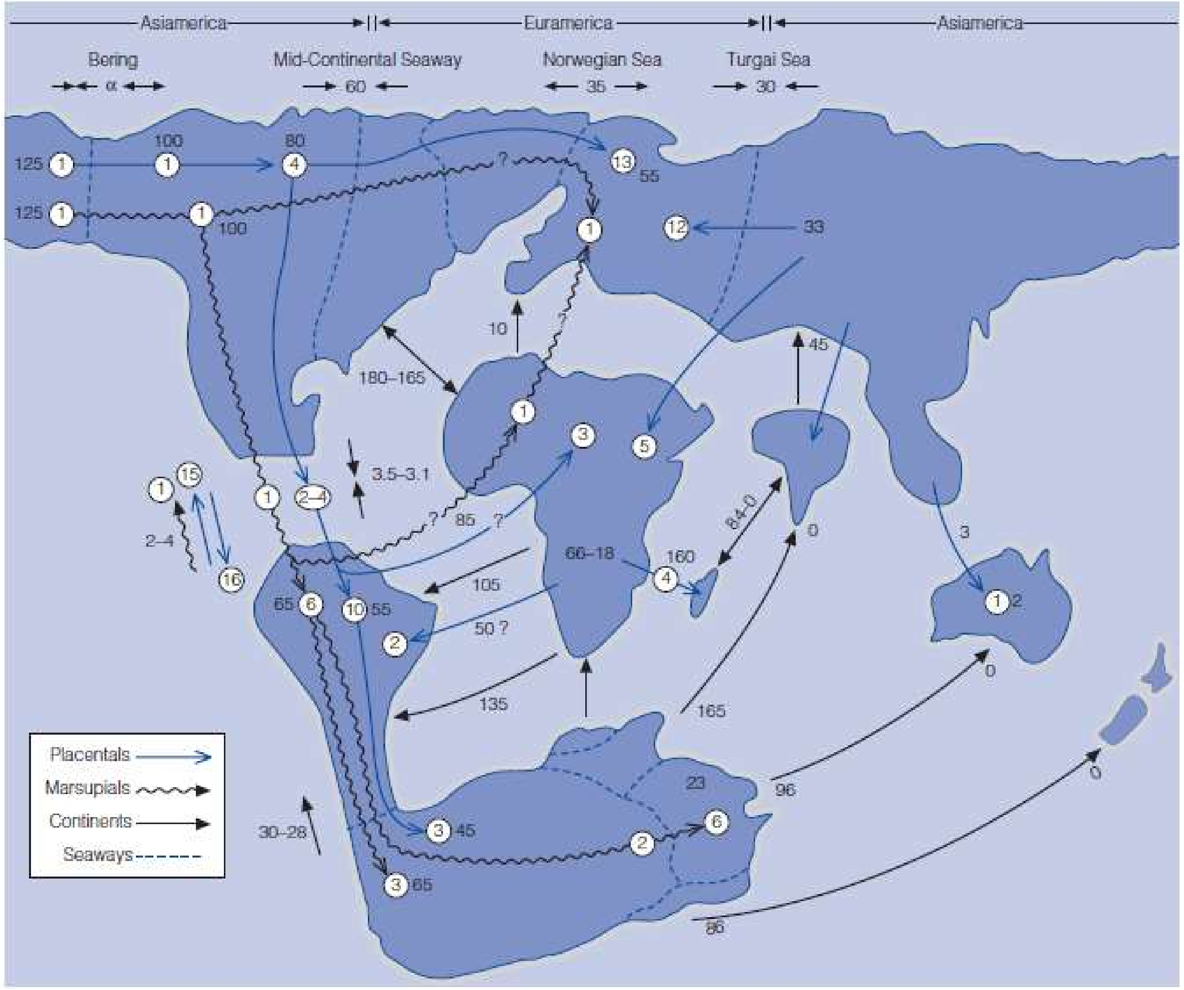


Figure 11.4 Diagram to illustrate the main events in the historical biogeography of mammalian dispersal. Arrows indicate the directions of dispersal of mammalian families or of continents. Dotted lines indicate the positions of the Bering, Mid-Continental, Labrador, Greenland and Turgai seas, with arrows indicating whether the sea opened or closed at the time indicated by the adjacent figure (in millions of years ago). (The alpha symbol at the Bering Sea indicates that it opened and closed a number of times.) The position of the Labrador Sea, west of Greenland, is shown as a dotted line, but no further information is given as it is irrelevant to mammalian dispersal. Figures in circles indicate the number of mammal families in the area in question, the adjoining figure indicating the relevant time in millions of years ago. No attempt has been made to give the total numbers of families in the different continents at any period later than 55 mya.

Table 11.1 Distribution of terrestrial mammals during the Late Cenozoic (Miocene–Pliocene).

	Africa	Oriental	Eurasia	North America	South America	Australia
Rodents	×	×	×	×	×	×
Insectivores, carnivores, lagomorphs	×	×	×	×	×	
Perissodactyls, artiodactyls, elephants	×	×	×	×	×	
Primates	×	×	×		×	
Pangolins	×	×				
Conies, elephant-shrews, aardvarks	×					
Edentates					×	
Marsupials					×	×
Monotremes						×
Total number of orders today*	12	9	7	8	9	3
Total number of terrestrial families today*	44	31	29	23	32	11

*The final totals of orders and families also take account of the Quaternary extinctions and dispersals (see text in this chapter).

The individual families within the orders of mammal show considerable variations in their success at dispersal. A few have been extremely successful.

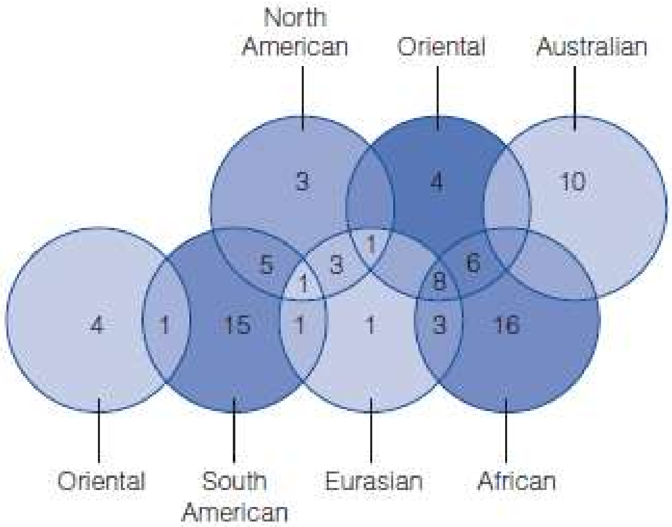


Figure 11.5 Venn diagram showing the interrelationships of the families of terrestrial mammals of their six zoogeographical regions today, excluding the 11 'wandering' families.

Table 11.2 Degree of endemicity of the families of terrestrial mammal (number of endemic families × 100 ÷ total number of families).

Region	Endemicity
Australia	10 × 100 ÷ 11 = 91%
South America	15 × 100 ÷ 32 = 47%
Africa	16 × 100 ÷ 44 = 36%
Holarctic	7 × 100 ÷ 37 = 19%
North America	3 × 100 ÷ 23 = 13%
Oriental	4 × 100 ÷ 31 = 13%
Eurasia	1 × 100 ÷ 30 = 3%

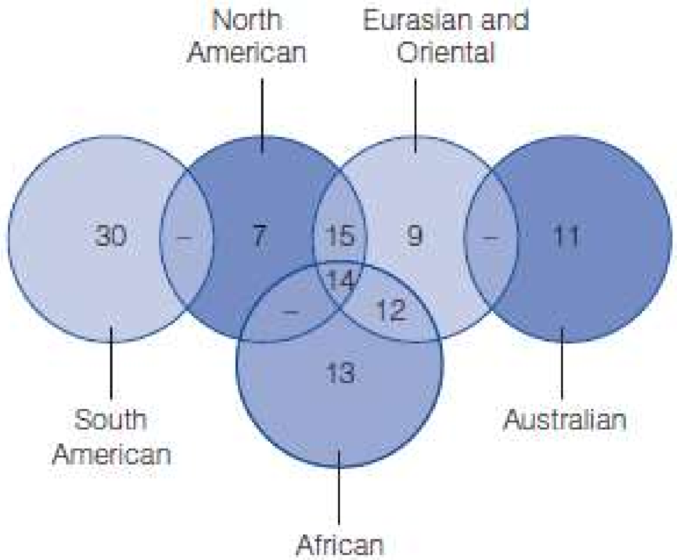


Figure 11.6 Venn diagram showing the interrelationships of the families of terrestrial mammals of the continents at the end of the Miocene, excluding the 11 'wandering' families.

- The Oriental region is shown twice, so that the single family shared with South America (the relict distribution of camelids) can be shown.
- in Figure 11.5, the majority of all the families of terrestrial mammal (51 out of 90, or 57%) are endemic to one region or another.
- These figures are the result of three main Factors: isolation, climate and ecological diversity