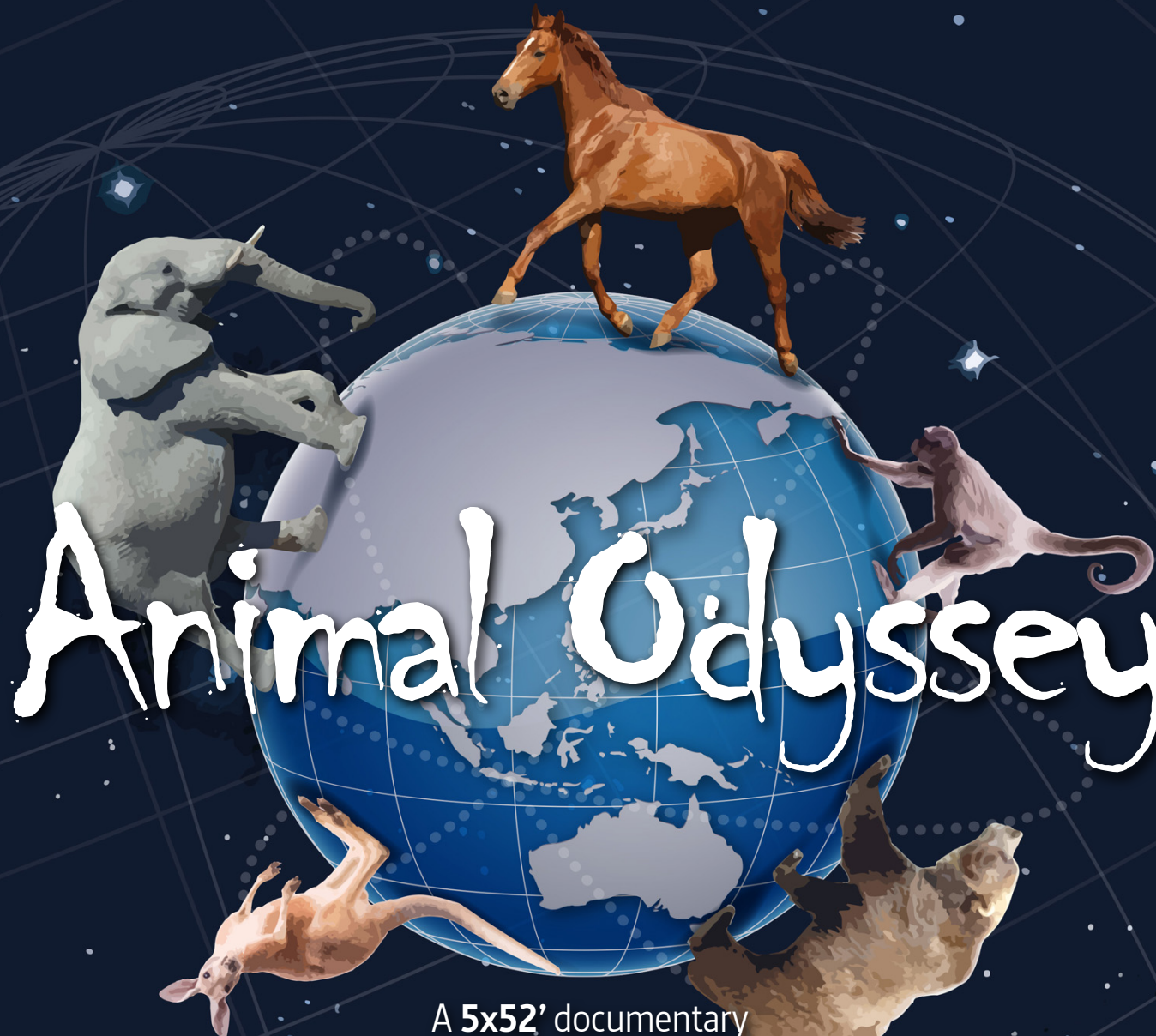


**arte**  
DISTRIBUTION



A 5x52' documentary

Directed by **Maurice Ribière, Paul Aurélien Combre, Benoît Laborde, Vincent Perazio**

Produced by **Arte France** and **Drôle de trame**



# Director's note

Thanks to paleontology, we now know that the history of animal colonization is closely linked to the major changes on our planet. Over the millions of years during which species spread out across the globe, sea levels rose and fell, periodically opening and closing passages to lands that had long been isolated. The climate has oscillated between glacial periods and times of drought, interspersed with torrential rains. Continents changed shape and shifted position, sometimes forming a single land mass, whilst islands were lost in the middle of vast oceans.

These shifts in the environment and geography played a role in the evolution of the animals, enabling them to conquer new territories, sometimes leading to adaptations and new families, and sometimes to extinction. We set out to challenge our current notions of animal population distribution, reconstructing it to tell the story of the great odysseys different species have undertaken to get to where they are today.

Telling the story of animal colonization involves evoking a strange bestiary. We will discover how our chief protagonists once took on unfamiliar forms, such as marsupials that looked like sabre-tooth tigers, or bears resembling dogs - even an elephant without a trunk. Recounting animal colonization means a succession of surprises, not least in terms of the original location of today's species. For example, the first panda lived on the Zaragoza plateau in Spain.

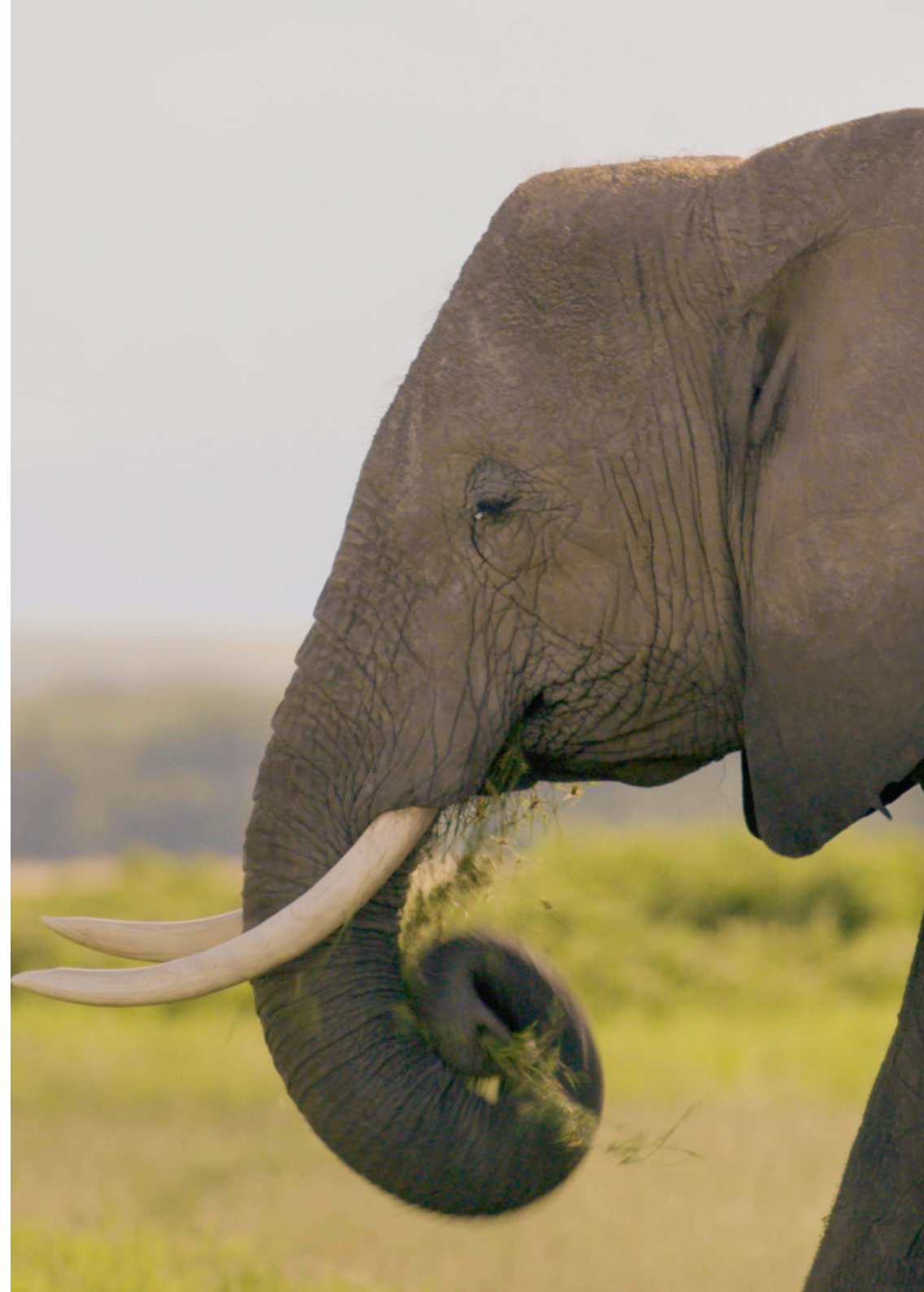


# The journey of the Elephant

Africa deserves to be called a true “paradise of biodiversity”. But if we had to pick one, iconic African animal, it would be the Elephant. However, this animal was not always African: while it started its journey in Africa, its ancestors have dominated the world and the five continents through an exceptional evolution in the animal kingdom. It was Emmanuel Gheerbrant who discovered the fossil of the elephant’s oldest ancestor. As he found it in phosphate mines, he named it Phosphaterium. Native to Morocco where it lived 53 million years ago, Phosphaterium did not yet resemble the elephants of today. Thanks to the fossils currently in the possession of the National Museum of Natural History in Paris, we know that Phosphaterium was the size of a large dog and did not have a trunk.

In a few tens of millions of years, it will diversify into many species. Régis de Bruynes tells us about one of Phosphaterium’s descendants: the Gomphother. This animal is the first to bear its descendants’ iconic trunk, and is now part of the order Proboscidea. Peter Maina, a ranger in Kenya, takes us to Amboseli Park to see how today’s elephants use this trunk, which is a direct legacy from the Gomphother. Thanks to continental drift, Africa is approaching Eurasia, and this geological phenomenon creates a passage between this continent and the rest of the world. The species present in the East of Africa flock to this new continent, including the Gomphother. It adapts there all the more easily as the climate of this new territory is identical to the one it has just left. It is in France, in the archaeological site of Montréal-sur-Gers, that Francis Duranthon found pieces of jaws and teeth of the Gomphother, attesting to its passage in Eurasia.

Nevertheless, this is not the end of the Gomphother’s epic. 20 million years ago, sea levels fell with the climatic cooling. The Bering Strait then became bare and created a passage between Eurasia and America. In Beeville, Texas, a fauna more often associated with Africa than with America has been excavated. Steven May, from the University of Austin, tells us about the cohabitation of the ancestors of zebras and rhinoceroses with the Gomphother, and shows us the remains of their encounter on American soil. At the same time, these discoveries have shattered the conventional wisdom that their first encounter took place on African soil. But the elephant did not stop in North America. It never stopped moving forward as soon as major geological developments allowed it to do so.





And when the Isthmus of Panama linking the two Americas was formed, it conquered a new continent. With South America, the representatives of elephantidae are now everywhere in the world, except for the poles and Australia. In this America conquered by the family of elephantidae will develop a group that will be present only on this territory and will disappear without leaving successors: the Mastodons. Régis de Bruynes shows us a Mastodon tooth preciously preserved in the National Museum of Natural History in Paris. The first discoveries of their fossils in Canada gave rise to the notion of extinct species, which marked the official birth of paleontology.

The Mastodons were confronted with violent climatic phenomena, alternating glacial and interglacial cycles, cold periods alternating with warmer periods. They migrated a lot, going from Mexico to Alaska and vice versa according to the climate. They ended up disappearing 11,000 years ago, unable to adapt to these sudden changes. However, Régis de Bruynes tells us that this ice age led to one of the most “successful” adaptations of the Proboscideans: the Mammoth. From being the dominant species in the fauna of temperate climates, the Mammoth became the master of the ice age at the time when it was most intense, when permanent glaciers covered the plains above the 45th parallel north. But when the climate suddenly warmed up, it did not evolve fast enough, and this until then thriving species suddenly became extinct.

If some, like the mammoths, tried to adapt, others tried to move to warmer climes. During the ice age when the Mammoths thrived, the sea level also fell in the Mediterranean. The elephant then moved to territories located today in the middle of the Mediterranean. But at the end of this great glaciation, global temperatures rise sharply. The ice melts and the sea level rises, which isolates America from Asia again, and submerges all the territories that had appeared at the time of cooling. Sicily, Malta and Crete became islands again. The elephants trapped in Sicily become smaller to adapt to the smaller amount of food than on the mainland. Paleontologist Pasquale Raia takes us to visit the caves of Spinagallo, where the smallest Proboscideans known to date were discovered.

They do not exist anymore because, following their isolation, they lost the habit to deal with predators. When sea levels dropped again, new species arrived against which the animals of the islands could not fight, having lost their mechanisms against predation. After dominating the world, the elephant is now restricted to a few territories: South Asia and Africa. After having conquered the world by its power of adaptation, the great cold was the reason for its dispersion on the surface of the planet. It remained in tropical areas of Africa or southern Asia. Still today, paleontologists like Jean-Renaud Boissérie or Frederick Manthi survey excavation sites like those of the Omo in Ethiopia or Olorgesailie in Kenya. These places and their fossils illustrate the ancient cohabitation between Proboscideans and Hominids.



# The Journey of the North American Bear

In Yellowstone National Park, in the United States, the grizzly bear is a star. Chris Servheen, professor at the University of Montana, has been leading the program for the protection and recovery of brown bears in the United States for 35 years. He knows this animal by heart, he is the one who presents it to us. The grizzly bear is recognizable by its stocky body with short and robust limbs, its plantigrade paw with long claws, a short tail, an elongated muzzle, round ears... And that fascinating ability to stand upright, like a human. Once very extensive in the western and central part of North America, the grizzly's territory has been restricted by human pressure and, apart from Alaska, Yellowstone Park is now its main refuge in the United States. Pioneers described the grizzly for the first time. During an expedition near the mouth of the Yellowstone River, the Americans Lewis and Clarke met a bear that terrified them. They nicknamed it "grisley", a combination of "grizzled" – which refers to the grey sheen of the coat – and "grisly" – which means scary. In common parlance, it is the first version, "grizzly", that has been kept, but for the Latin name it is the second, since it is officially named "*Ursus arctos horribilis*".

The populations of bears in North America are the result of several migrations, started tens of millions of years ago, and of multiple journeys between the two great continents of the northern hemisphere, America and Eurasia. The history of the bear is rooted in that of a large family of mammals: the carnivores, which appeared 60 million years ago. Paleontologist Xiaoming Wang of the Los Angeles Museum of Natural History explains that 45 million years ago, the order of carnivores divided into two major branches: the feliforms and the caniforms. Within the caniforms emerged the Canidae: wolves, coyotes, foxes... And the Arctoidae, which includes the branch of the Ursidae, our current bears. The bear is therefore a caniform like the wolf or the dog. But, within this group, its closest relative is none other than the sea lion! 30 to 40 million years ago, the earth's climate was still warm and humid all over the planet, and the ocean was lower than today. A land bridge, Beringia, connected Siberia and Alaska for millions of years, allowing animals to migrate constantly between America and Eurasia. It is here that a precursor branch of bears emerged from carnivorous animals related to sea lions: the cephalogales. Camille Grohé, paleontologist, takes us to the phosphate mines of Quercy in France, where many fossils have been found. The oldest cephalogale found there lived 30 to 35 million years ago. Thanks to the teeth found there, we know that they diversified their diet, becoming omnivores. Another striking characteristic of today's bears is that they are plantigrade: they walk on their whole foot, and not on their toes, like canids or felines.







The animals that can be considered as the bears' ancestors are thus descended from these cephalogales, spread throughout Europe and Asia. 25 million years ago, the Ursavus group emerged from the cephalogales. It is the beginning of a diversification in all directions: fossils of multiple species, ranging from the size of a cat to that of a wolf, have been found in different sites in Europe and Asia. It is on the excavation site of Montredon in the South of France that Camille Grohé and Gildas Merceron tell us about the discovery of a fossil bear, Indarctos, also found in Spain and in Western Europe. Its particularity lies in its dental characteristics: by analyzing the wear of the enamel of the teeth found there, Gildas Merceron notes that this ursid had a diet that, albeit omnivorous, was already specialized – which could correspond to a consumption of very hard plants, close to the diet of the current giant panda of China. It is very likely that these species of primitive bears, living in Hungary, France or Spain, consumed the same type of plants as the panda, perhaps plants close to the current bamboos. Nevertheless, all these species disappeared from Europe following an aridification that took place between 10 and 7 million years ago. With the disappearance of the tropical forests of Europe, these bears moved eastward and found refuge in Asia, becoming the modern panda 2 million years ago. The Ursavus branch originated the ursids. From the ursids, two branches arise: the first is that of the panda, and the second is that of Ursus minimus. While the panda continues its specialization in Asia, the branch that will give birth to all other current bears emerges in Eurasia. This is the lineage of the Ursines, to which the brown bear belongs, and of which one of the first representatives is the 5 million years old Ursus minimus. Called the Auvergne bear because its bones were found in the Puy de Dôme, Ursus minimus measured only 90 cm at the withers.

This species has spread throughout Eurasia, until the junction with America. 3 to 4 million years ago, these bears, very close to modern bears, made their way to the New World via Beringia. Natalia Rybczynski and Marisa Gilbert, paleobiologists, have found fragments of the skeleton of a primitive bear, related to the Ursines from Eurasia, on Ellesmere Island in Canada. This proves the continuity that existed between the two continents. As further evidence of this geographical continuity, the excavation site named “Beaver Pond” revealed to Natalia Rybczynski and her colleagues the remains of a now extinct species of beaver, found in both Eurasia and America. And while beaver may have been on the menu for the early Ellesmere bear, meat was not the only ingredient on it. Natalia Rybczynski shows us the jaw of the bear exhumed in Ellesmere: the teeth are decayed, proving the pronounced taste of the animal for sweet food. Sweet berries or honey? Lionel Garnery, a specialist in the genetics and evolution of bees, explains that we have proof of the honeybees' presence in North America dating back 13 million years ago. It is therefore likely that when bears from Eurasia began to settle in America, they were able to eat their honey. Garth Mowat, biologist and professor at the University of British Columbia in Canada, explains that their appetite for such sweet foods was so they could build up sufficient fat reserves to hibernate during the cold season.



But this is not the end of the journey: once past the Bering land bridge, the Arctic zones are merely a stopover for these bears that arrived from Eurasia before the ice ages and continue their southward journey. On the American continent, the grizzly and the black bear will have to share their territory. We have proof of the presence of the latter, *Ursus americanus*, on the American continent dating back nearly 4 million years. The adaptability of brown and black bears is a key to their evolutionary success. They have taken advantage of existing resources, occupying available niches, even when other, more massive bears were competing with them. On the other side of the ocean, in Europe, the brown bear has cohabited with another lineage from the small *Ursus minimus*: *Ursus spelaeus*, better known as the cave bear: it is in caves, where it spent the winter, that its bones were found. Hervé Bocherens, biogeologist of the University of Tübingen, makes us visit the caves of Goyet, in Belgium, where the bones of about forty cave bears were found. They were more than 3 meters high, standing on their hind legs, and weighed up to 500 kg. This massive bear disappeared more than 20,000 years ago: with the climate changes linked to the ice ages, its vegetarian diet, therefore restricted, would have largely contributed to its extinction. While the branch of the cave bear became extinct, the brown bear on the other hand, which comes from the same ancestor, had a great evolutionary success. *Ursus arctos* appears in Asia and then spreads westward, throughout Europe, while also dispersing eastward. Once again, this bear crosses Beringia and goes from Siberia to Alaska. The first wave of migrating brown bears thus set foot in North America about 100,000 years ago.

They are the direct ancestor to our modern grizzlies. There is another emblematic species of these great spaces of North America which requires protection in Canada today, since it also sees its territory shrinking because of the fragmentation of the forests: it is the caribou. Douglas Heard, a professor at the University of British Columbia, has been conducting an experiment for several years to feed caribou during the winter in an attempt to halt the decline of the population. But for several decades, the caribou of the tundra has had to face a new predator: the polar bear. Due to the warming of the Arctic Ocean, these polar bears are forced to diversify their hunting and go further inland. In the Ursinids family, which includes the brown bear and the black bear, the polar bear is the “last born”. It is the most recent in the evolutionary history of the family. The polar bear (*Ursus maritimus*) is a direct cousin of the brown bear. The evolutionary biologist Alexandre Hassanin from the Museum of Natural History in Paris explains that during its evolution, the polar bear developed a particular metabolism allowing it to survive on a diet very rich in lipids. By studying its genome, researchers have been able to date the appearance of this trait about 450,000 years ago. The adaptation of this polar bear to the extreme conditions of the Arctic Ocean was thus rapid. Today, it is challenged to adapt to rapid changes, which are counted in decades and no longer in hundreds of thousands of years. In the 21st century, these animals, present in America but also in Asia and Europe, are in spite of themselves the icons of the dangers that human activities and climate change pose to the planet's biodiversity.





# The Journey of the Monkey

Like us, humans, they are primates; sometimes their gestures resemble ours, their looks, their expressions... We most often think about the Amazonian jungle when we think of our cousin the monkey. But many questions remain about their origin: how did monkeys arrive in the Amazon? Where do they come from? Why are they so numerous and varied? The first apes probably appeared in Africa 55 million years ago. What did they look like? Scientists like Grégoire Boulinguez Ambroise think that the mouse lemur is the closest lookalike. In this laboratory of the National Museum of Natural History of Paris, the mouse lemur reveals its secrets. Without surprise, developing an opposable thumb is a trait that would make it particularly adapted to the forest.

Thierry Smith is a paleontologist at the Museum of Natural History of Brussels; a museum which preserves the very first fossil of a primate found: a jaw of Teilhardina. This fossil confirms that the first primates are similar to the mouse lemur – small size, insectivorous, with small pointed teeth. Fossils of Teilhardina dating from the same periods are found in Europe, Asia and North America. How did Teilhardina pass from one continent to the other? Around 45 million years ago, primates gradually divided into three distinct families: lemurs, such as the mouse lemur; tarsiers; and monkeys, that appeared in Eastern Asia. 33 million years ago, the climate cooled down abruptly following the freezing of Antarctica. The forests shrank towards the tropics and the equator while the savanna gained ground, and the monkeys deprived of trees were gradually pushed back to Africa. Elise Huchard, a primatologist at the CNRS, has long studied the impact of the evolution of the savanna on these monkey species, which are attached to their forests. Those among them who would descend to the ground, such as gorillas or chimpanzees, would be called the “great apes”. They will be totally separated from the tree-dwelling apes with whom they will have no further relationship.

If the adventure of the African apes is well documented, many mysteries remain about the history of the South American apes. How did they appear in these forests? For how long? So many questions that motivate paleontologists Laurent Marivaux and Pierre-Olivier Antoine to dig in Peru, where the first fossil of South American monkey was found. The more new fossils they find, the more comparisons they can make between them in their laboratory in Montpellier, and the more they can support the hypothesis that it is the apes of Africa that colonized South America. Their hypothesis is that they crossed the Atlantic on natural rafts, torn from the coast by the raging climate of 30 million years ago. Then, pushed by winds and favorable currents, these shipwrecked monkeys would have landed in the Amazon jungle. They were then called the monkeys of the New World.







This hypothesis of the traveling island, although incredible, currently remains the most plausible. Jean-Philippe Magnone, in charge of a care center for monkeys in French Guiana, shows us how these monkeys managed to adapt to their new environment.

One question remains, however: how did a handful of shipwrecked monkeys from Africa manage to thrive in such a wide variety of species? Today, from Central America to South America, we count 14 different species of Marmosets, 15 species of Tamarins, 17 of Capuchin, Squirrel monkeys, Night monkey, Sapajous... If the scenario of the traveling island is plausible, it could not have been repeated dozens of times, bringing each time different species of primitive monkeys. Moreover, according to evolutionary specialists, 40 million years is too short to count so much species diversity from so few strains. So how can we explain the presence of so many apes with so many different aspects and lifestyles? Mathieu Chouteau, a biologist specializing in the mechanisms of evolution at the CNRS, proposes an explanation based on his study of the fantastic tree frog, a species of frog also present in the Peruvian forest. There is so much competition in the Amazon rainforest, so much variation in the different habitats, that organisms tend to evolve much more rapidly than elsewhere on the globe. The Amazon rainforest has probably imposed the same competitive pressure on the monkeys by pushing them to diversify “in a hurry”. This would justify such a variety of species appearing in such a short time and would further validate the raft hypothesis.

But the paradise on earth that the Amazon represents for these New World monkeys does not remain one indefinitely. 15 million years ago, the two hitherto isolated Americas came together and connected. Two giant reservoirs of biodiversity, which had been isolated until then, start flowing into each other. The monkeys of South America do not find suitable forest environments in the North. However, several felines, such as the ocelot, the puma and the jaguar, are making the trip south. Rachel Berzins, biologist at the French Office of Biodiversity, explains how these super-predators have influenced the fate of the New World monkeys. She observes them at the CSG, the French Guiana Space Center, where she studies how the presence of these felines, sometimes good climbers, sometimes stealthy prowlers, has had the impact of preventing the monkeys from leaving their trees and prohibiting them from evolving on the ground like some of their distant African cousins.

For 55 million years and on several continents, apes have adapted to climatic upheavals, to the movement of continents, to the pressure of predators... Their incredible odyssey on Earth is however threatened because of one of their own, a primate that left Africa like them and spread all over the planet, a primate that practices hunting, poaching, deforestation and who is called Homo Sapiens. Sapiens meaning: intelligent, wise, reasonable, careful... Are we so sure of that?



# The Journey of the Eurasian Wild Horse

It is said that the horse is the most noble conquest of humankind. Thanks to it, humankind has been able to master the great spaces, to wage war and to trace trade routes. At least until the industrial revolutions of the 19th century, from the shores of the Atlantic to the steppes of Central Asia, the horse was ubiquitous. However, its history is long and eventful. It began about 60 million years ago, somewhere in the great steppes of present-day Mongolia. The horse we all know belongs to the large family of mammals that walk on their nails, not on their toes. Like zebras, donkeys, goats, antelopes or camels, the horse is therefore, for specialists, an “ungulate”. At the University of Montpellier, Fabrice Lihoreau specifies that ungulates can be distinguished into two main categories: the “artiodactyls”, which have an even number of toes on their feet, and the “perissodactyls”, which walk on an odd number of toes. This is the case of the rhinoceros, the tapir... and the horse. Fabrice confirms this surprising family relation by showing a mummified horse's foot: the hoof we all associate with horses today is in fact a toe. The horse is thus a “perissodactyl”.

Fabrice Lihoreau and his colleague Rodolphe Tabuce are particularly interested in how perissodactyls first appeared in Europe. The two researchers have been excavating for several years an exceptional fossil site, hidden under the Minervois vineyards, near the village of La Livinière. Very ancient skulls of perissodactyls have been found there, dating from the beginning of the Eocene, about 56 million years ago. If ungulates probably first appeared in Central Asia about 60 million years ago, they quickly dispersed, on one side towards North America via the Bering Strait, and on the other side all through the Eurasian continent. As early as 56 million years ago, perissodactyls were found in large numbers as far as Western Europe and this is confirmed by the presence of fossils in the Minervois. The first perissodactyls of the Eocene had little to do with today's horses, explains Rodolphe Tabuce. They certainly had an odd number of toes like the modern horse, but had three toes instead of one, and above all, they were generally the size of a small dog, a poodle at most. It is indeed a tiny skull that Fabrice and Rodolphe found during their excavations, and that Anne-Lise Charruault is cleaning. They identified this skull as that of a “pakinolofus”, one of the species of perissodactyls present in Western Europe at the beginning of the Eocene. Quentin Vautrin, PhD student, reminds us that the faunas of the Eocene were both numerous and diversified: multiple species of perissodactyls thrived in Europe from the beginning of the Eocene, among which the lophiodons – subject of his thesis.







He also tells us about a common misconception: 45 million years ago, due to climatic changes, all primitive perissodactyls disappeared one after the other from Eurasia! So paradoxically, the emblematic animal of Eurasia does not descend directly from its Eurasian ancestors – since all this fauna disappeared from Eurasia in the Miocene... However, some primitive perissodactyls had crossed the Bering Strait towards present-day North America. While the European species are gradually becoming extinct, the migrants to North America are still going strong. And so, to follow the perissodactyls' trail, next stop: the United States. In northern Wyoming, the Bighorn Basin has been a real Eldorado for paleontologists since the 1980s. It is here that the oldest Eocene horse skeletons in America have been found, including that of *Hyracotherium*, the oldest ancestor of the modern horse known to date. Philip Gingerich led the excavation in the 1980s. *Hyracotherium* was also quite a small animal, the size of a fox terrier, like its European counterpart. So, when did it appear on the American continent and under what conditions? For Hemmo Abels, a geologist at Delft University in Holland, the answer has long divided American and European researchers. Everywhere on the planet, he explains, in Wyoming as in the Minervois, the beginning of the Eocene is marked by a rapid, intense and brief (10,000 years) warming of the climate. This is what Philip Gingerich calls the "Paleocene-Eocene Thermal Maximum" (PETM). Wyoming's landscapes were very different from what they are today. During the PETM, *Hyracotherium* lived in tropical rainforests and its small size allowed it to move easily between the trunks and groves of the then highly forested America. Philip reminds us that *Hyracotherium* had three toes on the back of its hooves to allow for easy movement and stability when standing tall. Its dentition was also more complete than that of the present-day horse because the animal was a folivore, and not an herbivore.

Scott Wing, paleo-botanist and curator of botanical collections at the famous Smithsonian Museum of Natural History in Washington, D.C., also comes to Wyoming regularly to dig. He explains the botany of these American rainforests, where several species of American perissodactyls thrived during the millions of years of the Eocene, while they disappeared one after the other in Europe. After the PETM crisis, climatic conditions stabilized and species proliferated. It was not until the next period, the Miocene, that the living environment of these small horses deteriorated in North America. About 23 million years ago, the climate also began to cool in America. But unlike the Eurasian species, the American species will manage to adapt. Nick Famoso, a paleontologist at John Day National Park, traces the evolution that took place during the Miocene: we see these species becoming larger and larger because they now need to move over very large areas to find food. He possesses fragments of an emblematic species of the Miocene transition: *Merychippus*, considered the first herbivorous horse. Scott Wing, paleo-botanist and curator of botanical collections at the famous Smithsonian Museum of Natural History in Washington, D.C., also comes to Wyoming regularly to dig. He explains the botany of these American rainforests, where several species of American perissodactyls thrived during the millions of years of the Eocene, while they disappeared one after the other in Europe.



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After the last great ice age of the Würm, saber-toothed tigers, woolly mammoths, *canis dirus*... and horses were never to be seen again in America. Among the explanatory factors of this massacre: climate change, but also a new species, even more formidable than the steppe wolf... Humans. Jean-Luc Perrin is now the director of the Takh association, which has been protecting and studying Przewalski's horses since the 1970s in the Larzac plateau. He reminds us of the singularity of the species within the “horse” genus: for a long time, Przewalski's horses were considered to be the last descendants of the wild horse, *Equus*, but recent genetic studies have shown that they were in fact horses that returned to the wild state a long time ago after being first domesticated. But how can we explain that the horse has become such an important part of the American imagination today, when all scientists agree that *Equus* had no descendants in North America? Actually, answers Eric Scott, the wild horses of the United States all come from Europe. They arrived in the holds of Spanish ships after the “discovery” of America in 1492 and were left behind, where they gradually returned to the wild. Their presence is the result of hundreds of millions of years of evolution and, finally, of a little chance too! If Christopher Columbus had not set foot in the Bahamas, perhaps Buffalo Bill would never have hunted bison on horseback...





# The Journey of the Australian Kangaroo

While the kangaroo is associated with Australia, few know how its ancestors even came to be on this continent. In the heart of the Pacific, Australia is now an island continent, a place where the rules are not really the same. Most scientists consider it to be a unique laboratory of evolution, where one finds fauna unknown elsewhere and where the animals common to all other continents are absent. The biologist Katherine Hayes works for the Australian Wildlife Conservancy. She is looking for traces of the Australian fauna to reconstitute its past and evolution. For this, she studies a small and rare species: Sharman's rock-wallaby. Australia is home to many species of kangaroos and wallabies. But they are not the only animals found only on this island-continent. There are also koalas, wombats, or quokkas. Although different in appearance, these animals have something exceptional in common, unique in the whole animal kingdom that populates the Earth: they are marsupials.

Marsupials are a group of mammals that appeared more than 150 million years ago. These animals are the only ones to carry their young in a ventral pouch. A fold of the skin is used to cover the udders to form this pouch whose function is the same as an incubator. The young are born in a rudimentary state of development, a few centimeters, a few grams and just the strength to pull themselves up and slip by reflex into this maternal pouch. They complete their growth there, where during the time of breast feeding, the mother sends milk directly in their mouth by contracting specific muscles. Christian de Muizon, paleontologist, is interested in the first marsupials and their traces during evolution. While dinosaurs dominated the planet, some reptiles began to nurse their young after having laid their eggs. From these primitive "mammals", the marsupial branch emerged very early on, with fossils dating back 150 million years on all the continents of the northern hemisphere. And among them was Kokopellia, a marsupial found in North America and dating back 125 million years.

The problem for marsupials is not so much the dinosaurs, but the competition of another group of mammals: the placentals. For 150 million years, at the slow pace of evolution, competition has given the advantage to the placentals, which have gradually driven the marsupials out of Asia and back into North America. Inexorably, the marsupials lose more ground and retreat to South America. But the contact between the two Americas is ephemeral on the scale of geological time, and South America becomes an island isolated from the other continents.







Pierre-Olivier Antoine and Narla Stutz, French and Brazilian paleontologists, are trying to reconstruct the extinct ecosystems of South America to better understand the context in which marsupials lived. Indeed, marsupials did not succeed in getting rid of placentals when they reached South America. The latter have diversified as much as the former and occupy many ecological niches. But the marsupials will know a real golden age in South America and will be just as numerous as placentals. When the Isthmus of Panama closes again 15 million years ago, a new wave of placentals arrive from North America and compete with the marsupials of South America. This event will precipitate the near disappearance of marsupials on the continent. Only about a hundred species of marsupials remain in South America today, mainly represented by opossums. On the Murgon site in Australia, Mike Archer and Kenny Travouillon begin their day of excavation. Many of the fossils found here are reminiscent of South American faunas. 50 million years ago, the Antarctic, then free of ice, acts as a genuine bridge between landmasses. We can approximate the date of arrival of the marsupials that passed through Antarctica: they were already here 60 million years ago. When the marsupials arrived, Australia was not empty: there were snakes, birds, crocodiles, insects. But that is not a problem for the marsupials who will finally find their place on this continent and conquer many ecological niches left vacant. Then, about 40 million years ago, Australia moved away from Antarctica and became unreachable. Did the marsupials finally manage to avoid the placentals simply by getting ahead of them?

Another animal can attest to the incredible diversity of evolution that the Australian continent has fostered. This other mammal, neither marsupial nor placental, already lived there before these last ones even competed for the Australian land. It is the platypus, a monotreme, presented by Josh Griffith, ecologist at the Cesar Australia research center.. Platypuses are our most distant cousins. Although they nurse their young, they have retained many genes common to birds and reptiles. Drifting for 40 million years apart from other continents, Australia became the giant laboratory of marsupial life. Marsupials were present in all the territories, occupying all the ecological niches by adapting their morphologies and skills.

The first kangaroo fossils date back 26 million years and come from the Riversleigh excavation site. 20 million years ago, the circulation of marine currents around Antarctica changes, and it becomes a continent of ice, dooming all the species that populated it. In Australia, the luxuriant forest gives way to large areas of grassland dotted by a few trees: the savanna. The continent changes in a few million years, many species of marsupials disappear, while others manage to adapt to the desert and the savanna. But the aridity will be the cause of other natural phenomena that will prove very disturbing for the fauna, like fires or droughts. Kangaroos and wallabies will know a second golden age in this more arid Australia. They spread out to new ecological niches without competition from the placentals.



When a species sees its competitors and its predators disappear, and at the same time its food resources and its lodgings seem unlimited, it experiences a recurrent evolutionary phenomenon: gigantism. As recently as 30,000 years ago, giant kangaroos populated Australia. They were more than two meters tall and weighed 240 kg. But the entire Australian megafauna became extinct 50,000 years ago, due to the arrival of humans, climate change or both. Today's species are those that survived this last wave of extinction. Smaller or medium-sized species survive change better.

Biologist Helen Crisp's research at the Yookamurra Wildlife Sanctuary is helping us understand how animals as unique as marsupials came to be. She seeks to capture bilbies to study their genetics and document their distribution in the territory. Many marsupial species are easily comparable to their placental counterparts found on other continents: this is called evolutionary convergence. Similar to no other animal on Earth, the kangaroo owes part of its success to adaptations due to the harsh conditions offered by arid Australia.

The drying out of Australia over time will paradoxically create new forests, composed of a single species of tree: the eucalyptus. The only problem is that its leaves are toxic. Stephen Phillips is a biologist who monitors the local koala population, which has specialized in this neglected biotope. As long as their environment is not disturbed, the marsupials have demonstrated a solid capacity to adapt to the environment. Unfortunately, the honeymoon between marsupials and Australia will be seriously disturbed after 40 million years of isolation of the island-continent... As Australia is getting closer to Asia, the ocean floor is rising and creating many archipelagos which form as many bridges for some animals.

Finally, during the last millennia, the placentals – the marsupials' enemies of old – are back in what has become their sanctuary. Each one evolved on its own in the absence of the other and the competition fiercely resumed without skipping a beat. About 5,000 years ago, a new species appeared on the Australian continent: the dingo. Euan Ritchie is a biologist, he tries to understand their impact on the local fauna. With the return of the placentals, the marsupials are once again at a turning point in their history. Will they lose the only continent on which they had managed to impose their hegemony?













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