Museum of Natural Sciences

# the guide

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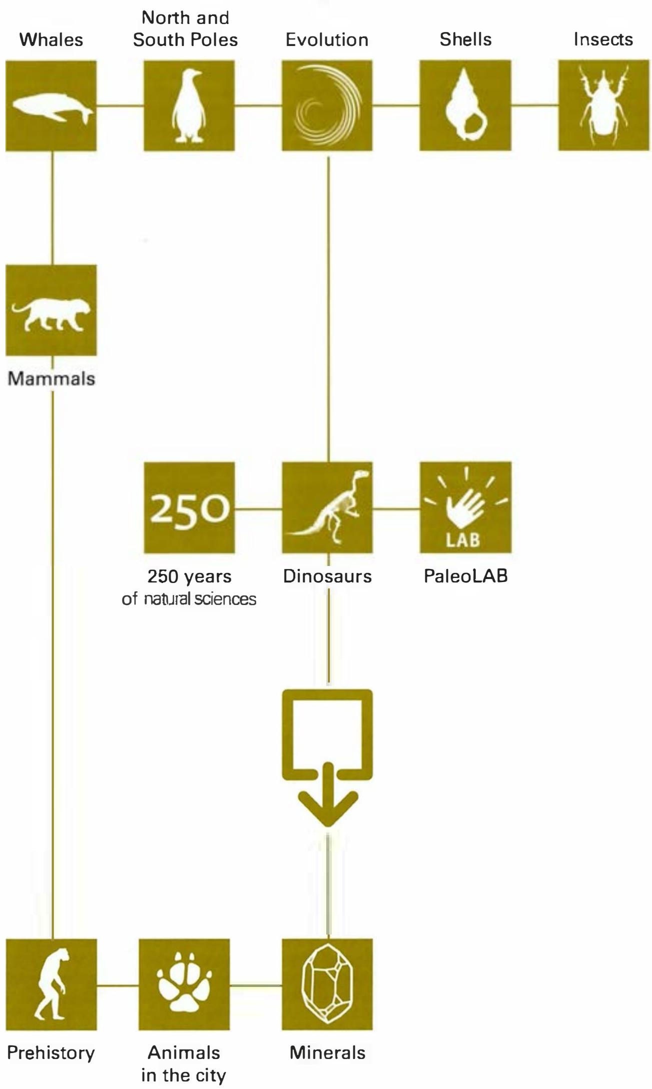
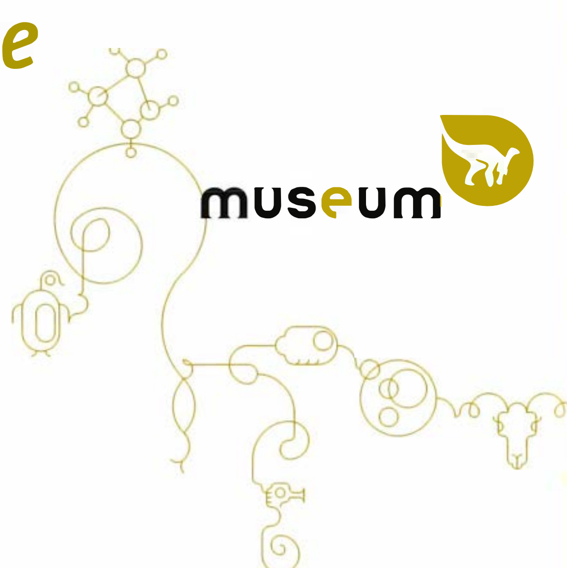
# galeries

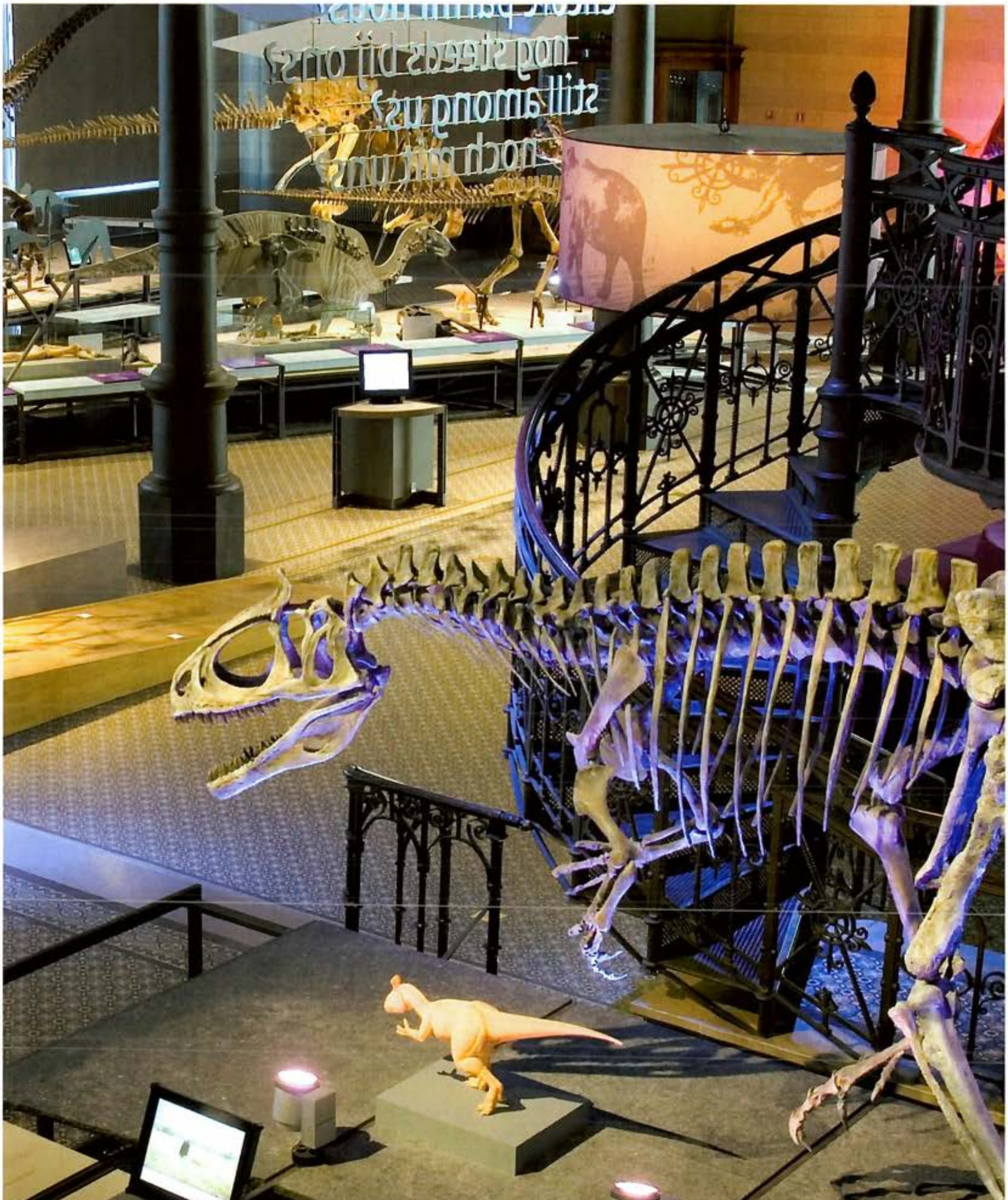


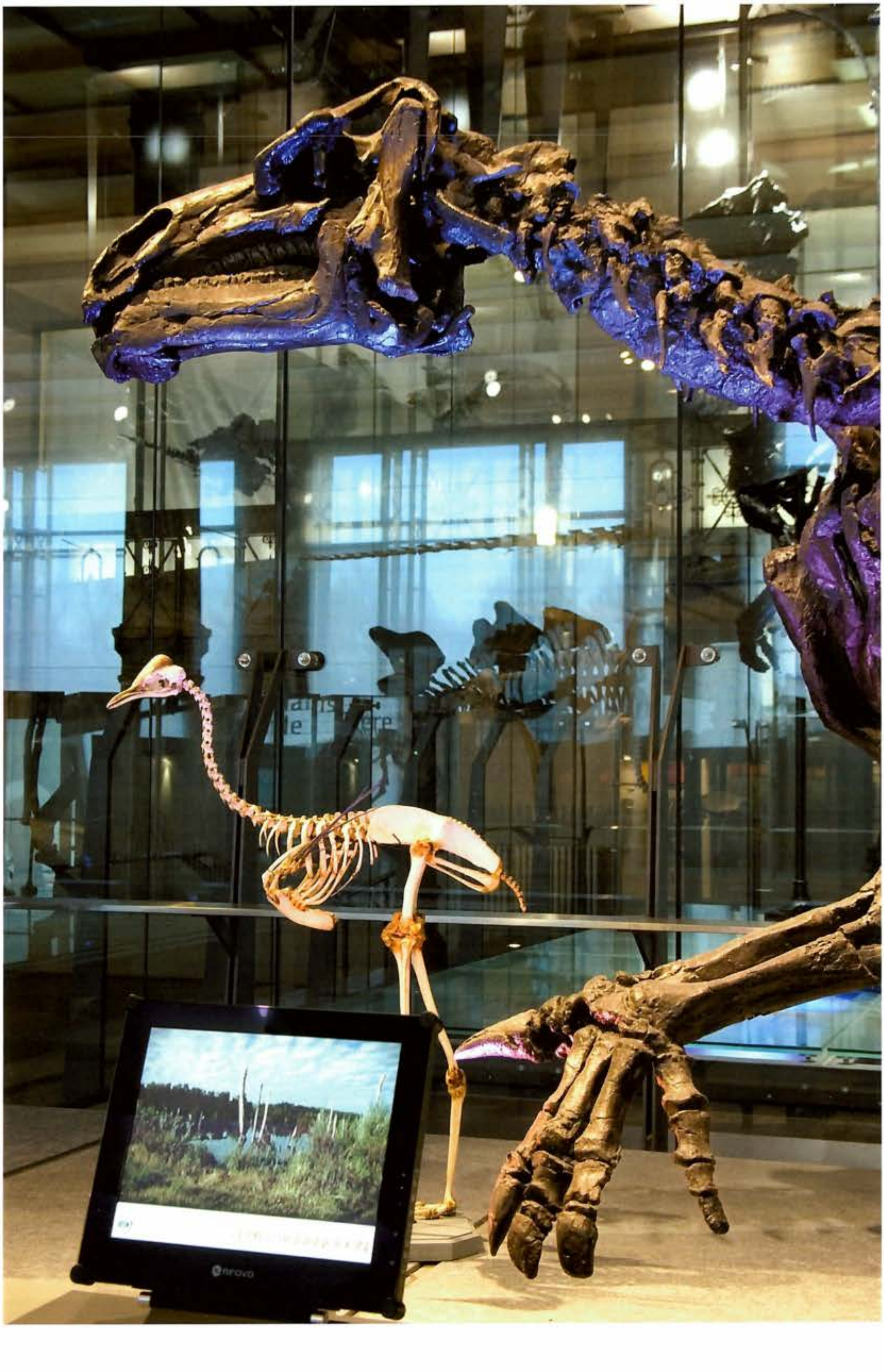

museum

## Museum of Natural Sciences

# *the guide*







# Animals protected now by law

Today, many international agreements aim to protect threatened species, as well as species that could become threatened if we don't control their exploitation or preserve their habitat.

CITES (the Convention on International Trade in Endangered Species of Wild Flora and Fauna) is one such agreement that aims to regulate the trade in threatened plant and animal species. The Bonn Convention, or CMS (Convention on the Conservation of Migratory Species of Wild Animals), aims to protect migratory animals. Our scientists are regularly consulted about these conventions. Their role is to inform the legislator and to identify specimens seized by customs.

Since 22 October 1987 the Siberian tiger, *Panthera tigris altaica*, is listed in Annex I of CITES. This annex lists the species that are in danger of extinction, and for which trade regulation is strictest. There were less than 400 of these tigers left in the wild! The specimen displayed in the *250 Years of Natural Sciences* gallery was confiscated and entrusted to the Museum by the Antwerp legal authorities in 2006.

In 2006, the Secretariat of the CMS entrusted our institute with preparing and negotiating an agreement for the conservation of gorillas and their natural habitat, in partnership with the Secretariat of GRASP (Great Apes Survival Partnership, a UN initiative for the conservation of great apes). The agreement was opened for signing on 26 October 2007. All ten countries where gorillas live had to sign the agreement before it could be enforced, which has now been done!

# Animals that were exterminated in the past

The thylacine, also known as theTasmanian 'wolf', or 'tiger', is an Australian marsupial. Well, it was: the last specimen - a male - died inTasmania's Hobart Zoo on 7 September 1936. This animal was a victim of prejudice and ignorance about its way of life. The carnivore hunted at dusk and could open its mouth very wide, making people suspect that it was a threat to sheep and so they eliminated it systematically, encouraged by bounties. Things could have been different: thylacines were easy to tame...

The specimen displayed in the *250 Years of Natural Sciences* gallery has been part of the Museum's collection since it was donated by Morton Allport in 1871. This Australian naturalist was a member of many scientific societies, including the Royal Belgian Societies of malacology, botany, and entomology!

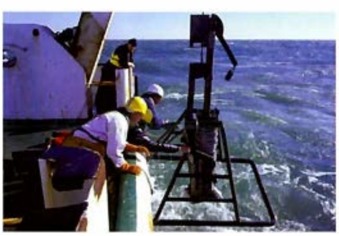
This photo of the very last living thylacine was taken in Hobart Zoo in 1933 by Dr David Fleay. The animal's wide open mouth was a warning sign that Fleay should have heeded: he was bitten just a few minutes later, something he was to be proud of for the rest of his life!

# ...to the Belgica of today

Since 1984, the Belgica has been patrolling the North Sea in its new incarnation as an oceanographic research ship. It is manned by the Belgian Navy, but the scientific equipment is provided by one of our departments, the Management Unit of the North Sea Mathematical Models (MUMM), which also organises the expeditions. Participating researchers originate from various Belgian and European universities and institutes. The main mission of the Belgica is to monitor the quality of the marine environment and to learn more about the marine ecosystem. To this end, the crew collect a huge amount of biological, chemical, physical, geological, and hydrodynamic data. They have five on-board laboratories to analyse their samples.

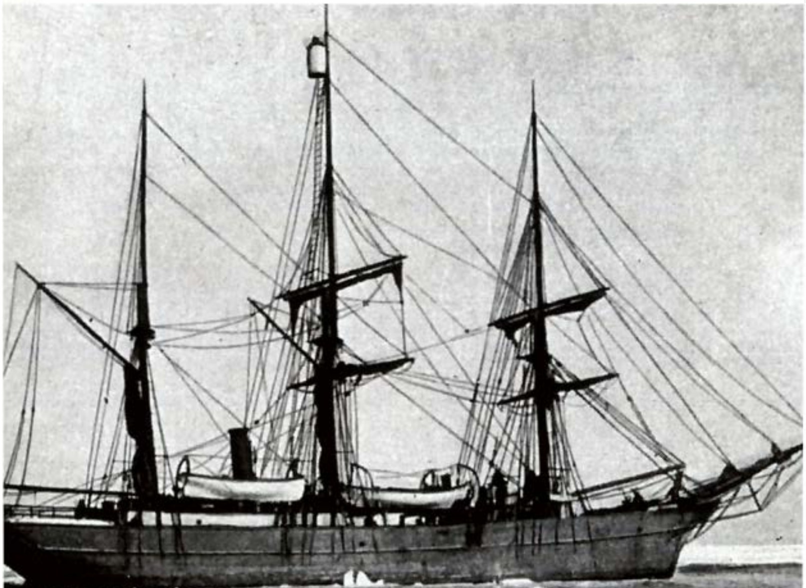
Whenever there is an oil slick or risk of pollution after a shipwreck, the Belgica is on the scene as soon as possible. Experts take over to determine the impact of the incident on the marine environment. To do this, they monitor the water quality and use mathematical models to study how the toxic substances disperse in the sea.


The Belgica is 50.9 m long and 10 m wide. Its cruising speed is 12 knots (22 km/h), which allows it to travel 5000 miles in 20 days.

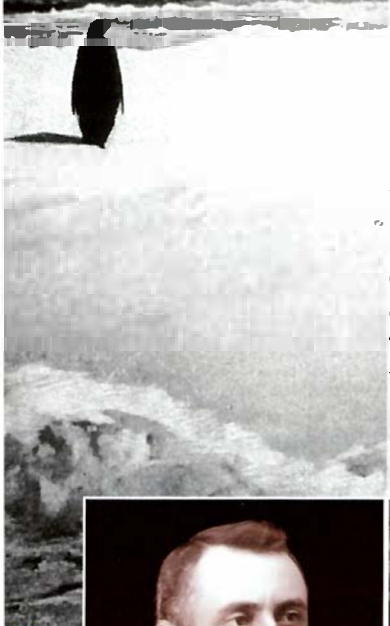


Multicorer, Van Veen grab, Niskin bottles ...: this equipment allows scientists to sample sediment, living organisms and water, day or night.

# From the first Belgica...



The Belgica was the first exploration ship to spend a winter in Antarctica: it was trapped in the ice between 5 March 1898 and 14 March 1899!



On 16 August 1897, the Belgica left the port of Antwerp and headed for the South Pole: the first international scientific expedition to Antarctica had begun.
On board were the Belgian Adrien de Gerlache (project initiator and captain of the ship), Amundsen (a Norwegian explorer), Arctowski (a Polish geologist / oceanographer / meteorologist), Cook (an American doctor / photographer), and Racovitza (a Romanian zoologist / botanist).
Over the course of two years, the crew were to make oceanographic and meteorological observations, map the 'Gerlache Strait', make an inventory of the local terrestrial fauna, take specimens of marine fauna and collect minerals, rare mosses, lichens, and tiny grasses. They discovered a large number of new species, which they brought back to the Museum. It took nearly 50 years to study them all!

Adrien de Gerlache, some time after his return: he was barely 31 years old when the expedition began.

Polish scientist Henryk Arctowski in his laboratory.

Romanian naturalist Emil Racovitza studying microscopic organisms.

The Messel site, near Frankfurt in Germany, was excavated by a team of our Palaeontology department in the 1980s. This extraordinary site is famous for being rich in high-quality, 47 million year-old fossils. And the diversity of these fossils is astounding: insects, fishes, frogs, crocodiles, snakes, lizards, turtles, birds, bats… and this *Kopidodon macrognathus*, a small arboreal (tree-living) herbivore, now extinct. Like today's squirrels, it had a long, bushy tail serving as a pole for its balance as it leapt from branch to branch. Larger specimens reached 115 cm; this one is a little over 70 cm long.

Our researchers frequently organise or participate in expeditions to collect arthropods from all over the world. Here, they are collecting insects and spiders from the forest canopy in Auvergne, France, in 2008. To reach the tops of the trees, the team used a helium balloon, which can only be used by one person at a time, and moves by sliding along a cable previously strung between the trees. It's a long way from the idea of the scientist confined to his laboratory.

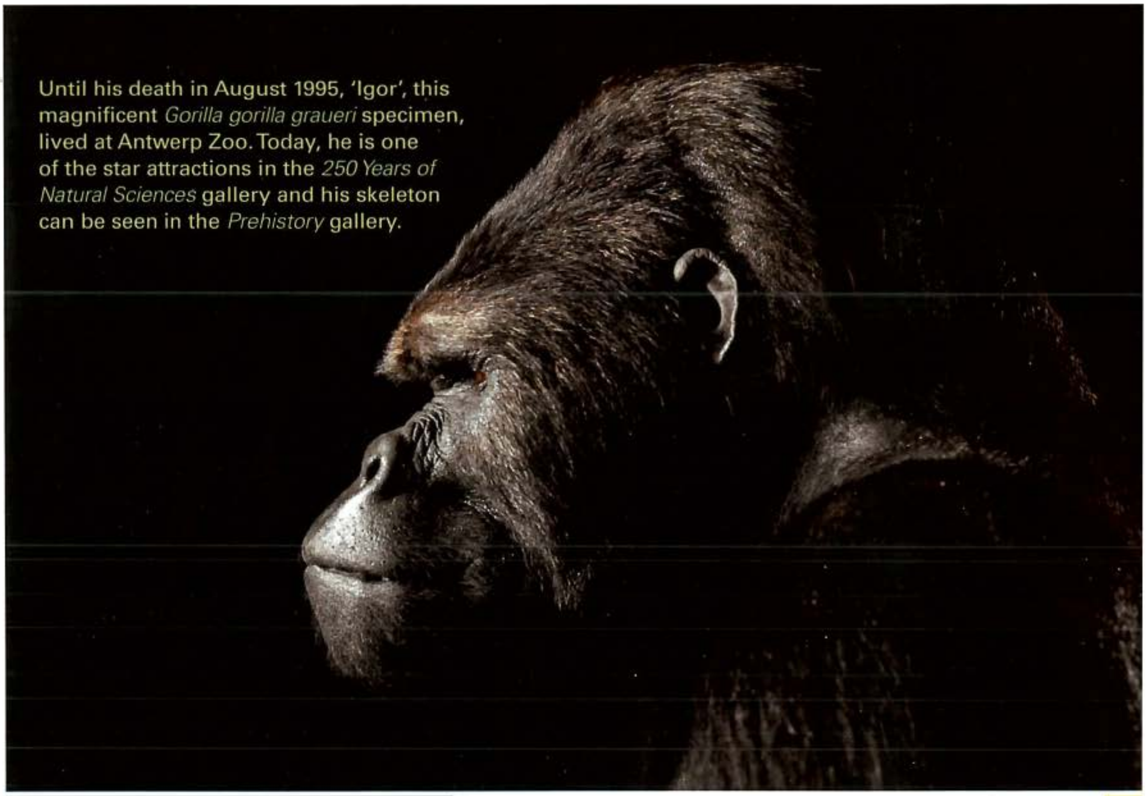

You don't have to travel to the other side of the world to find interesting specimens. The range of these viviparous lizards (*Lacerta vivipara*) in Europe extends from the North of Spain all the way to Scandinavia! In Belgium today, populations are greatly reduced and often number only around 10 individuals each. The researcher who brought these specimens back from the Kalmthout area in 1972 collected 55 in total. You could say that he was a little heavy-handed!

# Specimens from excavations and expeditions from around the world

Édouard Dupont, director between 1868 and 1909 of what was then known as the Royal Museum of Natural History, believed that collections should complement scientific exploration. Current specimens as well as fossils are essential to study nature adequately across space and time. Dupont was particularly interested in Belgium's natural heritage. Since then, the Museum has expanded its horizons to the entire planet...

The famous 'Ishango bone' was found in 1950 on the Congo bank of Lake Edward during excavations led by Jean de Heinzelin, a geologist at this Museum. This 10-cm long bone, topped with a fragment of quartz, is nearly 20 000 years old.

What's strange about it is that it is covered in notches that appear to be grouped together mathematically. On one side, for example, there are groups of 3, 6, 4, and 8 notches. Could these have been used for multiplying by two? Could this be the world's oldest calculator?



Until his death in August 1995, 'Igor', this magnificent *Gorilla gorilla graueri* specimen, lived at Antwerp Zoo. Today, he is one of the star attractions in the *250 Years of Natural Sciences* gallery and his skeleton can be seen in the *Prehistory* gallery.

King Leopold I loved to hunt wolves, foxes, wildcats, wild boar, and sometimes woodcocks. Despite this, he loathed killing hares or deer. In 1844 he donated to the Museum two wolves (amongst the last in Belgium) that he shot.

Most of the birds displayed in our galleries came from breeding centres (ostriches or chickens), bird shops (this rainbow lorikeet), and rehabilitation centres (owls and pigeons). Sometimes, individuals who find dead wild birds bring them to the Museum (swifts or wild ducks).

This bezoar wasn't one of the items in Charles de Lorraine's curiosity cabinet, although it would have fit in there perfectly. It has only been in our collection since 1929.
Bezoars are organic 'stones' that are usually formed from hair and plant debris in the stomachs of ruminants (such as cattle or sheep). They were considered powerful antidotes: their name 'bezoar' comes from the Persian *pādzahr*, meaning 'protection from poison'.

# A gigantic collection with diverse origins

With 37 million specimens, the Museum boasts the third largest natural history collection in Europe, after Paris and London. But where did they all come from? Some items were bought, some donated by individuals. Others were exchanges with other scientific institutes, or came from excavations or expeditions in Belgium and abroad. Animal specimens may have come to us from pet shops, zoos, rehabilitation centres, animal breeding centres, or customs seizures. A few are even hunting trophies from the past.


In 1987, the Museum acquired Émile Derenne's collection of nearly 90,000 Belgian beetles: an important reference collection. These insects were collected several decades ago, and the natural habitats of some of them are disappearing today. This is the case with these *Carabus (hemicarabus) nitens*, which were collected in 1937 and 1938 in the fens and heaths around Kalmthout.

# 1

# 250 *years of natural sciences*

The Museum of Natural Sciences has changed considerably since the days of Charles de Lorraine's curiosity cabinet. Of course, our main goal has always been to trigger the interest of the general public for natural sciences. But as the 14 remarkable items in this room demonstrate, our institution is also focused on conservation, research and expertise.


250 jaar
250 ans de
250 years
GRASDUINEN IN DE GESCHIEDENIS VAN HET
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This may seem like a lot, but it's nothing compared to the enormous variety of life forms that are still being discovered every day. Collecting objects and specimens is not a goal in itself, but a means: a means of better understanding life, its history, and how best to manage and preserve it now and in the future. This is why the Museum's backstage has as many laboratories as it does display cases. Furthermore, our microscopes and record-keeping systems are all electronic (and have been for some time).

This research reveals a fascinating world: a world billions of years old, whose fossils allow us to reconstruct its history; a world of land and sea, mountains and deserts, forests and cities; a world inhabited by millions of different, unique species of animals and plants; an incredibly inventive world that is always coming up with new ways to move, feed, and reproduce; a world in which human beings haven't lived for very long (what is 200,000 years in the grand scheme of things?), but upon which they have made a big impact; a world bursting with life, yet fragile; a world we live off and have today become responsible for.

The Museum invites you to come in and witness this incredible story: the story of the Earth, of life, and of the human race. The legacy and the future of evolution are contained within the Earth's current biodiversity. The story is illustrated by thousands of objects from our collections. Whether large or small, beautiful or ugly, each of these objects is unique and fascinating in its own right.

All in all, things haven't changed that much. After a complete renovation, the Museum is going back to its roots. It's a place to exercise your curiosity, a book of wonders, a place where you can explore the world in space and time. Will you be its Marco Polo?

**Camille Pisani**
*Director General*

# Foreword

The impulse to collect things seems to be as old as the human race itself. Collections of shells, minerals, and seeds, objects with nothing in common besides their unusual nature and faraway origins have been found at Palaeolithic human sites. Did Neanderthals like to collect things, and if so, for what reason? We just don't know. It's much easier for us to understand the motivations behind the curiosity cabinets that became so popular in Europe during the Enlightenment. At the time, our horizons were expanding rapidly. The Americas had just been discovered, and the world seemed even more full of wonders than before. Scientists and aristocrats of the day loved to collect, exchange, and study examples of the planet's incredible richness and diversity which had been brought back from numerous military, scientific, or commercial trips abroad.

Many natural history museums find their origins in these curiosity cabinets, and ours is no exception.

The cabinet of physical and natural history that belonged to Charles of Lorraine, 18th century governor of the Austrian Netherlands, is located in the Nassau Hotel in Brussels. This was the basis for the collections of the Brussels Museum (1802), and later the Royal Museum of Natural History (1846). The discovery of a whole troop of iguanodons (6m tall dinosaurs) in Bernissart between 1878 and 1881 meant that things had to change. The museum was transferred to the Park Leopold, where a display cage made of iron and glass was built for these unique world treasures. Other buildings followed, and today, the Museum – which has become the Royal Belgian Institute of Natural Sciences (or the Museum of Natural Sciences) – has 37 million specimens of animals, rocks, minerals, and fossils from around the world, accumulated through decades of exploration and research.

# Summary

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# *Dinosaurs*

With a surface area of over 3000 $m^2$, the *Dinosaurs* gallery is the largest in Europe that is entirely devoted to the discovery and study of dinosaurs. Of course, the famous Belgian dinosaurs, the Bernissart iguanodons, have the place of honour: their new glass case alone takes up a tenth of the room.

Dinosaurs first appeared nearly 230 million years ago, at the end of the Triassic period. During the Jurassic, they multiplied and diversified, colonizing all the continents. Then, suddenly they became extinct, at the end of the Cretaceous period, 65 million years ago.

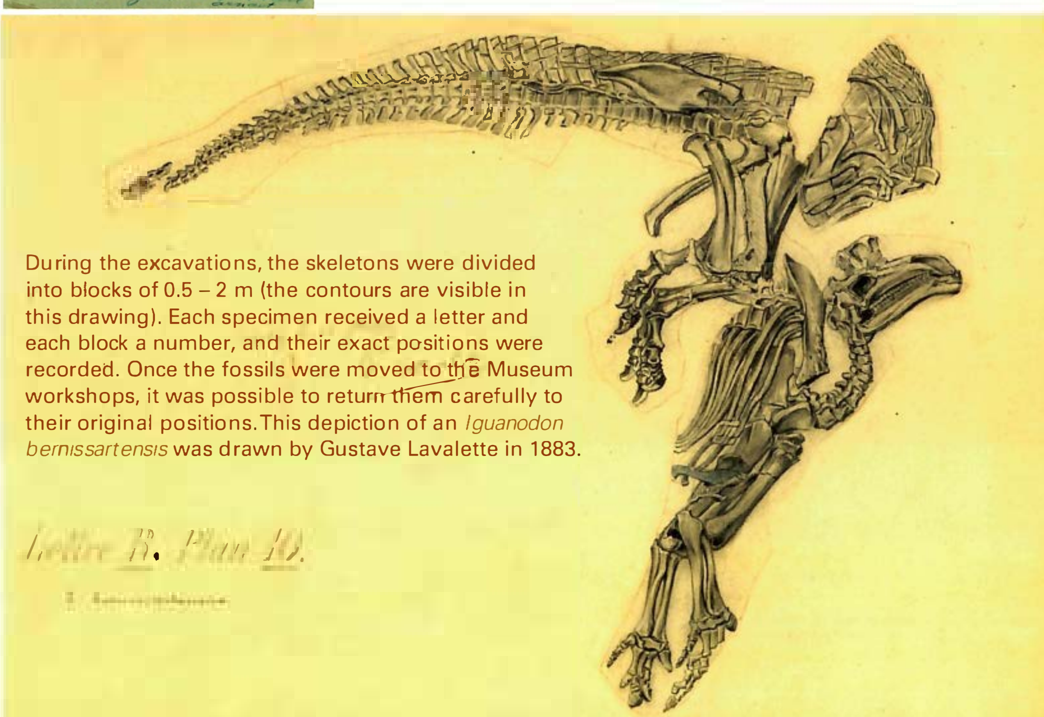
But did they really all disappear? We're not so sure...

# The Bernissart Iguanodons

In 1878, in a coal mine in Hainaut, 322 m underground, a historic discovery was made: a whole group of dinosaur skeletons! This was a world first, since the skeletons were complete and the bones were still in the correct order. During the following three years, around 30 *Iguanodon bernissartensis*, and at least one *Iguanodon atherfieldensis* were uncovered.

The most complete skeletons were mounted in their 'probable life posture' and exhibited in the Museum from 1883. Even back then, people travelled from all over the world to see them. Today they are still the best collection of iguanodons in the world, due to the quantity and the quality of the fossils.

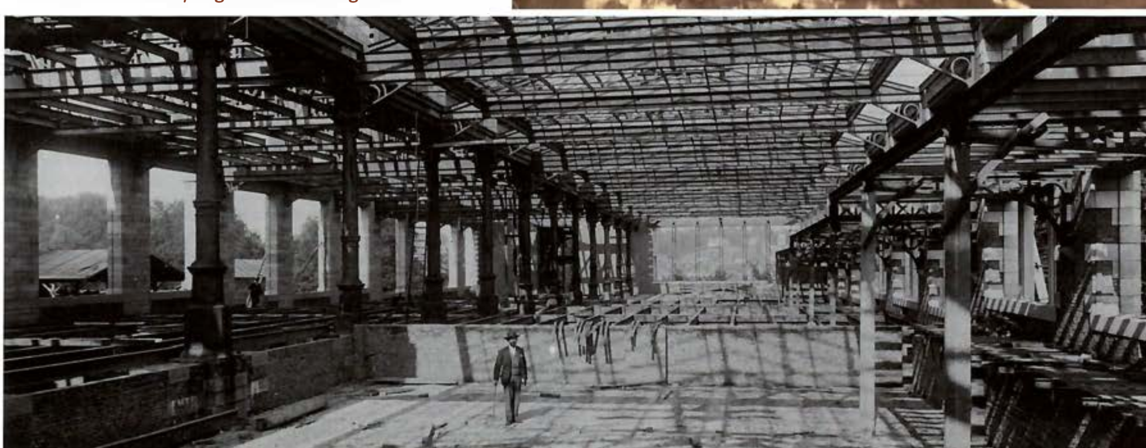

The story starts at the end of March 1878 at the Bernissart coal mine in Sainte-Barbe. Miners were digging at 322 m when they came across a pocket of clay. Instead of going around it, they decided to go through. Several days later, they made a startling discovery: tree trunks filled with gold! What they had actually found were *Iguanodon* bones encrusted with pyrite ('fool's gold'). On 12 April 1878, the Belgian Royal Museum of Natural History (as it was then known) was informed of the discovery by telegram.



During the excavations, the skeletons were divided into blocks of 0.5 – 2 m (the contours are visible in this drawing). Each specimen received a letter and each block a number, and their exact positions were recorded. Once the fossils were moved to the Museum workshops, it was possible to return them carefully to their original positions. This depiction of an *Iguanodon bernissartensis* was drawn by Gustave Lavalette in 1883.

In 1882, under the direction of Louis Dollo, Louis De Pauw (the man with the beard, bended on one knee) began assembling the most complete specimens in their 'probable life posture'. Due to their size, a room with a high ceiling was required. They used the St George chapel (today part of the Royal Library). Here, they built a scaffold hung with ropes. The best position for each bone was obtained by adjusting the length of the ropes. Finally, once the skeleton was assembled, it was fitted with an iron frame to hold the bones in place.

In the 1880s, the Nassau Hotel had become too small to exhibit the iguanodons. The Museum was thus transferred to a building in the Park Leopold: the 'Convent', to which they added the Janlet wing, which is where the iguanodons were kept from 1902 onwards. This photo was taken during its construction in 1900, right about where today's glass case begins.



Louis Dollo, who studied the iguanodons at the time, thought they were bipedal. He even suggested kangaroo skeletons as models for the tail and emus' skeletons for the pelvis and back legs. But David B. Norman, who studied them in the 1980s, concluded that they actually walked on four legs, but ran on two. The tail was maintained horizontally by ossified tendons to counterbalance the front part of the body.

# What our excavations can

Palaeontologists make use of the conditions in which fossils were found to deduce precious information on the dinosaurs and their environments: how they lived, how they died, and how they became fossilised. The number, type (animal or plant), completeness, and arrangement of the fossils, how they are distributed across one or more layers of sediment, and the type of sediment provides invaluable information. Every dig tells a story...

Dinosaurs were not alone at Bernissart: the excavations also revealed around 3000 fishes, one salamander, six freshwater turtles, four crocodiles (like this *Bernissartia fagesii*), a fragment of a cicada's wing, some pine cones, and several ferns. This tells us that Bernissart was a hot, swampy place back then: Also found were a phalanx of a carnivorous dinosaur and 280 coprolites – fossilised faeces, of which many contained animal remains. This could be a clue as to how some of the iguanodons could have perished...

The secret to the quality of the Bernissart fossils lies in the fact that they were buried so fast, protected from air and sunlight by fine clay sediment that preserves details, as you can see on this fragment of the fern *Weichselia reticulata*.

With its giant jackstraws of bones from different dinosaurs in mixed sediment, the Russian site of Kundur is what is known as a 'bone bed'. At the time of *Olorotitan*, the monsoon provoked mudslides that killed the dinosaurs they carried away. Wherever the current abated or ran up against an obstacle, bodies piled up, jumbled up, and decomposed.

But where should we look for dinosaurs? Often, new sites are discovered purely by accident. At Bernissart, miners were extracting coal when they found the iguanodons, while at Kundur, bulldozers were widening a road when they uncovered the first *Olorotitan* bones.

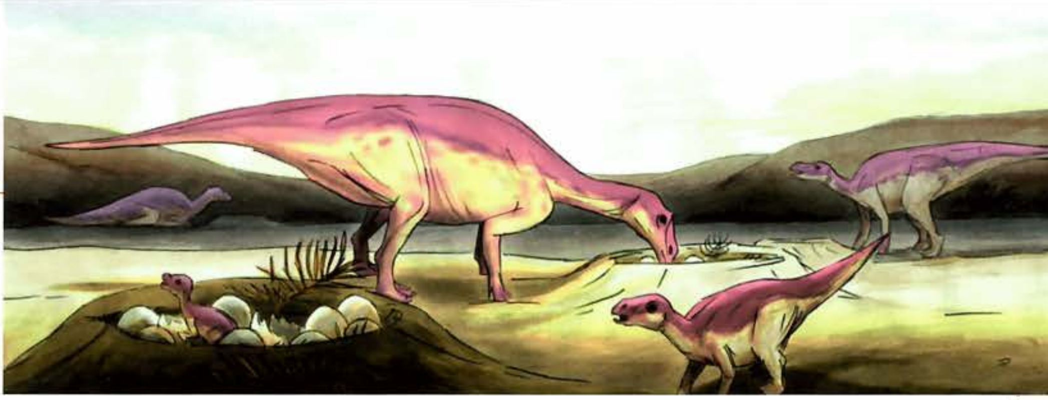
This tiny mammal also comes from the Bayan Mandahu site. It was a multituberculate, with rough molars and continually growing incisors like modern-day rodents. Like rodents, they probably ate mainly hard plant matter.
Actual size: approximately 15 cm long

The dinosaurs of Bayan Mandahu in China and their contemporaries lived near a desert: their fossils lay in friable sandstone made from very fine sand. Some would appear to have been buried by sandstorms, but this tortoise, *Zangerlia*, was probably caught in a collapsing dune and it didn't even have time to retract completely into its shell!
Actual size: approximately 56 cm long

# When dinosaurs were still alive

On top of the information gained at the excavations themselves, palaeontologists learn a lot about the biology and lives of the dinosaurs by studying the fossils themselves (including skeletons, skin imprints, and footprints). The speed at which the dinosaur moved, for example, can be worked out using the height of the hip joint, the size of the foot (one can be used to estimate the other), or the distance between two footprints of the same foot. Defining whether it was a carnivore or a herbivore can be deduced just by looking at its teeth.

Under the *Diplodocus*' tail, a virtual *Pachycephalosaurus* awaits any visitors that want to challenge him. Its name means "thick-headed lizard". It probably used its thick head as a battering ram, particularly during fights in the breeding season. Thanks to motion sensors placed beneath the screen, it reacts when people approach him. Be careful he doesn't charge you...



Like tree trunks, dinosaur bones have growth rings that allow us to estimate the age of the specimens. If we have examples of the same bone at different development stages, then we can work out their growth rate.

We know, for example, that *Maiasaura* grew from 30 cm when it first hatched to nearly 4 m one or two years later. It reached its adult size of approximately 9 m between the ages of 6 and 8.

To work out whether a dinosaur was bipedal or quadruped, you need to look at the skeleton structure, the balance between the front and back halves of the body, the shape of the forelegs, the direction of the joints, and the insertion points of the muscles. For some species it's obvious: on four legs, *T. rex* wouldn't have been able to keep its head off the ground! For others, like the iguanodon, it is more difficult...

*Diplodocus, Brachiosaurus*, and *Camarasaurus* were sauropods that occupied the same territory, yet avoided having to compete for food. How do we know this? Apart from the position of the muscles and tendons in the vertebral column, even the shape of the cervical vertebrae determines the flexibility of the neck to a large extent. So we know that while some of them browsed low ferns, others fed on the leaves of branches several metres off the ground.

When a skeleton is sufficiently complete, it is interesting to mount it in its 'probable life posture'. To do this, we first build a discrete metal frame upon which we place the dinosaur bones. Missing pieces are replaced by resin casts. Since each specimen is unique, the frames are made to measure. In this photo taken in the Park Leopold, you can see the welders and technicians from our Palaeontology department adjusting and readjusting the metal frame of the *Olorotitan*.

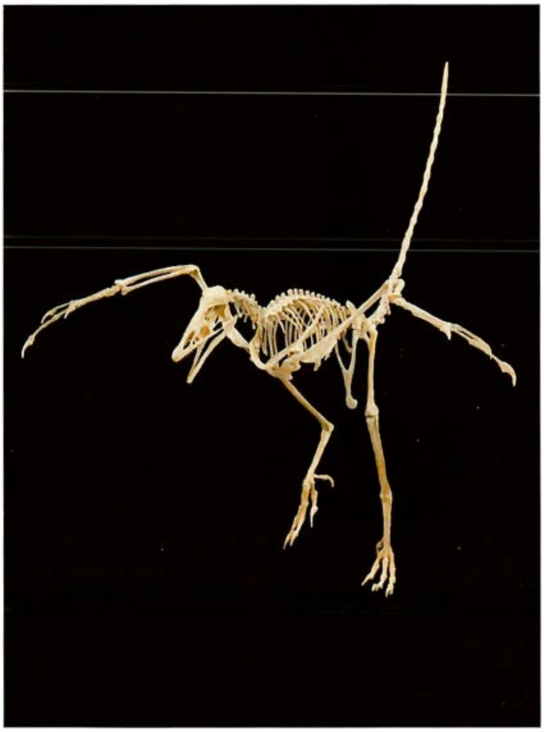
What did dinosaurs look like when they were alive? We have an idea of their shape (thanks to the insertion points of the muscles in the bone), and the texture of their skin (from fossilised imprints). But we have no idea what colour they were: the fossilisation process alters the original colours. Ceramic models are therefore ideal for representing dinosaurs: they allow us to imagine the living animal without having to worry about the structure or colour of its skin.

# Still with us?

After the first dinosaurs appeared 230 million years ago, two main groups quickly became apparent: the ornithischians, or 'bird-hipped' dinosaurs, and the saurischians, or 'lizard-hipped' dinosaurs. The former includes stegosaurs, ankylosaurs, ornithopods, pachycephalosaurs, and ceratopsians. The latter includes the prosauropods, sauropods, theropods, and their descendents - birds!

Birds are descended from theropods (some scientists even consider them to be dinosaurs). One of the proofs of their origins is the presence of rudimentary or even well-developed feathers on the bodies of certain carnivorous dinosaurs. Since 1996, fossils of such high quality were found at Sihetun in China that some even still bear traces of feathers.

Those of *Sinosauropteryx* are the most primitive: a layer of down made of simple hollow filaments. It couldn't fly, but its feathers did help to keep it warm.

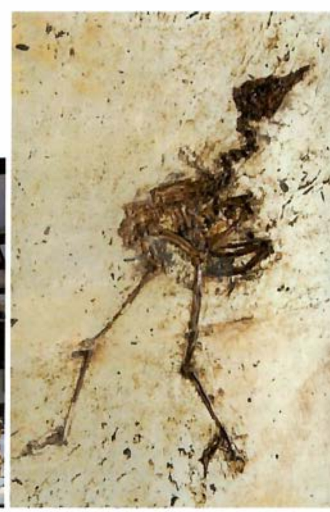


*Archaeopteryx* is the oldest bird we know of. It lived 150 million years ago. It kept the pointed teeth, clawed fingers (three of them), and long rigid tail of the dinosaurs, but it also had feathers all over its body, like modern-day birds. Plus, its wing feathers were asymmetrical: in other words, they were adapted for active flight. However, it didn't have the keel that birds have to attach powerful flight muscles to, so we think it must have climbed trees using its claws, and then glided from branch to branch.

Around 65 million years ago, at the end of the Cretaceous/beginning of the Tertiary, nearly two thirds of the planet's plant and animal species suddenly became extinct. Amongst the victims were the dinosaurs (*Triceratops* was one of the last ceratopsians in North America), the pterosaurs, the mosasaurs, the ammonites, and more than three quarters of the plankton.

The main causes of this mass extinction were a meteorite landing in Mexico, and a volcano erupting in India. These two phenomena threw up huge quantities of gas and dust into the atmosphere, blocking out the sun. Without sunlight, photosynthesis couldn't take place. No more plants meant no more herbivores...

*Olorotitan* and *Amurosaurus* belong to the same group as the iguanodons. These two hadrosaurs were excavated by a team made up of our palaeontologists and their Russian counterparts, in 2001 and 2003. They come from the region of the Amur River, which borders China and Russia, and date from the Late Cretaceous. As the numerous fossils discovered in this area show, the dinosaurs were still very numerous and varied just before the great mass extinction at the end of the Cretaceous wiped them all out.



Nevertheless, some animals were able to survive this mass extinction, amongst which insects, freshwater vertebrates (fishes, amphibians, turtles, and crocodiles), birds, small terrestrial reptiles such as lizards and snakes, and small insectivorous or granivorous mammals. This is probably because their diets depended on decomposing organic material, and not on plants or plankton, which became temporarily rare. The Messel site in Germany yielded fossils of all of these 'survivors', amongst them this *Messelornis cristata* from 47 million years ago.

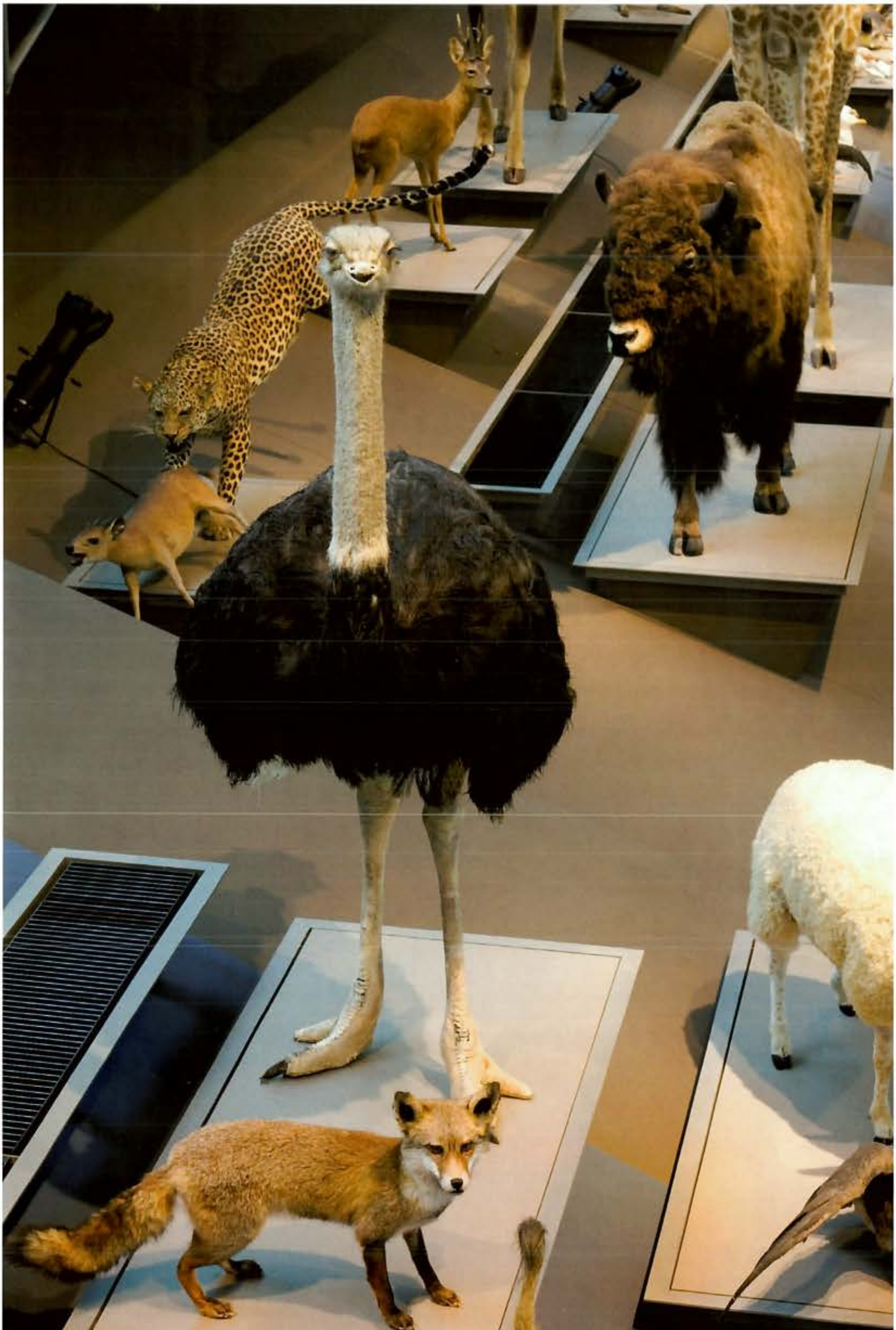
# The PaleoLAB - a place of discovery

LAB

Located in an annex of the *Dinosaurs* gallery, this discovery area is dedicated to palaeontology and geology. It was specially designed for family visits and class trips. The activities available allow children to observe, touch, measure, compare, sort, determine, and reconstruct dinosaurs, rocks, and minerals. In total, around 30 activities are available, all with a different level of difficulty according to the age groups (from the age of 5 up), and all regularly updated. Here are just a few...

You'll find all the necessary information on the PaleoLAB website:
http://www.naturalsciences.be/museum/paleolab

Create a sand storm to see erosion in action. Put yourself in the shoes of a caveman by putting on his clothes. Reconstruct a life-size stegosaur skeleton. Participate in the excavation of a real fossil. Assemble a 'jigsaw puzzle' of a mammoth on the huge magnetic wall. Give the allosaur his teeth back.



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# Evolution

Life on Earth first appeared nearly 3.8 billion years ago. The first living organisms were simple bacteria that evolved in water. With time these organisms multiplied and became more diverse. Some eventually left the oceans for dry land. Others conquered the skies. Today there are billions of individuals, belonging to millions of species, inhabiting our planet.

But as they evolved, these species went through many changes. Some were slow changes that took many generations. Others were more sudden, caused by mass extinctions like the one that killed off the dinosaurs (birds excepted). Let's have a closer look at some of the mechanisms and key moments of evolution...

# Chance and natural selection

Chance and natural selection play a key role in biological evolution. DNA is the substance that carries hereditary information in all living organisms. Changes, called mutations, in DNA are subject to chance. Mutations are caused by errors that occur during the replication of amino acid bases (adenine, thymine, guanine and cytosine), gene segments, and fragments of DNA.

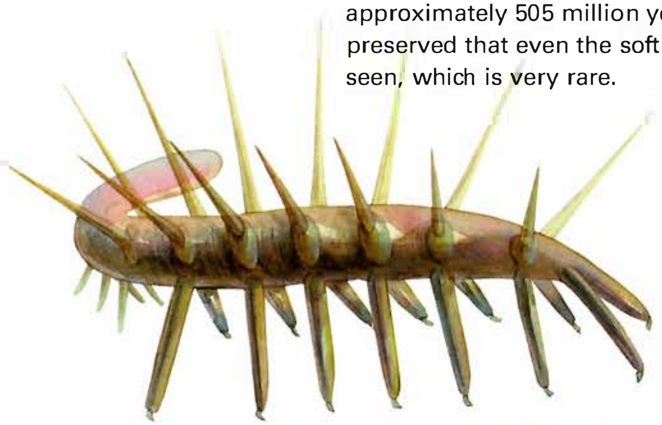
In organisms that reproduce asexually (such as bacteria and other unicellular organisms, some cnidarians, plants, and sponges), all of the organism's genetic information is passed on to its descendents. In organisms that reproduce sexually, however, each parent only passes on some of his/her genetic information. Whether or not a certain characteristic is inherited therefore depends on chance.

Natural selection is another important mechanism in evolution. The weakest individuals, that are less well adapted to their environment, are eliminated naturally by illness or predation. The strongest, best adapted individuals are better able to survive. They may find it easier to obtain food because they are bigger or better able to climb trees, or can dive for longer. They may be better able to escape from predators because they can run faster, fly higher, or have better camouflage. Since they survive for longer, they have a better chance of reproducing and passing on their positive adaptations to their offspring. In other words, natural selection enables species to adapt to their environment across the generations.

# Strange creatures of the Cambrian

We know very little about the organisms that lived before this period: most had soft bodies that rarely fossilised. But during the Cambrian period, around 540 to 490 million years ago, animals appeared with mineralised body parts. Exoskeletons, shells, spines, plates, and pincers: these hard body parts formed armour for prey and weapons for predators. They also provided support for the animal, as well as attachment points for muscles.

The Burgess shale (in Canada) is witness to the fact that during the Cambrian, animals diversified rapidly and extensively (hence the expression 'Cambrian explosion'). The fossils at this site are approximately 505 million years old, and so exceptionally well preserved that even the soft body parts of some of them can be seen, which is very rare.



*Hallucigenia sparsa* is probably one of the strangest and most difficult to classify of all the Burgess specimens. This animal had a long, soft body, covered in seven spines and several tentacles: large ones at (what we think is) the rear, and small ones at the front. They could grow up to 3 cm in length.

The most common species to be found in the Burgess shale is *Marrella splendens*, with 15,000 recorded fossils. It was a small marine arthropod that barely reached 20 mm in length. It is recognized by its head shield topped by four backwards-pointing spikes.

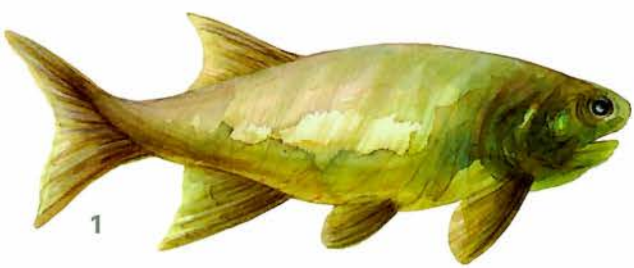
The trilobites are the most diverse category of all the fossilized marine arthropods. More than 18,000 species have been identified. The different species occupied a wide geographical area, and succeeded each other very rapidly in time. This makes them good fossil date indicators. If two geographically distant geological strata contain the same species of trilobite, then we can conclude that these strata date from the same period.
This is a small trilobite, probably a *Gerospina schachti* (38 mm long), but some species grew up to 70 cm long.

## The abundant waters of the Devonian

A huge ocean covered most of the planet during this period (between 416 and 359 million years ago). The shallow and relatively warm seas bordering the continental masses were inhabited by trilobites, crustacean, gastropods and jellyfish. The armoured and jawless fish of the beginning of the Devonian period were gradually replaced by jawed fish which no longer restricted themselves to soft food or plankton, but became active hunters.

Placoderms were the first jawed fish. Their powerful jaws didn't have teeth, but sharp, bony plates. As this fossilised *Bothriolepis Canadensis* shows, the front of their body was covered with an armour of bony plates. Placoderms died out at the end of the Devonian period, leaving no descendents.
Actual size: 16.5 cm tall

Dating from the end of the Devonian period, *Acanthostega gunnari* was a primitive aquatic tetrapod. Its limbs were more like legs than fins, but its joints were too stiff to bend, and so wouldn't have been able to support it out of water.
Actual size: 11.5 cm long



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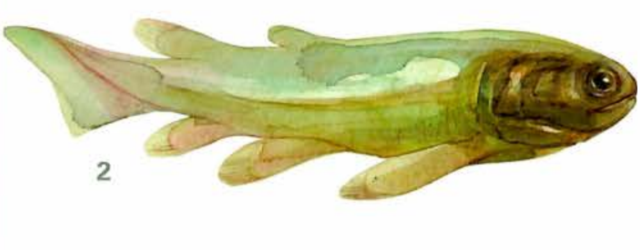


2

Jawed fish evolved into two main groups: cartilaginous fish (such as sharks and rays), and bony fish, which are themselves divided into actinopterygians (1) (the 'ray-finned' fish) and sarcopterygians (2) ('lobe-finned' fish). Since the end of the Devonian, actinopterygians are the largest category of fish, in terms of numbers. Sarcopterygians, on the other hand, gave rise to the tetrapods: amphibians, reptiles, mammals, and birds.

The main difference between these two types of fish is their fins: the former have highly efficient fins made of a membrane supported by fine, bony rays. The latter have thick, fleshy fins, which are less mobile, but more powerful. Their bony structure makes them the precursors of tetrapod limbs.

## The forests of the Carboniferous

Before the start of the Devonian, tiny plants had begun to colonise the shores of the land masses. With the evolution of spores, and then seeds, plants were able to spread inland. At the end of the Devonian, the development of leaves, needles, wood, and roots allowed them to grow bigger and bigger. At the start of the Carboniferous period (from 359 to 299 million years ago), the climate was warm and humid, and lacking in distinct seasons: the perfect conditions for the growth of biodiversity. Fertile forests and marshes provided a home for insects, spiders, scorpions, eurypterids, millipedes, snails, slugs, and the very first terrestrial tetrapods.

The Carboniferous gets its name from the giant lycophytes, horsetails, ferns, tree ferns, and conifers that lived during this period. Instead of being decomposed by bacteria, fungi, and insects, as would happen today, these plants accumulated over time, and formed coal (carbo in Latin). This is an imprint of the trunk of the lycophyte *Sigillaria ovata.*
Actual size: 60 cm long

Temnospondyls were amongst the first tetrapods to leave the water. But these giant amphibians probably still relied heavily on water, even if only as a place to lay their eggs. Most had a large, wide, flat head. However, *Archegosaurus decheni*'s head was just 28 cm long, and ended in a long thin snout. This suggests it fed on small fish.

The oceans were teeming with sharks, starfish, gastropods, sea urchins, and cephalopods with external coiled shells (such as goniatites and nautiloids). Placoderms and most of the sarcopterygians had disappeared, leaving actinopterygians like this 30 cm *Benedichtys deneensis* to take their place.

Although some of them lived in fresh water, eurypterids, fossilised aquatic arthropods, are known as 'sea scorpions'. Along with *Arthropleura*, a giant millipede from the Late Carboniferous, these were the biggest arthropods that ever lived. Some of them could reach 2.5 m in length!

## In the seas of the Jurassic

At the end of the Permian, the emerged land masses formed a single continent: Pangaea, which was surrounded by a single ocean, known as Panthalassa. During the Jurassic period (from 203 to 135 million years ago), Pangaea broke up, creating the Atlantic Ocean. Other shallow, warm seas also appeared. They were home to corals, bivalves, belemnites, ammonites, crustaceans, fish, plesiosaurs, and ichthyosaurs.

With their streamlined dolphin-like bodies, their four paddle-shaped legs, and their fin-like tails, the ichthyosaurs, like this *Stenopterygius longifrons*, were amongst the reptiles that were best adapted to the marine environment. Along with the plesiosaurs, they were the biggest predators in the Jurassic seas.
Actual size: 40 cm long

Crinoids, or 'sea lilies', were echinoderms, like starfish and sea urchins. They were made up of a calcareous stalk at the end of which were flexible 'arms', which caught algae, unicellular organisms, small crustaceans, and invertebrate larvae suspended in the water. They first appeared during the Cambrian period, and were so abundant that fossilised species, such as *Seirocrinus subangularis*, formed 'meadows' on the sea bed. However, they were badly affected by the largest mass extinction that the Earth has ever seen. At the end of the Permian, 250 million years ago, almost 95% of marine species and 70% of terrestrial species became extinct.
Actual size: approximately 3 x 2 m

## The diversification of mammals during the Eocene

Mammals appeared at the end of the Triassic period, almost 225 million years ago, around the same time as the dinosaurs. The first mammals were small and unassuming, but unlike the dinosaurs, they survived the mass extinction at the end of the Cretaceous, 65 million years ago. And they continued to evolve: the first modern mammals evolved during the Eocene epoch (from 55 to 34 million years ago).

At the beginning of the Eocene, the Earth's temperature rose considerably, making it 10 °C hotter than the current average temperature. As the fossils found at Messel show, primitive species were gradually replaced by modern forms which were better adapted and better able to compete in these conditions.

Messel, near Frankfurt in Germany, is an exceptional site for fossils. 47 million years old, it owes its reputation to the quality, richness, and diversity of its fossilised fauna: insects, frogs, crocodiles, snakes, lizards, turtles, birds, and numerous mammals. This site provides an excellent illustration of the transition between primitive and modern fauna. For example, the snakes and lizards are rather primitive while some of the mammals (bats in particular) possess modern characteristics.

47 million years ago, the Messel site was a lake, with a tropical or subtropical climate. So it's hardly surprising that fish, fresh water turtles, salamanders, frogs (such as this *Eopelobates wagneri*), and even crocodiles have been found there.
Actual size: 8 cm tall

Amongst the mammals found at Messel is this magnificent *Eurohippus parvulus*. Related to modern horses, it was just over 50 cm long, had five digits (as opposed to the single hoof of the modern horse), and lived in forests.

The first bats appeared around 50 million years ago, and closely resembled today's bats, although they probably didn't yet have echolocation. This *Palaeochiropteryx* sp. also comes from Messel.
Actual size: 7 cm tall

## Evolution today

Human beings play an important part in shaping the evolution of current species by breeding them, artificially selecting them, and even creating them in laboratories by manipulating genetic material from other species.

Humans also exert significant pressure on some populations. For example, the nets used in commercial fishing catch only the largest cod. Smaller adults escape and reproduce, and as a result the genes for small size are more frequently passed on and the average size of adult cod is decreasing.

But more importantly, humans today are directly or indirectly contributing to the extinction of many species. Deforestation, habitat degradation or fragmentation, excessive urbanisation, overexploitation of natural resources, pollution, and climate change: all of these things put pressure on the species that share the planet with us.

A new type of rose, orchid, or tulip: botanists are experts in artificial selection. They systematically choose the specimens with the required characteristics (colour, odour, size, number of petals, or resistance to frost) and then cross these plants again and again until the new variety displays these characteristics from generation to generation. In the animal kingdom, breeders try to create animals that run faster, carry heavier loads, or produce more milk.

Belgian Blue cattle (pictured) have been bred for muscular development, so as to produce more meat. Today, 45% of Belgian cattle are Belgian Blues. However, without human intervention, they wouldn't survive. Due to their unnatural morphology, the cows cannot give birth naturally, and calves must be delivered by Caesarean.

## What will the future bring?

The continents are still moving: Australia is moving back towards Indonesia, while Europe and Africa will eventually meet. An enormous ice cap is likely to cover the entire Northern hemisphere, drying out the planet's climate. Earth's flora and fauna will adapt to these new conditions, of course, but what animals will look like in 50 million years is anybody's guess.

# 4

# Biodiversity
## *in Belgium and abroad*

Some of our galleries essentially offer a systematic overview of current or recent species (for example the *Whales, Mammals, Shells,* and *Insects* galleries). Others deal mainly with extinct species or fossils (*Evolution, Dinosaurs,* and *Prehistory*). Some focus on the habitats of the animals on display (*Animals in the city, The Poles, North Sea,* and the *Vivarium*). But at the end of the day, whether we are dealing with species from yesterday, today, or tomorrow, from Belgium or from far away, the Museum as a whole is dedicated to biodiversity: the diversity of life.

And with good reason: our mission is to study, conserve, protect, and increase awareness about biodiversity in Belgium and abroad.

Because biodiversity today is under threat due to habitat destruction and fragmentation, pollution, overhunting, overfishing, the overexploitation of land and forests, climate change, and the introduction of alien species. Therefore, in order to take appropriate, lasting action to protect it, we must increase our knowledge of biodiversity. That's where we come in.

# Biodiversity in Belgium

According to the *Biodiversity in Belgium* report published in 2003 by our institute, there are close to 18,500 (of which 13,500 are recorded) species of plants, algae, and fungus, and approximately 35,000 (of which 22,800 are recorded) animal species living in this country. We estimate that more than a third of these species is currently under threat.

In the Belgian section of the North Sea, which only makes up 1% of its total area, there are around 90 species of fish (amongst them eels, herring, anchovies, whiting, turbot, plaice, brill, butterfish, blennies, and mullet). There are also a few marine mammals, such as porpoises and seals. These sometimes get caught in fishing nets, but their worst enemy is pollution. They feed on fish, molluscs, and crustaceans that are often contaminated with heavy metals, PCB, DDT, and other toxic chemicals.
This seal was photographed in the Yser estuary.

The coils of sand you see on the beach are actually lugworm excrement. This burrowing worm lives in a U-shaped, water-filled tunnel under the ground. It renews the water in this tunnel through movements of its body and the hairs that are found on some of its segments. The water gives the worm the oxygen it needs, while softening the sand for it to eat. It feeds off the organic material contained in the sand, then, at intervals, pushes the digested sand out onto the surface, creating the wormy coils.

Barnacles may look like molluscs, but they are actually crustaceans, like crabs and shrimps. They usually attach themselves to rocks in the intertidal zone (the zone that is alternately covered and uncovered by seawater as the tides come in and out), but can also be found on the hulls of boats and on the skin of some whales! When they are submerged in water, they stick out tiny feathery legs to catch the small planktonic particles they feed on. When not covered by water, they retreat into their shells.

Black-headed gulls, herring gulls, common terns, shelduck, common scoter, and European eider are just some of the many different birds you can see along the Belgian coast. Waders feed on the small animals that live in the mudflats. They tend to have long legs and a beak specially adapted to the kind of food they eat. The curlew's beak is long and thin with a slight downward curve: perfect for probing the sand.

The population decline of the peregrine falcon started in the 1940s and intensified in the 1960s, when the species was even considered extinct in Belgium. The decline was mainly due to massive use of organochlorine pesticides in agriculture. Today, however, the falcons are back, and have even entered our cities!

Since 2004, a pair has nested every spring in one of the towers of the Saint Michael and Saint Gudula Cathedral, in the heart of Brussels. These raptors have pointed wings, short, curved beaks, a wingspan of 95-115 cm (the female is larger than the male), and measure between 35 and 50 cm. In town, their preferred preys are pigeons.

Over the last few years, the red fox has become more and more common in villages and even in the wooded areas of large cities. Since it is an omnivore, it finds food easily in gardens (berries, earthworms and small rodents), pet bowls, and in bins (photo)! And there are plenty of places for it to live: it digs its den in parks and wastelands. Contrary to popular belief, it never attacks humans, and doesn't carry rabies (which was eradicated in Belgium ten years ago). However, it is sometimes affected by a parasitic tapeworm (*Echinococcus*), and so it can transmit echinococcosis through its faeces. That's why picking fruit or fungi that grow less than 60 cm off the ground is not recommended.

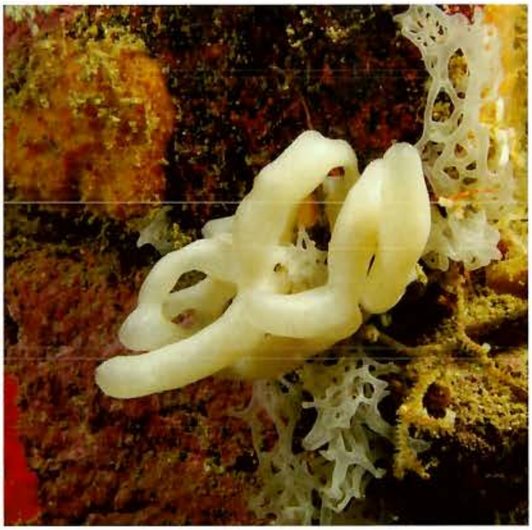
The marsh frog isn't native to Belgium: it comes from central Europe (its range extends from eastern France to Russia and Greece). This 'alien' frog was sold in pet shops until just a few years ago – people bought them to put in their garden ponds (today, it is illegal to release even native species of amphibian into the wild). The problem is that the marsh frog adapted a little too well to its new habitat, at the expense of the native green frog, which has already disappeared from the Brussels area.

## Biodiversity in the world

Every year, several of our scientists go on expeditions abroad to observe, collect, classify, and even discover species in their natural habitat. The data collected includes information about geographic range, habitat, feeding ecology, reproduction, longevity, and interactions with other individuals of the same and of other species. Knowing more about the species will help us to protect them more effectively. Although we may not always be conscious of this, we owe an awful lot to biodiversity: our food, our clothing (animal skins and natural fibres), dyes from plants, molluscs, and insects, wood for construction and fuel, the active ingredients of many medicines, and purification of air, water, and soil by plants, algae, and bacteria.

In order to protect biodiversity and to monitor it in the years to come, we need the most complete inventory that we can compile. With this in mind, an international team of scientists – all experienced divers – has been studying and inventorying sponges from the fjords and channels of the southern coasts of South America, from Peru to Patagonia. The cold (below 10°C) waters of this region harbour a benthic (deep sea) fauna that is both unique and extremely diverse. However, this fauna has hardly been studied.

This photo of *Latrunculia ciruela*, a sponge with siliceous spicules, was taken in Chilean waters, at a depth of 23 m.



*Leucaltis nuda* has calcareous (calcium) spicules.

The purifying role of sponges is well known: they continually filter the water that contains the micro-organisms they feed on. But biochemists today are interested in the molecules that they produce to protect themselves from predators and infection. This veritable arsenal includes antibiotics, antivirals, and antineoplastics which could one day revolutionise the treatment of diseases such as AIDS and some cancers.

Our institute is an active participant in IBISCA, an international program that studies the spatial distribution (the geographical location, height above ground level, and altitude) and temporal (seasonal) distribution of arthropods in tropical, subtropical, and temperate forests.

The study focuses on groups of insects that are representative of different ecological functions, such as pollinators (like the bee in photo 1), predators (like the army of ants in photo 2), and decomposers (like the termites consuming dead wood in photo 3). Collecting expeditions are organized all around the world: Panama in 2003, Queensland (Australia) and Vanuatu in 2006, Auvergne (France) in 2008.




It is very rare that a new mammal species is discovered, but no less than 8 new species of mouse were recently described in East Africa. All belong to the genus *Lophuromys* (which already contained 23 species). They are furry mice that live in humid areas.

Their irregular distribution suggests that they evolved as a result of 'allopatric speciation': the descendents of one original species were separated by a geographical barrier (in this case an arid plain) and evolved into different distinct species.


aune australien

# 5

# Insects and other arthropods

Nearly 80% of all known animal species are arthropods, and entomologists find new species every day! Arthropods include insects (ants, bees, butterflies, and beetles), crustaceans (crabs, shrimps, and lobsters), chelicerates (spiders, scorpions, and acarines), and myriapods (millipedes and centipedes).

# Insects

The bodies of insects are divided into three sections: the head, the thorax, and the abdomen. They have one pair of antennae and three pairs of moving legs. Most also have two pairs of wings.

This hoverfly may look like a bee – it's shaped like a bee, and its colours are like a bee's – but it actually wouldn't hurt a fly: it is one! It has bigger eyes than a bee, shorter antennae, and only one pair of wings (bees have two). And it doesn't sting. It lays its eggs in water, where its larvae (known as rat-tailed maggots) can grow by feeding off decomposing waste.

The mole cricket burrows underground like a mole and sings like a cricket. It mainly feeds on earthworms, larvae, and roots.

The Museum has its very own beehive in the *Insects* gallery! If you're lucky, you might see the queen – she has a coloured dot on her back. You may even witness the famous 'dance' of the bees. When a bee finds a source of food, she tells the other bees about it by 'dancing'. The other bees follow her by touching her with their antennae. A circular dance means that the food is less than 100 m away. A figure-of-eight dance means it's further away. The slower the dance, the further the food. The dance also shows the direction of the food in relation to the sun.

The praying mantis can remain still for hours as it waits for prey to come within reach. Its raised front legs, which make it look as though it is praying (hence its name), actually mean that it is ready to attack. The male must be careful during mating when he is on a female's back. It's not unusual for the flexible female to turn around, grab him by the neck and eat him!

## Chelicerates

Their bodies are usually divided into two sections: a cephalothorax and an abdomen. They have one pair of chelicerae (hook-shaped or pincer-shaped oral appendages), one pair of pedipalps (which are especially developed in scorpions, where they end in strong pincers), four pairs of moving legs, but no antennae.

The markings of the diadem spider (or European garden spider) form a white cross on its back. This relatively small spider (the female grows up to 18 mm) is common in gardens, where it eats its web every morning before making a new one for the day.

This animal with the strange shell is called a horseshoe crab but is not a crustacean: it's a chelicerate, like spiders. This marine animal lives on the muddy or sandy sea beds in the shallow waters along the coasts of Southeast Asia and the Eastern Americas. It is often classed as a 'living fossil'. because it hasn't evolved for more than 500 million years!

Scorpions are ovoviviparous: the young develop in eggs which are retained inside the female until birth. They need protection when they are born because they are not yet poisonous, and their mother carries them on her back until their first moult a few days later. After this, they can start to feed themselves by hunting tiny prey. They will go through several more moults before reaching an adult size.

## Crustaceans

The bodies of crustaceans are divided into three sections: head, thorax, and abdomen (the first two are usually fused to form a cephalothorax). They have two pairs of antennae and the number of legs depends on the species (usually five pairs)

Woodlice are crustaceans, like shrimps, but they live on dry land. They dwell in humid places like woods, gardens, and cellars. A couple of hours in a heated room would dry them out completely. They eat mainly fungi and decomposing plants.

The Japanese spider crab is the largest living arthropod. The eldest specimens, which can be up to a century old, can measure 4 m across! Like many other crab species it mainly feeds on dead animals, although it does sometimes kill other crustaceans. It has ten very long legs...

## Myriapods

Myriapods (millipedes and centipedes) have long bodies divided up into many similar segments. They have one or two pairs of moving legs per segment, and one pair of antennae.

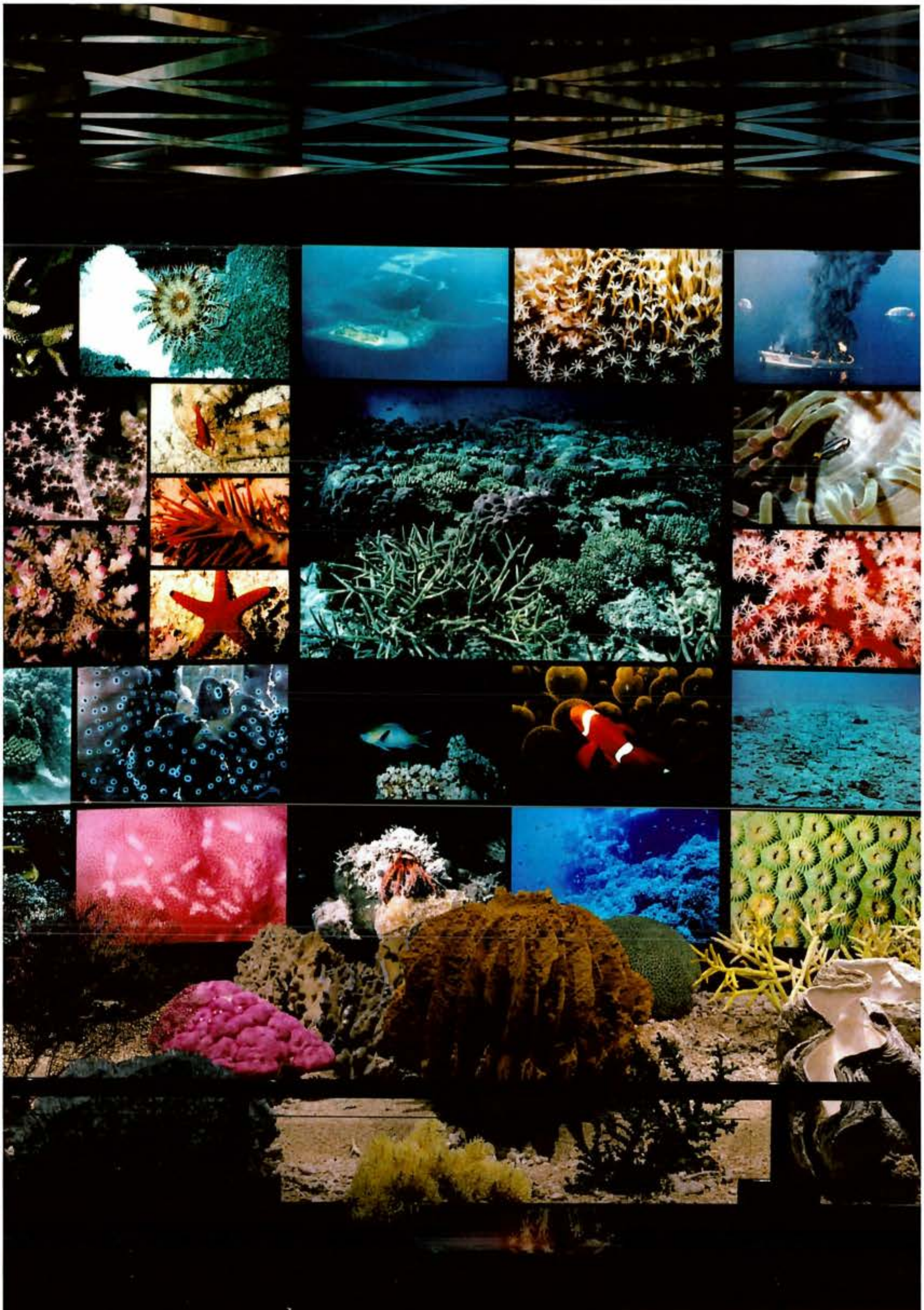
This myriapod has two pairs of legs on each segment, which means that it is a diplopod, or millipede. Centipedes (or chilopods) have only one pair per segment. Unlike centipedes, this millipede does not have venomous fangs, and it is not carnivorous. It is a detritivore: it lives in dark, humid places in gardens and forests, and contributes (though to a lesser extent than earthworms) to the formation of humus.

# The vivarium

This is the place to see live tarantulas, scorpions, stick insects, and cockroaches. But these aquariums and terrariums aren't just home to arthropods. Amphibians, like the bizarre axolotls, also live here. These salamanders can reproduce while still retaining characteristics of the larval stage, such as living in water, and breathing through gills. They can complete their metamorphosis and get used to life on land if their habitat suddenly dries out or if their thyroid gland is stimulated with hormone injections. If they live out of the water, they die younger.

Axolotls (this is an albino specimen) have been the subjects of many lab studies, particularly because of their ability to regenerate damaged tissue, meaning that they can grow back damaged skin, limbs, or even parts of the brain!

There are only a few spider species whose bite is dangerous to humans. In any case, the spiders in the vivarium (like this Mexican red-kneed tarantula, *Brachypelma smithi*) are safely locked behind two layers of glass. Try to make as little noise as possible: sound vibrations disturb them, and too much noise could make them hide away in a corner where you will not be able to see them.



6

# Shells and other invertebrates

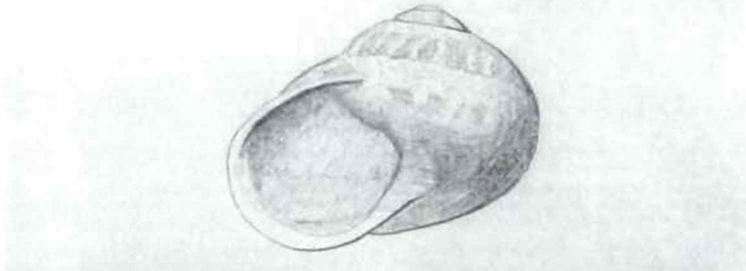
The *Shells* gallery is mainly devoted to molluscs, which include gastropods (such as whelks, limpets, slugs, and snails), bivalves (such as mussels, oysters, clams, and cockles), and cephalopods (such as octopuses, cuttlefish, and squids). Molluscs are invertebrates with soft, unsegmented bodies (unlike arthropods or worms). They usually have a calcareous shell which can be either external or internal. Some molluscs are terrestrial, but most are aquatic and live in the sea. However, some species live in fresh or even brackish water.

This gallery also contains other, often very strange looking, invertebrates: sponges, cnidarians (such as corals and jellyfish), worms, and echinoderms (such as starfish and sea urchins).

## Gastropods

Most of the molluscs in the *Shells* gallery are gastropods. These are recognized by their muscular foot, which they use to move themselves along (either by creeping, like most, or swimming in some aquatic species). They also have a radula, a kind of rough tongue, for scraping algae off rocks and walls or devouring their prey (in cone snails, the radula is used as a venomous harpoon), and a univalve shell (all in one piece), which is often spiralled. In slugs, the shell is extremely reduced and internal, or even completely absent.

The direction a gastropod's shell is coiled in depends on the species. For example, the edible garden snail, *Helix aspersa aspersa,* has a dextral (right-handed, from the Latin *dexter*, meaning 'right') shell: it coils in a clockwise direction from the opening. W the spiral goes the other way, like the shell on the right and the drawing above, it is called a sinistral shell (from the Latin *sinister*, meaning 'left').



Cowries, like this *Cypraea tigris,* have smooth, shiny shells that are often patterned. There are over 200 species, and they vary in colour from white to black, via orange, red, pink, and chestnut. Most measure between 5 and 10 cm in length.

There are more than 1000 species of murex snail. Most have ornate shells sporting projections of different shapes and sizes (this one has small spines). The shells from which the ancient Phoenicians, Greeks, and Romans extracted highly prized purple dyes (Tyrian purple and Tekhelet) belong to this family.

The Pleurotomaiidae, like this *Pleurotomaria rumphii*, have a spiral shell with a wide base whose diameter can sometimes reach 20 cm. It is said that, because they were so rare, in the past any specimens fished from the Sea of Japan had to be automatically given over to the emperor. They live on rocky sea beds, at depths of 100 to 600 m, and so are difficult to collect.

## Bivalves

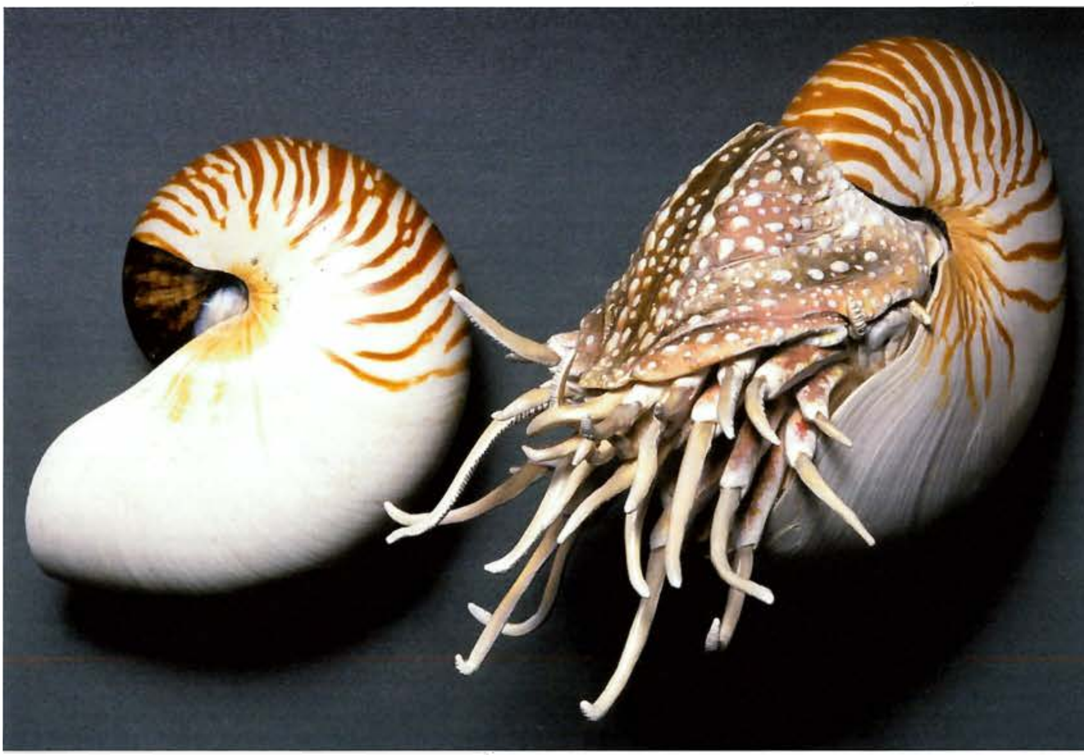
As their name suggests, bivalves have shells that are divided into two halves. These molluscs are exclusively aquatic. Most are filter feeders: thousands of tiny mucus-covered hairs line their gills, which retain particles of food that are suspended in the water, moving them towards the animal's mouth. There, the labial palps sort through the particles – those that aren't ingested are pushed back out of the shell and carried away by the current.

Pectinidae, which include scallops, are amongst the few molluscs that are able to actively escape from predators. They can close their two valves suddenly, creating a current of expelled water which propels them backwards!

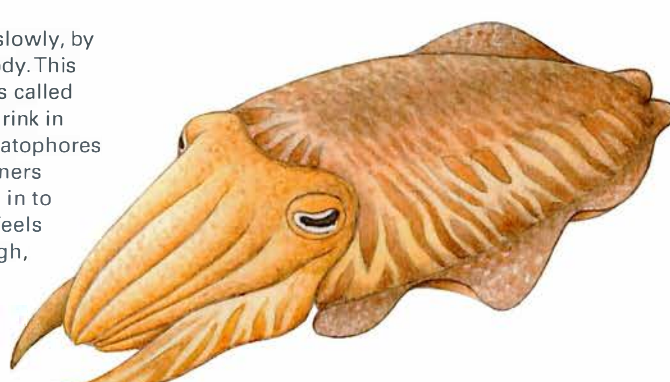
In this photo, you can clearly see the gland that mussels have at the base of their foot for producing byssal threads (the mussel's 'beard'). The mussel uses this strong biological glue to attach itself to rocks and other underwater supports.

## Cephalopods

Cephalopods are molluscs whose foot has evolved to form arms and/or tentacles surrounding their mouths. There are many fossil cephalopods with external shells, such as the ammonites and belemnites that lived in the seas of the Jurassic and the Cretaceous. However, the most recent became extinct with the dinosaurs, 65 million years ago. Today, nautiluses (photo) are the only cephalopods that have external shells. In other cephalopods, the shell is internal and greatly reduced, like the cuttlefish's 'bone', or the squid's 'pen'. In octopuses, the shell has completely disappeared.



Most of the time, the cuttlefish moves slowly, by undulating the fin that surrounds its body. This fin is covered with small coloured spots called chromatophores, which can grow or shrink in the blink of an eye. It uses these chromatophores to attract the attention of potential partners during the breeding season or to blend in to the surrounding environment. But if it feels threatened, and camouflage isn't enough, it can propel itself backwards by suddenly expelling water from its mantle. At the same time, it releases black ink which hides it as it escapes.

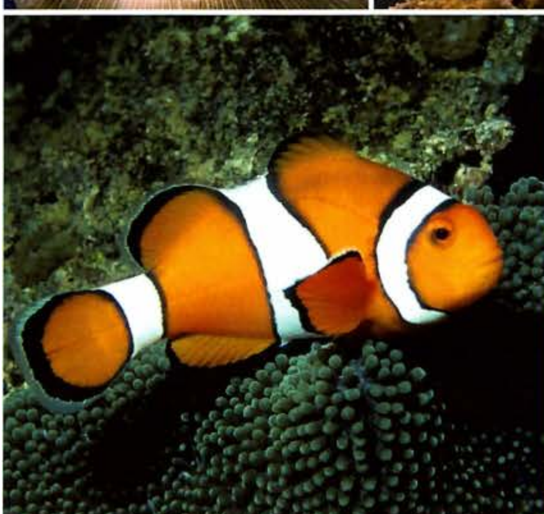


## And a few other aquatic invertebrates...

Cnidarians are very simple animals – their bodies are made up of two layers of cells separated by a gelatinous layer (the mesoglea), and their gastric cavity only has a single opening surrounded by tentacles. Essentially marine, they are covered in cnidocyte cells, which they use to catch prey or for defence (in Ancient Greek, *knidê* means 'stinging nettle'). There are two forms of cnidarian: sessile forms (polyps such as corals, sea anemones and hydras), and free-living forms (medusae or jellyfish). Some species, like most jellyfish, go through both forms in the course of their life cycle.

Sponges are very simple animals. Their bodies are made of only two layers of cells: the pinacoderm (external layer) and the choanoderm (internal layer), separated by a gelatinous layer called the mesohyl. The mesohyl contains the cells which produce spicules, the small calcareous or silica spines that reinforce the structure of the sponge. Sponges feed on organic detritus, bacteria, and unicellular organisms. They have no mouth or anus: their food is absorbed directly and digested by the cells of the choanoderm and the mesohyl. Sponges can live in salt, fresh, brackish, hot, cold, shallow, or deep water, depending on the species. This is a 6cm long *Sigmosceptrella tupecomareni*, which lives at a depth of 25 m along the coasts of Chilean Patagonia. Its spicules are made of silica.

Corals are polyps with calcareous skeletons. They group together in colonies of millions of individuals to form atolls and coral reefs in warm waters. They can also be found in colder waters, particularly along the British coasts and in the Norwegian fjords. In warm waters, they live in symbiosis with unicellular algae, the zooxanthellae. These benefit from the carbon dioxide released by the corals, which in turn absorb the glucose and oxygen produced by the algae. Today, corals are vulnerable because of pollution and rising sea temperatures, not to mention fishing trawlers. Some species are also exploited for making jewellery.



There are other examples of symbiosis involving cnidarians: sea anemones and clown fish, for example. The clown fish *(Amphiprion ocellaris)* keeps the anemones' predators away and eats its leftover food. In return, the fish can hide amongst the anemone's stinging tentacles. The fish is immune to the stinging cnidocyte cells thanks to the mucus covering its scales. However, the clown fish isn't the only fish to do this, you'll see others in the largest aquarium in the *Shells* gallery.

Echinoderms include starfish, brittle stars, sea urchins, and sand dollars. Adults have pentaradial symmetry: their arms always number a multiple of five, and are arranged radiating outwards from a central point. Their skeletons are made of calcareous plates, and are often covered in spines (the name 'echinoderm' comes from the ancient Greek *ekhinos*, meaning 'urchin' or 'hedgehog', and *derma*, meaning 'skin'). Sea urchin skeletons are known as 'tests'. Echinoderms are benthic animals (they live on the sea bed).

7

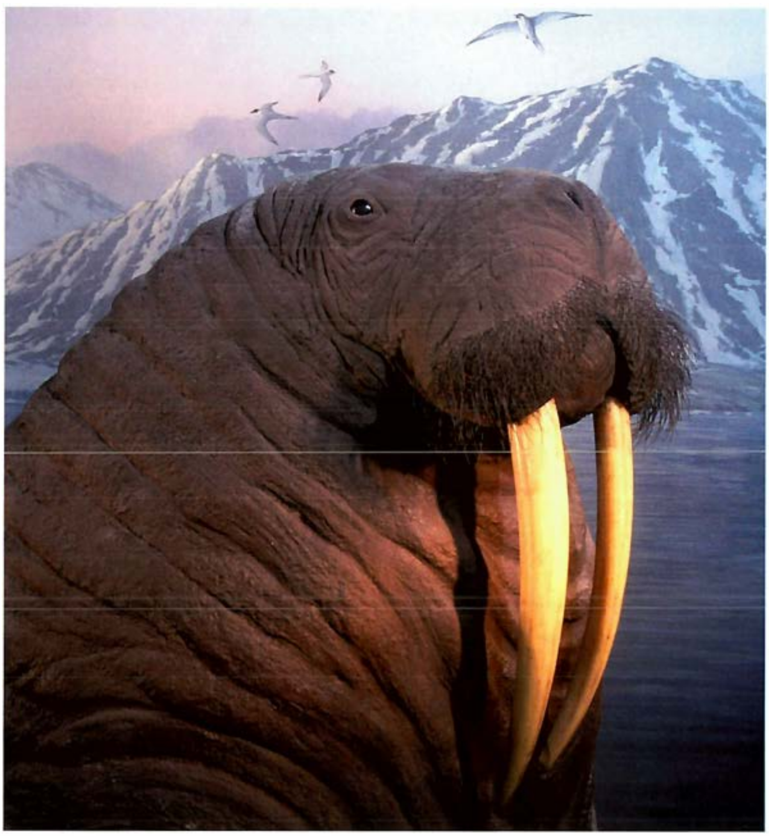
# The Poles

First, a little bit of etymology. The word 'arctic' is used to describe the land and sea that surround the North Pole. It comes from the Ancient Greek word *arktos*, which means 'bear'. The constellation known as the Great Bear (Ursa Major) is very close to the celestial North Pole, and so the area surrounding the North Pole came to be known as 'arctic'.

If we add the prefix 'ant' to the word 'arctic' (from the Ancient Greek *anti*, meaning 'opposite'), we get 'Antarctic'. This is the word used to describe the continent and the seas of the South Pole. So now you'll never forget that polar bears live in the North Pole: the Arctic. If in any doubt, remember that the Pole Star (the North Star) is part of the Ursa Minor constellation (the 'little bear').

The Arctic zone includes the Arctic Ocean and all land that lies within or borders the Arctic Circle. The temperature in this Arctic zone never rises above 10°C, even in the hottest month (July). This 'thermal frontier' or 'isotherm' also corresponds to the tree line above which trees cannot grow. The permafrost (permanently frozen ground) prevents their roots from obtaining the nutrients they need to grow. Only some herbs, mosses, and lichens can grow here.

The lands of the Arctic include the most northerly islands and coasts of Norway (Svalbard), Russia, Denmark (Greenland and the Faroe Islands), The USA (Alaska), Canada, and Iceland. They are inhabited by Inuits, Sami (Lapps), Samoyedic peoples, Yakuts, Chukchi, and Aleuts.



The male walrus is larger than the female, growing to 3.2 m long, and weighing up to 1200 kg, whereas the female grows up to 2.7 m and 800 kg. The male's tusks are also longer – up to a metre long. Tusks are used to fight rival males, to defend themselves from orca (killer whale) attacks, to heave themselves up out of the water, and to break ice. They are actually teeth: extra large upper canines. Many native arctic peoples sculpt them, creating ivory statuettes that immortalise scenes of arctic wildlife or traditional life.

Polar bears are the largest predators in the North Pole. They mainly prey on seals, which they hunt in water as well as on land. They are excellent swimmers. But in just three generations (45 years), their populations have shrunk by 30%. This decline is due to pollution, hunting, and climate change: the sea ice on which they live, hunt, and reproduce is slowly shrinking. Every summer it melts a little more, and it could disappear completely within the next 100 years. Every year, the bears find it increasingly difficult to build up the reserves of fat they need to survive the winter.

Narwhals have only two teeth on their upper jaw. In the male, the left one forms a long, straight, spiralled tusk which can grow to longer than 2 m. Females rarely grow tusks, and when they do, they are much shorter. During the Middle Ages, narwhal tusks were sold as unicorn horns.

Atlantic Puffins spend their winters out at sea, but they nest on cliffs and grassy slopes in the summer. During the breeding season, they have brightly coloured beaks with orange and yellow stripes. When courting a female, the male throws back his head, puffs up his chest, and shakes his wings at her. Then the pair face each other and knock their beaks together by shaking their heads. They stay faithful to one partner for the duration of the breeding season.

## The South Pole

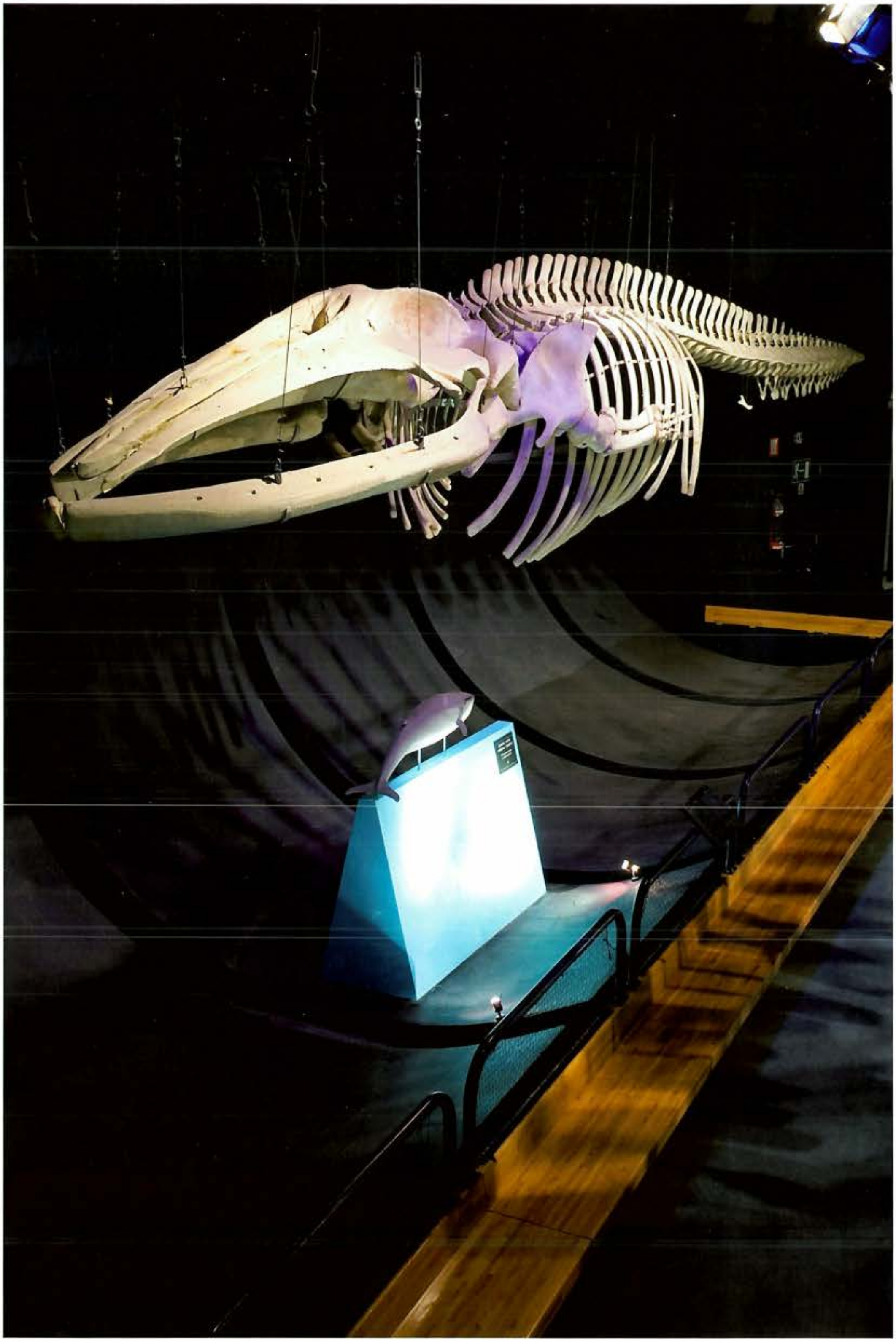
Antarctica is the name given to the 13 million km2 continent at the South Pole. It is located inside the Antarctic Circle, and is almost entirely covered by the Antarctic ice sheet, which is over 2 km thick in places. The continent's interior is an icy desert, buffeted by violent winds. The only people here are scientists working in research stations.

The coasts are slightly less inhospitable, and have a limited vegetation of algae, mosses, and lichens. A few animals also come here to breed or to take advantage of the plankton and krill which is more abundant in these seas than in tropical waters, making it a good place to feed and build up fat reserves.

Emperor penguins breed in the middle of the winter, tens of kilometres from the sea, which provides them with food. The mother stays here for a month without food: long enough to find a mate and lay her single egg. She then goes back to the sea, leaving the male behind to incubate the egg and wait for her. He keeps the egg warm between his feet and under a thick fold of skin, carefully keeping it several centimetres off the frozen ground. After two months, the chick hatches, the mother returns, and the male can finally go and feed.

A humpback whale breaching is always an impressive sight: its body comes up vertically, almost entirely coming out of the water, before turning and being swallowed again by the sea. In the breeding season, however, these displays go even further: the whale performs gigantic back flips, belly up and flippers out, which end in an almighty splash as the giant's back hits the water.

The leopard seal owes its name as much to its predatory nature as to the spots on its fur. It has been known to attack other seal species, but mostly feeds on penguins, krill, fish, and cephalopods. Males are slightly larger than females, growing to 3.4 m. Females, however, are fatter: they can reach 600 kg, as opposed to a maximum of 450 kg for the males.



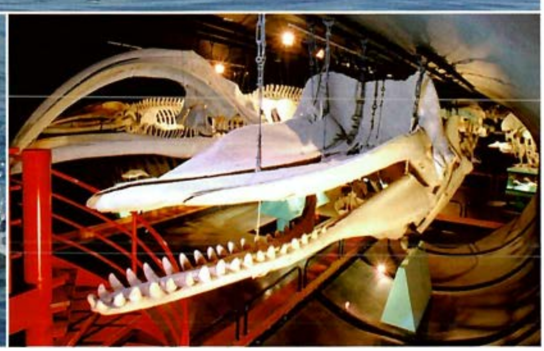
# 8

# *Whales and other marine mammals*

Cetaceans (whales) include baleen whales such as rorquals, and toothed whales such as sperm whales and dolphins. Whales are known to be descended from terrestrial mammals who returned to aquatic life around 50 million years ago. They aren't, however, the only mammals to have returned to the sea: sirenians (dugongs and manatees), seals, sea lions, and walruses have all adapted well to marine life.

## Toothed Whales (Odontoceti)

The Odontoceti or toothed whales (from ancient Greek *odous*, *odontos*, 'the tooth' and *kêtos, kêtous,* 'the large aquatic animal') are a sub-order of the Cetaceans that includes the sperm whales, orcas (killer whales), belugas, narwhals, dolphins, porpoises, pilot whales, and beaked whales. Like some bats, they use echolocation to navigate and to find their prey. They emit high-frequency sounds which bounce off obstacles (such as a shoal of fish or a boat) and return to the whale, giving it all the information it needs about the size, shape, distance, and speed of the obstacle. It's basically a kind of natural sonar.



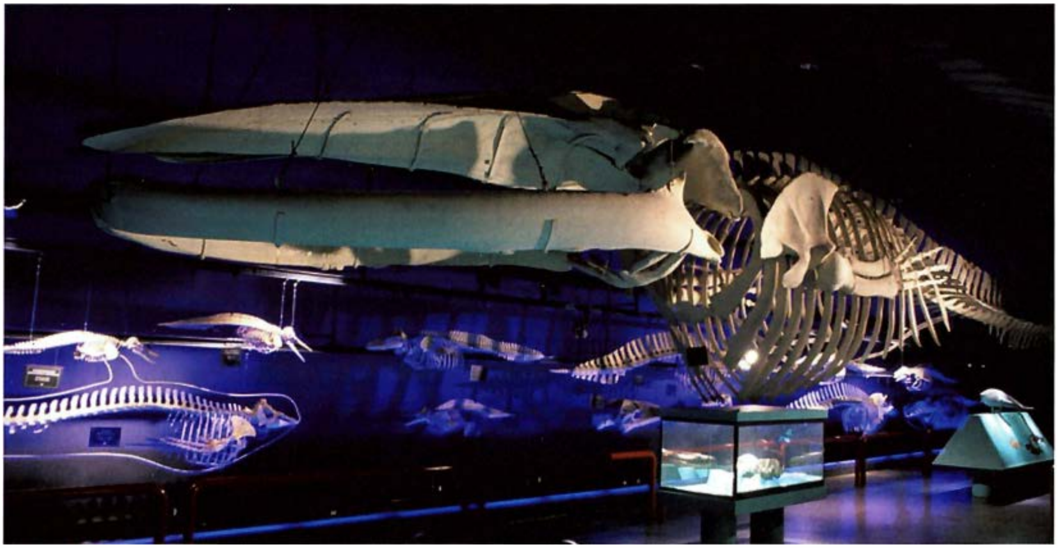
Dolphins are well-known for their intelligence. Because of this, they have been used in a number of experiments studying the acquisition of language. They make excellent students! A dolphin that has been taught to follow basic instructions (given in words or gestures) can tell the difference between a sentence such as 'bring the red frisbee to the basket', and 'bring the basket to the red frisbee', thus displaying a basic understanding of syntax. If the instructions make no sense, the dolphin simply ignores them! This common dolphin was photographed beside the Spanish coast as it swam alongside the Belgica, a Belgian research ship.

The sperm whale is the largest of all the toothed whales. It's also the largest living toothed mammal: the male can reach 18-20 m in length. The sperm whale has a large bump on its forehead, called a melon. When it dives, the oil contained within this melon cools and solidifies, streamlining and weighing down the front half of its body. This makes it easier for it to dive to depths of over 1 km, where it hunts its favourite prey: giant squid. It also feeds on fish and octopuses.

## Baleen Whales (Mysticeti)

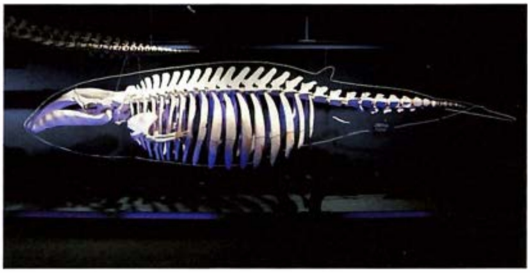
The Mysticeti are the baleen whales, which include the blue whales (the largest animal ever to have existed), fin whales, minke whales, pygmy right whales, right whales, and humpback whales.

Baleen, or whalebone, is made of keratin; the same substance that nails and hair are made of. Rows of long baleen plates hang from the whale's upper jaw like a comb. The plates are so close together that they catch food (such as krill, plankton, or fish) when the whale closes its mouth and pushes out the seawater.



The blue whale is probably the largest vertebrate ever to have lived on earth. Females can grow to over 30 m and weigh nearly 200 tonnes (this specimen is 21.2 m long). At birth, the calf is 'only' 7 m long and weighs between 2 and 3 tonnes. Thanks to the mother's milk, which is approximately 50% fat, the calf can increase its weight tenfold in the space of a year.

The common minke whale has very short baleen plates: they are only around 20 cm long.



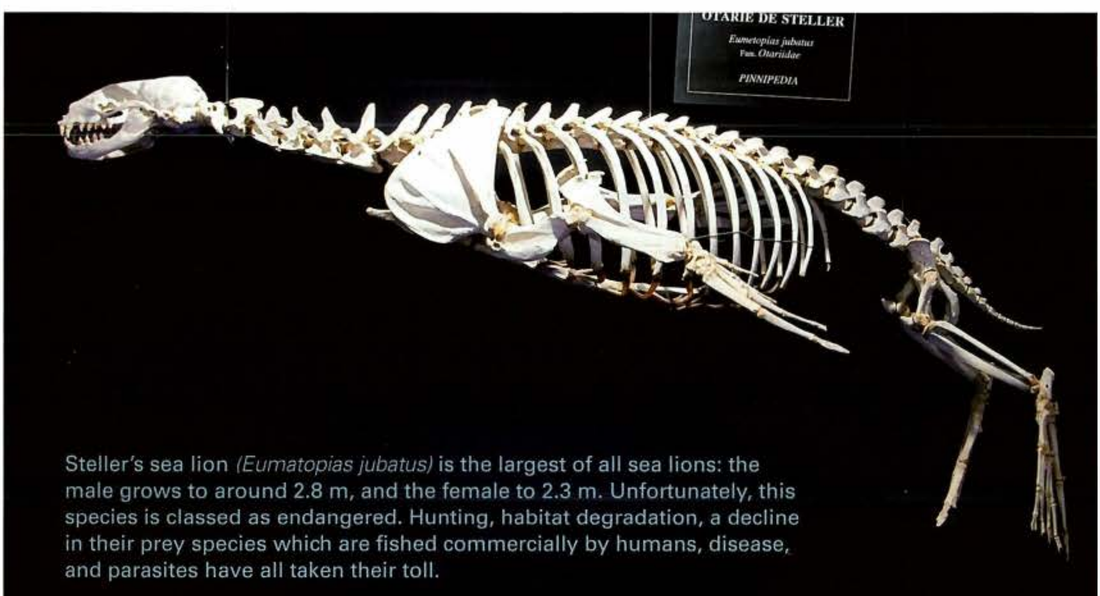
The pygmy right whale is the smallest of the baleen whales, with a maximum length of 6.5 m. It lives in the cold waters surrounding Antarctica. There are less than 10 museums in the world with a specimen of this species.

## Other marine mammals

As well as the herbivorous sirenians (also known as sea cows), which include the dugong and the manatee, there are the carnivorous marine mammals: the seals and sea elephants (family Phocidae), sea lions (family Otariidae), and the walrus (the only species in the Odobenidae family).

It's actually quite easy to tell these three families apart: sea lions have small ears, hold themselves up with their front legs, and move with their back legs; seals have no external ears, and crawl along horizontally on their stomachs. As for the walrus, its huge size and long tusks mean that it's easily recognised.

Sirenians live in warm water (salt or fresh, depending on the species), feeding on algae and aquatic plants. Instead of hind legs, they have a tail, with flippers. The dugong's tail (photo) resembles that of a whale, whereas the manatee's tail is more rounded. Another difference is that the dugong can bend its elbows (which face back), while the manatee (whose elbows face forward), cannot.

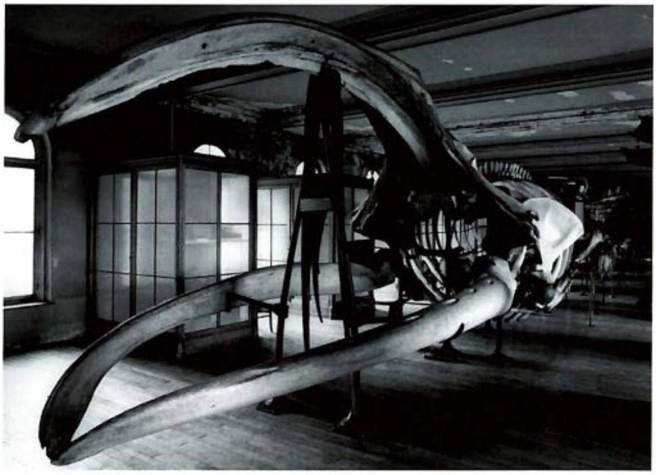



Steller's sea lion *(Eumatopias jubatus)* is the largest of all sea lions: the male grows to around 2.8 m, and the female to 2.3 m. Unfortunately, this species is classed as endangered. Hunting, habitat degradation, a decline in their prey species which are fished commercially by humans, disease, and parasites have all taken their toll.

## Whales through the roof

Renovations were carried out on the roof of the 'Convent' during the 1980s. We used this rare opportunity to move the *Whales* section to the top floor of the building. The whales' tails and thoracic cages were removed through the doors, even those of the largest specimens. The skulls, however, were another matter: they had to go through the roof.

This photo was taken on 28 May, 1984, when the skull of the sperm whale was hanging above the roof. Lowering the skull into the room was no easy task for the crane driver and the worker stood on the rafters. A lot of skill was required of both of them, since the skull had to be turned, lowered, brought forward, and turned again before finally being put into place.



This photo was taken before the renovations took place. As you can see, the ceiling was low and the specimens were simply displayed one behind the other.

9

# Mammals

With the exception of cetaceans (whales), and proboscideans (elephants), which are displayed elsewhere in the Museum, every mammal order is represented in this gallery. There are over 330 specimens from all around the world. Some of them may be familiar, whereas we know very little about some others. Several are rare. But one thing is for sure: you would never be able to observe any of them this closely in the wild.

## Curious creatures

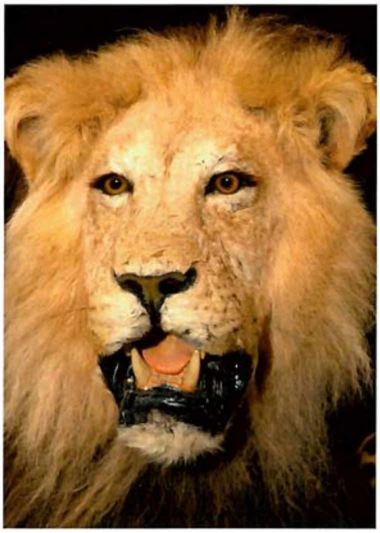
Some of the animals on display in this gallery may look a little odd to say the least. Take the duck-billed platypus, for instance: it has the beak of a duck, the flattened tail of a beaver, the webbed feet of an otter, and to top it all off the male has venomous spines and the female lays eggs! You can see why the first scientists to see pictures of this animal thought it was a hoax.

Some of the mammal specimens are very old: more than 150 years old in some cases. This is why they may sometimes look a little worn. We look after them as best we can, of course, but we won't replace them. How could we take new specimens from the wild, when we know how endangered some of these species already are?

Our taxidermists have chosen to show this hippopotamus in its element: muddy river water. Hippos spend the hottest hours of the day there, keeping cool and protecting their skin, which burns easily, from the sun's rays. Studies conducted over the past two decades have shown that the hippo shares a common ancestor with...whales!

The tiny Malaysian mouse deer *(Tragulus javanicus)* is only 60 cm long, including its tail, making it the smallest living artiodactyl ruminant. This order of mammals includes giraffes, okapis, reindeer, and cows. They are all even-toed ungulates, which means they have cloven hooves.

The Tasmanian devil is an Australian marsupial, like the kangaroo, the koala bear, and the thylacine. For some time it was considered a threat to livestock, but it's actually more of a scavenger than a hunter. It's been a protected species since 1941, but today faces extinction. This is due to a disease that affects only this species, causing facial tumours that prevent the animal from feeding.



Some of our older specimens come from the trophy-hunting that was so popular amongst rich Europeans in the 20th century. Jacques Henrijean accumulated a priceless collection of such trophies during expeditions to Africa, North America, and Asia. He was conscious of its scientific value, and donated part of this collection to the Museum. The bovid (antelope and buffalo) specimens in the *Cavicorn* section, several large carnivores in the *Mammals* gallery (cheetah, lion, and wolf), and the polar bear in the *Poles* gallery all come from his collection.

The female duck-billed platypus really does lay eggs (1 to 3 per clutch). However, she has fur and provides her young with milk, so she really is a mammal. The eggs are incubated for 10 days before they hatch. They are born bald, blind, and barely 25 mm long. They can't suckle, because the mother has no nipples. Instead, they drink milk that drips down her long hairs from a gland on her breast.

Chiropterans (bats) get their name from the Ancient Greek *kheir, kheiros*, meaning 'hand', and *pteron, pterou*, meaning 'wing'. They are the only mammals that can actively fly (flying squirrels, anomalures, and flying lemurs only glide from branch to branch). Bats are also famous for using echolocation, but in fact only the microchiroptera (which include pipistrelles, mouse-eared bats, and horseshoe bats) are capable of this. *Megachiroptera* (fruit bats, or flying foxes), like this *Pteropus melanopogon*, navigate by sight.

## Mammals in danger

Today, mammals face many problems. Primates, antelope, and bats are sold as 'bush meat' in the markets of Central and Western Africa. Dolphins and porpoises get caught in huge commercial fishing nets, and drown. Whales are killed for their meat, elephants for their tusks and rhinos for their horns. With intensive commercial fishing and hunting, illegal poaching, deforestation, habitat fragmentation, climate change, and pollution, it sometimes seems as though the odds are stacked against mammals, and their future is uncertain.

The wolf was deliberately exterminated from this part of the world because people suspected it of killing goats and sheep, and carrying rabies. By the end of the 19th century, it had disappeared. Today, wolves are protected in Europe under the Berne Convention and several other European directives. Wolves are still common in Russia, Canada, and the U.S. (Alaska), and they can still be found in Spain, Italy, France, Scandinavia, and the Balkans.

The bonobo or pygmy chimpanzee *(Pan paniscus)* is famous for being one of our closest living relatives, sharing 98% of its genes with human beings. It is also famous for the unique way it uses sex (heterosexual and bisexual) to solve conflicts and ease tension within the group. The species was only discovered in 1929 in Belgium: it was described from a specimen at the Royal Museum for Central Africa in Tervuren. Unfortunately, this primate is currently under threat from poaching and habitat destruction. It lives in the Democratic Republic of the Congo, in the forests between the Congo, Lualaba, and Kasaï rivers.

## The Sahel-Sahara antelope

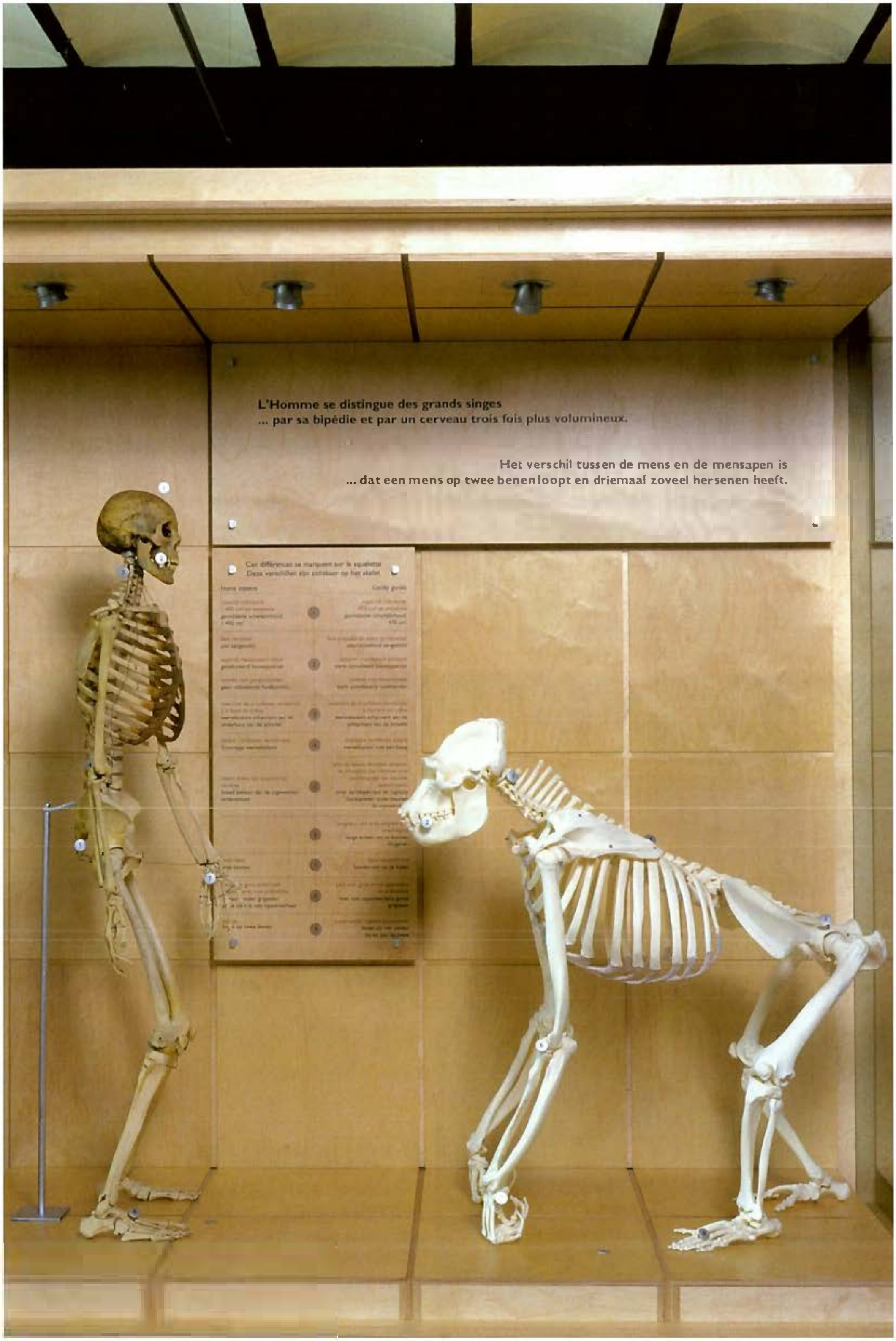
Several of the African species shown in the *Cavicorn* section are in danger of extinction, mainly due to human activity, although droughts in the last few decades have also played their part. Poaching, overgrazing, and increasing desert agriculture have all put pressure on the antelope. Six antelope species from the Sahel-Sahara region are particularly endangered. These are: *Oryx dammah, Addax nasomaculatus, Gazella dama, Gazella leptoceros, Gazella cuvieri,* and *Gazella dorcas.*

Since 1994, the CMS (Convention on the Conservation of Migratory Species of Wild Animals) has been working with 14 African states where the antelope are found, the *Fonds Français pour l'Environnement Mondial* (FFEM), and our institute to protect these antelopes. To solve the problems, large protected areas need to be established, along with captive breeding programmes, and reintroductions of animals into suitable areas. Educating local people of the benefits of protecting wildlife is also important, as it effectively controls poaching.

The Addra gazelle *(Gazella dama)* is nervous and difficult to see, especially now that it's extinct in the wild (photo taken in Tunisia in 2007).

Scimitar Oryx had been considered extinct in the wild since the 1980s (this photo was taken in Tunisia in 2007).

This photo was taken during an important translocation project that took place in Tunisia in February 2007. Scimitar Oryx *(Oryx dammah)*, and screwhorn antelope (*Addax nasomaculatus*, pictured) were moved from the Bou Hedma Park (where they were reintroduced in 1985) to the Djebil National Park, which is further south and provides a more suitable environment for both species.


L'Homme se distingue des grands singes
... par sa bipédie et par un cerveau trois fois plus volumineux.
Het verschil tussen de mens en de mensapen is
... dat een mens op twee benen loopt en driemaal zoveel hersenen heeft.

# 10

# The first humans

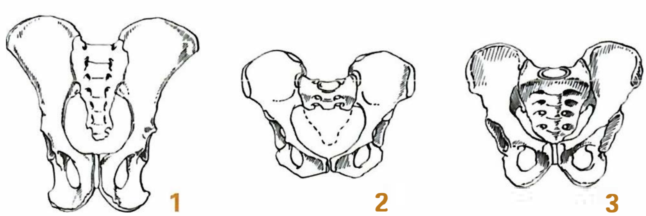
The very first human beings appeared around 2.5 million years ago. Unfortunately, we have very few fossils of these early humans. All we have are a few basic remains, some teeth and some incomplete skulls. But that's enough for anthropologists to deduce some important information. For example, if the foramen magnum (the hole where the spinal cord enters the skull) is located beneath the skull as opposed to at the rear, then we know that the individual in question walked upright, on two legs.

# Man the primate

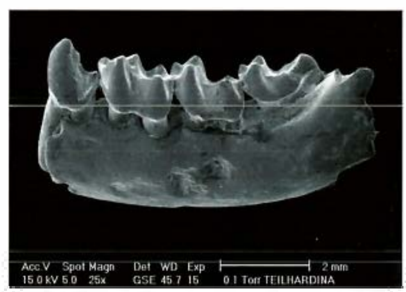
In the zoological sense, humans are primates, sharing certain characteristics with apes, monkeys, tarsiers, and lemurs. These include forward-facing eyes (which allows bifocal vision and thus good depth perception), and opposable thumbs (which give hands the ability to grasp).

Within the primates, humans are classified as Hominids. Hominids include our closest living relatives, the great apes (chimpanzees, bonobos, gorillas, and orang-utans), as well as several extinct species: the australopithecus and the first humans, including *Homo habilis*, *H. erectus*, and *H. neanderthalensis*. Modern man, *Homo sapiens*, is the only species of the *Homo* genus not to have gone extinct.

Hominids are characterized by an upright or almost upright stature: they are either completely bipedal (like humans), or incompletely bipedal (great apes walk upright only occasionally, while australopithecus were still very clumsy on two feet). They also have a relatively large cranium, a flatter face than most other primates, 32 teeth, flat nails instead of claws, and have no tail. They are known for their complex social behaviour, many different facial expressions, the ability to acquire at least basic language skills, and their ability to recognize themselves in a mirror.




We can tell whether a primate was bipedal or quadrupedal just by looking at its pelvis. The chimpanzee's pelvis (**1**) is characteristic of quadrupeds: the iliac crests are long and point backwards. On the other hand, the human pelvis (**3**) is characteristically bipedal: the crests are short, thick, and curved forwards to create a hollow for the internal organs. The pelvis of the australopithecine (**2**) has some bipedal characteristics, such as the short, thick crests, but also retains certain archaic characteristics: the crests still point backwards.



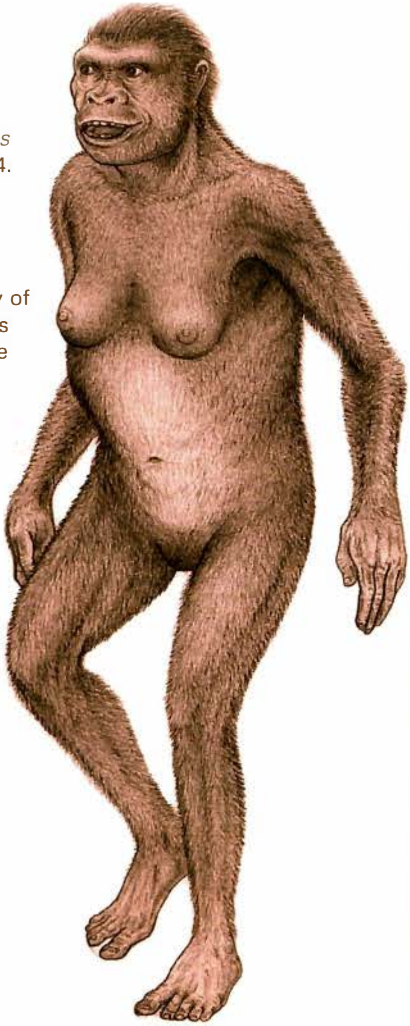

This left mandible was found in Belgium in 1883, in Dormaal (near St Trond). It is tiny, but far from insignificant, as it belonged to one of the very first primates, *Teilhardina belgica*, which lived around 55 million years ago. Palaeontologists think it resembled modern tarsiers and was arboreal like most primates. It was named in honour of an employee at this museum, father Teilhard de Chardin, who was the first to study it (and who would later participate in the discovery and study of Peking Man).

## The australopithecus

The australopithecus lived between 4.5 and 1 million years ago, and are considered the very first hominids. Their brains may have been no bigger than a gorilla's (470 $cm^3$), but we can tell from their pelvises that they were bipedal.
They probably walked very differently to us: they walked on the outer edges of their feet, with their knees apart. And their hands and feet (which had the big toe quite separate to the others), and their long arms were still very well adapted to life in the trees.

Were the bodies of the australopithecus covered in hair? Was their hair long, short, thick, or fine? What colour were their eyes? What shape were their lips? We don't know the answers to these questions: all we have are a few fossilized bones. Artist Emmanuel Casteels had numerous different options open to him when he created this reconstruction of an *Australopithecus africanus*.

This *Australopithecus afarensis* was found in Ethiopia in 1974. This is the famous 'Lucy', one of the most complete australopithecine skeletons we have. 52 bones or bone fragments were found, many of which have given us precious information about her stature and the way she walked.




There are several groups of australopithecine: archaic forms such as *Australopithecus anamensis* and *A. afarensis*, gracile forms such as *Australopithecus africanus* (**1**), and robust forms such as *Paranthropus robustus* (**2**). The 'robust' forms left no descendents when they became extinct, but the 'gracile' forms later gave rise to the *Homo* genus, which includes our own species.

The *Homo* genus encompasses all the extinct human species (such as *Homo habilis, H. rudolfensis, H. ergaster, H. erectus*, and *H. neanderthalensis)* as well as modern humans *(Homo sapiens)*. From the fossils discovered so far, we estimate that the oldest species, *Homo habilis* and *H. rudolfensis*, appeared nearly 2.5 million years ago.

*Homo habilis* lived in Africa between 2.5 and 1.6 million years ago. It closely resembled the gracile australopithecus, but had a more developed brain (around 600 $cm^3$), a flatter face, and a less sloping forehead. Another difference, and one that proves it was an accomplished biped, is that its big toe adjoined its other toes.

This *Homo rudolfensis* skull was found in Koobi Fora in Kenya and is estimated to be around 1.9 million years old. The original reconstruction (photo) gave it a relatively flat face. Along with its brain size, this was enough to classify it in the *Homo* genus. However, a more recent reconstruction gives it a more slanted face. Combined with certain characteristics of the base of the skull, this would put it closer to the robust australopithecus.

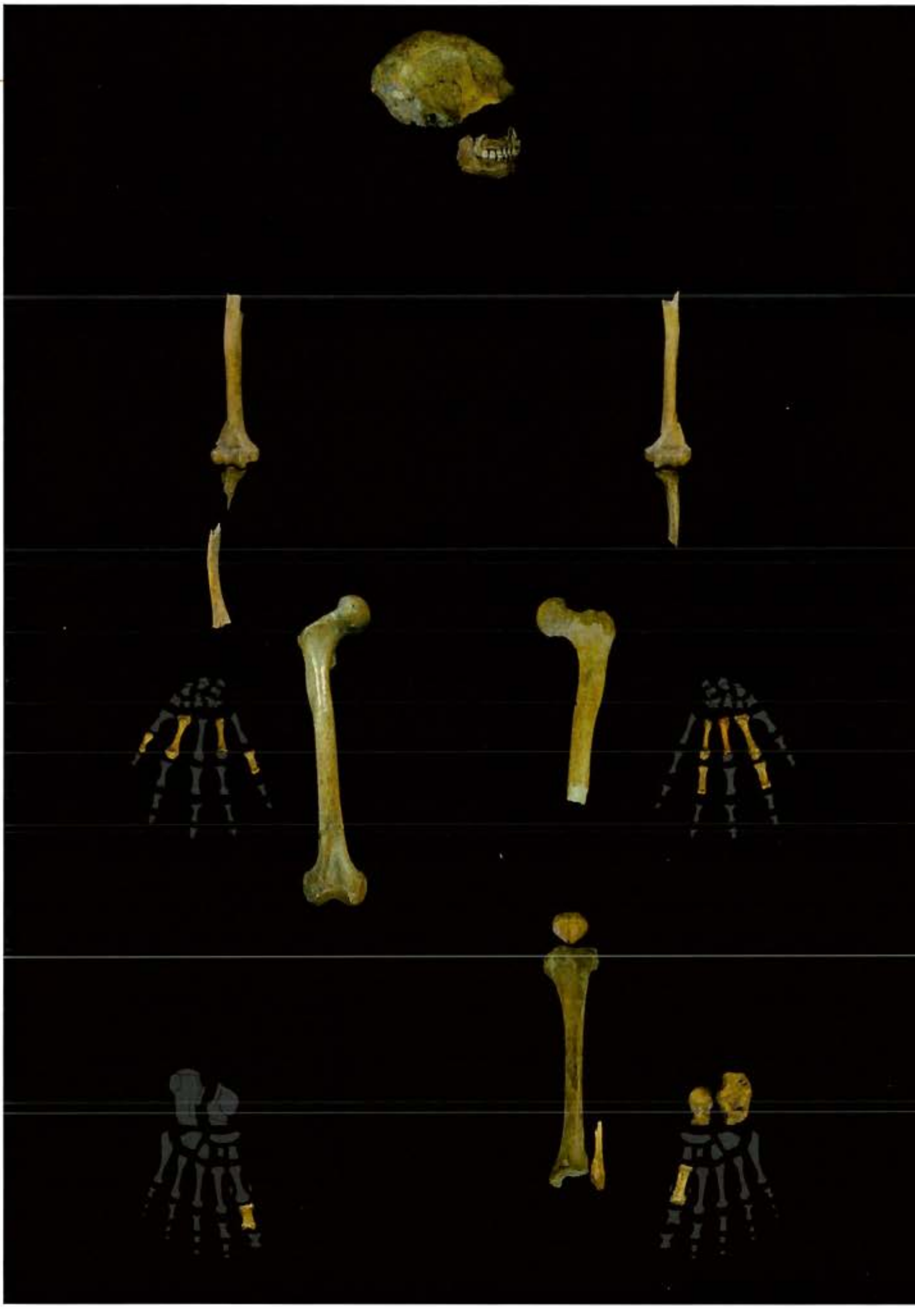
Both *Homo habilis* and *Homo rudolfensis* made very simple tools, known as pebble tools. They created a rough blade by knocking off some shards of rock using another rock. Depending on whether the tool is sharpened on one or both sides, it is known as either a 'chopper', or a 'chopping tool'.

*Homo erectus* was a nomadic hunter-gatherer. The stone tools it made were simple chopping tools and bifaces, and weren't yet very specialised. But it did make one very significant advance: it was the first human species to domesticate fire. The remains of hearths have been found at its camp sites. He was therefore able to use fire to chase prey during hunts, to keep nocturnal predators away, to make certain tools (such as wooden spears hardened in the fire), to cook food, and for light and warmth.

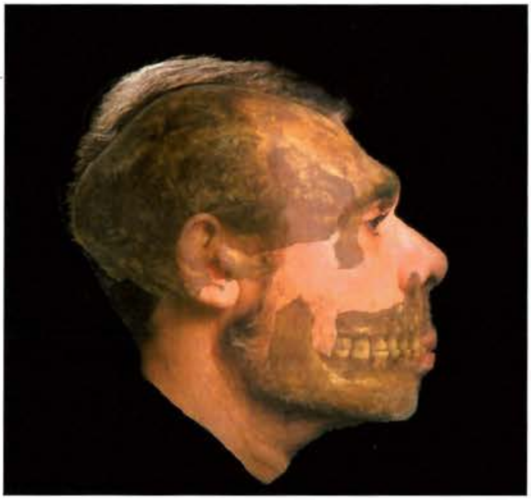
*Homo erectus* lived from 1.9 million years ago to less than 100,000 years ago and was one of the first human species to have colonized areas outside of Africa: fossils were found both in Europe and Asia. The Peking Man (formerly known as *Sinanthropus pekinensis)* is one of the most famous of the Asian representatives of the species. The bones that were found were mostly skulls, teeth, and jaw bones, and were around 350,000 years old. Unfortunately, most of them were lost whilst being transported to the USA during the Second World War.
Today, most scientists classify the more archaic African specimens as a separated species: *Homo ergaster*.
Either way, *Homo erectus/ergaster* was larger than its predecessors, and had a considerably larger brain, averaging 950 $cm^3$.

A biface is a stone tool that has been shaped by knocking off stone flakes alternately from both sides of the stone to create a regular, symmetrical cutting edge. They are generally made from flint.

Numerous bifaces were discovered in this area, particularly in the region of the Somme (in the North of France), where the ground is rich in flint. The 350,000 year old bifaces from Mesvin (in the Province of Hainaut) are some of the oldest evidence we have of a prehistoric human presence in Belgium. The bifaces shown here were found in Amiens, in France.



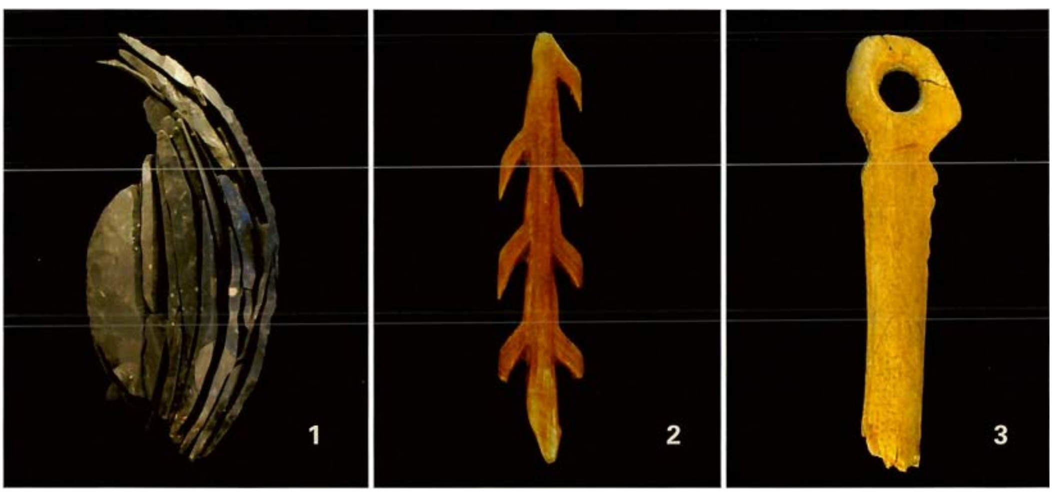
The first Neanderthal skeleton to be recognized as such was found in 1856 in the Neander valley near Düsseldorf, in Germany.
Thirty years later, excavations led by Belgians Max Lohest, Marcel Depuydt, and Julien Fraipont uncovered two other skeletons. "Spy 2", shown here, was one of them. They also found prehistoric tools and the bones of extinct animals (notably cave hyenas) at the cave site in Spy, in Namur. This was the first Neanderthal find based on scientific research and not made by accident, and to have been the subject of an official report. The Spy specimens are amongst the most recent: they are estimated to be 36,000 years old. Other Neanderthal remains were found in Belgium: sites at Sclayn, Fonds-de-Forêt, Goyet, La Naulette, and Engis have also yielded bones and numerous artefacts.



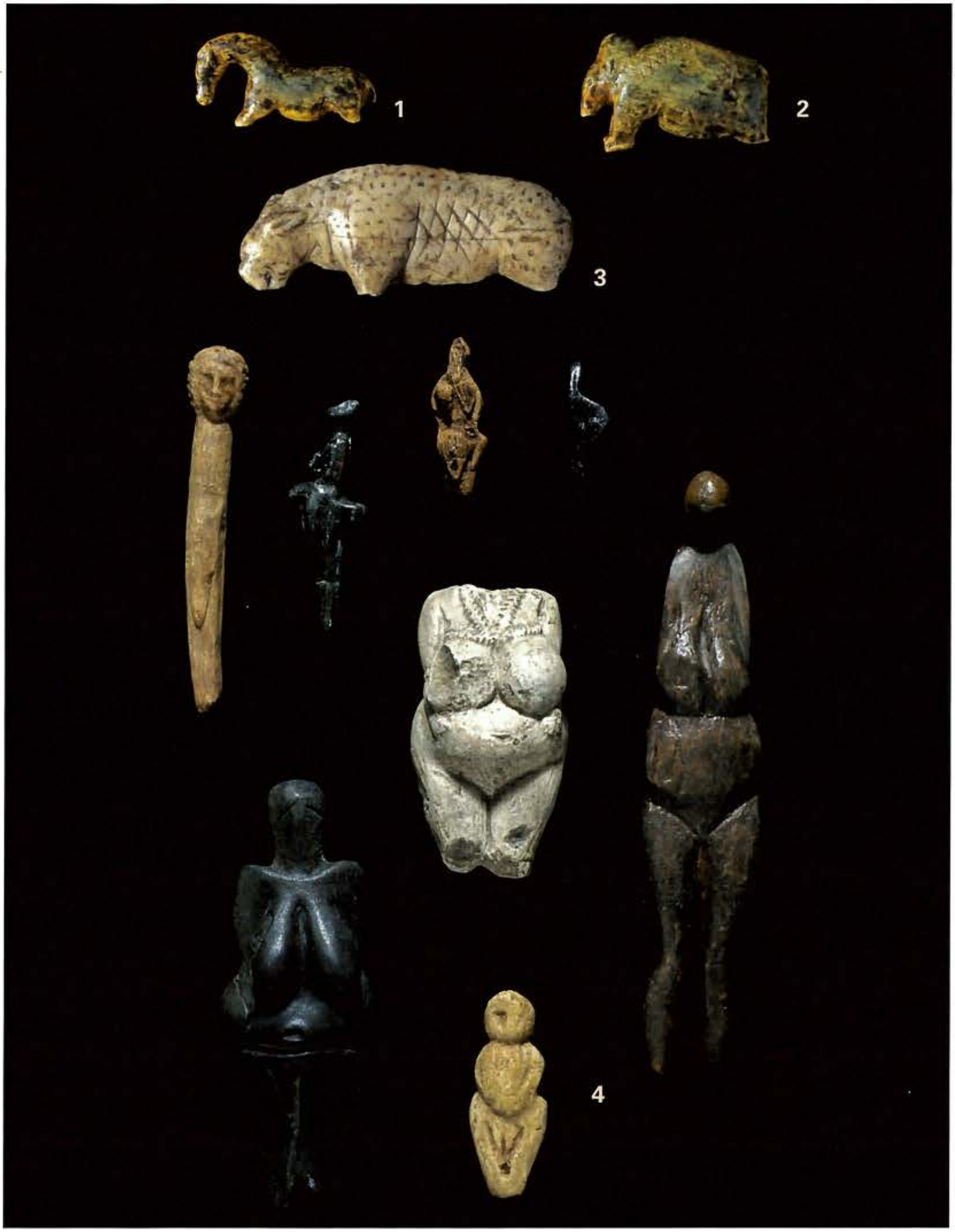
The Neanderthal line emerged in Eurasia 350,000 years ago, and remains of almost 300 individuals have been found in an area that stretches from Portugal to Uzbekistan. Compared to anatomically modern humans, Neanderthals had bigger brains: 1500-1600 $cm^3$ on average, as opposed to 1350 - 1400 $cm^3$ for *Homo sapiens*. They were also stockier in build, and thus better adapted to the harsh climate of the last ice age. The backs of their skulls were elongated, their faces sloped forwards, their chins were very slight or non-existent, their eyebrow ridges were very prominent, and they had large, circular eye orbits.

In 1829, Philippe-Charles Schmerling discovered this skull of a 5-6 year old child in Engis, in Liege. It was lying amongst prehistoric tools and the remains of extinct animals. It took almost a century for scientists to realize that this skull came from a Neanderthal, since the child died before it started showing typical adult characteristics.

Neanderthals became extinct around 30,000 years ago, apparently leaving no descendents. On the other hand, the anatomically modern humans that were their contemporaries survived and prospered. Having first appeared 150,000 – 200,000 years ago in Africa, they went on to colonise all the continents. During the last ice age, the sea levels were lower, enabling them to cross from Eurasia to America and Australia.
Our species, *Homo sapiens*, has a slenderer, more graceful skeleton, a rounder skull with a flatter face, a distinct chin, and a flat forehead (without such prominent supraorbital ridges). The skull shown here is 100,000 years old and comes from the Qafzeh site in Israel.




The tools of the first modern humans in Europe were more diverse and more elaborate than their predecessors. They improved their technique for making stone tools, making fewer mistakes and more workable tools. First they created a 'nucleus' of flint from the original block, before chopping off fine, regular-sized shards. This technique is known as 'lithic reduction' (**1**). These blades could then be used, as they were, as knives, or turned into burins, scrapers, or piercing tools as required.
Furthermore, unlike the Neanderthals, they also developed a way of making tools out of animal materials such as bone, ivory, and antlers, which were fashioned into harpoons (**2**), spear-throwers, or spear-heads. Fishing hooks, sewing needles, and tool handles were made from bone. This perforated stick (**3**) found in the caves of Groyet, in Namur, was probably used to straighten spear-heads made from curved reindeer antlers.

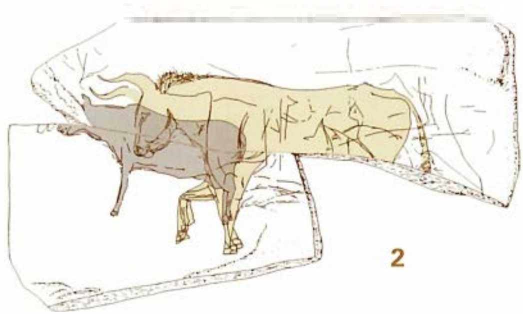



We have many proofs that the *Homo sapiens* of the Late Palaeolithic (35,000 – 10,000 years ago) were artists: the cave paintings of Chauvet, Lascaux, and Altamira; stone, ivory, bone, and antler engravings; statuettes sculpted from mammoth tusks or animal teeth; pendants made from mollusc shells.

Their favourite subjects were the animals they hunted, like this horse (**1**), this mammoth (**2**), and this cave lion (**3**). Representations of other humans are rarer. However, small 'Venus' figurines (**4**), displaying greatly exaggerated female characteristics, have been found all over Europe and Russia. They were probably fertility symbols.

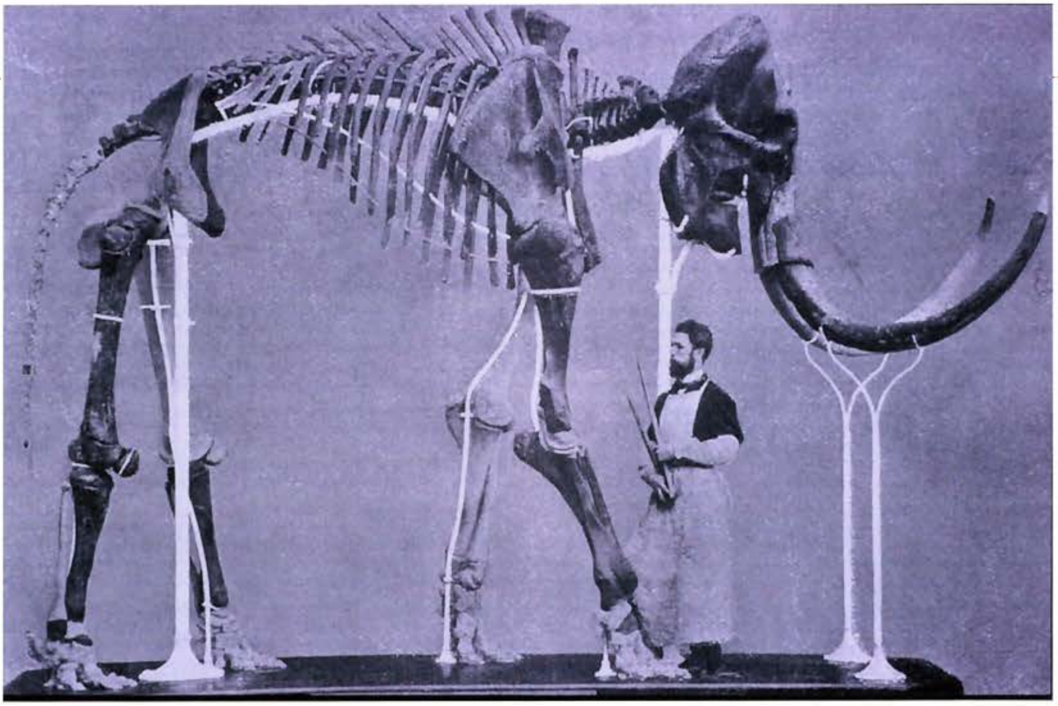
## The mammals of the last ice age

Bears, lions, cave hyenas, mammoths, woolly rhinoceroses, aurochs, giant deer, reindeers, and horses, *Homo sapiens* hunted all these animals during the Late Palaeolithic. If they didn't become extinct 10,000 years ago, most of these have certainly disappeared from these parts since.



The stone of Chaleux is the most famous artistic representation of Belgian fauna from the Late Palaeolithic. Both sides of this slab of psammite (sandstone with mica) are engraved. One side shows a horse, with a caprid (or possibly another horse) above it, and what is probably another caprid lying next to it (**1**). On the other side is a reindeer, partially superimposed over a walking auroch (**2**). This stone was found in 1865 in the Trou de Chaleux, in Hulsonniaux in the province of Namur, by the geologist Édouard Dupont, who was director of the Museum from 1868 to 1909.



While work was being done on the Nete River in Lier (in the province of Antwerp) in 1860, the bones of two adult mammoths, one young mammoth, a cave hyena, a horse, and a deer were discovered. All have been dated to the Late Palaeolithic. In 1869, Louis De Pauw (photo) was given the job of trying to reconstruct an adult mammoth skeleton (he would later be put in charge of assembling the Bernissart iguanodons). He used carved wooden pieces to replace missing bones. Visitors came from all over Europe to admire the result. At the time, the only other mounted mammoth skeleton in the world was in St Petersburg, in Russia.



Prehistoric humans weren't the only inhabitants of the Goyet caves (in the province of Namur). Cave lions and cave bears, amongst other animals, also lived there.
Cave lions were bigger than modern lions, and from the various paintings, engravings, and sculptures we have of them, it would appear that they had no manes. The bones of at least 5 specimens were found at Goyet. The cave lion you can see in the *Prehistory* gallery (**1**) is actually a composite of bones taken from several different individuals.
Thousands of cave bear bones were found at Goyet, as well as six relatively complete skeletons, including this male and this bear cub, which was maybe 6 months old (**2**). A newborn cub was also found. These bears probably exhausted their fat reserves before the end of the hibernation period and starved.

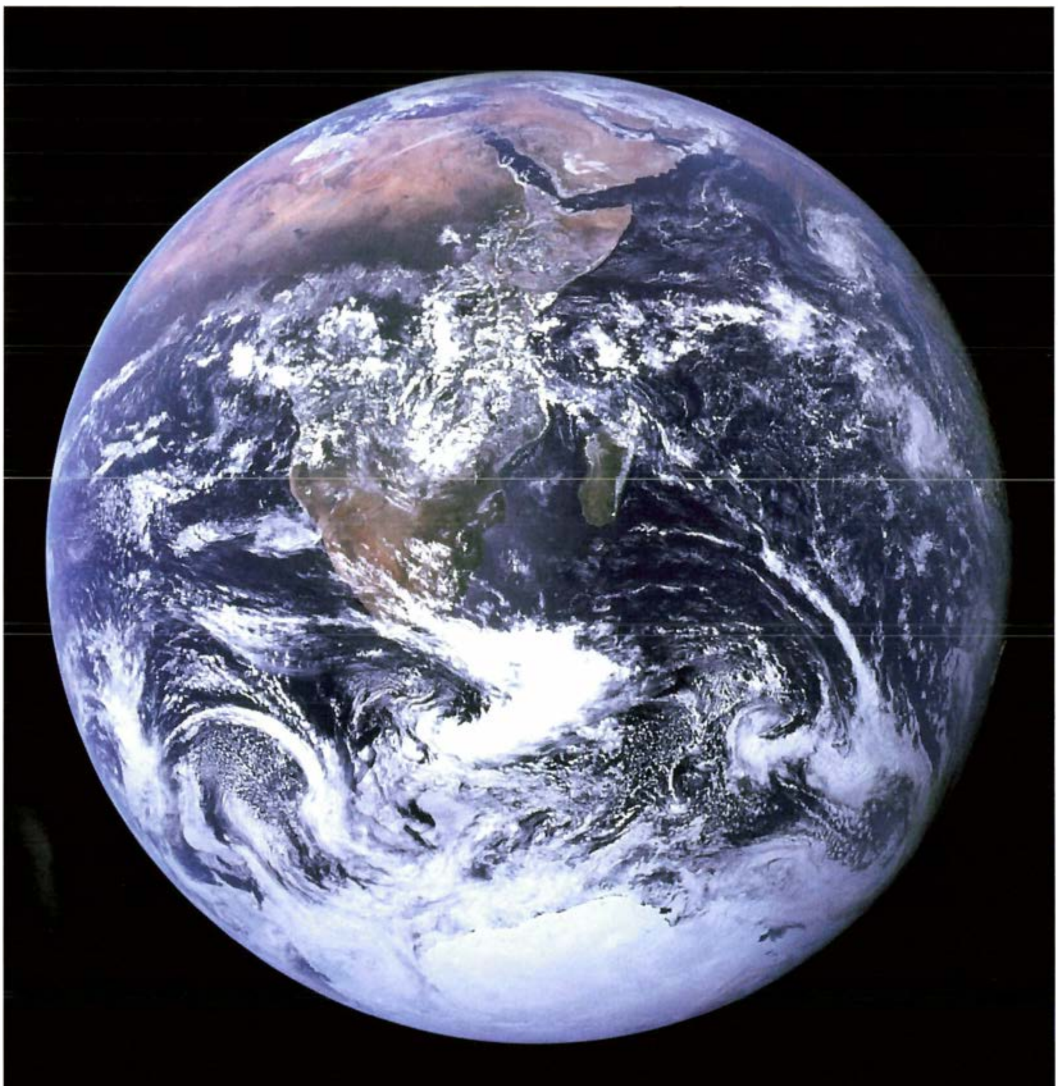

Gypse Gips
Italie Italië
Gypse Gips
Autriche Oostenrijk
Gypse Gips
Maroc Marokko
Gypse Gips
France Frankrijk
Gypse Gips
Pologne Polen
Gypse Gips
Algérie Algerië
Gypse Gips
Espagne Spanje
Gypse Gips
Espagne Spanje

# The Earth,
## *its rocks and its minerals*

Planets, asteroids, and all the other celestial bodies in our solar system were formed after the Sun, nearly 4.6 billion years ago. One of these planets was Earth, a slightly flattened sphere with a radius of 6378.14 km at the equator.

## The structure of the Earth

Just like Mercury, Venus, and Mars (but unlike Jupiter and Saturn, which are gas giants), the Earth is a telluric (rocky) planet. Like other telluric planets, it has a core, a mantle, and a crust.
The Earth's core is 90% iron and 10% nickel. Its centre, the inner core, is a primarily solid sphere and around 1300 kilometres in radius. The liquid outer core is nearly 2,200 km thick.
The mantle, which is 2,800 km thick, is a solid but viscous layer of rock which, at high temperature and low pressure, can liquefy and become magma.
The Earth's crust is a thin layer of rock, a mere 6 km thick at the oceans and averaging 33 km at the continents.

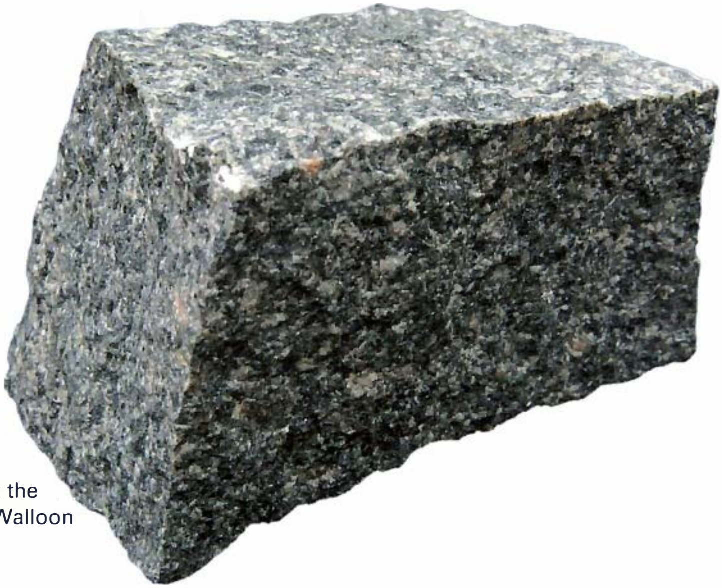


# The rocks of the Earth's crust

The Earth's crust is made up of three types of rock. Igneous rocks (like granite and basalt) are made of magma that has solidified, either beneath the Earth's crust or above it. Sedimentary rocks (such as sandstone and limestone) are formed when the sediments that result from erosion accumulate. They can sometimes contain fossils. Lastly, metamorphic rocks (like marble and quartzite) are either igneous or sedimentary rocks that have been transformed through the effects of pressure and heat.

Belgian 'pierre bleue' ('blue stone', or 'little granite'), is often used to make doorsteps, floors, and building facades. This type of limestone often contains fossils (these are corals and tiny crinoids).

Slate is a type of shale, a metamorphic rock. It breaks apart very easily into thin sheets of rock.



This porphyry, which was mined at the Quenast quarry in the province of Walloon Brabant, is an igneous rock.

## Rocks, minerals, and crystals

Most rocks are made up of many different minerals. Under the right conditions (pressure, temperature, space), these can 'grow' into crystals that can be seen with the naked eye.

To identify minerals, people use criteria such as colour, degree of transparency, streak colour (the colour it leaves when dragged across rough porcelain), brilliance (the way it reflects light), hardness (the degree of resistance it shows when scratched with different materials), and density.

Granite is an aggregate of quartz, mica, and feldspar. The granite shown here has been polished.

Feldspar crystals

Quartz crystals

Mica crystals

Aggregate of pyrite cubes. Pyrite may shine like gold, but it has nothing like the same value, hence its nickname, 'fool's gold'.

Geodes are formed from cavities within the rock (caused, for example, by trapped bubbles of gas). Their inside wall is covered with crystals. The most common crystals are quartz and amethyst (purple quartz), but in this case they are balls of green gyrolite on a carpet of white okenite. This geode comes from the Deccan plateau in India.

As you can see just by looking at these few specimens, minerals come in a wide variety of shapes and colours.

Rosettes of black aegirine on charoite. Murun, Sakha, Russia

Mammilated heterogenite. Mindigi, Congo

Needles of brochantite. Kabolela, Congo

Azurite (this mineral was used in the past as a pigment). Guanajuato, Mexico

Andradite. Valmalenco, Italy

Fibrous antigorite. Canada

Quartz containing needles of rutile. Bahia, Brazil

Malachite (in the past, this mineral was used as a pigment). Unknown origin

Fine tablets of wulfenite. Los Lamentos, Mexico

Sulphur. Lorca, Spain

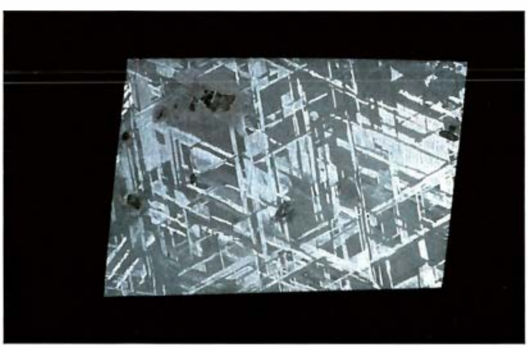
Rhodochrosite. Hotazel, South Africa

Sphaerocobaltite. Kolwezi, Congo

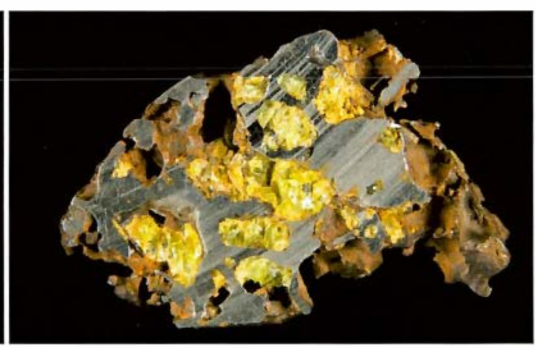
# Meteorites

Most meteorites are small fragments of asteroids or comets. They come mainly from the asteroid belt between Mars and Jupiter, so they can give us precious information about the formation of our solar system. We estimate that 100 tonnes of meteorites fall to Earth every year! Almost 90% of these are stony meteorites, such as chondrites and achondrites, which are less than a third metal. Metallic or iron meteorites, which are mainly composed of iron and nickel, make up only 5% of falls. The rarest meteorites (less than 1%) are stony-iron meteorites, also known as pallasites.

This is a slice of the metallic Mont-Dieu meteorite (41.4 cm long). It comes from a 435 kg fragment which is displayed in the *Dinosaurs* gallery. Whole, this meteorite would weigh more than 800 kg, making it one of the largest in Europe!



Slice of an iron meteorite which fell in 1836 near Gibeon, in Namibia (5.8 cm long). The geometric shapes are known as 'Widmanstätten patterns' after the scientist who first described them. They only show up once the meteorite has been polished and treated with nitric acid.



This is a slice of a pallasite which was found in Imilac, in Chile, in 1822 (length 7.7 cm). The yellow crystals are olivine.

## The Museum's rock and mineral collection

In 1828, prince William of Orange-Nassau (son of William II of Holland) donated 800 rocks and minerals from Russia to the 'Brussels Museum', which would later become the Museum of Natural Sciences . These were the first pieces in a collection which today includes more than 5,000 Belgian and 25,000 foreign specimens: 80% of known rock and mineral types are represented in this collection. There are also several tens of thousands of twinned crystals that belong to the Drugman collection, 500 cut stones, nearly 140 meteorites (4 of which fell in Belgium), and some very rare samples of lunar rock.

In 1973, Richard Nixon donated four fragments of lunar rock to the Belgian people. These were brought back by the Apollo 17 mission in December 1972. This stone is 18 mm long.

Twinned crystals are formed when two similar crystals interact in a specific way. There are different types of twins, with different shapes. 'Fishtail Twins', 'Butterfly Twins', and 'Star Twins' are just a few of the possibilities. This is a very beautiful 'Japan Law Twin' from Mount Ida, in Arkansas (USA).

Almandine garnet from Zlatoust in Russia (actual size 38 cm). This is one of the pieces from the 'Russian collection' donated by William of Orange-Nassau in 1828.

# Museum of Natural Sciences: *the guide*


Rue Vautier 29, 1000 Brussels

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## Museum of Natural Sciences:


Rue Vautier 29, 1000 Brussels

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## The Museum of Natural Sciences

has certainly evolved since the days of Charles de Lorraine's curiosity cabinet. In nearly 250 years, no less than 37 million specimens have been added to our collections, including minerals, dinosaurs, insects, shells, and mammals from both land and sea. Today, the Museum has the third largest Natural History collection in Europe. This guide will take you through our galleries to discover or rediscover some of the most remarkable pieces on display.